START

0027402

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 189905

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, N1-75, 376-6788		March 31, 1993
	5. Project Title/No./Work Order No. Remediation of Carbon Tetrachloride	6. Bldg./Sys./Fac. No. 200 West Area	7. Impact Level 2 ESQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-EN-SAD-004, Rev. 1	9. Related ECN No(s). 169357 (0-A) 186789 (0-B) 189902 (Rev 1)	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

A change has been made to operational safety limit number 2 to address the operation of several vapor extraction units at two different sites. Manual mode operation is required at these sites in the 200 West Area for removal of CCl_4 from the subsurface soils. The basis for manual mode operation is the adsorptive capacity of granular activated carbon canisters used onsite for removal of the CCl_4. The specific change provides the sampling frequencies required at the stack sample port based upon the maximum concentrations of CCl_4 anticipated and lower concentrations that may be encountered.

APR 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

These proposed changes are justified based on (1) the sampling frequency that provides a margin of safety; (2) personnel training in the use of monitoring instrumentation including the required frequencies for monitoring and system shutdown actions; and (3) provisions for surveillances and recovery actions.

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

See attached distribution sheet.

RELEASE STAMP

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DATE MAR 30 1993

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ENGINEERING CHANGE NOTICE	Page 2 of 2	1. ECN (use no. from pg. 1) 189905

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 Operations Waste 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 J. W. Green	3/30/93	PE	
Cog. Mgr. M. C. Hagood	3/30/93	QA	
QA T. L. Bennington	3/30/93	Safety	
Safety M. A. Tredway David D. Hess for	3/30/93	Design	
Security		Environ.	
Environ. L. P. Diediker	3-30-93	Other	
Projects/Programs			
Tank Waste Remediation System			
Facilities Operations		DEPARTMENT OF ENERGY	
Restoration & Remediation		Signature or Letter No.	
Operations & Support Services			
IRM		ADDITIONAL	
Other ERSS N. R. Kerr	3/30/93		
Environmental Field Services D. J. Moak	3-30-93		
RRSA J. J. Zimmer	3/30/93		

A-7900-013-3 (06/92) GEF096

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 189905

15. Design Verification Required
[] Yes
[X] No

16. Cost Impact

ENGINEERING			CONSTRUCTION		
Additional	[]	N/A	Additional	[]	N/A
Savings	[]	N/A	Savings	[]	N/A

17. Schedule Impact (days)

Improvement	[]	
Delay	[]	N/A

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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 Operations Waste Permit	[X]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

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

20. Approvals

	Signature	Date
OPERATIONS AND ENGINEERING		
Cog Engineer J. W. Green	[signature]	3/30/93
Cog. Mgr. M. C. Hagood	[signature]	3/30/93
QA T. L. Bennington	[signature] for	3/30/93
Safety M. A. Tredway	David O. Hess for	3/30/93
Security		
Environ. L. P. Diediker	[signature]	3-30-93
Projects/Programs		
Tank Waste Remediation System		
Facilities Operations		
Restoration & Remediation		
Operations & Support Services		
IRM		
Other ERSS N. R. Kerr	[signature]	3/30/93
Environmental Field Services D. J. Moak		[signature] 3-30-93
RRSA J. J. Zimmer	[signature]	[signature] 3/30/93

	Signature	Date
ARCHITECT-ENGINEER		
PE		
QA		
Safety		
Design		
Environ.		
Other		
DEPARTMENT OF ENERGY		
Signature or Letter No.		
ADDITIONAL		

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SUPPORTING DOCUMENT

1. Total Pages 280

2. Title
Safety Assessment for the 200 West Area Expedited Response Action for Remediation of Carbon Tetrachloride

3. Number
WHC-SD-EN-SAD-004

4. Rev No.
1-A

5. Key Words
Safety assessment
200 West Area
Carbon tetrachloride

APPROVED FOR PUBLIC RELEASE
3/30/93 D. Solis

6. Author
Name: R. R. Lehrschall
R R Lehrschall 3-30-93
Signature
Organization/Charge Code 29550/P121E

7. Abstract

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9. Impact Level 2 ESQ

10. RELEASE STAMP

OFFICIAL RELEASE BY WHC (20)
DATE MAR 30 1993
Sta. 21

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A-6400-073 (11/91) (EF) WEF124

RECORD OF REVISION	(1) Document Number WHC-SD-EN-SAD-004	Page 5

(2) Title
Safety Assessment for the 200 West Area Expedited Response Action for Remediation of Carbon Tetrachloride

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
1-A	Rev. 0 released per EDT 129408 Rev. 0-A released per ECN 169357 Rev. 0-B released per ECN 786789 Rev. 1 released per ECN 189902 Rev. 1-A released per ECN 189905		
1-A RS	Revisions have been made to the table of contents and pages 3, 4, 5, 33, 39, 40, 41, 42, 43, 44, and 45. Revisions were made to reflect a change in operational safety limit 2 to address the operation of several vapor extraction units at two different sites. The specific changes provide the sampling frequencies required at the stack sample port based on the maximum concentrations of CCl_4 anticipated and lower concentrations that may be encountered. Attachment G has been replaced.	J. W. Green JW Green 3/30/93	M. C. Hagood MC Hagood 3/30/93

CONTENTS

system (flow rate meters and logic system) must ensure instruments fail safely to assure shutdown of the blower.

- A minimum of two GAC canisters in place (two in series) to adsorb any CCl_4 if breakthrough of the first GAC canister occurs.

The following are the mitigating requirements based upon administrative controls:

- The sampling frequency (by operations personnel) at the 216-Z-1A and Z-18 well fields will be required once a day during the day shift to assure concentrations of CCl_4 at the point of discharge do not exceed 25 p/m_v. The sampling frequency is based upon a maximum concentration of 2,500 p/m CCl_4. The sampling frequencies at the Z-9 well field will be required based on measured concentrations at the CT-1 sample port. The assumed maximum flow rate in the analysis is 480 cfm. The maximum time required for breakthrough of CCl_4 through the GAC is also considered in the analysis. There shall be a minimum of three GAC canisters in place (in the production units) at all times when operating in manual mode.

- Verification of the hose configuration for the GACs and piping is required by the responsible operating organization before startup.

- Monitoring of flow rate meters will be required by operations personnel as prescribed in the work procedures if interlocks are not operable to detect a flow rate variance of greater than 10% (exceeding 10% variance for more than one minute will require shutdown of the VES). If flow rate meters and interlocks are not operable, constant monitoring (with instruments for detection of CCl_4 vapors) is required around the portion of the VES under positive air pressure. Detection of CCl_4 vapors that achieve $\geq$ 2 p/m will require shutdown of the VES.

- Constant monitoring (with instruments for detection of CCl_4 vapors) is required around the portion of the characterization unit under positive air pressure during operation. Detection of CCl_4 vapors that achieve $\geq$ 2 p/m will require shutdown of the VES.

- Personnel training shall be verified for personnel responsible for operating, sampling, and shutting down the VES before initial startup.

Two OSLs and sixteen prudent actions are provided in Section 4.0.

The following recommended prudent actions are provided to minimize the probability of occurrence or the consequences of a release of CCl_4 to the receptor groups of concern: the occupational workers, the uninvolved personnel, the public, and the environment.

- Monitor ambient air and workers' breathing zone for detection of CCl_4 vapors in areas where workers will be required to perform their work activities. Concentrations detected that exceed the TWA limits should require personnel (1) to be removed from the work area; or (2) to wear the appropriate protective gear as required by the Job Safety Analysis (JSA) or Hazardous Work Operations Permit (HWOP).

- Although radioactive particulates are not expected to be removed during the remediation activities, in-line monitoring should be provided. In the event continuous air monitor (CAM) alarms indicate possible radioactive contamination, the process shall be shut down. Concurrence for restart will be required from the Health Physics supervisor. The characterization unit should be surveyed for any radioactive contamination before movement to another site. A record sampler should be used during operation of the characterization unit for confirmation of no airborne radioactivity.

- Radon (^{222}Rn) gas monitoring equipment should be used to indicate the total quantities of ^{222}Rn and daughters adsorbed by the GACs during the VES operation. The quantities of ^{222}Rn measured will determine if the GAC canisters can be released from radiological controls. The ^{222}Rn gas concentrations of the stack effluent should be monitored.

- A routine survey program should be implemented to monitor the GAC canisters for potential gamma exposures that may result from ^{222}Rn buildup in the canisters. If exposure rate exceeds 2mR/h outside the canisters, the area should be posted in accordance with the requirements in WHC-CM-4-10, *Radiation Protection Manual*.

- The sites identified for remediation or site characterization work should be cleared of vegetation and combustibles not necessary to the activity.

- The electric generator should be located a minimum of 8 m (25 ft) from the propane storage tank as prescribed by fire codes.

- Replacement of existing in-line heaters should be with heater units that have a maximum air stream temperature capacity that does not exceed 400° F (205° C).

- Whenever saturated GAC canisters are removed from the process, covers will be placed over the inlet and outlet ports of the canister and verified to be secure.

- The VES components required for providing confinement of CCl_4 monitoring should be identified as safety class 3 components in a safety equipment list.

- The fire department shall be notified of the potential hazards involving CCl_4 in a fire and production of phosgene.

- Employees (drivers) responsible for handling the saturated canisters must have completed hazardous material training.

- Maintain a 15 m (50 ft) exclusion zone around the VES operations to prevent inadvertent access by uninvolved individuals at the work site.

- The site workers should not come into close proximity to the heaters during periods of operation. The maximum air stream temperatures of 400° F (205° C) is required to be maintained. The temperatures within 2.54 cm (1 in.) of the heater cal rod may exceed the 400° F (205° C) resulting in some production of phosgene. The site workers should be made aware of potential hazards associated with the operation of the heaters during VES operations. Heater will be shut down when the blower is not running or the individual hose line is not in use.

- An emergency response kit should be available at the work site for containment of any spills. Notification to the hazardous material response team (dial 811) should be made in the event of a spill.

- During the GMSS test no more than one drum containing up to a maximum of 115 L (30 gal) of liquid CCl_4 should be located at the work site. The loaded drum shall be removed from the work site before continuing the GMSS test.

- Emergency notification responsibilities and response actions should be addressed in the emergency plans for the work sites where CCl_4 remedial activities are planned and in the emergency plans for the adjacent affected facilities or activities.

2.0 WORK DESCRIPTION

2.1 LOCATION AND DESCRIPTION OF DISPOSAL SITES

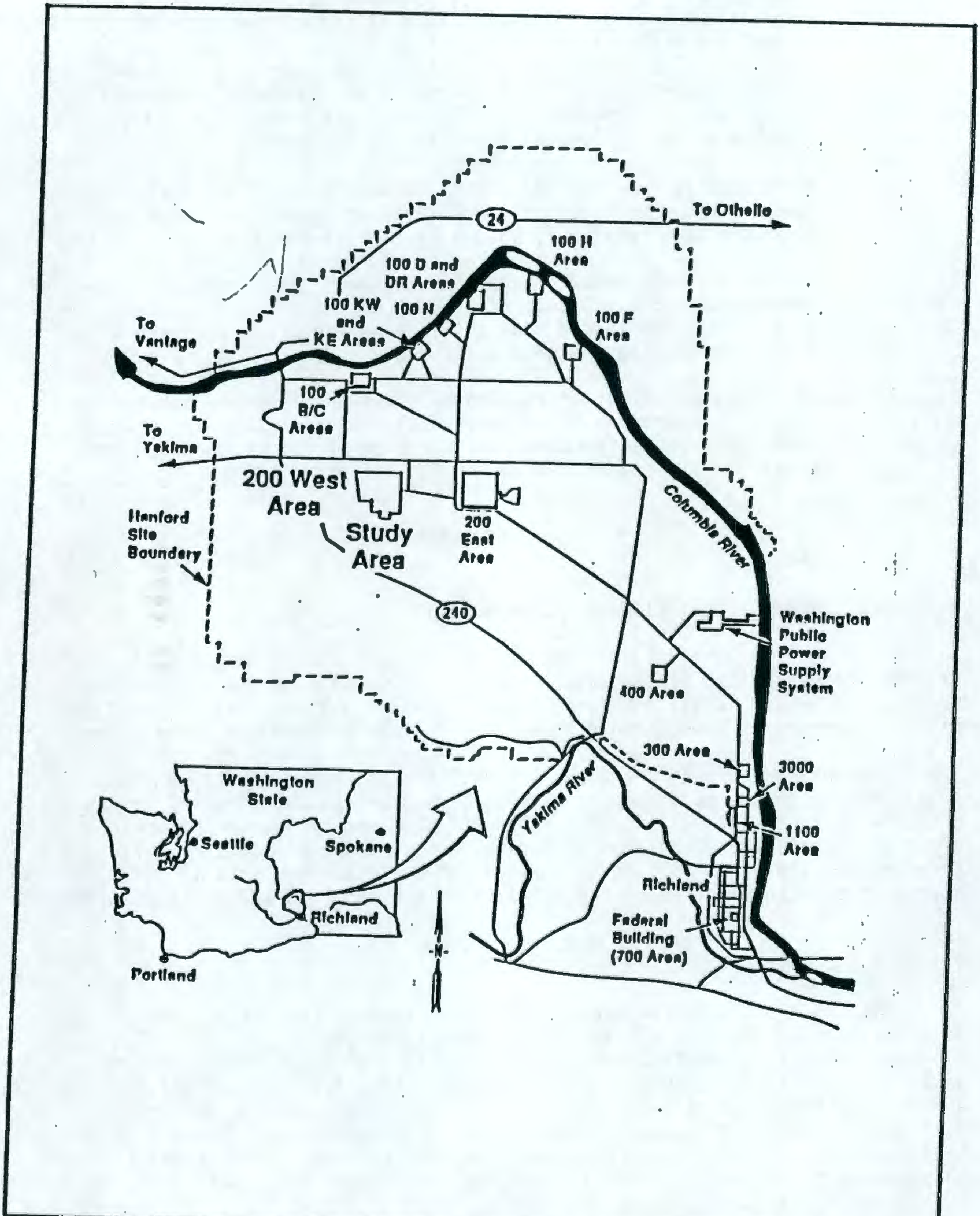
This section provides descriptions of disposal sites that were the principle contributors of the inventory of contamination to the soil and groundwater (DOE-RL 1991). Figures 1 and 2 provide a basic site orientation. Figure 3 provides the location of the three PFP waste discharge sites.

Past waste disposal practices included the discharge of actinide-bearing liquid waste, generated from plutonium purifying processes, directly to the ground via structures called cribs. The PFP disposed of liquid CCl_4-bearing organic solvents and associated high salt, acidic aqueous wastes primarily to three waste sites from 1955 to 1973 (when solvent discharge to soil was stopped): the 216-Z-9 Trench, the 216-Z-1A Tile Field, and the 216-Z-18 Crib.

2.1.1 216-Z-9 Trench

The 216-Z-9 Trench operated from 1955 to 1962 to receive all PFP Recuplex facility solvent and aqueous wastes discharged to the soil. The 216-Z-9 Trench is an enclosed earthen trench, located about 215 m (705 ft) east of the PFP. The trench excavation base is 18 m (60 ft) by 9 m (30 ft) and 6 m (20 ft) deep. The surface is a 36.5 m (120 ft) by 27 m (90 ft) by 0.23 m (0.75 ft) thick concrete trench cover at ground level. Six 7 m (23 ft) tall concrete columns support the cover. Waste was transferred by gravity through one of two 4-cm (1.5-in.) stainless steel pipes that entered the trench about 5 m (16 ft) above its bottom.

Figure 1. Map of the Hanford Site.



9 3 1 2 9 0 3 1 9 5 4

Table 6. Assessment of Hazards and Controls. (sheet 1 of 2)

Component Failure and Consequences	Mitigation Features
Failure of piping (hole in a flex hose), fittings, saturation of both the GAC canisters causing CCl_4 to breakthrough, or failure of a control system could cause a continuous release resulting in consequences to the uninvolved individual. Concentrations of CCl_4 at 100 m (330 ft) would be a maximum of 17 p/m.	Install a calibrated VOC detector downstream of the final GAC canister for detection of CCl_4 if the VES is operating in automated mode. The alarm set point of the detector shall be set for concentrations of 25 p/m_v of CCl_4 and shall also be interlocked to shut down the blower if the 25 p/m_v concentrations are exceeded. A minimum of two GAC canisters shall be in place (two in series with the second canister having > adsorptive capacity than the first unit) to adsorb any CCl_4 if breakthrough of the first GAC canister occurs when operating the VES in automated mode. A sampling frequency (for detection of concentrations of CCl_4) is required once a day during the day shift at the 216-Z-1A and Z-18 well fields and at the frequencies determined for the Z-9 well field (based upon concentrations of CCl_4) with three GAC canisters in place when operating the VES in manual mode. Train personnel who operate the VES production or characterization unit to monitor and shut down the blower in the event the 25 p/m_v is exceeded. Calibrate flow rate meters, located upstream of the blower and downstream of the final GAC, to indicate a flow rate variance of not more than 10% above the combined accuracy between the meters. Interlock flow rate meters to shut down the blower if a greater than 10% variance above the combined accuracy of the two flow rate meters is detected. Reliability of system must ensure instruments fail safely to assure shutdown of the blower. Monitoring of flow rate meters will be required by operations personnel as prescribed in the work procedures if interlocks are not operable to detect a flow rate variance of greater than 10% (exceeding 10% variance for more than one minute will require shutdown of the VES). If flow rate meters and interlocks are not operable, constant monitoring (with instruments for detection of CCl4 vapors) is required around the portion of the VES under positive air pressure. Detection of CCl_4 vapors that achieve ≥ 2 p/m will require shutdown of the VES.

Table 6. Assessment of Hazards and Controls. (sheet 2 of 2)

Component Failures and Consequnces.	Mitigation Features
Spill of carbon involving three GAC canisters (as a result of a rupture caused by dropping a canister) that results in consequences to the uninvolved individual. Maximum concentrations of CCl_4 at 100 m (330 ft) would be 28 p/m. An emergency response kit should be available for containment of a spill. Immediate notification to hazardous material response team using the 811 emergency notification system should be made in the event of a spill.	An emergency response kit should be available for containment of a spill. Immediate notification to the hazardous material response team using the 811 emergency notification system should be made in the event of a spill.
In-line heaters that have a maximum air stream temperature capacity of 275° F (135° C) at 50 acfm. The heaters will be used to remove moisture in the process flow stream. Hydrolysis of CCl_4 can occur (resulting in the production of some phosgene gas) caused by heating the process flow stream to temperatures that exceed 400° F (205° C).	Replacement of failed heater units should be with units that do not exceed a maximum air stream temperature capacity of 400° F (205° C).
A fuel fire that occurs in close proximity to the saturated GAC canisters providing sufficient temperatures to cause regeneration of the carbon. The heat from the fuel fire would strip and release the toxic pollutants in the smoke plume within a 30-minute period.	Locate the fuel sources a minimum of 15 m (50 ft) away from the GAC canisters whether the canisters are in storage or are being used in the process. Locate the generator a minimum of 8 m (25 ft) away from the GAC canisters. Maintain the fuel sources and generators at the specified distances to allow adequate clearance for flames that could result from a failure of the propane tank or fuel hose to the generator. This would provide a conservative distance at which flames could affect the CCl_4 canisters.

4.0 OPERATIONAL SAFETY LIMITS AND PRUDENT ACTIONS

The analysis disclosed that the VES remediation operations would be classified as a low hazard operation. The safety functions that will be provided for the remediation activities of the CCl_4 VES process are identified in OSLs. The following are the OSLs for the 200 West Area CCl_4 ERA.

4.1 OPERATIONAL SAFETY LIMITS

OPERATIONAL SAFETY LIMIT 1 - FUEL SOURCES

1.1 TITLE: Inventory Control of Fuel Sources

1.2 APPLICABILITY: This OSL applies to the location of the 3,785 L (1,000 gal) propane storage tank, fuel trucks that may be used for refueling the fuel tank, and the electric generator at the site. (This limit does not apply to the fork truck or similar equipment having small quantities of fuel).

1.3 OBJECTIVE: The objective of this OSL is to assure that a common mode fire affecting the propane tank, fuel truck, or generator would not provide sufficient temperatures that could affect the GAC canisters resulting in identified in Section 2.4.1.2.(c), "Noncompliance with the requirements."

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

2.4.2 MANUAL MODE OF OPERATION

2.4.2.1 Monitoring for Granular Activated Carbon Breakthrough

a. Requirement: The required sampling frequencies for assuring the concentrations of CCl_4 do not exceed 25 p/m_v at the point of discharge (stack sample port downstream of the final GAC canister) from the VES is as follows:

The sampling frequency by operations personnel for the production units at the 216-Z-1A and Z-18 well fields will be required once a day during the day shift at the sample port between the primary and secondary GAC canister. The interval between samples shall not exceed 32 hours.

The minimum sampling frequencies for the production units at the Z-9 well field required (at the stack sample port) are based on the concentrations of CCl_4 as measured at the CT-1 sample port as identified below. The sampling frequency at the CT-1 sample port is required once every 1.5 hours (for at least the first six hours) until the concentrations of CCl_4 from each Z-9 well has been established.

Concentrations of carbon tetrachloride at CT-1 sample port (p/m)	Sample frequencies at stack sample port (hours)
≤ 25,000	1.5
≤ 20,000	2.0
≤ 15,000	2.5
≤ 10,000	4.0
≤ 5,000	8.0

The responsible operating organization shall provide a second individual to verify (at the work site) the samples are taken at the frequency required.

There shall be three 2,000 lb GAC canisters in place (production units) at all times during operations with the secondary GAC canister having greater adsorptive capacity than the primary unit, and the tertiary unit having full adsorptive capacity whenever installed in the system.

Personnel who operate the VES production and characterization units shall be trained to monitor, sample and shut down the blower in the event the concentrations of CCl_4 detected at the stack sample port exceed 25 p/m_v.

Verification of the hose installation to the GACs and piping on the 1500 cfm unit is required by the responsible operating organization before any startup and following GAC changeout.

b. Surveillance: The sampling data shall be reviewed weekly to verify sampling frequency requirements are complied with and verification of sampling is conducted. Results of the weekly surveillance shall be documented in the field log.

The responsible operating organization shall verify the system configuration [three 2,000 lb GAC canisters in place (production units) with the secondary unit having greater adsorptive capacity than the primary unit, and the tertiary unit having full adsorptive capacity when installed in the system] before startup of the VES.

Personnel training shall be verified for those individuals responsible for operating, sampling, and shutting down the VES production and characterization units before initial startup.

Verification of the hose installation to the GACs and piping on the 1500 cfm unit is required before any startup and following GAC changeout.

c. Recovery: **Noncompliance with the requirements**

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

Failure to conduct sampling operations at the frequency identified and verification of sampling will necessitate immediate shutdown of the VES.

Failure to have three 2,000 lb GAC canisters in place (production units) with the secondary unit having greater adsorptive capacity than the primary unit, and the tertiary unit having full adsorptive capacity when installed in the system will necessitate immediate shutdown of the VES. Restart will not be allowed until three canisters are verified to be in place.

Failure to operate the VES production and characterization units with trained personnel shall require shutdown of sampling operations until trained personnel are provided.

Failure to verify the configuration of the hoses for the GACs and piping system will require verification that the configuration is correct prior to restart of operations.

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

Noncompliance with the surveillance

The surveillance shall be performed immediately.

If the surveillance determines noncompliance with the requirement, then initiate recovery actions as identified in Section 2.4.2.1.(c), "Noncompliance with the requirements."

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

2.4.2.2 Monitoring for Ambient Air Leakage of System Under Positive Air Pressure

a. Requirements: Monitoring of flow rate meters will be required by operations personnel as prescribed in the work procedures if interlocks are not operable to detect a flow rate variance of greater than 10% (exceeding 10% variance for more than one minute will require shutdown of the VES). If flow rate meters and interlocks are not operable, constant monitoring (with instruments for detection of CCl_4 vapors) is required around the portion of the VES under positive air pressure. Detection of CCl_4 vapors that achieve $\geq$ 2 p/m will require shutdown of the VES.

Personnel who operate the VES production and characterization unit shall be trained to monitor, sample, and shut down the blower in the event that CCl_4 vapors are detected around the portion of the VES under positive air pressure that achieve $\geq$ 2 p/m.

b. Surveillance: The data, documenting any flow variances, shall be reviewed weekly to verify compliance with these requirements. Results of the weekly surveillance shall be documented in the field log.

Personnel training shall be verified for those individuals responsible for operating, sampling, and shutting down the VES production and characterization units before initial startup.

c. Recovery: **Noncompliance with the requirements**

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

Failure of operations personnel to monitor the readout for detecting variances in the flow rate meters (if interlocks are not functioning) or not monitoring the portion of the VES under positive air pressure (if flow rate meters and interlocks are not operable) for detection of CCl_4 vapors that achieve ≥ 2 p/m will require shutdown of the VES.

Failure to operate the VES production and characterization units with trained personnel shall require shutdown of sampling operations until trained personnel are provided.

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

Noncompliance with the surveillance

The surveillance shall be performed immediately.

If the surveillance determines noncompliance with the requirement, then initiate recovery actions as identified in Section 2.4.2.2.(c), "Noncompliance with the requirements."

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

2.5 AUDIT POINT: An auditable log shall be maintained at the site documenting the results of the surveillances. This log shall be reviewed weekly by the operating organization.

2.6 BASIS: Sampling intervals and the number of GAC canisters required for manual mode operation are based on the time periods to achieve breakthrough of the primary, secondary, and tertiary GAC canisters, and a maximum system flow rate capacity of 480 cfm.

A maximum concentration of 2,500 p/m CCl_4 is assumed in the calculations for the 216-Z-1A and Z-18 well fields. Therefore, a minimum sampling frequency of once a day during the day shift is required (samples required a minimum of every 32 hours). A total of 34.4 hours adsorptive capacity is available for removal of CCl_4 before breakthrough at the tertiary GAC canister could occur (Attachment I).

The sampling frequencies for the production units at the Z-9 well fields are based on a maximum concentration of 25,000 p/m. Other sampling frequencies have been calculated based on lower concentrations. Reduced sampling frequencies are allowed after verification of the CCl_4 concentrations (at the CT-1 sample port) from the wells in the Z-9 well fields. The sampling frequencies are conservative (i.e., a minimum sampling frequency required every 1.5 hours for 25,000 p/m concentrations. A total of 3.3 hours adsorptive capacity are available for removal of CCl_4 before breakthrough at the tertiary GAC canister could occur).

Limiting the concentrations of CCl_4 to below the OSHA 8-hour TWA limit to the nearest uninvolved worker assures exposures to occupational carcinogens are maintained at levels that will reduce or eliminate adverse health effects to personnel.

4.2 PRUDENT ACTIONS

Function 1 - Minimize occupational workers' exposures of VOCs to as low as reasonably achievable.

Prudent Action 1 - Monitor ambient air and workers' breathing zone for CCl_4 vapors in areas where workers will be required to perform their work activities. Concentrations detected that exceed the TWA limits should require personnel (1) to be removed from the work area; or (2) to wear the appropriate protective gear as required by the JSA or HWOP.

Function 2 - Monitor VES for potential radionuclide particulate contamination.

Prudent Action 2 - Monitor for radioactive contamination even though radioactive particulates are not expected to be removed during remediation activities. In the event CAM alarms indicate possible radioactive contamination, shut down the process. Concurrence for restart will be required from the Health Physics supervisor. The characterization unit should be surveyed for any radioactive contamination before movement to another site. A record sampler should be used during operation of the characterization unit for confirmation of no airborne radioactivity.

Function 3 - Monitor for ^{222}Rn.

Prudent Action 3 - Use ^{222}Rn monitoring equipment to indicate the total quantities of ^{222}Rn and daughters adsorbed by the GACs during the VES operation. The quantities of ^{222}Rn measured will determine if the GAC canisters can be released from radiological controls. The ^{222}Rn concentrations of the stack effluent should be monitored.

Function 4 - Survey program.

Prudent Action 4 - Implement a routine survey program to monitor the GAC canisters for potential gamma exposures that may result from ^{222}Rn buildup in the canisters. If the exposure rate exceeds 2mR/h on contact with the outside of the canisters, the area will be posted per the requirements identified in WHC-CM-4-10.

Function 5 - Assure remediation and characterization sites are free of vegetation and combustibles.

Prudent Action 5 - Clear the sites identified for remediation or site characterization of vegetation and combustibles not necessary to the project.

Function 6 - Location of generator.

Prudent Action 6 - Locate the electric generator a minimum of 8 m (25 ft) from the propane storage tank as prescribed by the fire code.

Function 7 - Control the size (temperature capacity) of the in-line heaters used in the VES design.

Prudent Action 7 - Replace failed in-line heaters with heater units that have a maximum air stream temperature capacity that does not exceed 400° F (205° C).

Function 8 - Capping of the canister ports.

Prudent Action 8 - Whenever saturated GAC canisters are removed from the process, place covers over the inlet and outlet ports of the canister and verify to be secure.

Function 9 - Establish safety equipment list.

Prudent Action 9 - Identify the components of the VES required for providing confinement of CCl_4 and monitoring as safety class 3 components in a safety equipment list.

Function 10 - Apprise fire department of hazards.

Prudent Action 10 - Notify the fire department of the potential hazards involving CCl_4 in a fire and production of phosgene.

Function 11 - Training.

Prudent Action 11 - The employees (drivers) responsible for handling the saturated GAC canisters must have completed hazardous material training.

Function 12 - Exclusion zone.

Prudent Action 12 - Maintain a 15 m (50 ft) exclusion zone around the VES operations to prevent inadvertent access by uninvolved individuals to the work site.

Function 13 - Personnel exposure to heaters during operations.

Prudent Action 13 - The site workers should not come into close proximity to the heaters during periods of operation. The maximum air stream temperatures of 400° F (205° C) is required to be maintained. The temperatures within 2.54 cm (1 in.) of the heater cal rod may exceed the 400° F (205° C) resulting in some production of phosgene. The site workers should be made aware of potential hazards associated with the operation of the heaters during VES operations. Heater will be shut down when the blower is not running or the individual hose line is not in use.

Function 14 - Minimize consequences of spilled carbon with CCl_4.

Prudent Action 14 - Have an emergency response kit available on site for containment of spills. If a spill occurs, notify 811 requesting response by hazardous material response team.

Function 15 - Inventory control of liquid CCl_4 at the GMSS test site.

Prudent Action 15 - During the GMSS test no more than one drum containing up to a maximum of 115 L (30 g) of liquid CCl_4 should be located at the work site. Remove loaded drum from the work site before continuing GMSS test.
Function 16 - Notification and emergency response actions.

Prudent Action 16 - Address the emergency notification responsibilities and response actions in the emergency plan for the CCl_4 work site and in the emergency plans for the adjacent affected facilities.

5.0 REFERENCES

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

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

WHC-CM-7-5, *Environmental Compliance Manual*, Appendix A, "Derived Concentration Guides for Controlling Exposure to Members of the Public," Westinghouse Hanford Company, Richland, Washington.

ATTACHMENT G

CONSEQUENCE ANALYSIS FOR CARBON TETRACHLORIDE ACCIDENT SCENARIOS

Westinghouse
Hanford Company

Internal
Memo

From: Safety Hazards Analysis
Phone: 6-8009 N1-37
Date: December 13, 1991
Subject: CONSEQUENCE ANALYSES FOR CARBON TET ACCIDENT SCENARIOS

MAM-29250-91-003

To: R. R. Lehrschall B1-35

cc: N. R. Kerr B1-35
E. E. Leitz N1-37
L. D. Muhlestein N1-28 w/o
MAM File/LB

Attached is my report on the consequence analyses for carbon tetrachloride (CCl_4) that you requested. Three general scenarios are addressed in terms of their potential consequences to the onsite individual, the offsite individual, and the nearest public access.

The three scenarios included in this report are: 1) Excessive Retrieval, 2) GAC spill, and 3) Phosgene Production. The estimated potential concentrations are summarized in the table below for each of the scenarios.

Scenario	Downwind Concentrations		
	Onsite (100 m)	Nearest Public Access (4.5 km)	Offsite (12.5 km)
1	1.7E+1	7.0E-2	< 5.0E-2
2	1.1E+1	4.5E-2	< 5.0E-2
3	6.8E-3	2.5E-5	1.3E-5

The computer models used for the analyses were WHAZAN (Technica, 1988) and ARCHIE (FEMA, 1988). WHAZAN was used to estimate the source term for evaporation, while ARCHIE was used to model the plume dispersion for some scenarios.

M. A. Medsker
Engineer

siw

Attachment

CARBON TETRACHLORIDE SCENARIOS

ASSUMPTIONS COMMON TO ALL SCENARIOS:

- The GAC system under consideration consists of 6 GAC adsorption units; 3 parallel lines of two GAC units in series.
- Each GAC unit contains 2000 lbs of activated carbon and can adsorb 1200 lbs of CCl_4 (saturation at approximately 77 F and 1 atmosphere).
- During normal operations, the process air flow stream of 1500 cfm will be split equally along each of the three parallel legs of the GAC system, thus each leg sees 500 cfm.
- The temperature and pressure, unless otherwise specified, are 77 F and 1 atmosphere respectively.
- All scenarios analyzed last longer than 20 minutes so that credit may be taken for plume meander. Plume meander, for a wind speed of 1 m/s and stability class F, reduces the estimated concentrations by a factor of 4.0 at 100 meters, 2.0 at 4.5 kilometers, and 1.2 at 12.5 kilometers (USNRC, 1982).

SCENARIO 1: Excessive Retrieval (and Venting)

Scenario 1 illustrates the consequences associated with the recovery and release to the environment of CCl_4 during operations with the GAC units. This scenario could encompass any event which results in a continual release of the CCl_4 as it is recovered (a control system failure, component failure, etc.). The following assumptions were made:

- All CCl_4 recovered during the period of the scenario is vented to the environment.
- The GAC system maintains a total recovery air flow of 1500 cfm that is merged from three wells operating at 500 cfm each (under the assumption that 500 cfm is the maximum flow rate per well).
- The three wells have the following respective flows and concentrations: 6000 ppm at 500 cfm; 1000 ppm at 500 cfm; and 1000 ppm at 500 cfm. These values are based on the assumption that 1000 ppm is an average concentration while 6000 ppm is a maximum concentration that could be recovered.
- The inventory of CCl_4 in the GAC beds themselves does not contribute to the release.

The results of the consequence analysis performed for scenario 1 are shown in table 1, below.

SOURCE TERM

The source term was developed from the assumptions stated above. Initially, the concentration was converted from a volume basis to a mass basis for each stream by the equation

$$MG/M^3 = (PPMV) * (M)/(24.5)$$

Where:
- MG/M^3 is the concentration in mg/m^3
- PPMV is the concentration in ppm by volume (6000 or 1000)
- M is the gram molecular weight of CCl_4 (153.81)
- 24.5 is the molar volume in liters of an ideal gas at approximately 77 F and 1 atmosphere

Multiplying the concentration in mg/m^3 by the flow rate in m^3/min yields the source term in mg/min. Thus,

$$\text{Source Term} = (PPM) * (M)/(24.5) * (FLOW)$$

Where:
- FLOW is the volumetric flowrate in m^3/min (500 cfm yields 14 m^3/min)

Stream One (6000 ppm)

Source Term = (6000 ppm) * (153.81)/(24.5) * (14)
Source Term = 5.3E+5 mg/min = 1.2 lb/min

Stream Two (1000 ppm)

Source Term = (1000 ppm) * (153.81)/(24.5) * (14)
Source Term = 8.8E+4 mg/min = 0.19 lb/min

Stream Three (1000 ppm)

Source Term = (1000 ppm) * (153.81)/(24.5) * (14)
Source Term = 8.8E+4 mg/min = 0.19 lb/min

Total Source Term = 1.2 lb/min + 0.19 lb/min + 0.19 lb/min
Total Source Term = 1.6 lb/min (0.012 kg/s)

This source term was input into the ARCHIE computer code (FEMA, 1988) to estimate downwind airborne concentrations. These concentrations are given in table 1 for the onsite individual at 100 m, the nearest public access at 4.5 km, and the offsite individual at 12.5 km. The assumptions used in the consequence estimates include 95% meteorology (a wind speed of 1 m/s and Pasquill stability class F) and a ground level release.

TABLE 1: ESTIMATED CONSEQUENCES OF SCENARIO 1

RECEPTOR LOCATION	CONSEQUENCES, ppm
Onsite, 100 m	1.7E+1
Nearest Public Access, 4.5 km	7.0E-2
Offsite, 12.5 km	< 5.0E-2

SCENARIO 2: GAC Spill

Scenario 2 illustrates the consequences associated with the possible spill of carbon from two GAC units. Since this scenario requires that the GAC units be ruptured, the recovery of CCl_4 must stop due to disrupted air flow. The following assumptions were made for this scenario:

- Two fully saturated GAC units are ruptured and expose all of their contents to the environment.
- The retentivity of CCl_4 on granular activated carbon is 45% by weight (Cheremisinoff, 1978, pg 383).
- The volume of 2000 lbs of activated carbon is 65 ft^3 based on a density of 31 lb/ft^3 (Cheremisinoff, 1978, pg. 380)
- Since the process of desorption is similar to the process of vaporization, the CCl_4 at risk (55 wt%) is modeled as a liquid pool. The bund area of the pool is equal to the surface area of the ground covered by the carbon spill.
- The activated carbon does not impede the vaporization of CCl_4 in the "pool". Note that this assumption is very conservative and is used to estimate a release rate which is bounding. If the consequences shown in this scenario impact the operations of the GAC units, a further analysis could be performed to include a more reasonable release rate.
- The accident does not involve a heat source for the regeneration of the GAC units nor the formation of phosgene gas.

The results of the consequence analysis performed for scenario 2 are shown in table 2, below.

SOURCE TERM

The source term for scenario 2 was developed by estimating the bund area associated with each GAC unit and calculating the vaporization rate of the inventory at risk in that area. The total inventory at risk is estimated as two times the inventory at risk for a single GAC unit. The total bund area associated with two GAC units was based on the surface area covered by the 65 ft^3 of spilled carbon (assuming the spill was hemispherical).

Total inventory at risk = (2)(55%)(1200) = 660 lbs = 600 kg

Total bund area = $(2)(pi)(r)^2$

Where:
- pi = 3.14
- r = radius of the carbon hemisphere

r can be estimated from the volume of carbon in a unit by

$$r = [(1.5)(V)/(pi)]^{0.33}$$

Where: - V = volume of carbon in a GAC unit (65 ft^3)

$$r = [(1.5)(65)/(3.14)]^{0.33} = 3.1 \text{ ft}$$

$$\text{Total bund area} = (2)(3.14)(3.1)^2 = 60 \text{ ft}^2 = 5.6 \text{ m}^2$$

Based on the assumptions made, inventory at risk, and bund area, WHAZAN (Technica, 1988) calculated a vaporization rate for CCl_4 of 6.7E-3 kg/s.

The source term for scenario 2 was input into the ARCHIE computer code (FEMA, 1988) to facilitate the estimation of downwind airborne concentrations. These concentrations are given in table 2 (including plume meander) for the onsite individual at 100 m, the nearest public access at 4.5 km, and the offsite individual at 12.5 km. Since the model does not calculate concentrations below 0.05 ppm, any results less than this are shown as < 0.05 ppm. The assumptions used in the consequence estimates include 95% meteorology (a wind speed of 1 m/s and Pasquill stability class F) and a ground level release.

TABLE 2: ESTIMATED CONSEQUENCES OF SCENARIO 2

RECEPTOR LOCATION	CONSEQUENCES, ppm
Onsite, 100 m	1.1E+1
Nearest Public Access, 4.5 km	4.5E-2
Offsite, 12.5 km	< 5.0E-2

SCENARIO 3: Phosgene Production In Process Flow Stream

Scenario 3 illustrates the worst-case production of phosgene gas in the process flow stream of the GAC system. This analysis shows that even if extremely high temperatures are assumed the consequences of phosgene production from CCl_4 as it is retrieved are negligible. The following assumptions were used in this scenario.

- The conversion rate of CCl_4 to phosgene is one which assumes temperatures of 1100-1400 F. This conversion rate of 2.7E-4 lbs phosgene produced per lb CCl_4 exposed to the stated temperatures, is derived from experimental data (Yant, et al, 1936).
- The GAC units are not involved in the scenario based on two related assumptions: 1. the energy from upstream heating units is insufficient to heat the units to a temperature necessary for phosgene production; 2. no fuel source outside the GAC system contributes to heating the GAC units.
- The phosgene produced is vented to the environment without being adsorbed in the GAC unit.
- The phosgene produced does not react or undergo hydrolysis as the temperature decreases.

The results of the consequence analysis performed for scenario 3 are shown in table 3, below.

<u>SOURCE TERM</u>

The source term for scenario 3 was developed from the maximum flow of CCl_4 previously identified in scenario 1 (1.6 lb/min). The phosgene source term was calculated by

Source Term = (1.6 $lbCCl_4$/min) * (2.7E-4 $lbCOCl_2/lbCCl_4$)
Source Term = 4.3E-4 lb/min = 3.3 mg/s of $COCl_2$

Since the ARCHIE (FEMA, 1988) and WHAZAN (Technica, 1988) computer models do not allow source term inputs as small as 3.3 mg/s, a X/Q was calculated by hand for each downwind distance and applied to the source term (USNRC, 1988). The meteorological conditions assumed in this analysis were 1 m/s wind speed and Pasquill stability class F. The X/Q's were calculated by the following equation (USNRC, 1982).

$$X/Q = [(U)(pi)(sigma\ y)(sigma\ z)]^{-1}$$

Where:
- U = wind speed in m/s at a height of ten meters (1 m/s)
- pi = 3.14, dimensionless
- sigma y = lateral plume spread in meters
- sigma z = vertical plume spread in meters

At 100 meters: sigma y = 4 m

sigma z = 2.5 m

$X/Q = [(1\ m/s)(3.14)(4\ m)(2.5\ m)]^{-1} = 3.2E\text{-}2\ s/m^3$

Concentration at 100 m = $(3.2E\text{-}2\ s/m^3)(3.3\ mg/s) = 1.1E\text{-}1\ mg/m^3$
= <u>2.7E-2 ppm</u>

At 4.5 km: sigma y = 150 m
sigma z = 34 m

$X/Q = [(1\ m/s)(3.14)(150\ m)(34\ m)]^{-1} = 6.2E\text{-}5\ s/m^3$

Concentration at 4.5 km = $(6.2E\text{-}5\ s/m^3)(3.3\ mg/s) = 2.0E\text{-}4\ mg/m^3$
= <u>4.9E-5 ppm</u>

At 12.5 km: sigma y = 330 m
sigma z = 50 m

$X/Q = [(1\ m/s)(3.14)(330\ m)(50\ m)]^{-1} = 1.9E\text{-}5\ s/m^3$

Concentration at 12.5 km = $(1.9E\text{-}5\ s/m^3)(3.3\ mg/s) = 6.3E\text{-}5\ mg/m^3$
= <u>1.6E-5 ppm</u>

The above concentrations are summarized in table 1 (including plume meander) for the onsite individual at 100 m, the nearest public access at 4.5 km, and the offsite individual at 12.5 km.

TABLE 3: ESTIMATED CONSEQUENCES OF SCENARIO 3

RECEPTOR LOCATION	CONSEQUENCES, ppm
Onsite, 100 m	6.8E-3
Nearest Public Access, 4.5 km	2.5E-5
Offsite, 12.5 km	1.3E-5

REFERENCES

Cheremisinoff, Paul N., and Ellerbusch, Fred, 1978, Carbon Adsorption Handbook, Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan.

FEMA, USDOT, USEPA, 1988, Handbook of Chemical Hazard Analysis Procedures, Washington, D.C.

Technica, 1988, Whazan User's Guide, Technica International Ltd, Fullerton, California.

USNRC, 1982, Regulatory Guide 1.145, Atmospheric Dispersion Models For Potential Accident Consequence Assessments at Nuclear Power Plants, Office of Nuclear Regulatory Research.

Yant, et al, 1936, Industrial and Engineering Chemistry, Analytical Edition, Vol. 8, No. 1.

From: Safety Hazards Analysis MAM-29240-92-011
Phone: 6-8009 N1-37
Date: September 29, 1992
Subject: CONSEQUENCE ANALYSIS FOR CARBON TETRACHLORIDE REMEDIATION

To: R. R. Lehrschall N1-75

cc: R. G. Britton N1-19
J. S. Davis N1-19
N. R. Kerr N1-75
E. E. Leitz N1-37 EEL
J. C. Van Keuren N1-19
MAM File/LB

9312903197 6

Attached is the information regarding the analysis that you requested. It shows the potential worst-case concentrations of carbon tetrachloride as a result of a handling accident in which 3 Granular Activated Carbon (GAC) units are ruptured. The bases and assumptions made for the analysis are stated in the attachment along with the results.

If you have any questions regarding these results please feel free to call.

Mark A. Medsker

Mark A. Medsker
Engineer

siw

Attachment

SCENARIO REEVALUATION

The analysis below differs from the analysis in "Scenario 2" of WHC-SD-EN-SAD-004 rev 0, Appendix G (WHC 1992) only by increasing the number of GAC units ruptured from 2 to 3. Otherwise, the scenario assumptions are identical except as modified below.

- It is assumed that when GAC units are handled, for removal from the system, storage, etc., that one unit at a time is moved.

- It is assumed that the GAC units themselves are DOT approved shipping containers which are designed to withstand a minimum three foot drop without rupturing.

- It is assumed that one unit, while being handled, is maneuvered into a physical position which is beyond the testing criteria for DOT approval (e.g. above three feet in height). It is then assumed that the unit is dropped and ruptured. Since the units will be handled near each other, it is assumed that the dropped unit can cause the rupture of two others resulting in the release of the carbon from a total of three units. No more than three units, regardless of the total number present, can be credibly ruptured in a handling accident in which one unit is moved at a time.

<u>SOURCE TERM</u>

The bases for the source term estimate in this analysis are taken from the calculations in Scenario 2 (WHC 1992, Appendix G). The inventory at risk associated with each GAC unit ruptured is 660 lb (300 kg) of CCl_4. The area associated with the carbon spill from each GAC unit ruptured in Scenario 2 is 30.2 ft^2 (2.81 m^2). For three units this is an inventory at risk of 1,980 lb (900 kg) of CCl_4 and a release area of 90.6 ft^2 (8.42 m^2).

The source term is calculated from the assumptions stated above and the WHAZAN computer code (Technica 1988). The mass (900 kg), ambient temperature (305 K), and pool area (8.42 m^2) were input into the WHAZAN code to facilitate estimation of the vaporization rate of CCl_4. The WHAZAN code estimated a vaporization rate of 2.0 lb/min of CCl_4.

<u>DISPERSION</u>

This source term was then used as input into the dispersion model of the ARCHIE computer code (FEMA 1988) to facilitate the estimation of downwind airborne concentrations. These concentrations are given in Tables 2 and 3 for the onsite individual at 100 m, the nearest public access at 4.5 km, and the offsite individual at 12.5 km. The assumptions used in the dispersion estimates are intended to approximate 95% meteorology (a wind speed of 1 m/s and Pasquill stability class F), and a ground level release.

The concentrations in Table 1 include the effects of plume meander. The phenomenon of plume meander is the lateral movement of the plume over time as the wind direction changes. Thus, as the plume centerline "wanders" laterally with time, the receptor location is exposed to a lesser concentration (on the average). However, before plume meander may be used on calculated results in a non-radiological (i.e. toxicological) analysis, certain criteria must be met. The atmospheric conditions during the release must be neutral or stable (Pasquill D, E, F, or G); the wind speed must be less than 6 m/s; the release or exposure time (whichever is less) must be at least one hour in length; the averaging time of the criteria must be at least one hour; and the peak concentrations must be calculated to ensure that acute effects from exposure to the chemical under analysis do not exceed "prudent guidelines". The first three criteria may be found in Regulatory Guide 1.145 (NRC 1982), the fourth criterion follows from the third, and the fifth criterion is discussed in more detail below. It should be pointed out that strong arguments must be made in the scenario model to show that all of these criteria are satisfied before credit may be taken for plume meander. In this analysis, the effect of plume meander resulted in a reduction of the estimated concentration at 100 m by a factor of 4, at 4.5 km by a factor of 1.7, and at 12.2 km by a factor of 1.2 (NRC 1982).

Table 1: Estimated Consequences With Plume Meander Effects (Averaged Over Time)

RECEPTOR LOCATION	CONSEQUENCES (ppm)
Onsite, 100 m	2.2 E+01
Nearest Public Access, 4.5 km	1.1 E-01
Offsite, 12.5 km	< 5.0 E-02

The concentrations in Table 2 represent peak downwind concentrations at the specified distances. The peak concentrations are calculated to ensure that immediate, acute effects from exposure to hazardous chemicals are not overlooked in an analysis which utilizes a plume meander model. Peak concentrations are to be used for comparison to relevant criteria when the scenario model fails to show that plume meander is applicable.

Table 2: Estimated Peak Consequences Without Plume Meander

RECEPTOR LOCATION	CONSEQUENCES (ppm)
Onsite, 100 m	8.8 E+01
Nearest Public Access, 4.5 km	1.8 E-01
Offsite, 12.5 km	< 5.0 E-02

REFERENCES

FEMA 1988, *Handbook of Chemical Hazard Analysis Procedures*, U.S. Department of Transportation, U.S. Department of Energy, and the Federal Emergency Management Agency, Washington, D.C.

NRC 1982, *Atmospheric Dispersion Models For Potential Accident Consequence Assessment at Nuclear Power Plants*, Regulatory Guide 1.145, Office of Nuclear Regulatory Research, Washington, D. C.

Technica 1988, *Whazan User's Guide*, Technica International Ltd., Fullerton CA.

WHC 1992, *Safety Assessment for the 200 West Area Expedited Response Action for the Remediation of Carbon Tetrachloride*, WHC-SD-EN-SAD-004, Westinghouse Hanford Company.

Westinghouse
Hanford Company

Internal
Memo

From: Safety Hazards Analysis
Phone: 6-8009 N1-37
Date: September 30, 1992
Subject: GAS MEMBRANE SEPARATION SYSTEM ACCIDENT ANALYSIS

MAM-29240-92-012

To: R. R. Lehrschall N1-75

cc: R. G. Britton N1-19
J. S. Davis N1-19
N. R. Kerr N1-75
E. E. Leitz N1-37 EEL
J. C. Van Keuren N1-19
MAM File/Letterbook

Attached is the consequence analysis that you requested. It shows the worst-case concentrations resulting from an accident involving the Gas Membrane Separation System (GMSS). The attachment to this memo details the analysis and assumptions which led to the analysis results.

If you have any questions pertaining to this analysis do not hesitate to call.

Mark Q. Medsker

Mark Medsker
Engineer

siw

attachment

(Attachment B:\012.sta)

GAS MEMBRANE SEPARATION SYSTEM ACCIDENT ANALYSIS

The following analysis examines the Gas Membrane Separation System (GMSS) for potential worst-case consequences under accident conditions. In addition to analyzing new hazards, it includes source term input from Appendix G, WHC-SD-EN-SAD-004 rev 0, *Safety Assessment for the 200 West Area Expedited Response Action for Remediation of Carbon Tetrachloride* (WHC 1992).

The GMSS is a system by which CCl_4 is removed from an air flow stream by means of a halogenated hydrocarbon-selective membrane. The GMSS is designed to remove the CCl_4 from the stream prior to entering the granular activated carbon (GAC) units of the vapor extraction system (VES). This reduces the rate at which CCl_4 is adsorbed onto the GAC units and thus the rate at which the GAC units must be shipped offsite for regeneration.

The only new hazards presented by the GMSS is that the CCl_4 is collected in liquid form in a drum. The GMSS itself presents no new hazards as it does not introduce any new hazardous substances or energy sources that have not already been analyzed. Appendix G of WHC-SD-EN-SAD-004 rev 0 (WHC 1992) contains the applicable scenarios to determine the potential worst-case consequences of an accident involving the GMSS.

A review of Appendix G (WHC 1992) shows that three scenarios were considered: (1) Excessive Retrieval, (2) GAC Spill, and (3) Phosgene Production. Since no additional CCl_4 will be retrieved and no new energy sources are present to produce phosgene, only Scenario 2 is impacted by addition of the GMSS. The liquid CCl_4 inventory associated with the GMSS produces a source term via the following assumptions:

- The accident initiator which ruptures the 2 GAC units also ruptures the 55-gal drum containing the liquid CCl_4 associated with the GMSS.

- The quantity of liquid in the drum is 30-gal, 73% of which is water and 27% of which is CCl_4 (see Requesting Memos, attached). Thus, the volume of CCl_4 spilled is (0.27)*(30-gal) = 8.1-gal. Using a specific gravity of 1.594 (CRC 1984) this is 108 lb of CCl_4 (49 kg).

- The liquid CCl_4 spills from the 55-gal drum and forms a pool on a porous surface (the ground) which has a spread factor of 0.153 m^2/kg (AFESC 1983).

- The pool area is calculated by multiplying the mass of the CCl_4 in the spill, 49 kg, by the spread factor, 0.153 m^2/kg. Thus, the pool area is (49 kg)*(0.153 m^2/kg) = 7.5 m^2.

SOURCE TERM

The source term for this analysis is calculated from the assumptions stated above and the WHAZAN computer code (Technica 1988). The mass (49 kg), ambient temperature (305 K), and pool area (7.5 m^2) were input into the WHAZAN code to facilitate estimation of the vaporization rate of CCl_4 from the liquid pool. The WHAZAN code estimated a vaporization rate of 1.39 E-02 kg/s (1.8 lb/min) of CCl_4 from the pool.

This source term was added to the source term of Scenario 2 to determine the total source term for this analysis. The source term from Scenario 2 is 0.88 lb/min (6.7 E-03 kg/s) (WHC 1992, Appendix G). Therefore, the total source term for this analysis is (1.8 lb/min)+(0.88 lb/min) = 2.7 lb/min.

DISPERSION

This source term was then used as input into the dispersion model of the ARCHIE computer code (FEMA 1988) to facilitate the estimation of downwind airborne concentrations. These concentrations are given in Tables 2 and 3 for the onsite individual at 100 m, the nearest public access at 4.5 km, and the offsite individual at 12.5 km. The assumptions used in the dispersion estimates are intended to approximate 95% meteorology (a wind speed of 1 m/s and Pasquill stability class F), and a ground level release.

The concentrations in Table 1 include the effects of plume meander. The phenomenon of plume meander is the lateral movement of the plume over time as the wind direction changes. Thus, as the plume centerline "wanders" laterally with time, the receptor location is exposed to a lesser concentration (on the average). However, before plume meander may be used on calculated results in a non-radiological (i.e. toxicological) analysis, certain criteria must be met. The atmospheric conditions during the release must be neutral or stable (Pasquill D, E, F, or G); the wind speed must be less than 6 m/s; the release or exposure time (whichever is less) must be at least one hour in length; the averaging time of the criteria must be at least one hour; and the peak concentrations must be calculated to ensure that acute effects from exposure to the chemical under analysis do not exceed "prudent guidelines". The first three criteria may be found in Regulatory Guide 1.145 (NRC 1982), the fourth criterion follows from the third, and the fifth criterion is discussed in more detail below. It should be pointed out that strong arguments must be made in the scenario model to show that all of these criteria are satisfied before credit may be taken for plume meander. In this analysis, the effect of plume meander resulted in a reduction of the estimated concentration at 100 m by a factor of 4, at 4.5 km by a factor of 1.7, and at 12.2 km by a factor of 1.2 (NRC1982).

Table 1: Estimated Consequences With Plume Meander Effects (Averaged Over Time)

RECEPTOR LOCATION	CONSEQUENCES (ppm)
Onsite, 100 m	2.8 E+01
Nearest Public Access, 4.5 km	1.4 E-01
Offsite, 12.5 km	5.0 E-02

The concentrations in Table 2 represent peak downwind concentrations at the specified distances. The peak concentrations are calculated to ensure that immediate, acute effects from exposure to hazardous chemicals are not overlooked in an analysis which utilizes a plume meander model. Peak concentrations are to be used for comparison to relevant criteria when the scenario model fails to show that plume meander is applicable.

Table 2: Estimated Peak Consequences Without Plume Meander

RECEPTOR LOCATION	CONSEQUENCES (ppm)
Onsite, 100 m	1.1 E+02
Nearest Public Access, 4.5 km	2.3 E-01
Offsite, 12.5 km	6.0 E-02

REFERENCES

AFESC 1983, *A Simple Formula for Estimating Source Strengths from Spills of Toxic Liquids*, Engineering and Services Laboratory, Air Force Engineering and Services Center, Tyndall Air Force Base, Florida.

CRC 1984, *CRC Handbook of Chemistry and Physics*, R. C. Weast (editor-in-chief), CRC Press.

FEMA 1988, *Handbook of Chemical Hazard Analysis Procedures*, U.S. Department of Transportation, U.S. Department of Energy, and the Federal Emergency Management Agency, Washington, D.C.

NRC 1982, *Atmospheric Dispersion Models For Potential Accident Consequence Assessment at Nuclear Power Plants*, Regulatory Guide 1.145, Office of Nuclear Regulatory Research, Washington, D. C.

Technica 1988, *Whazan User's Guide*, Technica International Ltd., Fullerton, CA.

WHC 1992, *Safety Assessment for the 200 West Area Expedited Response Action for the Remediation of Carbon Tetrachloride*, WHC-SD-EN-SAD-004, Westinghouse Hanford Company.

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document reviewed (include title or description of calculation, document number, author, and date, as applicable):

Memo, M.A. Medsker to R.R. Lehrschall, "Gas Membrane Separation System Accident Analysis," Letter # MAM-29240-92-011, September 29, 1992.

Submitted by: Mark Medsker   Date Submitted: 9/21/92

Scope of Review: Environmental transport/consequences of the release

YES	NO*	N/A	
[X]	[ ]	[ ]	1. A detailed technical review and approval of the environmental transport and dose calculation portion of the analysis has been performed and documented.
[ ]	[X]	[ ]	2. Detailed technical review(s) and approval(s) of scenario and release determinations have been performed and documented.
[ ]	[X]	[ ]	3. HEDOP-approved code(s) were used.
[ ]	[ ]	[X]	4. Receptor locations were selected according to HEDOP recommendations.
[X]	[ ]	[ ]	5. All applicable environmental pathways and code options were included and are appropriate for the calculations.
[ ]	[ ]	[X]	6. Hanford site data were used.
[X]	[ ]	[ ]	7. Model adjustments external to the computer program were justified and performed correctly.
[X]	[ ]	[ ]	8. The analysis is consistent with HEDOP recommendations.
[X]		[ ]	9. Supporting notes, calculations, comments, comment resolutions, or other information is attached. (Use the "Page 1 of X" page numbering format and sign and date each added page.)
[X]	[ ]		10. Approval is granted on behalf of the Hanford Environmental Dose Overview Panel.

* All "NO" responses must be explained and use of nonstandard methods justified.

Janet S. Davis *Janet S. Davis*   9/29/92
HEDOP-Approved Reviewer (Printed Name and Signature)   Date

COMMENTS (add additional signed and dated pages if necessary):

2. The scenario was provided by the customer; no evidence of review and approval was provided. The source term development was reviewed and approved by the technical reviewer.

JS Davis
9/29/92

3. HEDOP has not approved any codes for nonradiological evaluations. ARCHIE was used to determine the carbon tetrachloride release rate and concentrations downwind.

4. There are currently no HEDOP recommendations regarding receptor locations.

6. ARCHIE requires a Pasquill stability class and a windspeed to perform dispersion calculations. Therefore no "site-specific" data could be used. However, the use of Pasquill stability class F and a 1 m/s windspeed are consistent with the 95% sector X/Qs obtained with Hanford meteorology data.

7. Plume meander corrections were applied in accordance with NRC Regulatory Guide 1.145. Applicability of plume meander to nonradiological releases is scenario- and criteria-dependent, and is generally not appropriate. Since no comparisons to criteria were made (and applicability of plume meander could not be determined), results with and without plume meander were provided.

CHECKLIST FOR TECHNICAL PEER REVIEW
Document Reviewed: Gas Membrane Separation System Accident Analysis

Submitted by: M. A. Medsker   Date Submitted: 9/25/92

Scope of Review: Entire Document

	Yes	No*	NA	
	[X]	[ ]	[ ]	Problem completely defined.
1.	[X]	[ ]	[X] RGB	Accident scenarios developed in a clear and logical manner.
	[X]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
	[X]	[ ]	[ ]	Computer codes and data files documented.
	[X]	[ ]	[ ]	Data used in calculations explicitly stated in document.
	[X]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
	[X]	[ ]	[ ]	Mathematical derivations checked including dimensional consistency of results.
	[X]	[ ]	[ ]	Models appropriate and used within range of validity or use outside range of established validity justified.
	[X]	[ ]	[ ]	Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
	[X]	[ ]	[ ]	Software input correct and consistent with document reviewed.
	[X]	[ ]	[ ]	Software output consistent with input and with results reported in document reviewed.
2.	[ ]	[ ]	[X]	Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
	[ ]	[ ]	[X]	Safety margins consistent with good engineering practices.
	[X]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
	[X]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.
	[X]		[ ] **	Review calculations, comments, and/or notes are attached.
	[X]	[ ]		Document approved (i.e., the reviewer affirms the technical accuracy of the document).

R.G. Britton   *R. G. Britton*   9/29/92
Reviewer (Printed Name and Signature)   Date

* All "NO" responses must be explained below or on an additional page.

** Any calculations, comments, or notes which the reviewer feels should be part of the review record should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

COMMENTS (add additional signed and dated pages if necessary):

1. Customer specified the accident scenario.
2. Scope of this analysis did not include comparison of results to applicable criteria.

[ ] [ ] [X] Analysis entered into analysis database

Mark A. Medsker   Mark A. Medsker   9/29/92
(Printed Name and Signature)   Date

HAZARDS ASSESSMENT OF THE CARBON TETRACHLORIDE SAMPLING ACTIVITIES USING THE NEW 60 CFM VACUUM SAMPLING UNIT

D. K. Oestreich, Engineer, Radiological and
Toxicological Analysis Group

1.0 INTRODUCTION

This document provides an assessment of potential hazards relating to the use of a characterization sampling unit (shown in Figure 1) for characterization of soil gases that are drawn from various extraction wells located in the 216-Z Crib areas south and east of the Plutonium Finishing Plant exclusion area. The extraction well locations are placed in a manner one would expect analysis of gases extracted would provide a basis for selection of the optimum location for the placement of full size extraction units for soil remediation. This document does not cover the boring of the extraction wells because the wells that are to be sampled are already in existence.

2.0 CHARACTERIZATION SAMPLING UNIT DESCRIPTION

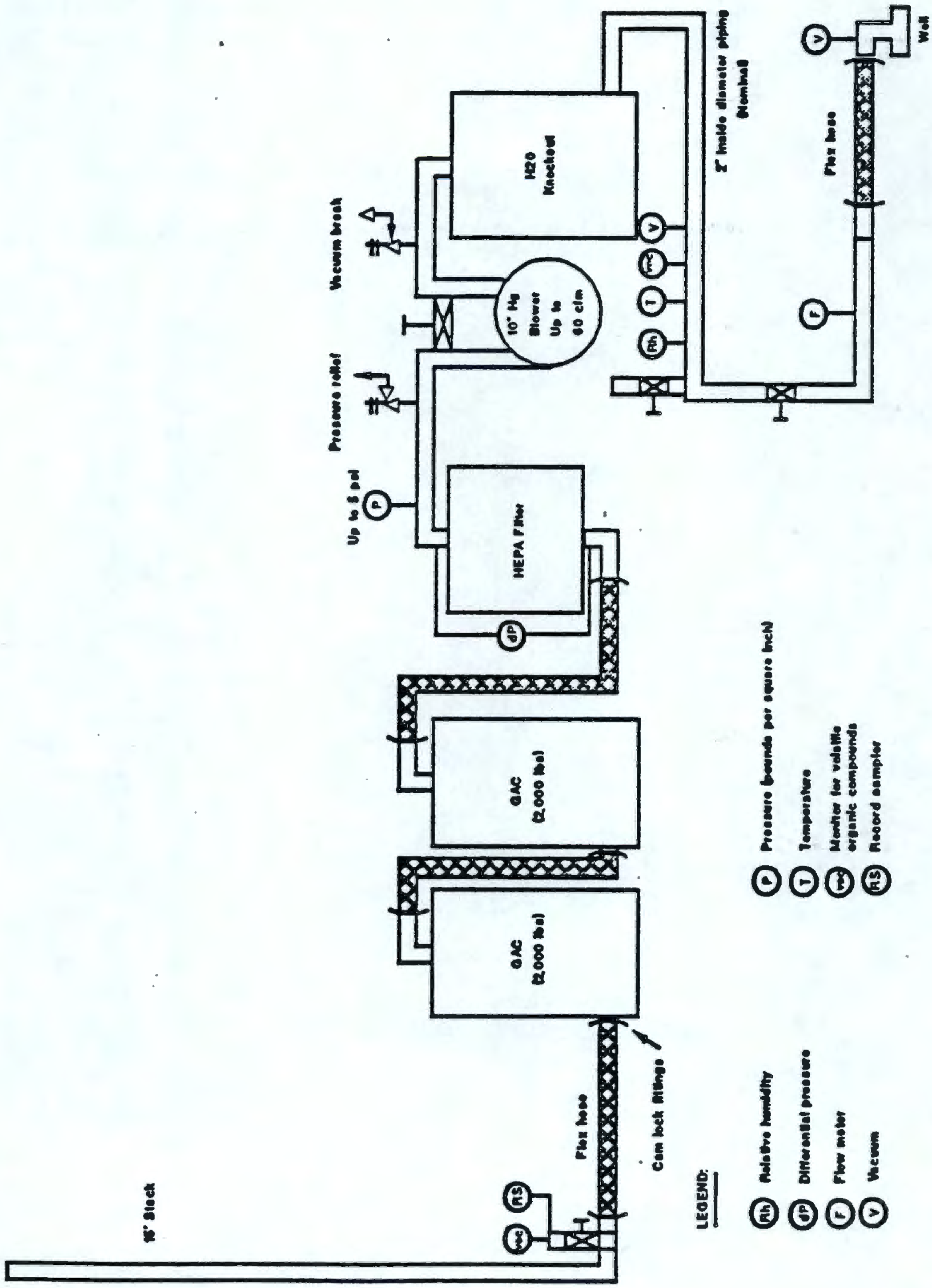
The sampling unit consists of an inlet piping manifold instrumented for flow, vacuum, and temperature and equipped with a sampling port through which gas samples may be drawn for analytical characterization. One end of the piping manifold connects to the wellhead and the other end connects to a knock out drum that connects to the low pressure side of a blower. The high pressure side of the blower connects to a high efficiency particulate air (HEPA) filter and then to a 2,000 lb granular activated carbon (GAC) filter. The exit side of the carbon filter has a second sampling port, and gases exhausted from the carbon filter are passed to the atmosphere via a 5 m (15 ft) high stack. It should be noted that the exit side of the knock out drum is equipped with a vacuum breaker, while the exit side of the blower is equipped with a pop-off valve that is set to maintain pressure in the system at < 5 lb/in^2. The capacity of the blower is 60 cfm which is equivalent to 28.3 liters/second.

3.0 CHARACTERIZATION UNIT OPERATION

Operation of the sampling unit can expected to essentially be free from any hazards relative to possible releases of hazardous materials. The system will be initially connected to well heads while the blower is not operating, and the connection secured prior to the blower being operated. Because the sampling manifold with its instrumentation and the knock out drum will be on the low pressure side of the blower, any leaks caused by weak joints, bad gaskets, or valve packing will be leaks into the system rather than the reverse. Thus, it is physically impossible for a release to take place on the low pressure side of the blower. The high pressure side of the blower is equipped with a pressure relief pop off valve set at 5 lb/in^2. Because the blower is only capable of 60 ft^3/min, the blower outlet could be dead headed, and the pressure would never begin to approach the 5 lb/in^2 required to blow the pop off valve. Thus, an environmental release via pop off valve actuation is a virtual impossibility.

A release to the environment from the sampling unit can only take place if a breach in the system takes place between the high pressure side of the blower and the inlet of the GAC unit. There are very few ways in which this could take place. The piping between the blower and the HEPA, and the HEPA and the GAC unit is flexible reinforced rubber hose. Consequently, piping or joint breaks resulting from earthquakes or other physical stresses would not be expected.

Figure 1. Characterization Sampling Unit.



Electrical generators, if used to supply power, will be located at a distance greater than 15 m (50 ft) from the sampling unit; thus the potential for fire causing a toxic release is very low. It is more likely electrical power will be supplied from the power grid. In either case, the probability of having a fire that could damage the sampling unit is very low.

Consideration has also been given to a scenario in which water condensed out from the extraction gas stream freezes up in cold weather and causes low points in the piping between the carbon vessel and the HEPA filter to burst. It is extremely unlikely that enough water would collect in the piping to cause a freeze-expansion induced failure because the piping is preceded by the knock out drum and HEPA filter. Condensation water normally collects in the knock out drum. Furthermore, because the piping between major pieces of equipment is 5 cm (2 in) diameter, reinforced rubber hose that has some capability to stretch, it is considered unlikely that the expansion created by water freezing would breach the hose.

It is also considered to be very unlikely that sufficient water could collect in the HEPA filter or the GAC unit to permit breaching of these units to result from the freezing of water.

In conclusion, no mechanisms have been identified that would provide pressure boundary failure that could result in a toxic release. The only other way that a toxic release could take place would be for the GAC unit to become saturated with CCl_4. If the unit was operated after the GAC was completely loaded, the gas exiting from the stack would be at the same carbon tetrachloride (CCl_4) concentration as the gas extracted from the ground. This will not happen because the 2,000 lb GAC unit is capable of adsorbing approximately four times the actual amount of CCl_4 that will be sent to the GAC during the planned sampling activity. This statement is based on assuming 30% capacity for the 2,000 lb GAC unit. The maximum sampling duration expected per well is 1 hour, a total of 50 wells.

If a concentration of 3,000 p/m by volume is assumed in the extraction gas which is under 25 cm (10 in) of mercury vacuum [thus pressure is 51 cm (19.9 in) mercury vacuum], and temperature is 0°C, then the source term will be the product of total gas molar flow rate and CCl_4 concentration. The gas molar volume at this pressure and temperature is 33.6 liters/mole, so the total gas molar flow rate is as follows:

28.3 liters/second/33.6 liters/mole = 0.842 moles/second

Because the extraction gas is 3,000 p/m by volume or 0.003 decimal fraction, then molar flow rate of CCl_4 is as follows:

(0.842)(0.003) = 2.53×10^{-3} moles CCl_4/second and mass flow rate is as follows:

(2.53×10^{-3})(154) = 0.389 grams/s = 0.0515 lb/minute.

This mass flow rate was input as a source term to the software to calculate downwind concentration to be expected at 100 m (330 ft) distance under worst case meteorological conditions. Results indicated that concentration at 100 m (330 ft) distance would be 4.7 p/m of CCl_4. This concentration is above the 2 p/m Threshold Limit Value (TLV), but is below the

50 p/m Emergency Response Planning Guidelines-2 which is the risk acceptance criteria appropriate to 100 m (330 ft) distance. The calculations indicated that concentrations would drop below the 2 p/m TLV at a distance of 164 m (540 ft) from the stack.

DON'T SAY IT --- *Write It!*

DATE: January 13, 1993

TO: Ron Lehrschall N1-75

FROM: D.K. Oestreich, N1-19

Telephone: 6-2208

SUBJECT: Use of Large Granular Activated Carbon Column on the Characterization Sampling Unit

Per your request I have considered the implications of a design change on the carbon tetrachloride (CCl_4) sampling unit that calls for increasing the size of the granular activated carbon (GAC) adsorber from 200 pounds (55 gal) to 2,000 lbs.

It has been suggested that, because of the larger size of the GAC adsorber now planned for use, handling the larger unit would increase the likelihood of dropping the unit and possibly creating a rupture spilling GAC upon the ground and releasing CCl_4. The rate at which CCl_4 would be desorbed to the air depends upon the following factors:

(1) The extent the GAC is saturated with CCl_4.

(2) The temperature of the carbon and air.

(3) The air pressure the spilled GAC is subjected to compared to the air pressure under which the GAC was loaded.

(4) The air flow rate the spilled GAC is exposed compared to the flow rate during the adsorption cycle.

The maximum duration of use of the sampling unit on any one well head is 60 minutes, while a more likely duration is 10 minutes. Because a maximum of 50 wells will be sampled, the maximum duration of the GAC unit use would be 3,000 minutes. The 2,000 lb GAC canister is predicted to have a useful lifetime of 23,301 minutes before break through, assuming a 30% working capacity for the GAC.

It can be concluded that the GAC will be far less than saturated under the reduced pressure (0.66 atmospheres) prevalent during the adsorption cycle. Because the spilled GAC is exposed to air pressure of 1 atmosphere, the CCl_4 is less likely to desorb than if the pressure were still 0.66 atmospheres. Furthermore, the air flow the spilled GAC is subject to would be far smaller than the air flow present during adsorption. It would logically follow that any loss of CCl_4 from spilled GAC to the air would be extremely slow, and resulting CCl_4 concentrations to the environment would be too low to detect.

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ID Number (include revision, volume, etc.)
WHC-SD-EN-SAD-[illegible]-004, Rev. 1-A

List attachments.
Attachment G

Date Release Required
March 30, 1993

Title Safety Assessment for the 200 West Area Expedited Response Action for Remediation of Carbon Tetrachloride

Unclassified Category UC-

Impact Level 2 ESQ

New or novel (patentable) subject matter? [X] No [] Yes
If "Yes", has disclosure been submitted by WHC or other company?
[] No [] Yes Disclosure No(s).

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Review Required per WHC-CM-3-4	Yes	No	Reviewer - Signature Indicates Approval Name (printed)	Signature	Date
Classification/Unclassified Controlled Nuclear Information	[]	[X]			
Patent - General Counsel	[]	[x]	OGC Memo 2493	H. Marquez	3/30/93
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Applied Technology/Export Controlled Information or International Program	[]	[X]			
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Information conforms to all applicable requirements. The above information is certified to be correct.

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Author/Requestor (Printed/Signature) Date
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Project Title/Work Order:

SAFETY ASSESSMENT FOR THE 200 WEST AREA EXPEDITED RESPONSE ACTION FOR REMEDIATION OF CARBON TETRACHLORIDE

EDT No.: ECN No.: 189905

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T. L. Bennington	H4-16	1		
L. P. Diediker	T1-30	1		
S. A. Driggers	H6-04	1		
S. J. Gale	N3-05	1		
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