E_3-Killam Inc.
environmental services

915066

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT

Project ID No. 9-15-066
Soil Remediation Unit

Documentation of Approval Process

TPS Technologies, Inc.
By E_3-Killam, Inc.

E_3-Killam, Inc.
80 Curtwright Drive, Suite #1
Buffalo, NY 14221-7072

A subsidiary of
Randers - Killam
Engineering Group
Muskegon, Michigan

Other offices

Florida
Massachusetts
New Jersey
Ohio
Pennsylvania
West Virginia

E_3-Killam Project #: 99023

October 13, 1999

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Project #99023

October 13, 1999

Michael Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington
Environmental Engineer III
Bureau of Program Management

Division of Environmental Remediation
New York State
Dept. of Environmental Conservation
50 Wolf Rd.
Albany, NY 12233-7010

Re: Westinghouse Plant Soil Remediation Project – No. 9-15-066
Final Documents Used to Obtain DEC Approval for Soil Remediation Program

Dear Mr. Ryan and Mr. Harrington:

The purpose of this letter is to convey a copy of all documents used to obtain approval of the NYSDEC to install and implement operation of the Soil Recovery Unit (SRU) at the Westinghouse Plant (Buffalo Airport Center) located on Genesee Street in the town of Cheektowaga, Erie County, State of New York. The items comprising this document are listed on the following page.

Tab	Originator	Date	Recipient	Document
CORRESPONDENCE	DEC-Albany	10/7/99	TPST Barry Hinton	Authorization to implement DTP.
	TPST	10/7/99	DEC-Albany Mike Ryan Jim Harrington	Discussion of soil to be used during the DTP
	TPST	10/4/99	DEC-Albany Mike Ryan Jim Harrington	Explanation of SRU manual feed system cutoffs.
	DEC-Albany	9/24/99	TPST Barry Hinton	Comments of the DEC to E_3-Killam letter to the DEC dated 9/22/99 describing SRU feed system cutoff plan.
	E_3-Killam	9/22/99	DEC-Albany Mike Ryan Jim Harrington	Response to DEC comments dated 9/1/99 and 9/15/99 on Parts 1, 2, and 3, E_3-Killam documents providing emission estimates, operating controls, and Demonstration Test Plan (DTP) respectively. Also includes replacement pages for Part 1 as required.
	DEC-Albany	9/15/99	TPST Barry Hinton	Notification that DTP is generally acceptable but requires some changes prior to full approval.
	DEC-Albany	9/1/99	TPST Barry Hinton	Comments of the DEC to E_3-Killam's Parts 1 and 2 submittals. Also includes comments on proposed SST pad design modification.
PART ONE SUBMISSION	E_3-Killam	8/6/99	DEC-Albany Mike Ryan Jim Harrington	Part 1 - SRU air emission estimates and ambient impact.
PART TWO SUBMISSION	E_3-Killam	8/18/99	DEC-Albany Mike Ryan Jim Harrington	Part 2 - SRU Operating Controls.
PART THREE SUBMISSION	E_3-Killam	9/8/99	DEC-Albany Mike Ryan Jim Harrington	Part 3 – SRU Demonstration Test Plan (DTP)

Sincerely,

E_3-Killam, Inc.

James L. McGarry, MS, P.E.
Environmental Engineer

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Enclosure
cc: TPST/ Blair Dominiak (1), B. Hinton (1)
IT/ L. Martin (1)
E_3-Killam/ E. Nesselbeck (1)
SoilPure/ K. Shellum (1)
NYDEC/ Greg Sutton (2)

CORRESPONDENCE

New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Western Remedial Action, Room 348
50 Wolf Road, Albany, New York 12233-7010
Phone: (518) 457-4343 FAX: (518) 457-3972

John P. Cahill
Commissioner

October 7, 1999

Mr. Barry M. Hinton
Vice President, Operations
TPS Technologies, Inc.
1964 S. Orange Blossom Trail
Apopka, FL 32703

Dear Mr. Hinton:

Re: Westinghouse Electric Site
Project ID No. 9-15-066

The purpose of this letter is to advise you that TPS Technology's letters of October 4th and October 7th have been reviewed. These letters respond to the New York State Department of Environmental Conservation's (NYSDEC) comments on E_3-Killam's submittals (Parts 1-3) and follow up on recent discussions. As the responses address the NYSDEC's outstanding concerns, TPS is hereby authorized to implement the Demonstration Test Program (DTP). Based on the results of the DTP, operational limits will be established for the various operating parameters, including carbon monoxide.

Please submit two copies of the final E_3-Killam documents (Parts 1-3) to Mr. Greg Sutton, P.E., of the NYSDEC Buffalo Office. Please submit one additional copy to this Office.

If you have any questions concerning the above, please do not hesitate to contact me at (518) 457-4343.

Sincerely,

Michael J. Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action
Division of Environmental Remediation

cc: B. Dominiak (TPS)
L. Brausch (CBS)
L. Martin (IT Corp.)

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October 7, 1999

Mr. Michael Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington
Environmental Engineer III
Bureau of Program Management

New York State Department of Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, NY 12233-7010

Re: Westinghouse Plant Soil Remediation Project - No. 9-15-066
Determination of Demonstration Test Program Soils and Constituents of Concern

Dear Messrs. Ryan and Harrington:

Upon consultation with IT Corporation (IT) personnel regarding contaminated soils scheduled for excavation in the near future and yourself regarding soil concentration levels suitable for demonstration testing, TPS Technologies Inc. (TPST) has selected a location and a quantity of contaminated soil (320 tons) for the Demonstration Test Program (DTP). TPST proposes remediation of soils from Area I at the Geoprobe 9 marker.

According to these recent geoprobe results from IT, soils at a depth of 16 feet or deeper represent a "hot spot' of trichloroethylene (TCE) and toluene contamination at 220-360 ppm and 7.9-17 ppm, respectively. Since no other contaminants, except 1,1,1-trichloroethane (TCA) at 2 ppm, were detected at this location, the selected "constituents of concern" for the October 12, 1999 DTP are TCE and toluene.

TPST understands that although the non-chlorinated VOC contaminant concentration levels in the selected DTP soils are not as high as desired, TPST/SoilPure will not be prevented in future production work from processing soils at a much higher non-chlorinated VOC content (2700-3500 ppm). This agreement is contingent, of course, on TPST achieving acceptable Destruction and Removal Efficiencies for both "constituents of concern" in the DTP.

With this final submittal, TPST believes that we have met all permitting requirements for this remediation project. We await NYSDEC approval to proceed with the DTP.

If any questions or clarifications remain, I can be reached at (407) 886-9570, ext. 136. Thank you for your valuable assistance in this matter.

Respectfully,

Blair W. Dominiak

Blair W. Dominiak
Manager, Regulatory Compliance

cc: L. Martin - IT Corp.
B. Hinton - TPST
H. Turner - TPST
J. McGarry - E3 Killam ✓
M. Hamilton - E3 Killam
K. Shellum - SoilPure (2)

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October 4, 1999

Mr. Michael Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington
Environmental Engineer III
Bureau of Program Management

New York State
Dept. of Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, NY 12233-7010

Re: **Westinghouse Plant Soil Remediation Project - No. 9-15-066**
Responses to DEC comments dated 9/24/99 on E_3-Killam submittals Part 1 dated 8/6/99, Part 2 dated 8/18/99, Part 3 dated 9/8/99.

Dear Messrs. Ryan and Harrington:

This responds to the comments made by the DEC in their correspondence of September 24, 1999 regarding the above-captioned documents.

The first comment addressed in Mr. Ryan's letter pertains to how a manual feed system shutdown will be accomplished by TPS Technologies/SoilPure personnel for those parameters in the ITRC guidance document that are not electronically linked to the Soil Remediation Unit's (SRU) automatic waste feed cutoff system. TPS proposes that a dedicated control room operator provide continual visual observation of the following six SRU parameters and their specified operational limits:

1. Outlet Soil Temperature below 300°F*
2. Afterburner Temperature below 1650°F.*
3. Rotary Drum Pressure above +0.2"w.c.*
4. Carbon Monoxide Level above 100 ppm.
5. Production Rate exceeds 40 tons/hr.*
6. Percent Damper Opening exceeds the maximum opening observed during the Demonstration Test Program (DTP) by more than 5%.

*Parameter may need to be adjusted following completion of the DTP.

In addition to visual observation of the above parameters, the control operator will be required to manually record each parameter in a logbook at 30 minute intervals. In the event that any of the above parameters deviate from its prescribed limit for more than two (2) consecutive minutes, the operator will be required to note the individual parameter and time in his logbook. He will then have a maximum of only eight (8) minutes to manually correct the problem. If, at the end of this eight minute period (10 minutes total deviation), the operator is unable to administer a proper correction (the parameter still deviates from its prescribed limit), the operator will then be required to manually shutdown the contaminated soil feed system until the situation is sufficiently remedied (the parameter is brought back to within its proper operating limits). Subsequent to waste feed cutoff, if it is determined by TPS Technologies/SoilPure personnel that the problem can only be corrected by a shutdown of other SRU systems, those subsystems will be shutdown utilizing normal shutdown procedures. A comment section will also be provided in the logbook to describe whether the operator's actions were successful or not at preventing a manual waste feed system shutdown.

In response to the second comment, the laboratory will determine the spiking amount for the two "constituents of concern". Because levels of these compounds are expected to be "ND" (non-detect), section 7.6.2 of EPA Reference Method 18 states that if a target compound is not detected, the concentration of the compound to be spiked shall be 5 times the limit of detection for that compound. The laboratory, however, recommends spiking the tubes at ten times the concentration. This would result in a spike of 100 ug for each compound, based on an MDL of 10 ug (0.01 mg).

We are confident that these responses will satisfy your comments and concerns. Should you have any further questions, please do not hesitate to contact me in Apopka, Florida at (407) 886-9570, ext. 136 or Mr. James McGarry in Buffalo at (716) 631-5858.

Respectfully,

Blair W. Dominiak

Blair W. Dominiak
Manager, Regulatory Compliance

cc: B. Hinton - TPST
H. Turner - TPST
L. Martin - IT Corp.
K. Shellum - SoilPure (2)
J. McGarry - E_3 Killam ✓
M. Hamilton - E_3 Killam

New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Western Remedial Action, Room 348
50 Wolf Road, Albany, New York 12233-7010
Phone: (518) 457-4343 FAX: (518) 457-3972

John P. Cahill
Commissioner

September 24, 1999

Mr. Barry M. Hinton
Vice President, Operations
TPS Technologies, Inc.
1964 S. Orange Blossom Trail
Apopka, FL 32703

Dear Mr. Hinton:

Re: Westinghouse Electric Site
Project ID No. 9-15-066

The purpose of this letter is to advise you that the responses provided by E_3-Killam (dated September 22, 1999) have been reviewed. These responses have been submitted to address the New York State Department of Environmental Conservation's (NYSDEC) comments on earlier Part 1 , Part 2 and Part 3 submittals. The responses generally address the NYSDEC's concerns, however, one matter requires your attention, prior to final approval. TPS has proposed automatic waste feed cutoffs for primary burner failure, induced draft fan failure and baghouse pressure drop. Pursuant to previous discussions, TPS was to provide an explanation of how shutdown will be handled for those parameters which will not be addressed by automatic waste feed cutoffs (as recommended by the ITRC guidance document). Please provide this information for review.

In response to the inquiry regarding the "spiked concentration" (ref. Section B, item 2a), the NYSDEC recommends the laboratory determine the concentration. Be advised, however, that the spike should be consistent with the quantity of contaminant expected to be collected from the stack.

If you have any questions concerning the above comments, please do not hesitate to contact me at (518) 457-4343.

Sincerely,

Michael J. Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action
Division of Environmental Remediation

cc L. Brausch (CBS)
L. Martin (IT Corp.)

E_3-Killam Inc.
environmental services

80 Curtwright Drive
Suite #1
Buffalo, NY 14221-7072
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Project #99023

September 22, 1999

Michael Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington
Environmental Engineer III
Bureau of Program Management

Division of Environmental Remediation
New York State
Dept. of Environmental Conservation
50 Wolf Rd.
Albany, NY 12233-7010

Re: **Westinghouse Plant Soil Remediation Project – No. 9-15-066**
A. Responses to DEC comments dated 9/1/99 on E_3-Killam submittals Part 1 dated 8/6/99 and Part 2 dated 8/18/99.
B. Responses to DEC comments dated 9/15/99 on E_3-Killam submittal Part 3 dated 9/8/99.

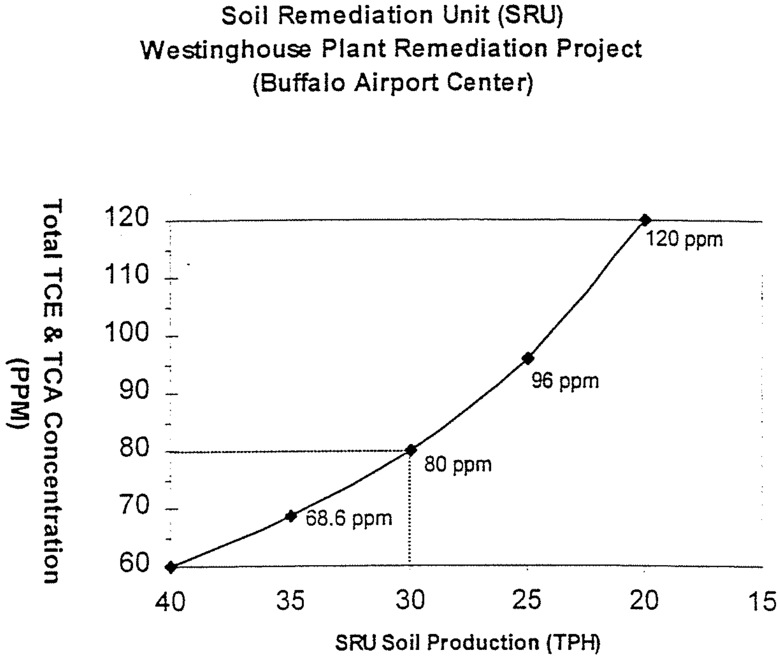
Dear Mr. Ryan and Mr. Harrington:

This responds to the comments made by the DEC on the captioned documents.

A. Responses to comments on the Part 1 (Phase I) document

1. We agree to determine VOC emissions based on a DRE of 99.99%. Attached and listed below are updated pages from the Part 1 document: Air Emission Summary page 1, Emission Calculation Assumption page 2, Toluene, Ethylbenzene, and Xylene (TEX) Emissions page 6, VOC Emission page 7, Estimated Emission Compliance Status and Ambient Impact Summary tables.
2. We agree with your assessment for this job and will use a contamination of 5000 ppm mixed VOCs to estimate VOC air emissions from the SRU. Therefore, the updated pages listed in item 1 above that were affected by this change have been revised. You may want to retain the estimated air emission calculations based on an assumed mixed VOC soil contamination of 10,000 ppm because future remediation at this site may involve petroleum contaminated soil in which the mixed VOC contamination could be as high as 10,000 ppm.
3. We confirm that the total of TCE and TCA must be below 60 ppm to comply with the 4.0 lbs/hr limit on HCl emissions – We point out however, that the allowable contamination level varies with soil remediation rate.

Calculations show that the 60 ppm allowable total TCE and TCA concentration in the contaminated soil that will comply with the limit of 4.0 lbs/hr HCl emissions is at a soil production rate in the SRU of 40 TPH. The allowable TCE and TCA concentration increases as the soil production rate decreases. The following graph shows the relationship while maintaining an HCl emission rate of 4.0 lb/hr:


Soil Remediation Unit (SRU)
Westinghouse Plant Remediation Project
(Buffalo Airport Center)

Total TCE & TCA Soil Concentration (ppm) vs. SRU Soil Production Rate (TPH) for 4.0 lb/hr HCl emissions.

Therefore, soil production rate must be considered when using the combined soil contamination of TCE and TCA in the SRU feed soil to determine compliance with HCl emissions.

4. E_3-Killam has determined that the computer modeling run for the originally proposed TPST SRU was inadvertently joined with the summary tables for the SPI SRU. The DEC was advised of this in E_3-Killam's letter dated September 8, 1999 submitting the Part 3 Demonstration Test Plan. The updated Ambient Impact Summary Tables listed in item 1 in the foregoing has been revised to show the impact based upon the SPI SRU emission parameters. We are also attaching the computer modeling run based on SPI SRU criteria.

Responses to comments on the Part 2 document

5. E_3-Killam reports that TPS Technologies agrees to provide these automatic waste feed cut-offs (AWFCO's) of those recommended in the ITRC Guidelines for LTTDs in Table 6-1 on page 18. The cut-offs are instantaneous and triggered by

    a. Primary Burner Failure
    b. Induced Draft Fan Failure
    c. Baghouse pressure drop outside of the operating envelope established during the Demonstration Test Program (DTP).

Note: ITRC Guidelines Table 6-1 Condition No. 4 on Page 18 lists two conditions, i.e, blower failure or positive pressure at the desorber (drum). Blower failure automatic waste feed cut-off will be provided; positive pressure automatic waste feed cut-off at the desorber will not be provided.

6. We propose total hydrocarbons (THC) analysis during the stack test as a replacement for full time THC continuous emission monitoring. We expect that the THC analysis during the Demonstration Test Program will show THC concentration at or near non-detect levels. Assuming our expectation is realized, TPST proposes that the THC continuous emission monitor (CEM) will not be needed during production. A discussion with DEC staff following the Demonstration Test Program will be required.

7. The following is an addendum by Mr. Jack Lauber to his statement to Mr. Blair Dominiak of TPS Technologies dated 8/17/99.

> "My August 17, 1999 letter to you referenced W. Troxler's data that dioxin emissions would appear to be an order of magnitude or less than the EPA MACT standard based upon tests of similar thermal treatment facilities.
>
> In addition, the previous KC Lee Union Carbide report predicts a worst case 99.99% DRE temperature of 1372°F with 2 seconds residence time. Your technology is designed to operate at 1650°F at greater than 2 seconds residence time which is much better than the worst case conditions for achieving 99.99% DRE.
>
> Therefore, it is highly unlikely that significant dioxin emissions would occur, and it would be counterproductive and costly to stack test for such emissions. Therefore, dioxin stack testing is not recommended."
>
> Jack D. Lauber PE DEE
> September 17, 1999

Response to Comments on the proposal to modify the SST pad design

8. Yes, we agree to each comment. Attached is a copy of two sketches revised 9/7/99 showing SST pad redesign to conform to comments in your letter of 9/1/99. Also, we confirm that 20 mil liner thickness is acceptable to the DEC.

B. Response to comments on Part 3 document

Item 1

As stated in your letter, the objective of this test program is to determine the destruction removal efficiency (DRE) of the MSRU. Testing will be performed to demonstrate a 99.99% DRE, and will determine the operating parameters of the unit once the 99.99% DRE is achieved.

Item 2a

As stated in EPA Reference Method 18 section 7.6.3, the recovery study will be performed. A "spiked" train and "non-spiked" train will run simultaneously for each of the three samples being collected. The method states that the "spiked" tubes will contain approximately 40 to 60 percent of the mass expected to be collected. Because the expected mass will be at or below the detection limit, it is proposed that a known "quantifiable" concentration of each "constituent of concern" be spiked onto the tubes to satisfy the recovery study requirements. The "spiked" concentration can either be determined by your office, or by the laboratory doing the analysis. Please advise us as how to proceed with this matter.

Item 2b
The sampling rates for the EPA Reference Method 18 samples will be increased to the maximum allowable rate as dictated by the NIOSH method being followed (0.2 L/min.). As stated in the protocol, sixty minute samples will be collected; however, if either toluene or 1,1,1-trichloroethane are selected as the "constituents of concern", the sampling time will be reduced to forty minutes to ensure that the maximum sample volumes for these parameters are not exceeded.

Item 2c
Glass wool will be inserted into the end of the probe to remove particulate matter. Due to the high stack temperatures expected, the glass wool plug will be placed in the probe end closest to the "flexible" Teflon tubing connecting the charcoal tubes to the probe. By doing this, the gas stream should have had the opportunity to cool enough to prevent the glass wool from melting.

Included in this submittal is an authorized agent letter and a PE Certification.

The attachments cited in this letter are enclosed under a listing which indicates where the attachments should be inserted into the E$_3$-Killam documents submitted on 8/6/99, 8/18/99 and 9/8/99 by E$_3$-Killam.

We anticipate that these responses will satisfy your comments and concerns. Should you have any further questions and or comments, please do not hesitate to contact me in Buffalo at (716) 631-5858 or Mr. Blair Dominiak of the TPS Technologies at (407) 886-2000 will also be of help.

Sincerely,

E$_3$-Killam, Inc.

James L. McGarry, MS, P.E.
Environmental Engineer

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Enclosure
cc: TPST/ Blair Dominiak (2), B. Hinton (2)
IT/ L. Martin (1)
E$_3$-Killam/ E. Nesselbeck (1)
SoilPure/ K. Shellum (2)
Jack Lauber (1)
53 Fairlawn Drive
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August 3, 1999

New York State
Department of Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, NY 12233-7010

Attn: Mr. Mike Ryan, Environmental Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington, Environmental Engineer III
Bureau of Program Management

Re: Authorized Permitting Representative

Dear Messrs. Ryan and Harrington:

By this correspondence, TPS Technologies Inc. (TPST) hereby notifies the Department that E3-Killam Inc. of 80 Curtwright Drive, Buffalo, New York is authorized to act in TPST's behalf regarding all permitting and environmental matters pertaining to the thermal remediation of NYSDEC Inactive Hazardous Waste Site No. 9-15-066, Cheektowaga, NY.

If you have any questions pertaining to E3-Killam's responsibilities on this job, please contact me at (407) 886-2000.

Respectfully,

Blair W. Dominiak

Blair W. Dominiak
Manager, Regulatory Compliance

cc: L. Martin - IT Corp.
J. McGarry - E3-Killam
B. Hinton - TPST

A subsidiary of Thermo TerraTech Inc.,
a Thermo Electron company

Westinghouse Soil Remediation Project
Operable Unit No. 1
TPS Technologies Soil Remediation SRU

E_3-Killam, Inc.   P.E. Certification

I certify that under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments as they pertain to the practice of engineering. This is defined as the performance of a professional service such as consultation, investigation, evaluation, planning, design or supervision of construction or operation in connection with any utilities, structures, buildings, machines, equipment processes, works, or projects wherein the safeguarding of life, health and property is concerned, when such service or work requires the application of engineering principles and data. Based on my inquiry of those individuals with primary responsibility for obtaining such information, I certify that the statements and information are to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

Name of P.E. James L. McGarry

Signature of P.E. J McGarry

Date 09 / 22 / 1999

NYS License No. 047232

Phone (716) 631-5858

\\E3KILLAM\SYS\ENG\PROJECTS\TPS_TECH\pe_Cert.doc

Westinghouse Soil Remediation Project No. 9-15-066
Response to DEC Comments dated 9/1/99 on Submitted Phase I (Part 1) and Part 2 & Comments Dated 9/15/99 on Submitted Part 3

List of Documents attached to E3-Killam Response Letter Dated 9/22/99

Response Letter Item	Document Being Attached	Location
Response to Comments on Phase 1 (Part 1)		
Reply A.1	Revised pages of Phase I (Part 1) showing estimated VOC emissions based on 99.99% DRE:	All pages except items e & f located in Est. Emissions Section
	a. Air Emission Summary page 1	Replacement for page dated 8/6/99
	b. Emission Calculation Assumption page 2	Replacement for page dated 8/6/99
	c. TEX Emissions page 6	Replacement for page dated 8/6/99
	d. VOC Emissions page 7	Replacement for page dated 8/6/99
	e. Estimated Emission Compliance Status	Replacement for page dated 8/6/99
	f. Ambient Impact Summary Tables	Replacement for page printed 8/6/99 (In Ambient Impact Section)
	NOTE: Items a, b, d, e & f have also been revised to reflect the reduced VOC soil contamination of 5000 ppm by weight.	
Reply A.2	No Attachment Required. Replacement pages noted in Response A.1 have been revised to show impact of lower VOC concentration.	
Reply A.3	No Attachment Required.	
Reply A.4	Three-page Ambient Impact Analysis revised to reflect results with SoilPure SRU. Also, project heading has been added to page 1 for identification.	Replacement pages for the three-page computer modeling run dated 7/30/99 in the Ambient Impact section of Part 1.
Response to Comments on Part 2		
Reply A.5	No Attachment Required.	
	No Attachment Required.	
Reply A.6		
Reply A.7	No Attachment Required	
Response to Comments on the SST pad design submitted on 8/30/99 by TPST		
Reply A.8	Two sketches of pad design features that show compliance with the three bullet items in Comment 8.	Insert where appropriate with pad design proposed.
Response to Comments on Part 3		
Reply B	No Attachment Required.	

Westinghouse Plant Soil Remediation Project
Operable Unit #1
Town of Cheektowaga, NY
TPS Technologies Inc.

Air Emission Summary

Contaminant	Emission Rate Potential (lb/hr)	Hourly Emissions (lb/hr)	Project Emissions (lb)
Hydrogen Chloride	4.0	4.0	5586
Toluene, Ethylbenzene, Xylenes	273	0.0272	110
Volatile Organic Compounds	400	0.56	535
Sulfur Dioxide	0.019	0.019	7.7
Carbon Monoxide	3.30	3.30	1337
Nitrogen Oxide	19.6	19.6	7938
Particulate Matter	760	5.14	7178

Note: The emission rates listed above are representative of actual operations and are not meant to be maximum values for limiting emissions.

Emission Calculations for TPS Technologies, Inc.
Town of Cheektowaga, New York (Westinghouse Plant) Soil Remediation Project

Assumptions used in these calculations are as follows:

1. Soil remediation unit will process a maximum of 40 tons (80,000 lbs) per hour.
2. Minimum amount of soil to be remediated is 16,200 tons. The maximum concentration of chlorinated solvents in the soil is 204 ppm. When required, soil of appropriate quality will be blended to achieve a maximum HCl emission rate of 4.0 lb/hr.
3. Unit will operate on propane fuel with a heating value of 91,500 BTU/gal.
4. Output of rotary drum burner is 50 MM BTUs/hr and the output of the afterburner is 44.4 MM BTUs/hr for a total of 94,400,000 BTUs/hr.
5. Maximum contamination level of processed soil is 5,000 ppm mixed VOCs.
   This assumption is based on the soil contamination sampling survey for the soil being processed in this part of the remediation project. This does not preclude the existence of soil with contamination "hot spots" which contain greater than 5000 ppm of mixed VOCs and when processed could result in VOC emissions higher than those estimated in these calculations.
6. Afterburner will operate at a minimum temperature of 1650 °F.
7. Compilation of Air Pollution Emission Factors, Fifth Edition, (AP-42) is used for emission factors.

Toluene, Ethylbenzene, and Xylene (TEX) Emissions

Maximum observed Toluene concentration in soils is 29 ppm, Ethylbenzene 480 ppm, and total Xylene 2900 ppm; Total TEX of 3409 ppm.

Assume:
- System Destruction Removal Efficiency of 99.99%
- VOCs from fuel already accounted for in "VOC Emission"

<u>TEXs from contaminated soil:</u>

$$\text{Max: } \frac{80.000 \text{ lb}}{\text{hr}} \times \frac{0.0034 \text{ lb TEX}}{\text{lb soil}} \times \frac{100-99.99}{100} = \frac{0.0272 \text{ lb TEX}}{\text{hr}}$$

<u>Total TEX:</u>

$$0.0272 \text{ lb/hr} \times \frac{16.200 \text{ tons}}{40 \text{ ton/hr}} = 11 \text{ lb Total TEX}$$

The uncontrolled potential to emit:

$$\frac{80.000 \text{ lb soil}}{\text{hr}} \times \frac{0.003409 \text{ lbs TEX}}{\text{lb soil}} = 273 \text{ lb/hr TEX}$$

VOC Emissions

Volatile organic compounds are derived from two sources. The first is from the fuel being used in the process and the second is from the contamination in the soil.

Assume: All soil has a 5,000 ppm contamination level
System Destruction Removal Efficiency of 99.99%

VOCs from the fuel:

From AP-42, Sec. 1.5 Liquefied Petroleum Gas Combustion, Table 1.5-1 the total organic compound emission factor is 0.5 lbs/1000 gals of propane. The heating value of propane = 91.5 MMBtu/1000 gals.

$$\frac{94.4\text{MM BTUs}}{\text{hr}} \times \frac{1000\text{ gals}}{91.5\text{ MMBTUs}} \times \frac{0.5\text{ lbs}}{1000\text{ gals}} = 0.52\text{ lbs/hr VOCs}$$

VOCs from the contaminated soil:

$$\text{MAX: } \frac{80.000\text{ lbs}}{\text{hr}} \times \frac{0.005\text{ lbs VOC}}{\text{lb soil}} \times \frac{100 - 99.99}{100} = 0.04\text{ lbs/hr VOCs}$$

Total VOCs/hr:

$$\text{MAX: } 0.52 \div 0.04 = 0.56\text{ lbs/hr VOCs}$$

Total VOCs:

$$\frac{0.56\text{ lbs}}{\text{hr}} \times \frac{16.200\text{ tons}}{40\text{ tons/hr}} = 227\text{ lbs VOC Total Emissions}$$

Uncontrolled potential to emit:

$$\frac{80.000\text{ lb soil}}{\text{hr}} \times \frac{0.005\text{ lbs VOC}}{\text{lb soil}} = 400\text{ lbs/hr VOCs}$$

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT

Operable Unit #1

TPS Technologies Soil Remediation Unit (SRU)

Comparison of SRU emissions with requirements of 6 NYCRR Part 212 General Process Emission Sources dated August 31, 1994.

Contaminant	Emission Rate Potential (ERP) (lbs/hr)	Actual Emission Rate (lbs/hr)	Part 212 Requirement	Compliance Status
Hydrogen Chloride	4.0	4.0	Table 2 Env. Rating "B" or "C" ERP < 10 lb/hr Allowable per Commissioner	Compliant
Toluene, Ethylbenzene, and Xylene	273	0.0272	Table 2 Env. Rating "B" 20> ERP < 500 94% Removal Required allowable = 16.38 lb/hr	Compliant
*VOCs	400	0.56	Table 2 Env. Rating "C" 20> ERP <500 94% Removal Required allowable = 24 lb/hr	Compliant
SO_2	0.019	0.019	Table 2 Env. Rating "C" ERP <1.0 lb/hr Allowable per Commissioner	Compliant
CO	3.30	3.30	Table 2 Env. Rating "C" ERP < 10 lb/hr Allowable per Commissioner	Compliant
NO_x	19.6	19.6	Table 2 Env. Rating "D" 10>ERP < 20 lb/hr Allowable per Commissioner	Compliant
Particulate Matter	760	5.14	Part 212.4 (c) allows 0.050 gr/dscf	Compliant

Calc. to determine PM emission in gr/dscf:

$$\text{Stack volume} = 71{,}307 \times \frac{530}{2110} = 17{,}911 \text{ dscfm}$$

$$\text{emission rate (gr/dscf)} = \frac{5.14\text{ lb}}{\text{hr}} \times \frac{7000\text{ gr}}{\text{lb}} \times \frac{\text{min.}}{17{,}911\text{ dscf}} \times \frac{\text{hr.}}{60\text{ min.}}$$

$$= 0.033\text{ gr/dscf}$$

* VOC emissions based on soil contaminated by 5000 ppm by weight of mixed VOCs.

This table shows that the air emissions from the SRU are in compliance with the limits specified in 6 NYCRR Part 212.

E3-Killam, Inc.
August 6, 1999

Mary Cedeno
H:\projects\tps_tech\stat7_30.doc

08/06/99
Revised 09/21/99

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT
Operable Unit No. 1
TPS Technologies Soil Remediation Unit (SRU)
Air Emission Ambient Impact Analysis By E_3-Killam, Inc 7/30/99

Pollutant	Emission Rate lb/hr	Emission Rate Project	Limits ($\mu g/m^3$) AGC	Limits ($\mu g/m^3$) SGC
HCl	4	5,586	20	150
T,E,X†	0.0272	11	400	45,000
***VOC's**	0.560	227	620	62,000
SO_2	0.019	7.7	80	1,400
CO	3.30	1,337	69	40,000
NO_x	19.6	7,938	100	180
PM	5.14	7,178	50	380

Reference: Estimated Air Emissions Report, July, 1999.

†Toluene, Ethyl Benzene, Xylene

* VOC impact based on emissions from soil contaminated by 5000 ppm by weight of mixed VOCs.

		Average One Hour Concentration of Specific Pollutants at Various Distances						
Distance (meters)	Generic 1 hour Concentration ($\mu g/m^3$)**	**HCl** ($\mu g/m^3$)	**T,E,X** ($\mu g/m^3$)	***VOC's** ($\mu g/m^3$)	**SO_2** ($\mu g/m^3$)	**CO** ($\mu g/m^3$)	**NO_x** ($\mu g/m^3$)	**PM** ($\mu g/m^3$)
100	2.014	1.0	0.007	0.142	0.0	0.84	5.0	1.30
200	7.186	3.6	0.025	0.507	0.0	2.99	17.7	4.65
300	5.793	2.9	0.020	0.409	0.0	2.41	14.3	3.75
400	4.724	2.4	0.016	0.333	0.0	1.96	11.7	3.06
500	4.006	2.0	0.014	0.283	0.0	1.67	9.9	2.59
600	4.627	2.3	0.016	0.326	0.0	1.92	11.4	3.00
700	5.430	2.7	0.019	0.383	0.0	2.26	13.4	3.52
800	6.172	3.1	0.021	0.435	0.0	2.57	15.2	4.00
900	6.856	3.5	0.023	0.484	0.0	2.85	16.9	4.44
1000	7.485	3.8	0.026	0.528	0.0	3.11	18.5	4.85
1100	7.962	4.0	0.027	0.562	0.0	3.31	19.7	5.16
1200	8.307	4.2	0.028	0.586	0.0	3.45	20.5	5.38
1300	8.542	4.3	0.029	0.603	0.0	3.55	21.1	5.53
1400	8.685	4.4	0.030	0.613	0.0	3.61	21.4	5.62
1500	8.756	4.4	0.030	0.618	0.0	3.64	21.6	5.67
1600	8.770	4.4	0.030	0.619	0.0	3.65	21.7	5.68
1700	8.739	4.4	0.030	0.617	0.0	3.63	21.6	5.66
1800	8.673	4.4	0.030	0.612	0.0	3.61	21.4	5.62
1900	8.582	4.3	0.029	0.605	0.0	3.57	21.2	5.56
2000	8.471	4.3	0.029	0.598	0.0	3.52	20.9	5.49
2100	8.345	4.2	0.029	0.589	0.0	3.47	20.6	5.40
2200	8.210	4.1	0.028	0.579	0.0	3.41	20.3	5.32
2300	8.067	4.1	0.028	0.569	0.0	3.35	19.9	5.22
2400	7.920	4.0	0.027	0.559	0.0	3.29	19.6	5.13
2500	7.771	3.9	0.027	0.548	0.0	3.23	19.2	5.03
2600	7.621	3.8	0.026	0.538	0.0	3.17	18.8	4.93
2700	7.471	3.8	0.026	0.527	0.0	3.11	18.4	4.84
2800	7.322	3.7	0.025	0.517	0.0	3.04	18.1	4.74
2900	7.176	3.6	0.025	0.506	0.0	2.98	17.7	4.65
3000	7.032	3.5	0.024	0.496	0.0	2.92	17.4	4.55

* VOC impact based on emissions from soil contaminated by 5000 ppm by weight of mixed VOCs.

** The concentration of a pollutant with an emission rate of 1 g/s. Based on EPA's SCREEN3 program.

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT
Operable Unit No. 1
TPS Technologies Soil Remediation Unit (SRU)
Air Emission Ambient Impact Analysis By E3-Killam, INC 08/03/99

Modeling done by E3-Killam using EPA's SCREEN3 Program.

```
                                                                08/03/99
                                                                09:45:27

 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 95250 ***

TPS Technologies Soil Remediation Unit

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        POINT
   EMISSION RATE (G/S)    =      1.00000
   STACK HEIGHT (M)       =      11.4000
   STK INSIDE DIAM (M)    =       1.2200
   STK EXIT VELOCITY (M/S)=      29.4872
   STK GAS EXIT TEMP (K)  =    1171.9000
   AMBIENT AIR TEMP (K)   =     293.0000
   RECEPTOR HEIGHT (M)    =       1.5000
   URBAN/RURAL OPTION     =        URBAN
   BUILDING HEIGHT (M)    =       4.1150
   MIN HORIZ BLDG DIM (M) =       3.5050
   MAX HORIZ BLDG DIM (M) =      18.2880

   STACK EXIT VELOCITY WAS CALCULATED FROM
   VOLUME FLOW RATE =    73038.000     (ACFM)

BUOY. FLUX =    80.694 M**4/S**3;  MOM. FLUX =   80.891 M**4/S**2.

*** FULL METEOROLOGY ***
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 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************

 *** TERRAIN HEIGHT OF     0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

   DIST     CONC              U10M   USTK  MIX HT   PLUME  SIGMA   SIGMA
    (M)   (UG/M**3)   STAB   (M/S)  (M/S)    (M)    HT (M)  Y (M)   Z (M)  DWASH
 -------  ----------  ----   -----  -----  ------   ------  ------  ------  -----
    100.   2.014        4    20.0   20.7  6400.0    37.32   15.82   13.95    NO
    200.   7.186        4    20.0   20.7  6400.0    37.32   30.97   27.39    NO
    300.   5.793        4    15.0   15.5  4800.0    46.20   45.71   40.63    NO
    400.   4.724        4    10.0   10.3  3200.0    63.60   60.32   53.92    NO
    500.   4.006        4     8.0    8.3  2560.0    76.65   74.57   66.99    NO
    600.   4.627        6     3.0    3.1 10000.0    84.34   62.83   40.58    NO
    700.   5.430        6     2.0    2.1 10000.0    94.89   72.12   45.81    NO
    800.   6.172        6     1.5    1.6 10000.0   103.30   80.97   50.51    NO
    900.   6.856        6     1.0    1.0 10000.0   116.59   90.06   55.76    NO
   1000.   7.485        6     1.0    1.0 10000.0   116.59   97.70   58.85    NO
   1100.   7.962        6     1.0    1.0 10000.0   116.59  105.22   61.85    NO
   1200.   8.307        6     1.0    1.0 10000.0   116.59  112.59   64.77    NO
   1300.   8.542        6     1.0    1.0 10000.0   116.59  119.82   67.60    NO
   1400.   8.685        6     1.0    1.0 10000.0   116.59  126.91   70.35    NO
   1500.   8.756        6     1.0    1.0 10000.0   116.59  133.86   73.04    NO
   1600.   8.770        6     1.0    1.0 10000.0   116.59  140.68   75.65    NO
   1700.   8.739        6     1.0    1.0 10000.0   116.59  147.37   78.19    NO
   1800.   8.673        6     1.0    1.0 10000.0   116.59  153.94   80.67    NO
   1900.   8.582        6     1.0    1.0 10000.0   116.59  160.38   83.09    NO
   2000.   8.471        6     1.0    1.0 10000.0   116.59  166.71   85.46    NO
   2100.   8.345        6     1.0    1.0 10000.0   116.59  172.93   87.77    NO
   2200.   8.210        6     1.0    1.0 10000.0   116.59  179.04   90.04    NO
   2300.   8.067        6     1.0    1.0 10000.0   116.59  185.04   92.26    NO
   2400.   7.920        6     1.0    1.0 10000.0   116.59  190.95   94.43    NO
   2500.   7.771        6     1.0    1.0 10000.0   116.59  196.76   96.56    NO
   2600.   7.621        6     1.0    1.0 10000.0   116.59  202.48   98.65    NO
   2700.   7.471        6     1.0    1.0 10000.0   116.59  208.11  100.71    NO
   2800.   7.322        6     1.0    1.0 10000.0   116.59  213.66  102.73    NO
   2900.   7.176        6     1.0    1.0 10000.0   116.59  219.12  104.71    NO
   3000.   7.032        6     1.0    1.0 10000.0   116.59  224.51  106.66    NO

 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
   1576.   8.771        6     1.0    1.0 10000.0   116.59  138.99   75.00    NO

  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
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```
 *** CAVITY CALCULATION - 1 ***         *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)       =    .0000        CONC (UG/M**3)       =    .0000
  CRIT WS @10M (M/S)   =    99.99        CRIT WS @10M (M/S)   =    99.99
  CRIT WS @ HS (M/S)   =    99.99        CRIT WS @ HS (M/S)   =    99.99
  DILUTION WS (M/S)    =    99.99        DILUTION WS (M/S)    =    99.99
  CAVITY HT (M)        =     6.29        CAVITY HT (M)        =     4.14
  CAVITY LENGTH (M)    =    19.74        CAVITY LENGTH (M)    =     5.06
  ALONGWIND DIM (M)    =     3.51        ALONGWIND DIM (M)    =    18.29

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S.  CONC SET = 0.0

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------    -----------    -------   -------
SIMPLE TERRAIN       8.771        1576.        0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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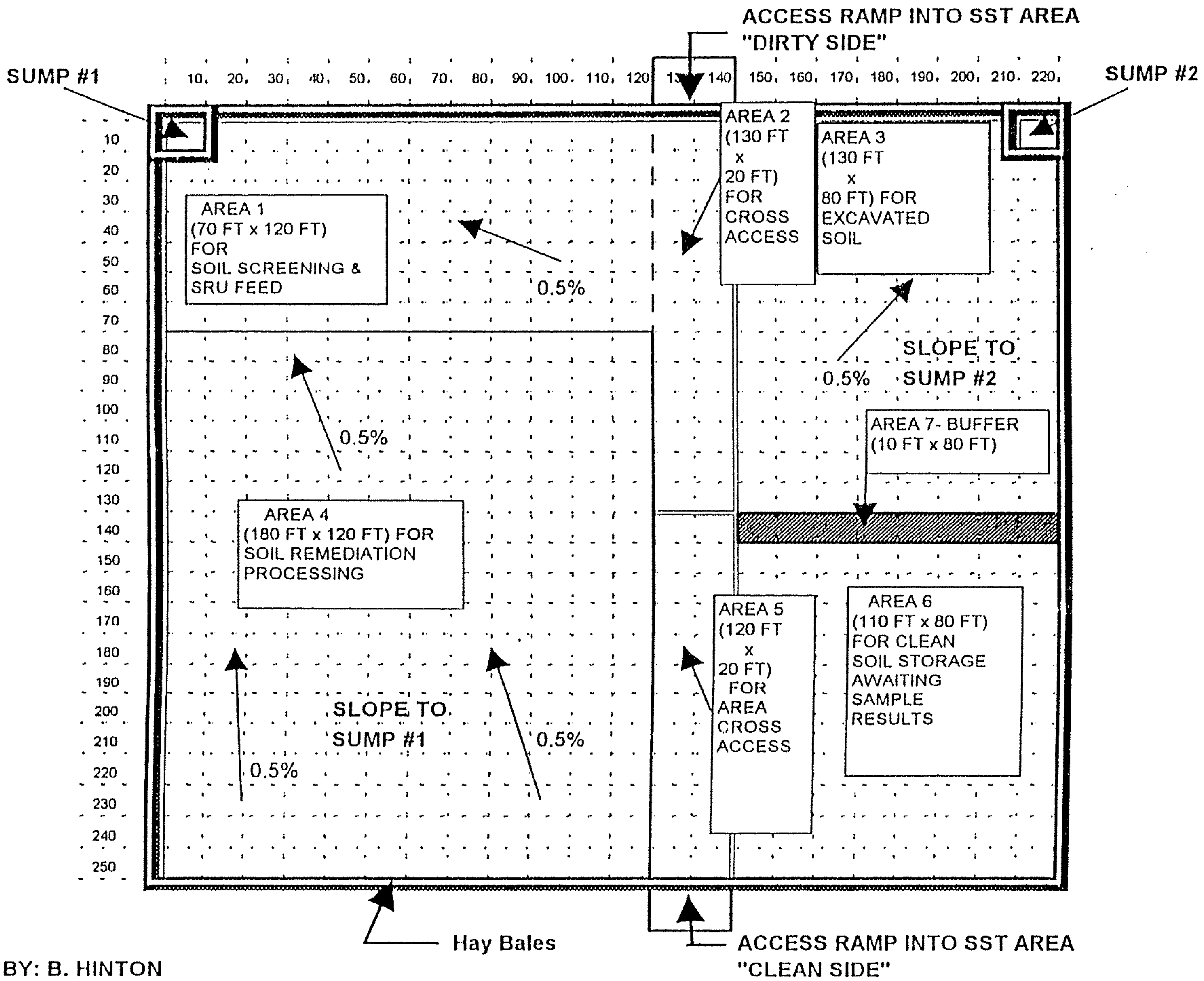
THERMORETEC/TPS TECHNOLOGIES INC.
PROPOSED SOIL TREATMENT AREA (220 FT x 250 FT) - REDESIGN (8/99)
(REVISED 9/7/99)
as approved by NYSDEC 9/1/99

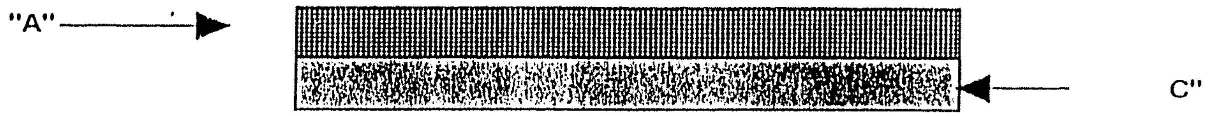


BY: B. HINTON

THERMORETEC/TPS TECHNOLOGIES INC.
PROPOSED SOIL TREATMENT AREA (220 FT x 250 FT) - REDESIGN (8/99) as approved by NYSDEC 9/1/99
MATERIALS OF CONSTRUCTION FOR AREAS: 1,2, 3 & 4
(REVISED 9/7/99)

LAYER	MATERIAL	DEPTH (inches)	Sq. Footage	Ft3	Yd3
"A"	Crushed Rock/Stone/Concrete	6	43000	21500	796.3
"B"	Sand	4	43000	14333	530.9
"C"	4 to 6 oz Geo Fabric	N/A	43000	n/a	n/a
"D"	20 mil HDPE Liner	20 mil	43000	n/a	n/a
"E"	Sand	4	43000	14333	530.9

MATERIALS OF CONSTRUCTION FOR AREAS: 5,6 & 7



LAYER	MATERIAL	DEPTH (inches)	Sq. Footage	Ft3	Yd3
"A"	Crushed Rock/Stone/Concrete	6	12000	6000	222.2
"C"	Sand	4	12000	4000	148.1

New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Western Remedial Action, Room 348
50 Wolf Road, Albany, New York 12233-7010
Phone: (518) 457-4343 FAX: (518) 457-3972

John P. Cahill
Commissioner

September 15, 1999

Mr. Barry M. Hinton
Vice President, Operations
TPS Technologies, Inc.
1964 S. Orange Blossom Trail
Apopka, FL 32703

Dear Mr. Hinton:

Re: Westinghouse Electric Site
Project ID No. 9-15-066

The demonstration test plan prepared by E_3-Killam (dated September 8, 1999) has been reviewed. The approach described is generally acceptable, however, several matters require your attention prior to final approval. Please address the following:

- Section 1.2 discusses the plan's objectives. Note that one of the objectives of the emission testing is to demonstrate that the unit operates with a Destruction Removal Efficiency (DRE) equal to or exceeding 99.99% and to determine the operating conditions when that DRE is achieved. Please incorporate this objective in Section 1.2.
- Section 2 discusses Sampling and Analytical procedures. EPA Method 18 is proposed for volatiles sampling. This method is acceptable, however, the recovery study specified in the method must be performed (ref. Section 2.7.6). In addition, since the levels in the stack are expected to be near or below the detection limit of the method, the sampling rate should be increased to the maximum rate for the carbon tubes being used. Further, the method specifies a plug of glass wool in the end of the probe to remove particulate matter.

If you have any questions concerning the above comments, please do not hesitate to contact me at (518) 457-4343.

Sincerely,

Michael J. Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action
Division of Environmental Remediation

cc L. Brausch (CBS)
L. Martin (IT Corp.)

New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Western Remedial Action, Room 348
50 Wolf Road, Albany, New York 12233-7010
Phone: (518) 457-4343 FAX: (518) 457-3972

John P. Cahill
Commissioner

September 1, 1999

Mr. Barry M. Hinton
Vice President, Operations
TPS Technologies, Inc.
1964 S. Orange Blossom Trail
Apopka, FL 32703

Dear Mr. Hinton:

Re: Westinghouse Electric Site
Project ID No. 9-15-066

The purpose of this letter is to provide comments on E_3-Killam's submittals dated August 6th and August 18th, entitled "Phase I" and "Part 2, SRU Operating Controls & Safety Features", respectively. Also, below please find comments on the recent proposal to modify the Soil Stockpile and Treatment (SST) Area pad design.

<u>Comments on the Phase I document</u>

The first document contains estimates of air emissions and air impacts that will result from the proposed remediation system. Based on the information submitted, it appears the air emissions will comply with the air regulations and will not have an unacceptable impact on the environment. However, several issues require followup. These are as follows:

1. The air emission estimates for organic compounds are overstated. Thermal remediation units must demonstrate a DRE of 99.99%. All of the calculations for VOCs use levels lower than this.

2. The emission rate potential for VOCs is shown as 800 lbs/hr, based on an assumed 10,000 ppm contamination level. The data does not support an assumption of this magnitude. The maximum levels of toluene, ethyl benzene, and xylene total to 3400 ppm and the maximum levels of chlorinated compounds total to 204 ppm. While the assumption is an overestimate and conservative, it makes the situation look worse than it is.

3. To comply with the 4 lb/hr limit on HCl, the total of TCE and TCA must be below 60 ppm.

4. The summary table in the impacts analysis section does not match the included computer run. The computer run shows maximum impact to be 15.22 $\mu g/m^3$ which occurs at 1129 meters (based on a unit emission). However, the summary which shows the impact by contaminant, uses a maximum of 8.770 $\mu g/m^3$ (based on a unit emission). The NYSDEC has calculated the impacts based on the higher value and determined that they are acceptable, however, the discrepancy needs to be addressed.

Comments on the Part 2 document

5. Section 2 of this document addresses System Alarms, Shutdowns, and Process Monitoring. This section discusses various operator assisted shutdowns. This is not acceptable. As required by the ITRC protocol, automatic waste feed cutoffs (some with delays) are required for burner failure, outlet temperature below set point, afterburner below set point, blower failure or positive pressure, baghouse pressure drop outside of the operating envelope, carbon monoxide above set point, waste feed rate above limit, and surrogate for gas flow outside of the envelope. Please address how these requirements will be accommodated.

6. Section 2 also contains a list of process operating parameters. This section is generally complete with the exception of a surrogate for gas flow. Also, relative to continuous monitoring, total hydrocarbons must be measured continuously.

7. Section 4 is an "Analysis of Potential Products of Incomplete Combustion from the Remediation of Soils by Thermal Desorption" prepared by Mr. Jack Lauber. This assessment was submitted as justification for not requiring stack testing for dioxin, in response to the NYSDEC's earlier comment. The discussion, however, fails to directly address the NYSDEC's concern. While the analysis concludes that the system would have a negligible dioxin emission potential and would pose negligible public health risk, nowhere does the analysis indicate that stack testing should not be required. Should Mr. Lauber believe that stack testing for dioxin not be required, this should be clearly stated and the basis for this view cited.

Comments on the proposal to modify the SST pad design

8. On August 30th, TPS Technologies submitted a proposal to modify the design of the SST Area pad from that which currently appears in Appendix E of the Remedial Action Plan. The proposal incorporates two distinct designs for various sub-areas within the SST Area. The proposal designates Areas 1, 2 and 3 as areas in which soils will be "worked", thus requiring a liner and Areas 4, 5, 6 and 7 as areas in which no liner will be required. The proposal includes various proposed thicknesses for sand and crushed stone and a proposal to modify the liner thickness from 40 mil to 20 mil.

The NYSDEC has evaluated the proposal. The following comments pertain to the re-design:

- The design proposed for Areas 1, 2 and 3 is generally acceptable, however, this lined system must also be used beneath Area 4, the Soil Remediation Processing area.
- The thicknesses proposed for the two sand layers may be modified to 4 inches minimum.
- The access ramp into the SST Area should be relocated to insure no transport of contaminated/untreated materials between the Soil Remediation Processing Area (Area 4) and the Clean Soil Storage Area (Area 6). That is, Area 5 should serve only for cross access between Areas 4 and 6.

If you have any questions concerning the above comments, please do not hesitate to contact me at (518) 457-4343.

Sincerely,

Michael J. Ryan, P.E.
Project Engineer
Bureau of Western Remedial Action
Division of Environmental Remediation

cc L. Brausch (CBS)
L. Martin (IT Corp.)

PART ONE SUBMISSION
AIR EMISSIONS IMPACT

TABLE OF CONTENTS

E3-Killam Inc.
environmental services

80 Curtwright Drive
Suite #1
Buffalo, NY 14221-7072
Telephone: 716-631-5858
Fax: 716-631-5864

Project #99023

August 5, 1999

Michael Ryan, P.E.
Environmental Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington
Environmental Engineer III
Bureau of Program Management

Division of Environmental Remediation
New York State
Dept. of Environmental Conservation
50 Wolf Rd.
Albany, NY 12233-7010

Re: Westinghouse Plant Soil Remediation Project - Operable Unit No. 1 Documents for DEC Review for Approval to Install and Operate Soil Remediation Unit (SRU

Dear Mr. Ryan and Mr. Harrington:

TPS Technologies (TPST) has engaged E_3-Killam, Inc. to assist in obtaining NYSDEC approval for installation and operation of a soil remediation unit (SRU) of low temperature thermal desorber design. Therefore, E_3-Killam has assembled this package of documents for your office to evaluate the impact of the air emissions on the environment in the area of the remediation site.

These documents only address the air emissions and their environmental impact. The information you require regarding the SRU operating controls and safety features designed to protect the public and the equipment will be submitted on or before August 18, 1999 followed by the SRU Performance Testing Protocol on September 3, 1999.

The attached documents show the extensive soil remediation experience that SoilPure, Inc. (SPI) have accumulated with their SRU. Note that TPST has chosen SPI to process the contaminated soil using SPI personnel to operate an SPI soil remediation unit. This voluminous record of satisfactory performance will satisfy this aspect of the DEC concern.

The estimated air emissions have been subjected to the U.S. EPA Screen3 Dispersion Model and no guideline concentrations AGC or SGC are exceeded.

When the SRU is treating soil contaminated to the maximum observed concentration of TCE and TCA, considerable "clean" soil must be blended with the contaminated soil to limit HCl emission to below 4.0 lb/hr. However, calculations also show that when soil contaminated to the level of 60 ppm of TCE or TCA is treated, no soil blending is required.

E_3-Killam has taken the liberty of estimating the compliance of the air emissions with the requirements of 6NYCRR Part 212 General Process Emission Sources. Our evaluation shows that estimated emission rates for each contaminant is well under the allowable.

We have included in this submittal an Authorized Agent letter and a P.E. Certification.

We thank you for your patience in this matter and expect that this submission is satisfactory. If you have any questions or comments please contact me at (716) 631-5858 or Mr. Blair Dominiak of TPST at (407) 886-2000.

Sincerely,

E_3-Killam, Inc.

James L. McGarry, MS, P.E.
Environmental Engineer

JLM/mac
\\E3KILLAM\SYS\ENG\PROJECTS\TPS_TECH\CORRES\cvrltr.doc
Enclosure
cc: TPST/ Blair Dominiak
w/o enc. B. Hinton
IT/ L. Martin
E_3-Killam/ E. Nesselbeck

TPS Technologies Inc.
A ThermoRetec Company
1964 S. Orange Blossom Trail
Apopka, FL 32703

ThermoRetec
Smart Solutions. Positive Outcomes.

(407) 886-2000 Phone
(407) 886-8300 Fax
www.thermoretec.com

August 3, 1999

New York State
Department of Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, NY 12233-7010

Attn: Mr. Mike Ryan, Environmental Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington, Environmental Engineer III
Bureau of Program Management

Re: **Authorized Permitting Representative**

Dear Messrs. Ryan and Harrington:

By this correspondence, TPS Technologies Inc. (TPST) hereby notifies the Department that E3-Killam Inc. of 80 Curtwright Drive, Buffalo, New York is authorized to act in TPST's behalf regarding all permitting and environmental matters pertaining to the thermal remediation of NYSDEC Inactive Hazardous Waste Site No. 9-15-066, Cheektowaga, NY.

If you have any questions pertaining to E3-Killam's responsibilities on this job, please contact me at (407) 886-2000.

Respectfully,

Blair W. Dominiak

Blair W. Dominiak
Manager, Regulatory Compliance

cc: L. Martin - IT Corp.
J. McGarry - E3-Killam
B. Hinton - TPST

New York State Department of Environmental Conservation
Air Permit Application

DEC ID
- -

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT
Operable Unit No. 1
Documents provided to the NYSDEC RE: TPST
Soil Remediation Unit by E3-Killam

P.E. Certification

I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments as they pertain to the practice of engineering. This is defined as the performance of a professional service such as consultation, investigation, evaluation, planning, design or supervision of construction or operation in connection with any utilities, structures, buildings, machines, equipment, processes, works, or projects wherein the safeguarding of life, health and property is concerned, when such service or work requires the application of engineering principles and data. Based on my inquiry of those individuals with primary responsibility for obtaining such information, I certify that the statements and information are to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

Name of P.E. James L. McGarry

Signature of P.E.

Date 8 / 4 / 99

NYS License No. 047232

Phone (716) 631-5858

JAMES L. McGARRY
No. 047232

Westinghouse Plant Soil Remediation Project
Operable Unit No. 1
TPS Technologies Soil Remediation Unit (SRU)
By E_3-Killam Environmental Services

Introduction

The job site contains soil contaminated with chlorinated hydrocarbons and volatile organic compounds which are to be remediated using a low temperature thermal desorber to drive off volatile contaminants in a heated rotary drum dryer and destroy the organics with an afterburner. The cleaned soil can then be recycled on site.

IT Corporation (IT) has selected TPS Technologies (TPST) as a subcontractor to do the soil remediation operations and E_3-Killam has been requested by TPST to assist them in obtaining approval from the NYSDEC to install, test and operate the SRU at the job site.

TPST has chosen SoilPure Inc. (SPI) to process the contaminated soil with their SRU. TPST personnel will manage the site and SPI staff will operate the SRU. The SPI unit has been used to satisfactorily remediate many contaminated soil sites. A copy of a Statement of Qualifications (SOQ) by SPI is attached. This document describes their experience with the SRU, the thermal process and equipment, specification of equipment and generic drawings.

The documents comprising this submission provide an estimate of air emissions from their SRU, the estimated compliance status of these emissions, and their ambient impact.

SoilPure, Inc.

Statement of Qualificatons

SoilPure, Inc.
6121 Excelsior Blvd.
Suite 201
Minneapolis, MN 55416-2725

Tel. (612) 928-0100
Fax (612) 928-0200

email: info@soilpure.com
www.soilpure.com

Table of Contents

BIOGRAPHY / BACKGROUND

SoilPure, Inc. (SPI) is a Minnesota Corporation, founded to perform environmental remediation throughout the country. SPI is a *Small Disadvantaged Minority Business (SDB)*. The company is more than 51% owned by a recognized minority. Currently SPI is the only minority owned business in the thermal remediation industry that owns and operates thermal remediation equipment. The company has applied for and expects to become an 8A certified firm in the near future.

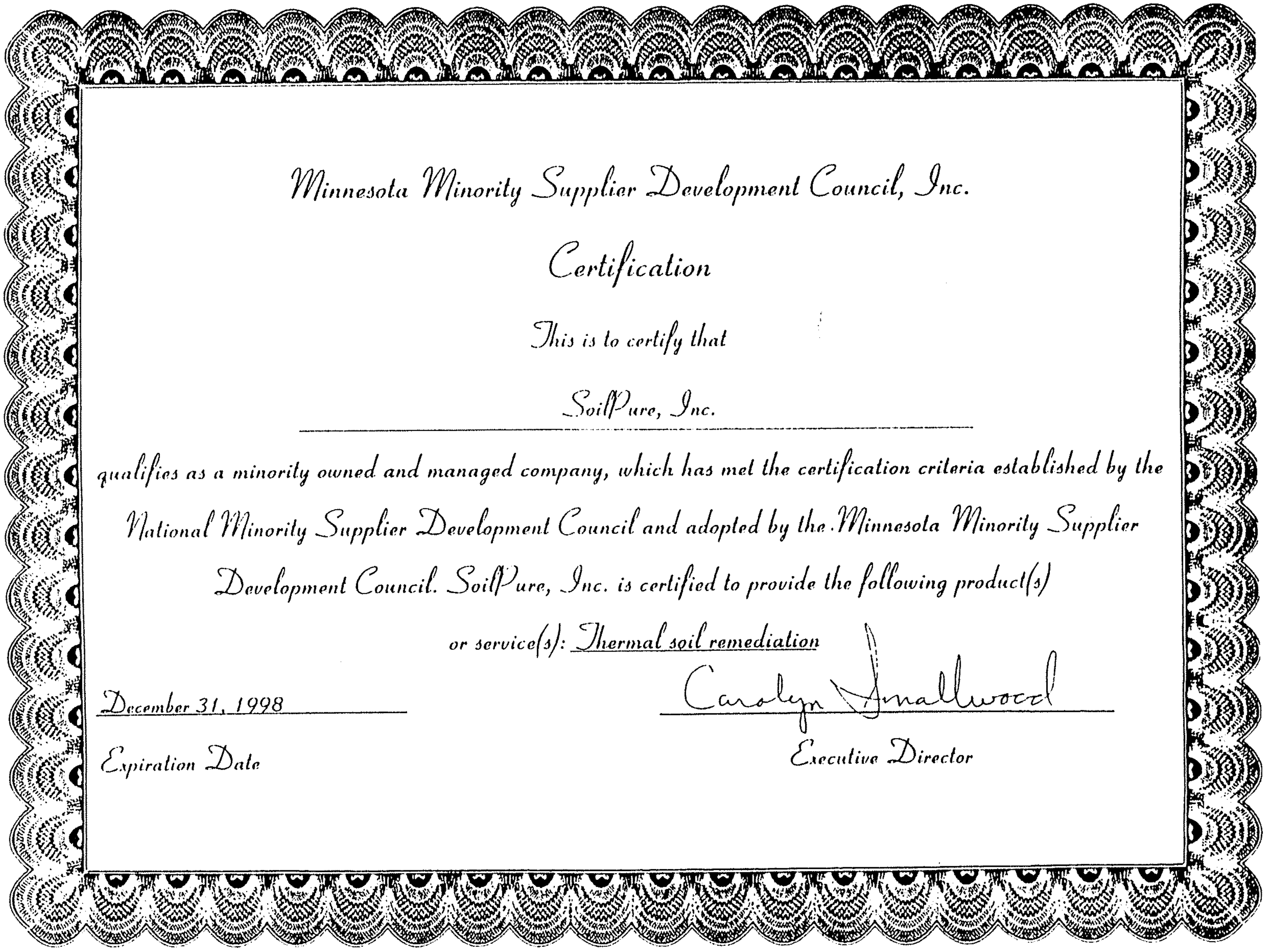
SPI personnel bring a diverse background of experience in such areas as; design and production of soil remediation equipment, excavation, permitting, sewer and water treatment systems, oil / water separation, health and safety as well as regulatory and public interface. The SPI team combined, has in excess of 30 years of thermal remediation, excavation, material handling and multiple project management experience.

The goal of SPI is to become a leading contractor in the petroleum hydrocarbon, PAH and chlorinated solvent contaminated soil remediation industry. SPI offers *Low Temperature, High Temperature* and *Indirect Thermal Treatment* as options. SPI has worked as a Prime Contractor or as a Sub-Contractor and will team up depending on site and project scope. SPI will permit thermal treatment units in any state.

The SPI principles and operations team has gained valuable experience working for various thermal remediation contractors over the past eight years. The team has been involved in over 100 thermal remediation projects and has commissioned 15 thermal treatment systems. These projects range from fixed base operations to Superfund Incineration and mobile operations. SPI's team has processed in excess of 500,000 tons of contaminated soil, from Alaska to Florida and California to Pennsylvania and many states in between. This core group has been together for the better part of eight years. SPI's operations group are all knowledgeable and experienced personnel, with training in hazardous site operations (OSHA 29 CFR 1910.120 and confined spaces training (OSHA 29 CFR 1910.146). In addition to having all employees OSHA certified SPI offers training and certification in both OSHA courses. This allows us the opportunity to ensure all job site personnel are working together in a safe environment.

SPI's high temperature thermal treatment unit will treat up to 50 tons of contaminated soil per hour. The production rate will vary depending on contaminate concentration levels and moisture content. The thermal unit is a counter flow system with a control house, feed system, primary treatment unit (rotary kiln), baghouse and thermal oxidizer. SPI's equipment is designed to work on mobile sites or fixed base locations. The plant and heavy equipment require five semi-trailer loads to transport. Setup time generally requires five days, with two days for system shake-out. In most cases the plant will be fully operational within 7 days of arrival on site. The plant is powered by electricity and natural gas or liquid propane. SPI's generator is available for electrical power that may be needed in remote locations.

SPI has at it's disposal, the services of several well known construction contractors, engineering / environmental consulting firms as well as that of several PE's and Ph.D's. Their expertise in the areas of chemical, geological, and environmental engineering assist us in providing a complete thermal remediation service.



Minnesota Minority Supplier Development Council, Inc.

Certification

This is to certify that

SoilPure, Inc.

qualifies as a minority owned and managed company, which has met the certification criteria established by the National Minority Supplier Development Council and adopted by the Minnesota Minority Supplier Development Council. SoilPure, Inc. is certified to provide the following product(s) or service(s): Thermal soil remediation

December 31, 1998

Expiration Date

Carolyn Smallwood

Executive Director

Statement of Qualifications

SoilPure, Inc. (SPI) is striving to become a leader in the thermal remediation field. SPI offers low, medium and high temperature thermal treatment technologies, and will offer indirect thermal treatment through teaming arrangements with other companies. SPI is capable of providing your project with highly qualified and trained personnel and the necessary equipment to safely and effectively complete the project. SPI strives to complete projects on schedule and stay within the budgetary parameters of the project.

PROFESSIONAL QUALIFICATIONS

SPI's remediation team is comprised of knowledgeable and experienced personnel. Our mandatory training includes hazardous site operations (OSHA 29 CFR 1910.120), confined spaces training (OSHA 29 CFR 1910.146), supervisory training in hazardous site operations, basic as well as advanced first aid, and CPR training. All company personnel are encouraged to continue their education as it relates to all aspects of environmental science. In addition to having all employees OSHA certified SPI offers training and certification in both OSHA courses. This allows us the opportunity to ensure all job site personnel are working together in a safe environment. SPI retains the services of several well known Ph.D's in different specialty areas. These experts can be utilized in unique situations.

ADDITIONAL SERVICES

- Permitting on all levels; Internationally, Federal, State, Regional and Local.
- Site specific work plans, health and safety plans.
- Qualified and highly trained personnel available for sub contractor work.
- Prime Contracting Capabilities.
- Teaming Arrangements.
- Light excavation, back fill and compaction.
- Small Disadvantaged Minority Business teaming status.

EQUIPMENT

- We own and operate a 30-50 ton per hour thermal remediation unit (high temperature).
- We have available to lease and operate a 20-30 ton per hour thermal remediation unit (low temperature).

- We operate and maintain loaders, generators and other heavy equipment.
- Our plants use data loggers, printers and interlocks for system control and regulatory reporting.
- Computers for plant to office interface via remote phone lines (internet).

PROJECT EXPERIENCE

The following list of projects that SPI's principles and/or operations personnel were involved in.

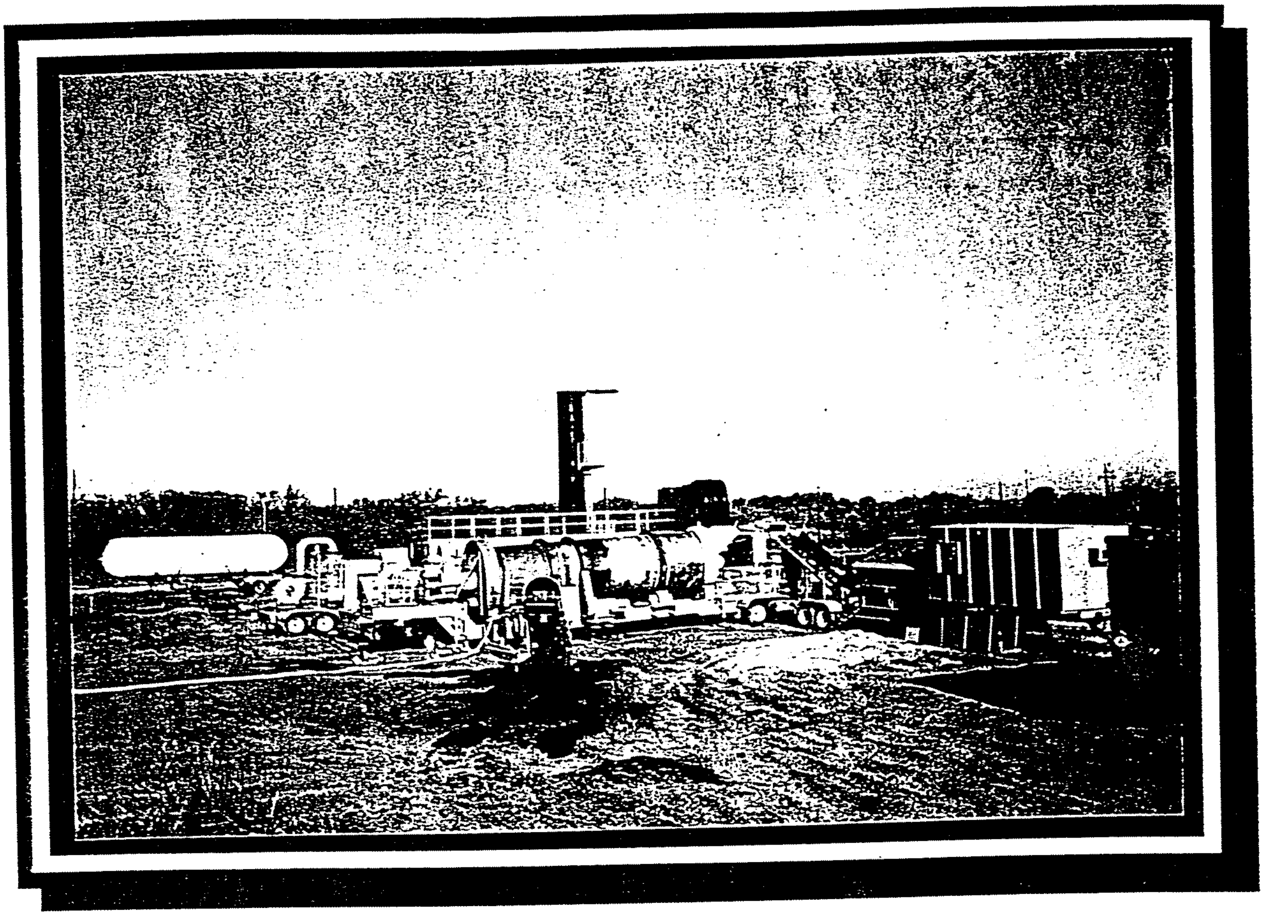
- Ashland Petroleum, Inc., Cottage Grove, MN ★
- Dallas / Fort Worth International Airport, Dallas, TX ★
- Summit National Superfund Site, Deerfield, OH ★
- Chicago & Northwestern Railway Company, Minneapolis, MN ★
- Scott Air Force Base, Belleville, IL ★
- Genesee Aggregate Corporation, Genesee, WI
- Mercury Marine, Hartford, WI
- Alyeska Pipeline Company, Valdez to Prudhoe Bay, AK
- Eielson Air Force Base, Fairbanks AK
- Numerous fixed base projects ranging in size from 100 tons to 3,000 tons.

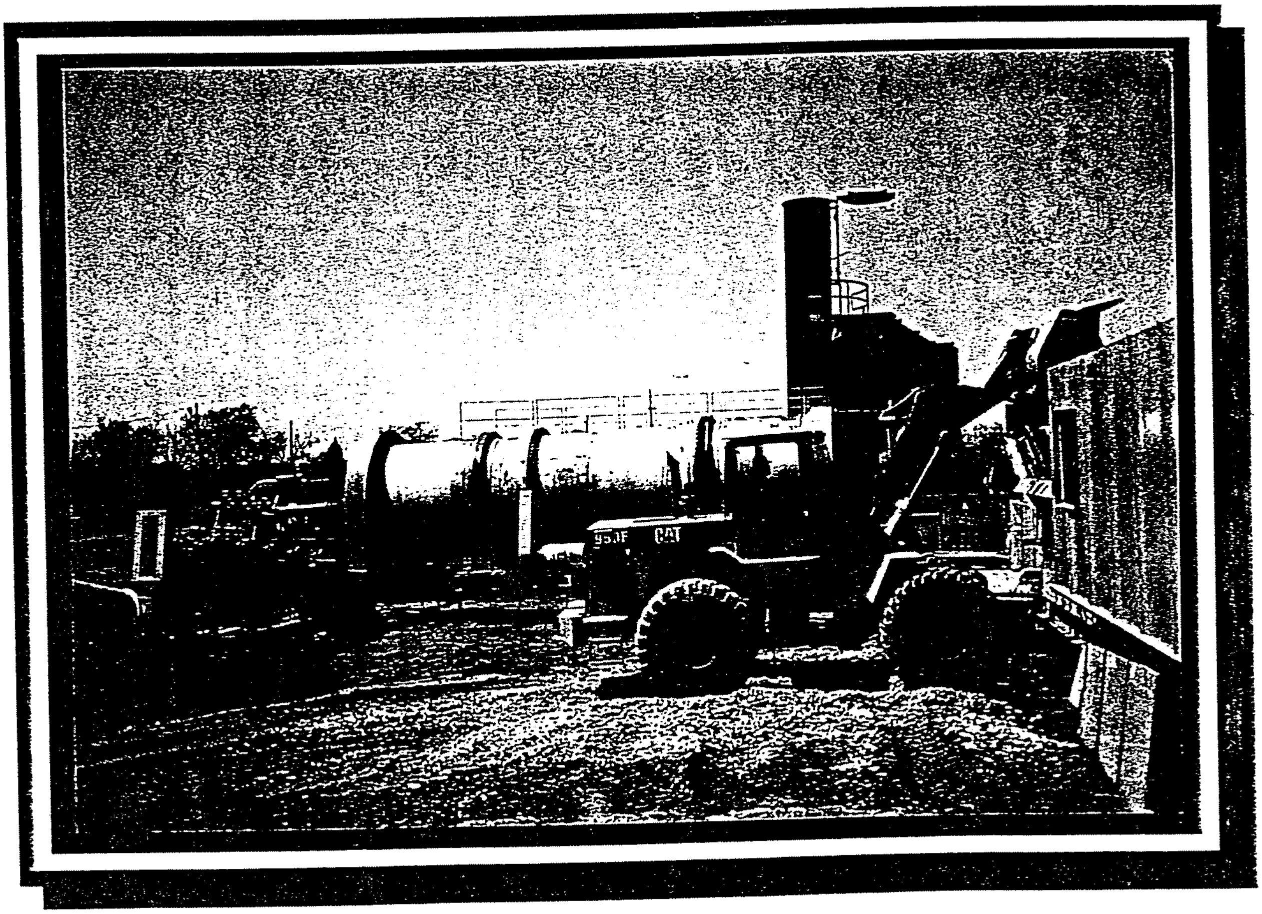
★ See attached description under *Project Experience.*

REFERENCES

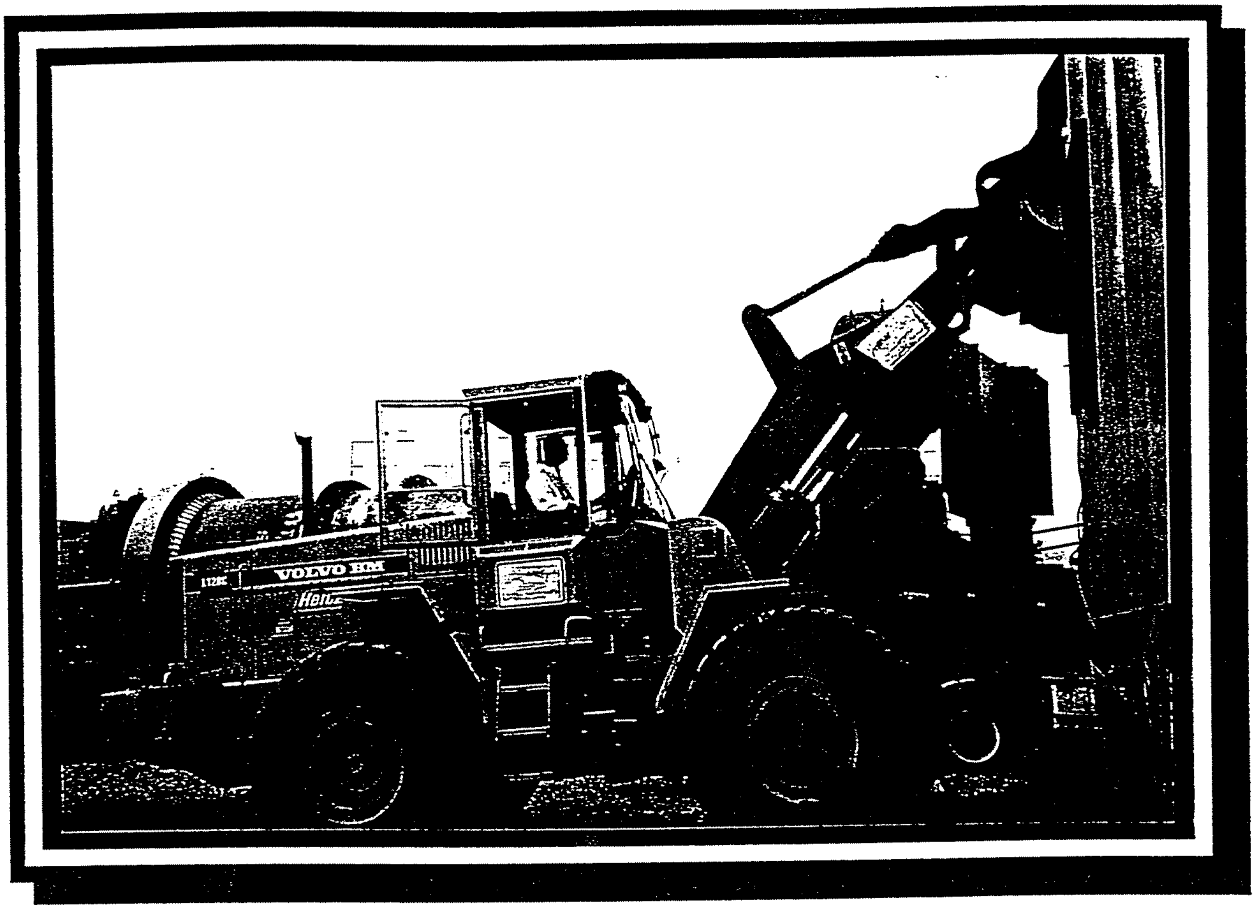
- Jeff Mayen, Environmental Engineer, Ashland Petroleum, (612) 458-2661
- Rick Reeter, Sr. Environmental Engineer, DFW Airport, (972) 574-0654
- Rick Elia, Vice President, Sevenson Environmental, (716) 284-0431
- Tom Lembo, President, International Technologies & Trade, (705) 526-8744
- Dr. Robert Wills, Vice President, Crown Environmental, (612)639-8900
- Bill Troxler, Focus Environmental, Senior Partner, (615) 694-7517
- Tony Rutter, U.S.E.P.A. Region V, (312) 886-8961
- Gordon Girtz, Environmental Coordinator, University of Minnesota, (612) 626-3595
- Dahl & Associates, Rod Jasmer, Sr. Hydrologist , (612) 490-2905
- Sig Williams, Ohio EPA, (216) 963-1210

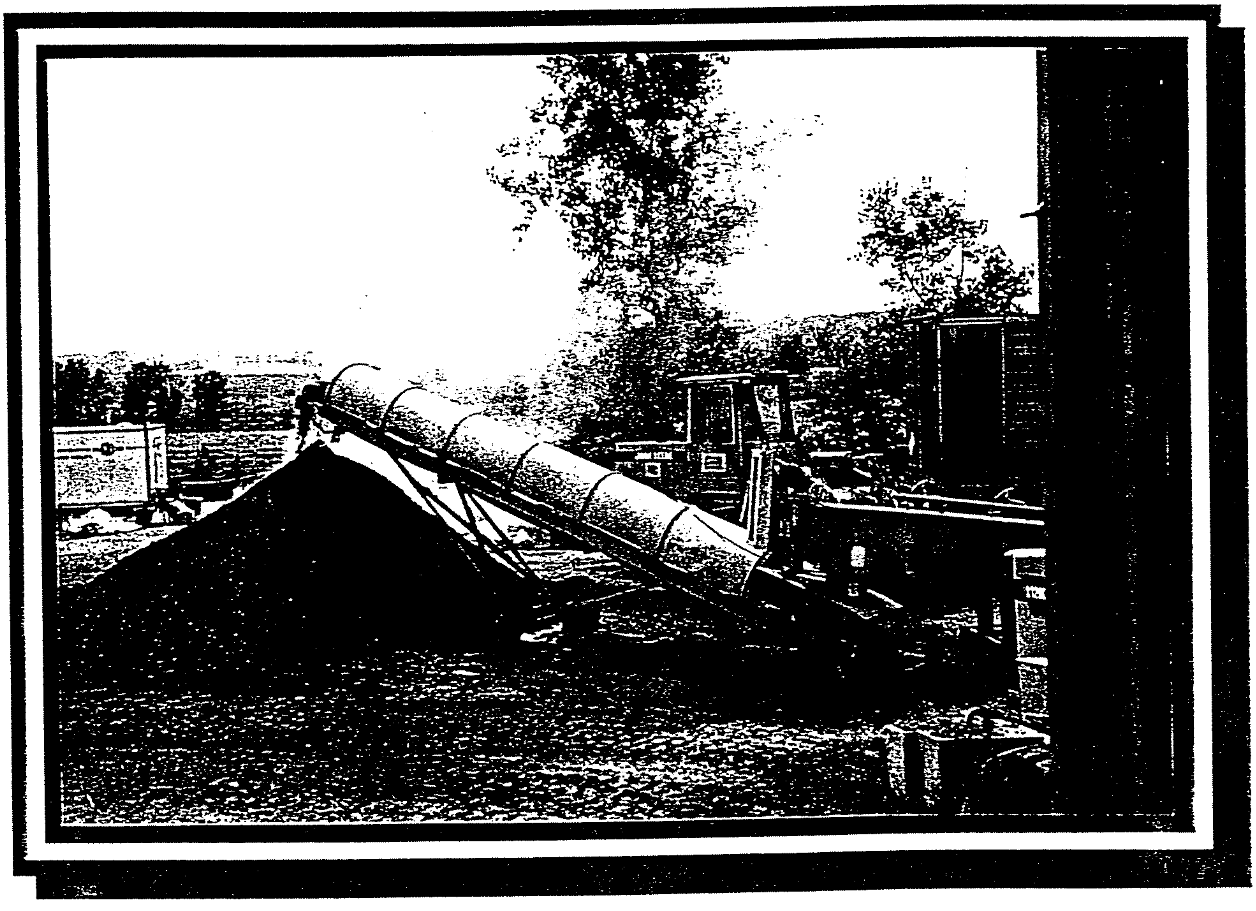
SoilPure, Inc.





SoilPure, Inc.





Thermal Process Description

Overview

The SoilPure, Inc. (SPI) soil remediation system is designed to remediate soil contaminated with petroleum hydrocarbons, including; gasoline, jet fuel, diesel oil, polynuclear aromatic hydrocarbons (PAH) as well as solvents. This is done by rapidly volatilizing these products from the soil, then thermally destructing them in the air pollution control system. The major mechanical components of the unit consist off; a control house, soil feed system including a weigh scale, a rotary drum desorber, a treated soil handling system (which includes; an auger mixer/cooler and a stacking conveyor), a baghouse and a thermal oxidizer air pollution control system. Auxiliary systems include fuel, air and water delivery systems and a process control, monitoring and interlock system.

A generic site plan, process flow diagram, and system specifications of the SPI soil remediation unit are provided. An engineering description of the unit is provided in the following sections.

Soil Feed System

Contaminated soil in need of treatment is transported to the unit with a front end loader from the contaminated soil staging area and is passed through a grizzly into a hopper. The soil is conveyed to an inline magnet and the soil drops onto an incline conveyor. The incline belt conveys the soil to a final 2" minus screening device and onto a belt weigh scale. The belt scale provides soil feed rate and totalized weights to the unit's control system. The feed belt feeds the contaminated soil into a stainless steel counter flow rotary drum desorber.

Rotary Drum Desorber

The primary treatment unit of the SPI remediation system is an 8'X32' counter-current stainless steel rotary drum desorber with stainless steel internal flights. Soil is fed into the rotary drum desorber where the internal flights lift and veil the soil through the hot gas stream produced by the direct fired primary burner. Soil flows counter-currently to the air flow in the desorber. The burners are located on the soil discharge end of the desorber. The soil discharges the desorber at temperatures of approximately 350° Fahrenheit to 1200° Fahrenheit depending on engineering specifications and regulatory objectives.

Soil residence time in the rotary drum is a function of the desorber rotation speed and depth of fill desired in the system. At a feed rate of 35 tons per hour, the soil residence time will be approximately seven to ten minutes.

Primary Fuel System

Heated air is supplied to the rotary desorber through a propane or natural gas fired burner. If propane is used, the liquid propane is stored in an 18,000 gallon portable vessel. Propane is pumped out of the tank and through regulators and modulating valves to the burners. If natural gas is used, a service line and a regulator is installed to connect with an existing local distribution line.

The rotary desorber burner is direct fired with a capacity of 50 MM BTU/hour. A centrifugal blower supplies combustion air to the burner.

Treated Soil Handling System

The heated, dry soil from the thermal desorber is discharged into an enclosed auger system. The remediated soil and dust mixture is then augured to the mixer cooler where it is cooled with a water spray. Water is used in the treated soil handling system at a rate dependent on the temperature of the treated soil entering the mixer/cooler, and the desired final material moisture content. The treated soil is discharged from the discharge auger onto a stacking conveyor. The stacking conveyor discharges the treated material to a temporary stockpile. The final soil temperature will be 150° F to 200° F and will have a moisture content of 4 to 8%.

Baghouse Operation

The evaporated organics and water, along with dust released by the desorption process are carried with the rotary drum exhaust gases into a knockout chamber where larger particles drop out of the gas stream prior to entering the crossover duct. The gas stream then flows to the baghouse. Dust collected from the duct and baghouse are dropped onto the slat conveyor system, which conveys the fines to an auger for transport to the rotary drum desorber prior to exiting to the discharge auger. The baghouse includes 504 filter media P-84 bags, a single drag chain bottom slat conveyor with airlock and the auger. The baghouse utilizes P-84 filter media that are capable of handling the desorber exit gases. Typical desorber exit gas temperature ranges from 300° F to 475° F. The baghouse filter elements are rated for continuous service at temperatures up to 475° F. Dust removal from the baghouse filter media is assisted by compressed air pulsation.

Induction Fan

Condition off-gas exits the baghouse and is discharged to the induction (ID) fan. The ID fan is capable of production a negative pressure throughout the system and has a capacity of 18,000 acfm at twelve inches of static pressure. The fan is equipped with a 75 horsepower motor. The gas from the ID fan is discharged to the thermal oxidizer.

Thermal Oxidizer

The gas stream output from the baghouse is routed through the ID fan into a modular thermal oxidizer / stack unit, which reduces the hydrocarbon content of the gas stream with a destructive removal efficiency (DRE) capable of up to 99.99% depending on contaminate concentrations. The thermal oxidizer consists of a refractory lined combustion chamber utilizing a 44.4 MMBTU direct fired burner with an operating temperature of 1,800 Fahrenheit at 2.0 to 2.5 seconds retention time. The unit has a removable insulated 24' long stack (37'6" above grade) which includes a ladder, OSHA platform and test ports.

Construction Materials

The materials of construction for the major components of the SPI soil remediation unit are provided in the following Table 1-1.

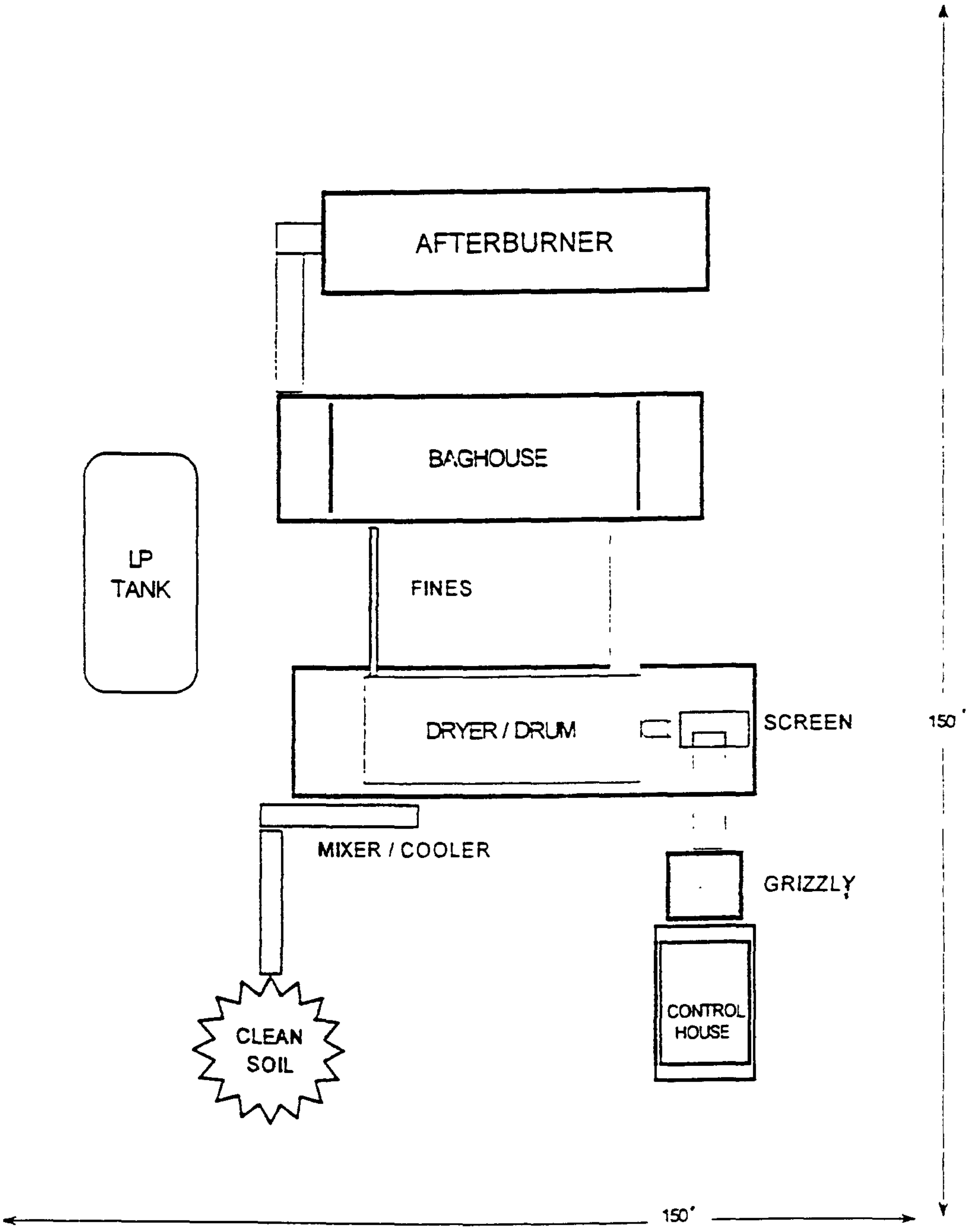
CONTROLS. MONITORING AND INTERLOCK SYSTEMS

Control Systems

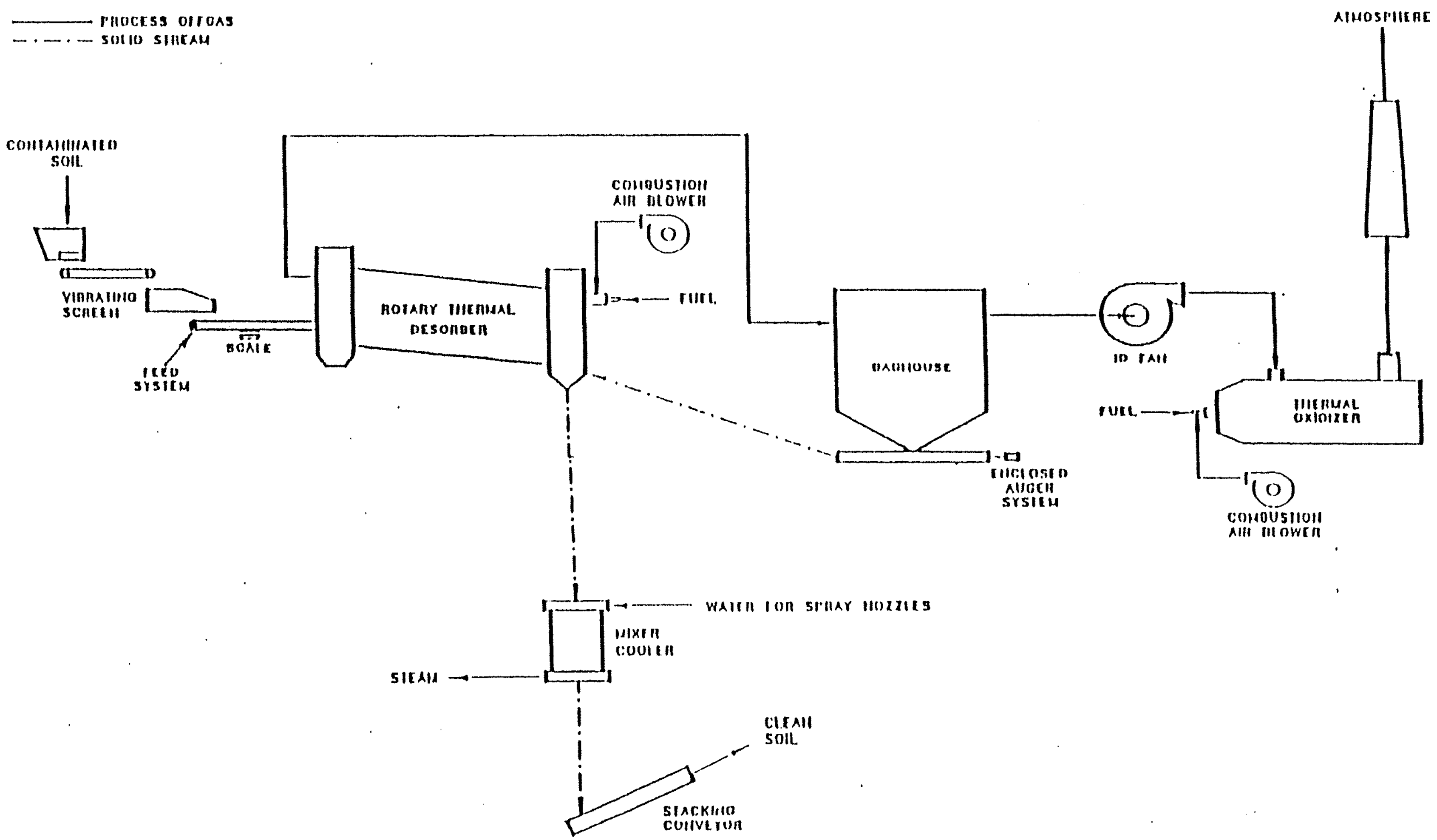
The SPI soil remediation unit control center is located in the 10'X20' control house which is position on the feed trailer. The controls are composed of a centeralized control system containing manual and interlocked controls, indicators, recorders of flow, burner controls, temperature and pressure measurements in the soil feed system, rotary drum desorber, treated soil handling system, baghouse, thermal oxidizer and auxiliary systems, which are consistent with SPI's permits (MPCA, WDNR, and TNRCC Air Quality Use Permits). The control center and overall process is continuously monitored by an SPI certified operator to ensure that the soil remediation unit is operated in compliance with regulatory and other process operating limits.

Table 1-1: Materials of Construction for the Major Components

Component	Construction Material
Rotary Dryer Drum	Stainless Steel
Thermal Oxidizer	Carbon Steel / Refractory Insulation
Baghouse	Carbon Steel
ID Fan	Carbon Steel
Stack	Carbon Steel / Refractory Insulation



SoilPure, Inc.
Thermal Desorption Site Plan (generic)



System Block Flow Diagram

Thermal Desorber System Specifications

Process Design Parameters:

Design Moisture Content	5-20%
Processing capacity	30-50 tph
Contaminates to be treated:	
1. #2 Fuel Oil, maximum percent by weight	1.5
2. Gasoline, maximum percent by weight	1.5
3. Jet Fuel, Kerosene, maximum percent by weight	1.5
4. PAH's	.5 - 1.0
Design ambient temperature	60° [f]
Design soil temperature entering kiln	60° [f]
Thermal oxidizer operating temperature	1400-1800° [f]
Design residence time	2.0 - 2.5 sec
Kiln exhaust temperature (maximum)	650° [f]
Soil exit temperature (maximum)	1200° [f]

(1) ROTARY KILN:

- 8' Diameter X 32' long. T-316L SS trailer mounted drum. Drum is counter flow.
- Flights T-316L with forward pitch kicker flights at inlet.
- Thrust Rollers for longitudinal control of drum.
- Wheel guards.
- Girth and pinion sprocket guards.
- 50 hp TEFC drive motor.
- Inline drive unit.
- Dryer inlet and discharge breeching and duct work constructed from 1/4" high strength, high temperature ASTM A-588 weathering steel. This material will handle temperatures up to 1000 degrees Fahrenheit with minimum expansion.
- Mounted on heavy duty tandem custom designed trailer unit.
- Side discharge.
- Hauck Burner Model ES50B total air burner with 10 hp primary blower and 30 hp integral blower.
- LP pump set with regulators.
- Hauck BCS 5000 table to burner control panel mounted in control room.
- Belt feed unit equipped with belt scale and remote totalizer mounted in control room.
- 3' X 5' vibrating screen mounted over feed unit to prevent oversized material from entering kiln.

(2) THERMAL OXIDIZER:

- Trailer mounted approximately 11'-6" width by 13'-6" high by 60' length.
- Operating temperature 1800 degrees Fahrenheit at 2.0 - 2.5 seconds residence time.
- Hauck Burner (1) Model BBG118.
- LP pump set.
- Hauck BCS 3000 control panel mounted in control room.
- Removable insulated stack 24' in length (37'-6" above grade) must be transported separately, and includes ladder, OSHA platform, weather cover, threaded fittings for addition of optional EMS equipment, and test ports.

(3) BAGHOUSE:

- SPI, Model PC504-6000 Portable dust collector including 6565 square feet of cloth area.
- Air/Cloth ratio at 350° Fahrenheit equals 4.19:1 at (27509ACFM).

- Automatic pneumatic / temperature controlled isolation damper.
- Drag chain bottom with air lock and discharge auger.
- (504) 16 oz P-84 bags, snap band top, with galvanized cages and 3" venturi.
- Built in 5' X 11' (nom) inlet hopper/knockout with vertical inlet.
- Pulse jet design.
- 25 hp rotary screw air compressor.
- 75 hp exhaust fan at 12" S.P.
- Controls include a magnehelic gauge, power off/on switch, temperature controller, Goyen Sequential Timer, Start/Stop switches for the drag conveyor, cross screw conveyor, air compressor and exhaust fan.
- Goyen "T" series diaphragm valves mounted on a 6" compressed air header.
- Fan outlet damper.

(4) Feed Unit With Control Unit

- Hydralic powered shredder mounted at the end of the feed belt to break clods and lumps.
- 8 CY feed hopper with variable speed feed belt and feed conveyor, hydraulic powered.
- Hopper and 6" grizzly.
- Control room, 10' X 20' with (3) 3' X 6' windows to provide visibility, air conditioning, heating insulation.
- Magnet on feed conveyor.
- Baghouse and burner controls are mounted in control room.
- Thermal oxidizer temperature recorder.
- Soil exit temperature indicator/controller.
- Thermal oxidizer temperature indicator / controller.
- Kiln gas temperature indicator.
- Stack temperature indicator
- Baghouse inlet temperature indicator.
- 6 pin data logger.

MISCELLANEOUS:

- Emergency water quench including thermocouple, controller, and solenoid valve. Does not include water source.
- 20' auger / mixer cooler to receive hot material and transfer treated material to optional stacking conveyor.

All of the above equipment is mounted on four (4) trailers for ease of transport. Miscellaneous equipment requires additional flat bed trailers for transportation.

APPROXIMATE POWER REQUIREMENTS:

- Electric, 3 Phase, 480 V, 600 Amp
- Natural Gas @ 4" line, 20 PSI
- Potable water @ 50 GPM @ 30 - 50 PSI

Project Experience

CLIENT / SITE	LOCATION	TONS TREATED / HANDLED	CHEMICALS OF CONCERN
Ashland Oil Corporation	Okey Farms, Cottage Grove, Minnesota	10,961	Petroleum Hydrocarbons
Confidential Commercial Client	Ohio	14,472	
Dallas / Fort Worth International Airport	DFW Airport, Dallas, Texas	2,700	Petroleum Hydrocarbons
Summit National Superfund Site	Deerfield, Ohio	17,500	PCB, PAH, BTEX
Chicago & Northwestern Railway	Minneapolis, Minnesota	7,696	Creosote, PAH
US Air Force	Scott Air Force Base, Belleville, Illinois	15,000	DDT, DDD, DDE, Arochcor 1254, Petroleum Hydrocarbons
Genesee Aggregate Corp.	Genesee, Wisconsin	6,000	No. 2 fuel oil
Mercury Marine	Hartford, Wisconsin	27,000	gasoline, fuel oil, kerosene, naphtha
West Shore Pipeline (Amoco)	Milwaukee, Wisconsin	15,000	No. 2 fuel oil
US Army	Fort McCoy, Wisconsi	5,000	gasoline, fuel oil, diesel fuel, lubricants
Southern California Edison	Long Beach, California	6,000	No. 5 fuel oil, bunker oil
Alyeska Pipeline Company	Valdez to Prudhoe Bay, Alaska	30,000	fuel oil, crude oil, petroleum Hydrocarbons

Project Name: Okey Farms Site

Client: Ashland Oil Corporation
St. Paul Park Refinery
Jeff Mayen
Tel: 612-458-2661
Fax: 612-458-2699

Project *Location*: 10301 Hadley Avenue South
Cottage Grove, Minnesota

Facility Type: Hydrocarbon Sludge Lagoons.

Regulatory Agency: Minnesota Pollution Control Agency

Project Manager: Eric Shellum, SoilPure, Inc.
Health & Safety Officer: Patrick Beyer, SoilPure, Inc.
QA / QC Officer: Edward O'Connor, SoilPure, Inc.

Date Completed: December 31, 1997

<u>Summary</u>: In September 1997; SoilPure, Inc. (SPI) was awarded the general contract for on-site thermal treatment of TPH and PAH impacted soils. The work under this contract included;

1. Site Health and Safety Plan.
2. Approved Work Plan.
3. Site Preparation.
4. Thermal treatment documentation.
5. Treatment of 10,961 tons of heavily contaminated soil.
6. Excavation, back fill and compaction.
7. Stockpile management.
8. Soil sampling and analysis.
9. Site security.
10. Site restoration.

Prior to the arrival of the thermal remediation equipment, SoilPure designed and built a soil staging containment cell. This area consisted of a bermed cell that was lined to control water run-on / run-off.

Due to the recreational use of the area a perimeter fence was erected to ensure the safety of the on-site personnel and the general public as well. A <u>Site Specific Work Plan</u>, <u>Emergency Site Safety and Health Plan</u> and a <u>Sampling and Analysis Plan</u> (SAP) was prepared and submitted to both the Minnesota Pollution Control Agency (MPCA) and to Ashland Oil Corporation for approval. It was under these strict guidelines that SoilPure began setup, excavation, plant shakeout and thermal remediation. In addition to many of these state and self imposed guidelines it was SPI's intention to have the project completed before snowfall. Further contamination was discovered thus extending the project into winter. The project was completed in early January 1998. For additional information regarding this project please contact SoilPure, Inc.

Project Name:	Dallas Fort Worth International Airport
Client:	Dallas Fort Worth International Airport
Project Location:	Dallas County, Texas
Facility Type:	Former Remediation Site
Regulatory Agency:	Texas Natural Resources Conservation Committee Federal Aviation Administration (FAA)
Project Representative:	Rick Reeter, Environmental Engineer Dallas Fort Worth International Airport PO Box 61428 DFW Airport, TX 75261 Tel: 972-574-0654 Fax: 972-574-0662
General Contractor:	Thos. S. Byrne Construction Steve Lawerence Tel: 972-574-3519 Fax: 972-574-3512
Project Manager:	Eric Shellum, SoilPure, Inc.
Health & Safety Officer:	Martin V. Aschenbrener, SoilPure, Inc.
QA / QC Officer:	Frank O'Connor, SoilPure, Inc.
Date Completed:	May 22, 1997

Summary: Acting as a subcontractor, SoilPure, performed a turnkey project consisting of:

1. Thermal treatment documentation.
2. Treatment of over 8,000 tons of contaminated soil.
3. Excavation.
4. Water run-on / run-off protection
5. Soil screening.
6. Stockpile management.
7. Soil and water sampling.
8. Landfill.

This project started in early January, 1997. At this time SPI mobilized heavy equipment to the site in preparation of remedial activities. Before remediation could begin ingress and egress roads had to be constructed. Due to records amounts of rainfall in the area a new water control plan had to be devised. Because of the soil matrices (red clay) standard water control plans were not applicable. A series of pumps, drainage ditches and an intricate system of irrigation hoses were setup to regulate and control the water.

All soil was screened to <2" and thermal treated. SPI treated the soil (with extremely high moisture content, >30%) never missing the cleanup objective. Thousands of tons of non-impacted soil were screened and hauled to a landfill.

This project was completed on time and within the contract guidelines. Because of the exceptional work done SoilPure has been contacted by DFW Environmental Services to bid on the design and implementation of a state approved remediation site. This site will be used to collect contaminated soils on the airport property that are in need of remediation.

Past Project Experience

SoilPure personnel have been directly involved in several large projects. During the spring of 1995, at **Summit National Superfund Site** in Deerfield, Ohio, SPI personnel worked as an incineration contractor for Sevenson Environmental Services (John Robbins, 800-777-2283). The project manager was Eric Shellum of SPI. Our personnel prepared and completed the following as part of the thermal treatment documentation and the actual incineration;

1. Performance Demonstration Plan (PDP)
2. Performance Demonstration Report
3. Equipment Operations and Maintenance Manual
4. Back up and Redundancy Plan
5. Operations and controls Description
6. Materials Handling Systems
7. Reliability and Operations History
8. Process and Instrumentation Diagram (P&ID)
9. Process Flow Diagram
10. Air Pollution Equipment Diagram
11. Noise Impact Study
12. Incinerator Quality Assurance Plan

As SPI's team of remediation professionals went to work on this project, it became clear very early on that some major changes in equipment were necessary. SPI personnel then made modifications to it's existing plant. These design changes were necessary to achieve the desired output.

These design changes were necessary because of the wide range of constituents in the soil. These soils were primarily contaminated with polynuclear aromatic hydrocarbons (PAH), bix(2-ethylhexyl)phthalate, hexachlorobenzene, polychlorinated biphenyls (PCB), volatile organic compounds, and semi-volatile organic compounds. Meeting the task of cleaning all these contaminates and the 99.99% destruction removal efficiency (DRE) was no small challenge.

The only major problem encountered was the abnormally high BTU values in the feed stock and the occurrence of an exthothermic reaction in the baghouse. The project was completed within four working days of the project deadline.

Another major project that SoilPure personnel successfully completed was for **Chicago and Northwestern Railways** (CNW). This project, located at the former Southeastern Minneapolis

Railway Yards and was once the former site of a creosote wood treating plant. The property now belongs to the University of Minnesota (Gordon Girts; 612-626-3595) and is adjacent to Williams Arena. It was contaminated with PAH's. The project manager was Kirk Shellum of SPI.

As the prime contractor for CNW, SPI personnel were responsible for; thermal treatment area preparation, soil excavation, soil transporting, soils management, utilities, storm water maintenance, run off protection, crushing, thermal soil remediation, soils testing, back fill, compact ion (to 90% modified proctor) and site restoration.

SoilPure personnel have worked on a wide array of projects. One such project was a **Treatability Study of Contaminated Soils**. This was done at Scott Air Force Base in Belleville, Illinois (Scott Air Force Base, Tim Tedesco, 618-256-4165). SPI personnel worked for the Tennessee Center for Research and Development ((TCRD) 615-966-5409)) in conjunction with Cheryl Bievenue of Svedrup Environmental (210-377-0040). This study addressed petroleum contaminated soils that had been attributed to products leaking from underground storage tanks. In the initial characterization process a Total Analyte List / Total Compound List (TAL/TCL) screening was performed. The predominated constituents found were BTEX and PAH's. These are the compounds that were studied but in addition to these it was found to be contaminated with DDT, DDD, DDE, and Arochlor 1254.

This study was designed to illustrate the cost effectiveness of low temperature thermal desorption on the targeted compounds. Through this joint effort between TCRD, and SoilPure personnel a workable cost benefit analysis was developed. This has been used as an aid in governmental procurement and budgeting.

Outline

SoilPure, Inc.

HEALTH, SAFETY & EMERGENCY RESPONSE PLAN

Summer, 1998

HEALTH, SAFETY, AND EMERGENCY RESPONSE PLAN

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QUALITY CONTROL

The purpose of the SoilPure, Inc. (SP) quality control program is twofold:

a. To prevent recontamination or cross contamination of previously cleaned soils by strict design and enforcement of site soil processing guidelines.

b. To give the client assurance that all processed soils are free of the previous contamination.

Material Handling

Strict maintenance procedures on the equipment are enforced and documented with daily and monthly maintenance logs (loaders, excavators, etc.) are followed to insure against contamination of soils from machinery lubrication oils. Good housekeeping procedures are also followed to insure a clean work atmosphere and environment. All maintenance employees are trained in the different aspects of maintenance procedures.

Petroleum contaminated soils are handled in a controlled method to isolate the contaminated soils from the "clean" soils. The "clean " soils are never in contact with contaminated soils, so there is no chance of re-contaminating the "clean" soils.

Upon excavation, the contaminated soils are placed in an area designated for contaminated soils. The equipment used for excavation will handle only contaminated soils, unless it has been properly cleaned and decontaminated. Only then will it be allowed to handle any "clean" soil.

After placing the contaminated soils in the designated area, the soils are handled in accordance with our local air quality permits. A front end loader will handle the contaminated soils from the excavation to the loading into the remediation equipment. This end loader will not handle the "clean" soils until it has been properly decontaminated.

When the soils have been treated by the thermal process, the soils are placed into separate piles to be tested. Strict soil sampling protocol is followed as outlined in the "Soil Sampling Protocol Manual."

After verification by a certified independent analytical laboratory, the soils are now classified as "clean," the separate piles are ready to be replaced in the excavation. The "clean" soils are then combined into the area designated for the "clean" soils or placed directly into the excavation. The handling of the "clean" soils is performed by a decontaminated or second end loader. This front end loader is responsible for the "clean" soils solely, and is not used for the contaminated soils.

Processing

There are also control measurements during the thermal process that must be followed to insure that the soils will meet the specific cleanup objectives. All monitoring is done via operator and data logger in the control house. This is done not only for quality control, but also safety. The process is monitored and controlled with the following major instrumentation systems:

1. *ROTARY DRUM PRESSURE CONTROL:* A negative pressure is maintained on the drum and desorption process. The negative pressure assures that dust is kept in the system and flows to the baghouse. A pressure indicator, sensing a higher than set point pressure, actuates the damper of the baghouse exhaust fan to maintain the negative pressure.

2. *PRODUCT SOIL TEMPERATURE CONTROL:* Soil remediation temperature is maintained by a temperature controller, which senses the temperature in the soil being discharged from the rotary drum. If the soil temperature drops below the set point, the drum burner is actuated to raise the thermal duty. A burner damper is automatically actuated by a pressure control actuator to maintain air to the burner. A burner level gauge in the control house monitors the burner operation capacity.

3. *BAGHOUSE PRESSURE DIFFERENTIAL:* Baghouse pressure drop is monitored by a differential pressure indicator. A sudden decline in pressure differential indicates a possible bag rupture. An increase in pressure differential indicates possible plugging.

4. THERMAL OXIDIZER TEMPERATURE CONTROL: A thermocouple in the oxidizer stack senses the stack gas temperature. If the stack has temperature drops below its set point, a signal will actuate the thermal oxidizer burner to increase the thermal duty. Similar to the drum burner, a blower damper is automatically actuated to feed air flow to the burner. A separate over temperature control system is provided for the thermal oxidizer, in the event that excess hydrocarbons are sent to the point where burner turndown is sufficient. Should this occur, a signal from a thermocouple set at a maximum limit for the stack gas temperature shuts the unit down.

Strict maintenance and approved calibration procedures are followed to insure proper operation of all instruments. All maintenance employees have proper training to ensure accurate and efficient maintenance of equipment.

It should be noted that the soil discharge temperature necessary to "clean" the soil is site specific. The minimum temperature of the discharged soils will vary depending on the levels and types of contaminates, soil matrix and particular size. The minimum soil discharge will be determined after review of the analyticals from the contaminated soils. The results from the certified analytical laboratory of the "clean" soils will verify that the minimum temperature is sufficient to "clean" the soils.

SoilPure, Inc. (SP) assures that the thermal remediation process will meet the cleanup objectives as determined prior to the start of the project. If the cleanup objectives are not met, SPI will process the soil again at no cost to the generator.

"Clean" as used in this text means that the soils have met the cleanup objectives and that the levels of contaminates are below the acceptable levels of the contract or local governing agency.

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT
Operable Unit#1
TPS Technologies Soil Remediation Unit (SRU)

Estimated Air Emissions

By E_3-Killam, Inc.

August, 1999

Westinghouse Plant Soil Remediation Project
Operable Unit #1
Town of Cheektowaga, NY
TPS Technologies Inc.

Air Emission Summary

Contaminant	Emission Rate Potential (lb/hr)	Hourly Emissions (lb/hr)	Project Emissions (lb)
Hydrogen Chloride	4.0	4.0	5586
Toluene, Ethylbenzene, Xylenes	273	0.272	110
Volatile Organic Compounds	800	1.32	535
Sulfur Dioxide	0.019	0.019	7.7
Carbon Monoxide	3.30	3.30	1337
Nitrogen Oxide	19.6	19.6	7938
Particulate Matter	760	5.14	7178

Note: The emission rates listed above are representative of actual operations and are not meant to be maximum values for limiting emissions.

Emission Calculations for TPS Technologies, Inc.
Town of Cheektowaga, New York (Westinghouse Plant) Soil Remediation Project

Assumptions used in these calculations are as follows:

1. Soil remediation unit will process a maximum of 40 tons (80,000 lbs) per hour.
2. Minimum amount of soil to be remediated is 16,200 tons. The maximum concentration of chlorinated solvents in the soil is 204 ppm. Soil with no detectable chlorinated solvents will be blended to achieve a maximum HCl emission rate of 4.0 lb/hr. Therefore, the total amount of soil to be processed through the TDU is approximately 55,800 tons.
3. Unit will operate on propane fuel with a heating value of 91,500 BTU/gal.
4. Output of rotary drum burner is 50 MM BTUs/hr and the output of the afterburner is 44.4 MM BTUs/hr for a total of 94,400,000 BTUs/hr.
5. Maximum contamination level of processed soil is 10,000 ppm mixed VOCs.
6. Afterburner will operate at a minimum temperature of 1650 °F.
7. <u>Compilation of Air Pollution Emission Factors, Fifth Edition</u>, (AP-42) is used for emission factors.

Hydrogen Chloride Emissions (HCl)

A. HCl emissions are derived from the chlorine present in the solvent contamination in the soil. The maximum observed chlorinated solvent contamination is 120 ppm trichloroethylene (TCE) and 84 ppm trichloroethane (TCA). The carbon emissions of these compounds are easily oxidized in the thermal oxidizer so that only HCl is emitted to atmosphere.

The Westinghouse "Invitation to Make Presentation" to ICF-Kaiser Engineers dated July 3, 1997 lists the maximum observed concentration of TCE as 120 ppm and TCA as 84 ppm.

$$\text{Maximum throughput is 40 TPH} = \frac{80{,}000\text{ lb}}{\text{hr}} \times \frac{10^6\text{ lbs}}{\text{lb TCE}} = \frac{0.08\text{ million lbs}}{\text{hr}}$$

$$\text{TCE content} = 120\text{ ppm} \times 0.08\text{ million lb/hr} = \frac{9.6\text{ lb}}{\text{hr}}\text{ TCE}$$

$$\text{TCE Cl content} = 0.81\text{ lbs Cl/lb TCE} = \frac{9.6\text{ lbs TCE}}{\text{hr}} \times \frac{0.81\text{ lb /Cl}}{\text{lb TCE}} = \frac{7.78\text{ lb Cl}}{\text{hr}}$$

$$\text{TCA content} = 84\text{ ppm} \times 0.08\text{ million lb/hr} = \frac{6.72\text{ lbs TCA}}{\text{hr}}$$

$$\text{TCA Cl content} = 0.798\text{ lb Cl/lb TCA} = \frac{6.72\text{ lbs TCA}}{\text{hr}} \times \frac{0.798\text{ lb Cl}}{\text{lb TCA}} = \frac{5.36\text{ lb Cl}}{\text{hr}}$$

Each Cl molecule combines with one H molecule to form an HCl molecule which weighs $1 + 35.5 = 36.5$ lb/mol

$$\text{Total HCl emitted} = \left[\frac{7.78\text{ lbs}}{\text{hr}}\text{ Cl from TCE} + \frac{5.36\text{ lbs}}{\text{hr}}\text{ Cl from TCA}\right]\frac{36.5\text{ mol wt HCl}}{35.5\text{ mol wt Cl}}$$

$$= \frac{13.5\text{ lbs Cl}}{\text{hr}} \times \frac{36.5}{35.5} = \frac{13.9\text{ lbs}}{\text{hr}}\text{ HCl}$$

Soil contaminated to the maximum observed concentration must be blended with non-chlorinated compound soil to reduce HCl emissions below 4.0 lb/hr and eliminate need for acid gas control.

Hydrogen Chloride Emissions (HCl) Continued

Emissions

Hydrogen Chloride: 4.0 lb/hr

Total Hydrogen Chloride:

$$\frac{4.0\ \text{lb}}{\text{hr}} \times \frac{(16.200 + 39.662)\ \text{tons}}{40\ \text{ton/hr}} = 5586\ \text{lb HCl total emission}$$

Emission Rate Potential:

With soil blending: same as actual emissions

Without soil blending: 13.9 lb/hr

B. Calculation in Item A shows the results when soil contaminated to the maximum concentration observed in testing is blended with "clean" or "Cl-free" soil to limit the emission of HCl to 4.0 lb/hr. It is likely that we will find much soil with less than maximum observed chlorinated hydrocarbon concentrations which must be remediated. In such cases, blending of "clean" soil with contaminated soil may not be required. The following calculations illustrate this:

TCE Contamination Remediation:

Maximum allowable HCl emission rate is 4.0 lb/hr.
TCE Cl content = 0.81 lb/lb TCE;

$$\text{HCl generated} = 0.81\ \text{lb Cl/lb TCE} \times \frac{36.5\ \text{mol. wt HCl}}{35.5\ \text{mol. wt. Cl}} = 0.833\ \text{lb HCl/lb TCE}$$

$$4.0\ \text{lb/hr HCl} = \frac{0.833\ \text{lb HCl}}{\text{lb TCE}} \times \frac{X\ \text{lbs TCE}}{\text{hr}}$$

$$\frac{X\ \text{lbs TCE}}{\text{hr}} = \frac{4.0\ \text{lb/hr HCl}}{0.833\ \text{lb HCl/lb TCE}} = \frac{4.8\ \text{lb TCE}}{\text{hr}}$$

$$\frac{4.8\ \text{lb TCE}}{\text{hr}} \times \frac{1}{0.08\ \text{million lb/hr soil}} = \frac{60\ \text{lb TCE}}{\text{million lb soil}} = 60\ \text{ppm TCE concentration}$$

It can be seen that soil contaminated with TCE concentrations up to 60 ppm by weight requires no blending with "clean" soil to meet the allowable emission of 4.0 lb/hr HCl.

Hydrogen Chloride Emissions (HCl) Continued

TCA Contamination Remediation:

Maximum allowable HCl emission rate is 4.0 lb/hr

TCE Cl content = 0.798 lb/lb TCA;

$$\text{HCl generated} = 0.798 \text{ lb Cl/ lb TCA} \times \frac{36.5 \text{ mol. wt. HCl}}{35.5 \text{ mol. wt. Cl}} = 0.82 \text{ lb HCl/lb TCA}$$

$$4.0 \text{ lb/hr HCl} = \frac{0.82 \text{ lb HCl}}{\text{lb TCA}} \times \frac{\text{X lbs TCA}}{\text{hr}}$$

$$\frac{\text{X lbs TCA}}{\text{lb}} = \frac{4.0 \text{ lb/hr HCl}}{0.82 \text{ lb HCl/lb TCE}} = \frac{4.88 \text{ lb TCA}}{\text{hr}}$$

$$\frac{4.88 \text{ lb TCA}}{\text{hr}} \times \frac{1}{0.08 \text{ million lb/hr soil}} = \frac{61 \text{ lb TCA}}{\text{million lb soil}} = 61 \text{ ppm TCA concentration}$$

It can be seen that soil contaminated with TCA concentrations up to 61 ppm by weight requires no blending with "clean" soil to meet the allowable emission of 4.0 lb/hr HCl.

Toluene, Ethylbenzene, and Xylene (TEX) Emissions

Maximum observed Toluene concentration in soils is 29 ppm, Ethylbenzene 480 ppm, and total Xylene 2900 ppm; Total TEX of 3409 ppm.

Assume:
- System Destruction Removal Efficiency of 99.9%
- VOCs from fuel already accounted for in "VOC Emission"

TEXs from contaminated soil:

$$\text{Max:}\quad \frac{80{,}000 \text{ lb}}{\text{hr}} \times \frac{0.0034 \text{ lb TEX}}{\text{lb soil}} \times \frac{100-99.9}{100} = \frac{0.272 \text{ lb TEX}}{\text{hr}}$$

Total TEX:

$$0.272 \text{ lb/hr} \times \frac{16{,}200 \text{ tons}}{40 \text{ ton/hr}} = 110 \text{ lb Total TEX}$$

The uncontrolled potential to emit:

$$\frac{80{,}000 \text{ lb soil}}{\text{hr}} \times \frac{0.003409 \text{ lbs TEX}}{\text{lb soil}} = 273 \text{ lb/hr TEX}$$

VOC Emissions

Volatile organic compounds are derived from two sources. The first is from the fuel being used in the process and the second is from the contamination in the soil.

Assume: All soil has a 10,000 ppm contamination level
System Destruction Removal Efficiency of 99.9%

VOCs from the fuel:

From AP-42, Sec. 1.5 Liquefied Petroleum Gas Combustion, Table 1.5-1 the total organic compound emission factor is 0.5 lbs/1000 gals of propane. The heating value of propane = 91.5 MMBtu/1000 gals.

$$\frac{94.4\text{MM BTUs}}{\text{hr}} \times \frac{1000\text{ gals}}{91.5\text{ MMBTUs}} \times \frac{0.5\text{ lbs}}{1000\text{ gals}} = 0.52\text{ lbs/hr VOCs}$$

VOCs from the contaminated soil:

$$\text{MAX: } \frac{80{,}000\text{ lbs}}{\text{hr}} \times \frac{0.01\text{ lbs VOC}}{\text{lb soil}} \times \frac{100 - 99.9}{100} = 0.8\text{ lbs/hr VOCs}$$

Total VOCs/hr:

$$\text{MAX: } 0.52 + 0.8 = 1.32\text{ lbs/hr VOCs}$$

Total VOCs:

$$\frac{1.32\text{ lbs}}{\text{hr}} \times \frac{16{,}200\text{ tons}}{40\text{ tons/hr}} = 535\text{ lbs VOC Total Emissions}$$

Uncontrolled potential to emit:

$$\frac{80{,}000\text{ lb soil}}{\text{hr}} \times \frac{0.01\text{ lbs VOC}}{\text{lb soil}} = 800\text{ lbs/hr VOCs}$$

Sulfur Dioxide Emissions

Sulfur dioxide (SO_2) emissions are derived from the fuel being used in the process.

SO_2 from the fuel:

From AP-42 Sec. 1.5 Liquefied Petroleum Gas Combustion, Table 1.5-1 the emission factor for SO_2 is 0.10S lb SO_2 /1000 gals. Assume S = 0.18 gr/100 ft^3 for propane. Emission factor is then (0.10S x 0.18 gr/100 ft^3) = 0.018 lb SO_2/1000 gal propane.

$$\frac{94.4\ \text{MMBtu}}{\text{hr}} \quad \text{x} \quad \frac{1000\ \text{gals}}{91.5\ \text{MM Btu}} \quad \text{x} \quad \frac{0.018\ \text{lb SO}_2}{1000\ \text{gal}} \quad = \quad 0.019\ \text{lb/hr SO}_2$$

Total SO_2:

$$\frac{0.019\ \text{lbs}}{\text{hr}} \ \text{x} \ \frac{16{,}200\ \text{tons}}{40\ \text{tons/hr}} = 7.7\ \text{lbs total SO}_2\ \text{emissions}$$

The potential to emit is the same as the actual emissions.

Carbon Monoxide Emissions

Carbon Monoxide (CO) is produced from the burning of the fuel. AP-42 Sec 1.5 Liquefied Petroleum Gas Combustion, Table 1.5-1 has a factor of 3.2 lbs CO per 1000 gals of propane.

Lbs/hr CO:

$$\frac{94.4 \text{ MM BTUs}}{\text{hr}} \text{ x } \frac{1000 \text{ gal}}{91.5 \text{ MM Btu}} \text{ x } \frac{3.2 \text{ lb CO}}{1000 \text{ gal}} = 3.30 \text{ lbs/hr CO}$$

$$\text{Total CO} = \frac{3.30 \text{ lbs}}{\text{hr}} \text{ x } \frac{16{,}200 \text{ tons}}{40 \text{ ton/hr}} = 1337 \text{ lbs total emissions}$$

The potential to emit is the same as the actual emissions.

Nitrogen Oxide Emissions

Nitrogen oxides (reported as NO_x) is produced from the burning of the fuel. AP-42, Sec. 1.5 Liquefied Petroleum Gas Combustion, Table 1.5-1, has a factor of 19 lbs NO_x per 1000 gal of propane.

lbs/hr NO_x:

$$\frac{94.4 \text{ MM BTUs}}{\text{hr}} \times \frac{10^3 \text{ gal}}{91.5 \text{ MM Btu}} \times \frac{19 \text{ lbs}}{10^3 \text{ gal}} = 19.6 \text{ lbs/hr } NO_x$$

Total NO_x:

$$\frac{19.6 \text{ lbs}}{\text{hr}} \times \frac{16{,}200 \text{ tons}}{40 \text{ tons/hr}} = 7938 \text{ lbs total } NO_x \text{ emissions}$$

The potential to emit is the same as the actual emissions.

Particulate Matter Emissions

Particulate Matter has been measured in stack test of units similar to this one at .04 grains per DSCF of flow when fired with No.2 oil. This unit has a maximum flow rate of 71,307 ACFM and is fired with propane.

Assume: Average moisture content of 16%
Gas exit temperature of 1650 °F
Standard temperature = 68 °F
Degree K = Degree F + 460

Correcting to DSCF:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \text{ (1-moisture content): } \frac{V_1}{528} = \frac{71{,}307\ (.84)}{2110}$$

V1 = 14,989 DSCFM

Lbs/hr PM:

$$\frac{0.04\text{gr}}{\text{DSCF}} \times \frac{14{,}989 \text{ DSCF}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}} = 5.14 \text{ lbs/hr PM}$$

Tons/yr PM:

$$\frac{5.14 \text{ lbs}}{\text{hr}} \times \frac{(16{,}200 + 39{,}662) \text{ tons}}{40 \text{ tons/hr}} = 7178 \text{ lbs/yr}$$

Uncontrolled Emissions (Emission Rate Potential):

From AP-42, Table 11.1-5, Emission Factors for Drum Mix Hot Asphalt Plants, the total uncontrolled particulate emissions is 19 lbs/ton of product. At a production rate of 40 tons per hour, the uncontrolled potential to emit is:

$$\frac{40 \text{ tons}}{\text{hr}} \times \frac{19 \text{ lbs}}{\text{ton}} = 760 \text{ lbs/hr PM}$$

$$\text{Control efficiency of baghouse} = \frac{760-5.14}{760} \times 100 = 99.3\ \%$$

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT

Operable Unit #1

TPS Technologies Soil Remediation Unit (SRU)

Comparison of SRU emissions with requirements of 6 NYCRR Part 212 General Process Emission Sources dated August 31, 1994.

<table>
<tr><th>Contaminant</th><th>Emission Rate Potential (ERP) (lbs/hr)</th><th>Actual Emission Rate (lbs/hr)</th><th>Part 212 Requirement</th><th>Compliance Status</th></tr>
<tr><td>Hydrogen Chloride</td><td>4.0</td><td>4.0</td><td>Table 2 Env. Rating "B" or "C"
ERP < 10 lb/hr
Allowable per Commissioner</td><td>Compliant</td></tr>
<tr><td>Toluene, Ethylbenzene, and Xylene</td><td>273</td><td>0.272</td><td>Table 2 Env. Rating "B"
20> ERP < 500
94% Removal Required
allowable = 16.38 lb/hr</td><td>Compliant</td></tr>
<tr><td>VOCs</td><td>800</td><td>1.32</td><td>Table 2 Env. Rating "C"
500> ERP <1000
96% Removal Required
allowable = 32 lb/hr</td><td>Compliant</td></tr>
<tr><td>SO_2</td><td>0.019</td><td>0.019</td><td>Table 2 Env. Rating "C"
ERP <1.0 lb/hr
Allowable per Commissioner</td><td>Compliant</td></tr>
<tr><td>CO</td><td>3.30</td><td>3.30</td><td>Table 2 Env. Rating "C"
ERP < 10 lb/hr
Allowable per Commissioner</td><td>Compliant</td></tr>
<tr><td>NO_x</td><td>19.6</td><td>19.6</td><td>Table 2 Env. Rating "D"
10>ERP < 20 lb/hr
Allowable per Commissioner</td><td>Compliant</td></tr>
<tr><td>Particulate Matter</td><td>760</td><td>5.14</td><td>Part 212.4 (c) allows
0.050 gr/dscf</td><td rowspan="2">Compliant</td></tr>
<tr><td colspan="4">Calc. to determine PM emission in gr/dscf:
Stack volume = $71{,}307 \times \frac{530}{2110} = 17{,}911$ dscfm
emission rate (gr/dscf) = $\frac{5.14\ \text{lb}}{\text{hr}} \times \frac{7000\ \text{gr}}{\text{lb}} \times \frac{\text{min.}}{17{,}911\ \text{dscf}} \times \frac{\text{hr.}}{60\ \text{min.}}$
= 0.033 gr/dscf</td></tr>
</table>

This table shows that the air emissions from the SRU are in compliance with the limits specified in 6 NYCRR Part 212.

E3-Killam, Inc.
August 6, 1999

Mary Cedeno 08/06/99
\\E3KILLAM\SYS\ENG\PROJECTS\TPS_TECH\STAT7_30.DOC

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT
Operable Unit No. 1
TPS Technologies Soil Remediation Unit (SRU)
Air Emission Ambient Impact Analysis By E3-Killam, INC 7/30/99

Pollutant	Emission Rate lb/hr	Emission Rate Project	Limits (μg/m³) AGC	Limits (μg/m³) SGC
HCl	4	5,586	20	150
T,E,X†	0.272	110	400	45,000
VOC's	1.320	535	620	62,000
SO_2	0.019	7.7	80	1,400
CO	3.30	1,337	69	40,000
NO_x	19.6	7,938	100	180
PM	5.14	7.178	50	380

†Toluene, Ethyl Benzene, Xylene

Reference: Estimated Air Emissions Report, July, 1999.

Distance (meters)	Generic 1 hour Concentration (μg/m³)**	Average One Hour Concentration of Specific Pollutants at Various Distances: HCl (μg/m³)	T,E,X (μg/m³)	VOC's (μg/m³)	SO_2 (μg/m³)	CO (μg/m³)	NO_x (μg/m³)	PM (μg/m³)
100	2.014	1.0	0.069	0.335	0.0	0.84	5.0	1.30
200	7.186	3.6	0.246	1.195	0.0	2.99	17.7	4.65
300	5.793	2.9	0.199	0.963	0.0	2.41	14.3	3.75
400	4.724	2.4	0.162	0.786	0.0	1.96	11.7	3.06
500	4.006	2.0	0.137	0.666	0.0	1.67	9.9	2.59
600	4.627	2.3	0.159	0.769	0.0	1.92	11.4	3.00
700	5.430	2.7	0.186	0.903	0.0	2.26	13.4	3.52
800	6.172	3.1	0.211	1.026	0.0	2.57	15.2	4.00
900	6.856	3.5	0.235	1.140	0.0	2.85	16.9	4.44
1000	7.485	3.8	0.256	1.245	0.0	3.11	18.5	4.85
1100	7.962	4.0	0.273	1.324	0.0	3.31	19.7	5.16
1200	8.307	4.2	0.285	1.381	0.0	3.45	20.5	5.38
1300	8.542	4.3	0.293	1.420	0.0	3.55	21.1	5.53
1400	8.685	4.4	0.298	1.444	0.0	3.61	21.4	5.62
1500	8.756	4.4	0.300	1.456	0.0	3.64	21.6	5.67
1600	8.770	4.4	0.301	1.458	0.0	3.65	21.7	5.68
1700	8.739	4.4	0.299	1.453	0.0	3.63	21.6	5.66
1800	8.673	4.4	0.297	1.442	0.0	3.61	21.4	5.62
1900	8.582	4.3	0.294	1.427	0.0	3.57	21.2	5.56
2000	8.471	4.3	0.290	1.409	0.0	3.52	20.9	5.49
2100	8.345	4.2	0.286	1.388	0.0	3.47	20.6	5.40
2200	8.210	4.1	0.281	1.365	0.0	3.41	20.3	5.32
2300	8.067	4.1	0.276	1.341	0.0	3.35	19.9	5.22
2400	7.920	4.0	0.271	1.317	0.0	3.29	19.6	5.13
2500	7.771	3.9	0.266	1.292	0.0	3.23	19.2	5.03
2600	7.621	3.8	0.261	1.267	0.0	3.17	18.8	4.93
2700	7.471	3.8	0.256	1.242	0.0	3.11	18.4	4.84
2800	7.322	3.7	0.251	1.218	0.0	3.04	18.1	4.74
2900	7.176	3.6	0.246	1.193	0.0	2.98	17.7	4.65
3000	7.032	3.5	0.241	1.169	0.0	2.92	17.4	4.55

** The concentration of a pollutant with an emission rate of 1 g/s. Based on EPA's SCREEN3 program.

WESTINGHOUSE PLANT SOIL REMEDIATION PROJECT
Operable Unit No. 1
TPS Technologies Soil Remediation Unit (SRU)
Air Emission Ambient Impact Analysis By E3-Killam, INC 7/30/99

Modeling done by E3-Killam using EPA's SCREEN3 Program.

```
                                                              07/30/99
                                                              10:38:16
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 95250 ***

 TPS Technologies

 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =       9.7500
    STK INSIDE DIAM (M)    =        .9840
    STK EXIT VELOCITY (M/S)=      21.7900
    STK GAS EXIT TEMP (K)  =    1172.0000
    AMBIENT AIR TEMP (K)   =     283.0000
    RECEPTOR HEIGHT (M)    =       1.5000
    URBAN/RURAL OPTION     =        URBAN
    BUILDING HEIGHT (M)    =       3.9600
    MIN HORIZ BLDG DIM (M) =       3.9600
    MAX HORIZ BLDG DIM (M) =      15.2400


 BUOY. FLUX =   39.234 M**4/S**3;  MOM. FLUX =   27.753 M**4/S**2.

 *** FULL METEOROLOGY ***
```

```
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************

 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

   DIST     CONC              U10M   USTK  MIX HT   PLUME  SIGMA   SIGMA
   (M)    (UG/M**3)   STAB   (M/S)  (M/S)    (M)    HT (M)  Y (M)   Z (M)  DWASH
 -------  ----------  ----   -----  -----  ------   ------  ------  ------  -----
    100.   13.25        4     20.0   20.0   6400.0   25.74   15.78   13.90    NO
    200.   12.62        4     15.0   15.0   4800.0   32.05   31.00   27.43    NO
    300.   9.674        4     10.0   10.0   3200.0   43.34   45.89   40.83    NO
    400.   7.716        4      8.0    8.0   2560.0   51.73   60.35   53.95    NO
    500.   8.823        6      2.0    2.0  10000.0   75.50   53.61   35.60    NO
    600.   10.71        6      1.5    1.5  10000.0   82.12   62.77   40.50    NO
    700.   12.45        6      1.0    1.0  10000.0   92.59   72.06   45.72    NO
    800.   13.76        6      1.0    1.0  10000.0   92.59   80.17   49.21    NO
    900.   14.59        6      1.0    1.0  10000.0   92.59   88.13   52.59    NO
   1000.   15.04        6      1.0    1.0  10000.0   92.59   95.93   55.86    NO
   1100.   15.21        6      1.0    1.0  10000.0   92.59  103.57   59.01    NO
   1200.   15.18        6      1.0    1.0  10000.0   92.59  111.06   62.06    NO
   1300.   15.00        6      1.0    1.0  10000.0   92.59  118.38   65.01    NO
   1400.   14.73        6      1.0    1.0  10000.0   92.59  125.55   67.87    NO
   1500.   14.40        6      1.0    1.0  10000.0   92.59  132.57   70.65    NO
   1600.   14.03        6      1.0    1.0  10000.0   92.59  139.46   73.34    NO
   1700.   13.64        6      1.0    1.0  10000.0   92.59  146.20   75.96    NO
   1800.   13.24        6      1.0    1.0  10000.0   92.59  152.82   78.51    NO
   1900.   12.83        6      1.0    1.0  10000.0   92.59  159.31   81.00    NO
   2000.   12.44        6      1.0    1.0  10000.0   92.59  165.68   83.43    NO
   2100.   12.05        6      1.0    1.0  10000.0   92.59  171.93   85.80    NO
   2200.   11.68        6      1.0    1.0  10000.0   92.59  178.08   88.11    NO
   2300.   11.32        6      1.0    1.0  10000.0   92.59  184.11   90.38    NO
   2400.   10.97        6      1.0    1.0  10000.0   92.59  190.05   92.60    NO
   2500.   10.64        6      1.0    1.0  10000.0   92.59  195.89   94.77    NO
   2600.   10.32        6      1.0    1.0  10000.0   92.59  201.63   96.90    NO
   2700.   10.02        6      1.0    1.0  10000.0   92.59  207.29   98.99    NO
   2800.   9.725        6      1.0    1.0  10000.0   92.59  212.86  101.04    NO
   2900.   9.448        6      1.0    1.0  10000.0   92.59  218.34  103.06    NO
   3000.   9.183        6      1.0    1.0  10000.0   92.59  223.74  105.04    NO

 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
   1129.   15.22        6      1.0    1.0  10000.0   92.59  105.68   59.88    NO

  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
```

```
 *** CAVITY CALCULATION - 1 ***        *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)      =    .0000        CONC (UG/M**3)      =    .0000
  CRIT WS @10M (M/S) =    99.99        CRIT WS @10M (M/S) =    99.99
  CRIT WS @ HS (M/S) =    99.99        CRIT WS @ HS (M/S) =    99.99
  DILUTION WS (M/S)  =    99.99        DILUTION WS (M/S)  =    99.99
  CAVITY HT (M)      =     5.69        CAVITY HT (M)      =     4.00
  CAVITY LENGTH (M)  =    16.23        CAVITY LENGTH (M)  =     5.54
  ALONGWIND DIM (M)  =     3.96        ALONGWIND DIM (M)  =    15.24

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S.  CONC SET = 0.0

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION       MAX CONC    DIST TO  TERRAIN
  PROCEDURE       (UG/M**3)    MAX (M)   HT (M)
--------------   -----------  -------  -------
SIMPLE TERRAIN    15.22         1129.      0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

UP LOCATION FA ION P I

A ADD
C CHANGE
D DELETE

READ INSTRUCTIONS CONTAINED IN FORM 76-11-12 BEFORE ANSWERING ANY QUESTION

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

WHITE - ORIGINAL
G - DIV OF AIR
WHITE - REGIONAL OFFICE
WHITE - FIELD REP.
YELLOW - APPLICANT

PROCESS, EXHAUST OR VENTILATION SYSTEM

APPLICATION FOR PERMIT TO CONSTRUCT OR CERTIFICATE TO OPERATE

SECTION A

1. NAME OF OWNER / FIRM: TPS TECHNOLOGIES, INC.
2. NUMBER AND STREET ADDRESS: 1964 S. Orange Blossom Trail
3. CITY - TOWN - VILLAGE: Apopka
4. STATE: FL
5. ZIP: 32703
6. OWNER CLASSIFICATON: A. ☐ COMMERCIAL C. ☐ UTILITY E. ☐ STATE H. ☐ HOSPITAL B. ☒ INDUSTRIAL D. ☐ FEDERAL F. ☐ MUNICIPAL I. ☐ RESIDENTIAL G. ☐ EDUC. INST. J. ☐ OTHER
7. NAME & TITLE OF OWNERS REPRESENTATIVE: Blair Dominiak, Mgr. Regulatory Compliance
8. TELEPHONE: (407) 8862000
9. NAME OF AUTHORIZED AGENT: E3-Killam, Inc.
10. TELEPHONE: (716) 6315858
11. NUMBER AND STREET ADDRESS: 80 Curtwright Dr. Suite 1
12. CITY - TOWN - VILLAGE: Williamsville
13. STATE: NY
14. ZIP: 14221
15. NAME OF P.E. OR ARCHITECT PREPARING APPLICATION: James L. McGarry
16. N.Y.S. P.E. OR ARCHITECT LICENSE NO.: NY 047232
17. TELEPHONE: (716) 6315858
18. SIGNATURE OF OWNERS REPRESENTATIVE OR AGENT WHEN APPLYING FOR A PERMIT TO CONSTRUCT: J. McGarry
19. FACILITY NAME (IF DIFFERENT FROM OWNER / FIRM): Westinghouse Elec. Corp. Site
20. FACILITY LOCATION (NUMBER AND STREET ADDRESS): Genesee St.
21. CITY - TOWN - VILLAGE: Cheektowaga
22. ZIP:
23. BUILDING NAME OR NUMBER: Plant Grounds
24. FLOOR NAME OR NUMBER: —
25. START UP DATE: 09 / 99 (MO / YR)
26. DRAWING NUMBERS OF PLANS SUBMITTED: —
27. PERMIT TO CONSTRUCT: A. ☐ NEW SOURCE B. ☐ MODIFICATION
28. CERTIFICATE TO OPERATE: A. ☐ NEW SOURCE B. ☐ MODIFICATION C. ☐ EXISTING SOURCE

SEC. B

29. EMISSION POINT ID.	30. GROUND ELEVATION (FT.)	31. HEIGHT ABOVE STRUCTURES (FT.)	32. STACK HEIGHT (FT.)	33. INSIDE DIMENSIONS (IN.)	34. EXIT TEMP. (°F)	35. EXIT VELOCITY (FT./SEC.)	36. EXIT FLOW RATE (ACFM)
LTTD	13.5	13.5	37.5	48	1650	94	71,307

37. SOURCE CODE	38. HRS / DAY	39. DAYS / YR	40. % OPERATION BY SEASON Winter	Spring	Summer	Fall
	24		25			75

SEC. C

41. DESCRIBE PROCESS OR UNIT:
1. A low temperature thermal desprption unit will
2. be installed on the old Westinghouse plant
3. grounds and will treat soil contaminated with
4. chlorinated hydrocarbons and other organics
5. To make the soil safe for use at the site. The
6. unit will be fired by propane and will be
7. equipped with a filter tocollect particulate
8. matter and an afterburner to destooy organic.

SEC. D

EMISSION CONTROL EQUIPMENT I.D.	CONTROL TYPE	MANUFACTURER'S NAME AND MODEL NUMBER	DISPOSAL METHOD	DATE INSTALLED MONTH / YEAR	USEFUL LIFE
42.	43. 08	44. SoilPure Model PC504-6000	45. 3	46. /	47.
48.	49.	50.	51.	52. /	53.

SECTION E

CALCULATIONS Attached are three documents which indicate that this LTTD is compliant with the requirements of 6NYCRR Part 212 General Process Emission Source and Air Guide -1 recommendations for ambient impact limitations.

- * Estimated air emissions dated August, 1999
- * Air Emission Ambient Impact Analysis Dated August, 1999
- * Comparison of LTTD emissions with requirements of 6NYCRR Part 212, Dated August, 1999

SECTION F

CONTAMINANT NAME	CAS NUMBER	INPUT OR PRODUCTION	UNIT	ENV. RATING	EMISSIONS ACTUAL	EMISSIONS UNIT	EMISSIONS HOW DET.	EMISSIONS PERMISSIBLE	% CONTROL EFFIC'CY	HOURLY EMISSIONS (LBS/HR) ERP	HOURLY EMISSIONS (LBS/HR) ACTUAL	ANNUAL EMISSIONS (LBS/YR) ACTUAL	10ˣ	PERMISSIBLE
54. Hydrogen chloride	55. 007647 01 0	56.	57.	58.	59. 4.0	60. 1	61. 6	62.	63.	64. 4.0	65. 4.0	66. 5586	67. 0	68.
69. Toluene, Ethylbenzene and Xylene (TEX)	70. 000108 88 3	71.	72.	73.	74. 0.272	75. 1	76. 4	77.	78. 99.9	79. 273	80. 0.272	81. 110	82. 0	83.
84. Volatile Organic	85. 000067 56 1	86.	87.	88.	89. 1.32	90. 1	91. 4	92.	93. 99.9	94. 800	95. 1.32	96. 535	97. 0	98.
99. Sulfur Dioxide	100. 007446 09 5	101.	102.	103.	104. 0.019	105. 1	106. 6	107.	108.	109. 0.019	110. 0.019	111. 7.7	112. 0	113.
114. Carbon Monoxide	115. 000630 08 0	116.	117.	118.	119. 3.30	120. 1	121. 4	122.	123.	124. 3.30	125. 3.30	126. 1337	127. 0	128.
129. Oxides of Nitrogen	130. 010102 44 0	131.	132.	133.	134. 19.6	135. 1	136. 4	137.	138.	139. 19.6	140. 19.6	141. 7938	142. 0	143.

SEC. G

SOLID FUEL TYPE	SOLID FUEL TONS / YR	% S	LIQUID FUEL TYPE	LIQUID FUEL THOUSANDS OF GALLONS/YR	% S	GAS TYPE	GAS THOUSANDS OF ~~CF/YR~~ gal/yr	~~MBTU/CF~~ MMBTU/1000 gal	APPLICABLE RULE	APPLICABLE RULE
144.	145.	146.	147.	148.	149.	150. 72	151. ~~47,703~~ 418	152. ~~2950~~ 91.5	153. 212	154.

Upon completion of construction sign the statement listed below and forward to the appropriate field representative

THE PROCESS, EXHAUST OR VENTILATION SYSTEM HAS BEEN CONSTRUCTED AND WILL BE OPERATED IN ACCORDANCE WITH STATED SPECIFICATIONS AND IN CONFORMANCE WITH ALL PROVISIONS OF EXISTING REGULATIONS.

155. SIGNATURE OF AUTHORIZED REPRESENTATIVE OR AGENT
DATE

AGENCY USE ONLY

156. LOCATION CODE	157. FACILITY ID. NO.	158. U.T.M. (E)	159. U.T.M. (N)	160. SIC NUMBER	161. DATE APPL. RECEIVED	162. DATE APPL. REVIEWED	163. REVIEWED BY:
					/ /	/ /	

PERMIT TO CONSTRUCT

164. DATE ISSUED	165. EXPIRATION DATE	166. SIGNATURE OF APPROVAL	167. FEE
/ /	/ /		

168.
1. DEVIATION FROM APPROVED APPLICATION SHALL VOID THIS PERMIT
2. THIS IS NOT A CERTIFICATE TO OPERATE
3. TESTS AND/OR ADDITIONAL EMISSION CONTROL EQUIPMENT MAY BE REQUIRED PRIOR TO THE ISSUANCE OF A CERTIFICATE TO OPERATE

CERTIFICATE TO OPERATE

169. DATE ISSUED	170. EXPIRATION DATE	171. SIGNATURE OF APPROVAL	172. FEE
/ /	/ /		

173.
1. ☐ INSPECTED BY ____________ DATE ____________
2. ☐ INSPECTION DISCLOSED DIFFERENCES AS BUILT VS. PERMIT, CHANGES INDICATED ON FORM
3. ☐ ISSUE CERTIFICATE TO OPERATE FOR SOURCE AS BUILT
4. ☐ APPLICATION FOR C.O. DENIED ____________ DATE ____________ INITIALED

174. SPECIAL CONDITIONS:

1.	2.
3.	4.
5.	6.
7.	8.

76-19-3 (9/81)

OP	LOCATION	FACILITY	EMISSION POINT
			J

A ADD
C CHANGE
D DELETE

READ INSTRUCTIONS CONTAINED IN FORM 76-11-12 BEFORE ANSWERING ANY QUESTION

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

WI… - ORIG…
GREEN - DIVISON OF AIR
WHITE - REGIONAL OFFICE
WHITE - FIELD REP.
YELLOW - APPLICANT

CONTINUATION

PROCESS, EXHAUST OR VENTILATION SYSTEM

APPLICATION FOR PERMIT TO CONSTRUCT OR CERTIFICATE TO OPERATE

CONTINUATION

SECTION A

1. NAME OF OWNER / FIRM: TPS TECHNOLOGIES, INC.
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4. STATE: FL
5. ZIP: 32703
6. OWNER CLASSIFICATON: A. ☐ COMMERCIAL B. ☐ INDUSTRIAL C. ☐ UTILITY D. ☐ FEDERAL E. ☐ STATE F. ☐ MUNICIPAL G. ☐ EDUC. INST. H. ☐ HOSPITAL I. ☐ RESIDENTIAL J. ☐ OTHER
7. NAME & TITLE OF OWNERS REPRESENTATIVE:
8. TELEPHONE:
9. NAME OF AUTHORIZED AGENT:
10. TELEPHONE:
11. NUMBER AND STREET ADDRESS:
12. CITY - TOWN - VILLAGE:
13. STATE:
14. ZIP:
15. NAME OF P.E. OR ARCHITECT PREPARING APPLICATION:
16. N.Y.S. P.E. OR ARCHITECT LICENSE NO.:
17. TELEPHONE:
18. SIGNATURE OF OWNERS REPRESENTATIVE OR AGENT WHEN APPLYING FOR A PERMIT TO CONSTRUCT:
19. FACILITY NAME (IF DIFFERENT FROM OWNER / FIRM):
20. FACILITY LOCATION (NUMBER AND STREET ADDRESS):
21. CITY - TOWN - VILLAGE:
22. ZIP:
23. BUILDING NAME OR NUMBER:
24. FLOOR NAME OR NUMBER:
25. START UP DATE: MO / YR
26. DRAWING NUMBERS OF PLANS SUBMITTED:
27. PERMIT TO CONSTRUCT: A. ☐ NEW SOURCE B. ☐ MODIFICATION
28. CERTIFICATE TO OPERATE: A. ☐ NEW SOURCE B. ☐ MODIFICATION C. ☐ EXISTING SOURCE

SEC. B

29. EMISSION POINT ID.	30. GROUND ELEVATION (FT.)	31. HEIGHT ABOVE STRUCTURES (FT.)	32. STACK HEIGHT (FT.)	33. INSIDE DIMENSIONS (IN.)	34. EXIT TEMP.(°F)	35. EXIT VELOCITY (FT./SEC.)	36. EXIT FLOW RATE (ACFM)
0PPD							

37. SOURCE CODE	38. HRS / DAY	39. DAYS / YR	40. % OPERATION BY SEASON Winter	Spring	Summer	Fall

SEC. C

41. DESCRIBE PROCESS OR UNIT
1.
2.
3.
4.
5.
6.
7.
8.

SEC. D

EMISSION CONTROL EQUIPMENT I.D.	CONTROL TYPE	MANUFACTURER'S NAME AND MODEL NUMBER	DISPOSAL METHOD	DATE INSTALLED MONTH / YEAR	USEFUL LIFE
42.	43.	44.	45.	46. /	47.
48.	49.	50.	51.	52. /	53.

SECTION E

CALCULATIONS

SECTION F

CONTAMINANT NAME	CONTAMINANT CAS NUMBER	INPUT OR PRODUCTION	UNIT	ENV. RATING	EMISSIONS ACTUAL	EMISSIONS UNIT	EMISSIONS HOW DET.	EMISSIONS PERMISSIBLE	% CONTROL EFFIC'CY	HOURLY EMISSIONS (LBS/HR) ERP	HOURLY EMISSIONS (LBS/HR) ACTUAL	ANNUAL EMISSIONS (LBS/YR) ACTUAL	10ˣ	PERMISSIBLE
54. Particulate Matter	55. 0NY075 -00 -0	56.	57.	58.	59. 0.033	60. 20	61. 3	62.	63. 99.3	64. 760	65. 5.14	66. 7178	67. 0	68.
69.	70. - -	71.	72.	73.	74.	75.	76.	77.	78.	79.	80.	81.	82.	83.
84.	85. - -	86.	87.	88.	89.	90.	91.	92.	93.	94.	95.	96.	97.	98.
99.	100. - -	101.	102.	103.	104.	105.	106.	107.	108.	109.	110.	111.	112.	113.
114.	115. - -	116.	117.	118.	119.	120.	121.	122.	123.	124.	125.	126.	127.	128.
129.	130. - -	131.	132.	133.	134.	135.	136.	137.	138.	139.	140.	141.	142.	143.

SEC. G

SOLID FUEL TYPE	SOLID FUEL TONS / YR	% S	LIQUID FUEL TYPE	LIQUID FUEL THOUSANDS OF GALLONS/YR	% S	GAS TYPE	GAS THOUSANDS OF CF/YR	BTU/CF	APPLICABLE RULE	APPLICABLE RULE
144.	145.	146.	147.	148.	149.	150.	151.	152.	153.	154.

Upon completion of construction sign the statement listed below and forward to the appropriate field representative

THE PROCESS, EXHAUST OR VENTILATION SYSTEM HAS BEEN CONSTRUCTED AND WILL BE OPERATED IN ACCORDANCE WITH STATED SPECIFICATIONS AND IN CONFORMANCE WITH ALL PROVISIONS OF EXISTING REGULATIONS.

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AGENCY USE ONLY

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					/ /	/ /	

PERMIT TO CONSTRUCT

164. DATE ISSUED	165. EXPIRATION DATE	166. SIGNATURE OF APPROVAL	167. FEE
/ /	/ /		

168.
1. DEVIATION FROM APPROVED APPLICATION SHALL VOID THIS PERMIT
2. THIS IS NOT A CERTIFICATE TO OPERATE
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CERTIFICATE TO OPERATE

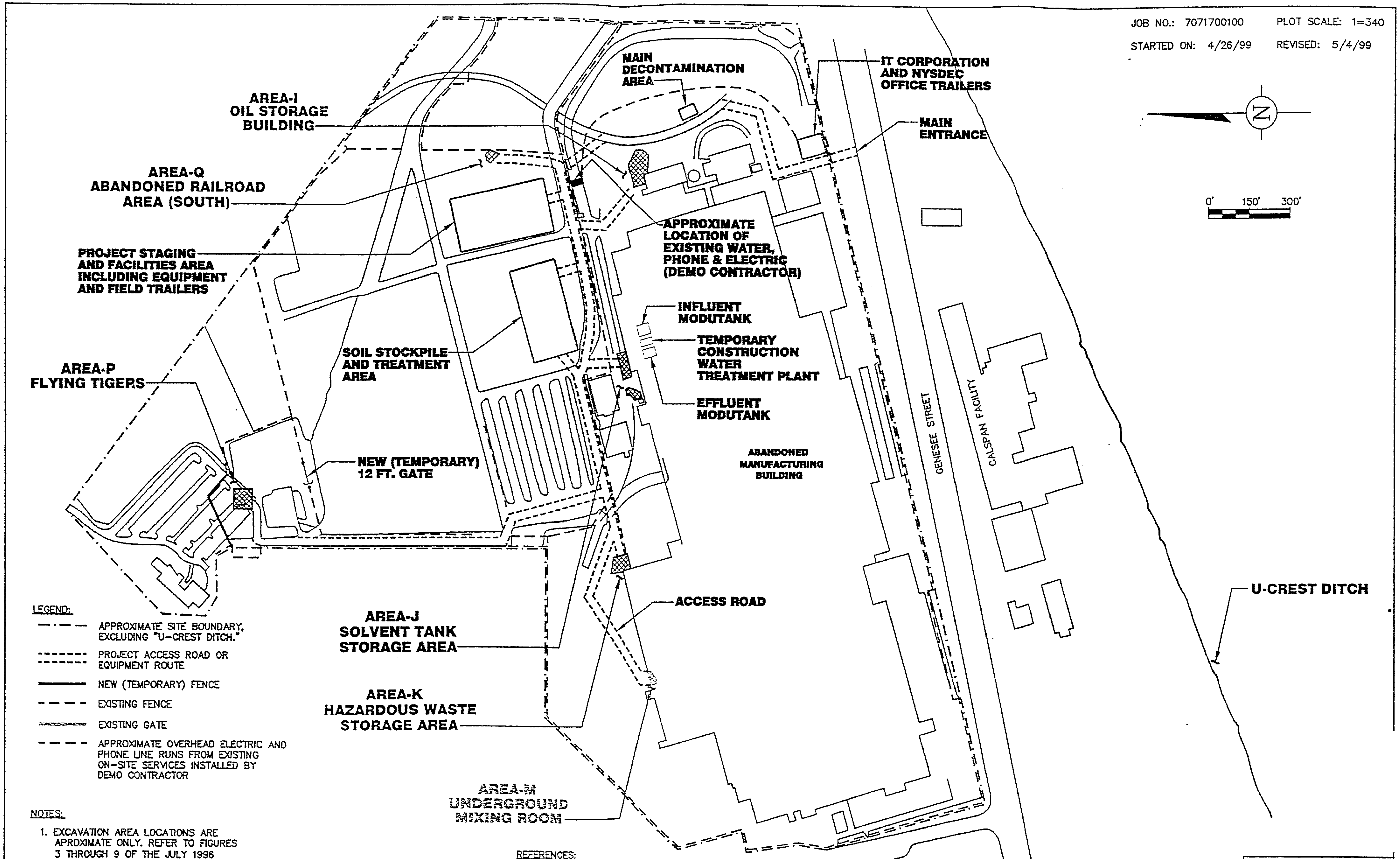
169. DATE ISSUED	170. EXPIRATION DATE	171. SIGNATURE OF APPROVAL	172. FEE
/ /	/ /		

173.
1. ☐ INSPECTED BY ______ DATE ______
2. ☐ INSPECTION DISCLOSED DIFFERENCES AS BUILT VS. PERMIT, CHANGES INDICATED ON FORM
3. ☐ ISSUE CERTIFICATE TO OPERATE FOR SOURCE AS BUILT
4. ☐ APPLICATION FOR C.O. DENIED ______ DATE ______ INITIALED

174. SPECIAL CONDITIONS:
1.
2.
3.
4.
5.
6.
7.
8.

JOB NO.: 7071700100 PLOT SCALE: 1=340

STARTED ON: 4/26/99 REVISED: 5/4/99



LEGEND:

—·—·—	APPROXIMATE SITE BOUNDARY, EXCLUDING "U-CREST DITCH."
- - - - - -	PROJECT ACCESS ROAD OR EQUIPMENT ROUTE
———	NEW (TEMPORARY) FENCE
— — —	EXISTING FENCE
▬	EXISTING GATE
— — —	APPROXIMATE OVERHEAD ELECTRIC AND PHONE LINE RUNS FROM EXISTING ON-SITE SERVICES INSTALLED BY DEMO CONTRACTOR

NOTES:

1. EXCAVATION AREA LOCATIONS ARE APROXIMATE ONLY. REFER TO FIGURES 3 THROUGH 9 OF THE JULY 1996 "PRE-DESIGN INVESTIGATION SUMMARY REPORT" BY BLASLAND, BOUCK & LEE, INC., FOR EXPLICIT EXCAVATION AREA LIMITS.
2. TEMPORARY (CONSTRUCTION) FACILITY LOCATION AND SIZES ARE SUBJECT TO CHANGE, BASED ON ACTUAL FIELD CONDITIONS SUCH CHANGES ARE SUBJECT TO PRIOR APPROVAL.
3. HEALTH AND SAFETY EXCLUSION ZONE (S), CONTAMINATION REDUCTION ZONE (S) AND SUPPORT AREA (S) LIMITS NOT SHOWN. THESE THREE AREAS WILL BE ESTABLISHED IN THE FIELD ACCORDING TO THE SITE SPECIFIC HEALTH & SAFETY PLAN.

REFERENCES:

1. PRE-DESIGN INVESTIGATION SUMMARY REPORT, JULY 1996.
2. REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT, VOLUME 1: REMEDIAL INVESTIGATION REPORT (TEXT) SEPTEMBER, 1994 (DUNN ENGINEERING COMPANY).

FIGURE 1-2

NYSDEC INACTIVE HAZARDOUS WASTE
SITE NO. 9-15-066, CHEEKTOWAGA, N.Y.

SITE LAYOUT PLAN

IT CORPORATION
PITTSBURGH, PA

DATE: 4/26/99
DR.: B. SNYDER
SCALE: AS SHOWN
FILE NAME: 10156030

PART TWO SUBMISSION
OPERATING CONTROLS/SAFETY

E3-Killam Inc.
environmental services

80 Curtwright Drive
Suite #1
Buffalo, NY 14221-7072
Telephone: 716-631-5855
Fax: 716-631-5864

Project #99023

August 18, 1999

Michael Ryan, P.E.
Environmental Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington
Environmental Engineer III
Bureau of Program Management

Division of Environmental Remediation
New York State
Dept. of Environmental Conservation
50 Wolf Rd.
Albany, NY 12233-7010

Re: **Westinghouse Plant Soil Remediation Project - Operable Unit No. 1 Documents for DEC Review for Approval to Install and Operate Soil Remediation Unit (SRU) - Part 2**

Dear Mr. Ryan and Mr. Harrington:

TPS Technologies (TPST) has engaged E_3-Killam, Inc. to assist in obtaining NYSDEC approval for installation and operation of a soil remediation unit (SRU) of low temperature thermal desorber design. E_3-Killam has already submitted under cover dated August 6, 1999, Phase I (Part 1) of the documents required for your office to evaluate the impact of the air emissions on the environment in the area of the remediation site.

We are herewith submitting Part 2 of the required documents for your evaluation. Part 2 contains the information you require regarding the SRU operating controls and safety features designed to protect the public and the equipment. Part 3 will contain the SRU Performance Testing Protocol and all remaining information requirements and will be submitted on or before September 3, 1999.

The attached documents consist of a description of the SoilPure, Inc. SRU System Alarms and Shutdowns and Continuous Monitoring and Recording Data, the Process Flow Diagram, and an analysis of potential products of incomplete combustion from the remediation of soils by thermal desorption.

We have included in this submittal an Authorized Agent letter and a P.E. Certification.

We thank you for your patience in this matter and expect that this submission is satisfactory. If you have any questions or comments please contact me at (716) 631-5858 or Mr. Blair Dominiak of TPST at (407) 886-2000.

Sincerely,

E_3-Killam, Inc.

James L. McGarry, MS, P.E.
Environmental Engineer

JLM/mac
H:\PROJECTS\TPS_TECH\CORRES\CVRLTR2.DOC
Enclosure
cc: TPST/ Blair Dominiak
w/o enc. B. Hinton
IT/ L. Martin
E_3-Killam/ E. Nesselbeck

SoilPure, Inc. (SPI) Soil Remediation Unit
Control & Monitoring System

SoilPure, Inc. (SPI) Soil Remediation Unit
System Alarms & Shutdowns

1. Controls System

The SPI soil remediation unit control center is composed of a central control system containing the controls, indicators, and records of flow, temperature, and pressure measurements in the soil feed system, rotary drum desorber, treated soil handling system, baghouse, thermal oxidizer, and auxiliary systems. The instrumentation system has the capability to control valves, motors, fans, and dampers initiating system shut downs if process conditions deviate from acceptable ranges.

A trained SPI panel operator continuously monitors the control center and overall process. In addition to the following systems, a Chessell Data Logger is utilized to receive and store operating data on a continuous basis.

2. Monitoring System

Critical parameters are monitored to ensure that the soil remediation unit is operated in compliance with regulatory and other process operating limits. Key operating parameters are interlocked within the system to automatically sound an alarm or shut down the system if parameters are outside of allowable limits. During minor process upsets the SPI control room operator will manually adjust process conditions to keep the system within allowable limits.

Emergency Plant Shut Down Button: The control panel is equipped with a one button shut down system. This button can be manually pressed by the control room operator to immediately halt all plant operations.

Emergency Plant Shut Down Cables: These cables are attached to the feed and discharge system located along all belts and augers. Manually pulled these cables immediately halt all plant operations.

Continuous Emissions Monitoring System (CEMS): The system stack gas is continuously monitored for CO and O_2. In the event of an upset condition an alarm will sound in the control room. The CEMS is continuously recorded on the system data logger and monitored by the panel operator.

ID Fan Failure: In the event of an ID fan failure, an alarm will sound and the burners will be shut down instantaneously.

Burner Failure: A burner management system flame out indication will trigger an alarm in the control house.

Power Failure: In the unlikely event of a power failure, soil feed and fuel are immediately shut off. This is accomplished by providing the feed system with instrumentation that positions controls in a "safe" (closed or off) position. This will immediately halt all plant operations.

SPI Continuous Monitoring and Recorded Data

The SPI control center is equipped with instrumentation to monitor process flows, temperatures, pressures and transmit signals to the central control system. Each of the major process instruments listed below is recorded via a digital process recorder. The digital process recorder contains a data logger (Chessel Data Logger) that records discrete data values for each process parameter being monitored and is computer data linked for storage on disk.

1.1 Rotary Desorber Soil Feed Rate

The soil feed rate to the rotary desorber is measured by a weigh cell located on the feed conveyor belt. The feed rate is continuously recorded.

1.2 Rotary Desorber Pressure

A negative pressure (positive draft) is always maintained whenever soil is being fed in order to control fugitive emissions. Rotary desorber pressure is continuously recorded in the control center.

1.3 Rotary Desorber Treated Soil Exit Temperature

The temperature of the treated soil is continuously measure with a thermocouple at the inlet to the treated soil discharge auger. This temperature is continuously recorded in the control center.

1.4 Baghouse Differential Pressure

The differential pressure across the baghouse is continuously monitored by a pressure sensor. The baghouse differential pressure is continuously recorded in the control center.

1.5 Baghouse Inlet Temperature

The temperature of the gas entering the baghouse is continuously measured with a thermocouple at the baghouse inlet. This temperature is continuously recorded in the control center.

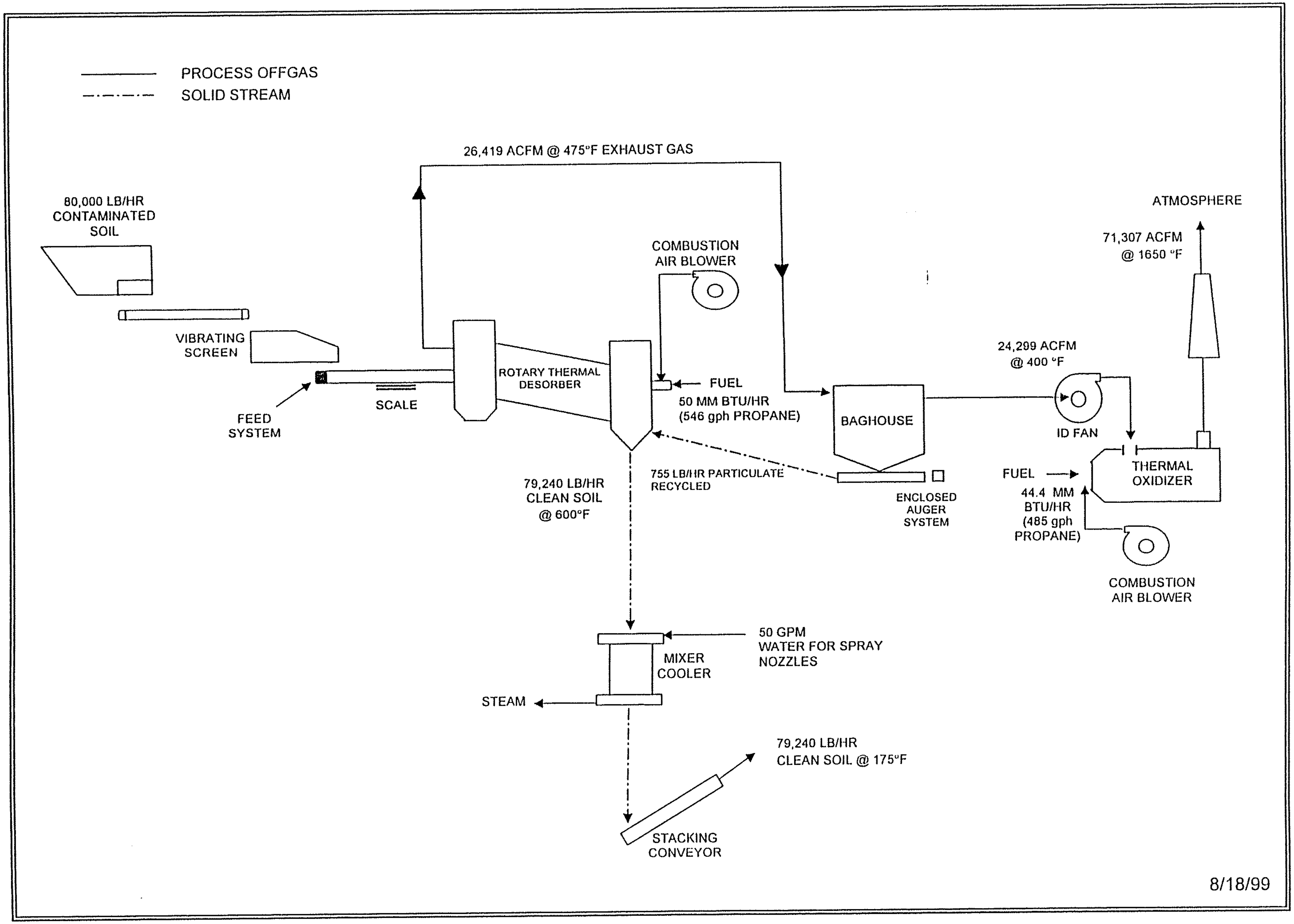
1.6 Thermal Oxidizer Exit Gas Temperature

The temperature of the gas exiting the thermal oxidizer is continuously measured with a thermocouple at the thermal oxidizer stack. This temperature is continuously recorded in the control center.

1.7 Continuous Emission Monitoring System

The system stack gas is continuously monitored for CO and O_2. The values of CO and O_2 are continuously recorded in the control center.

SoilPure Inc. Soil Remediation Unit
System Block Flow Diagram



Analysis of Potential Products of Incomplete Combustion from the Remediation of Soils by Thermal Desorption

By

Jack Lauber

JACK D. LAUBER, P.E.-D.A.A.E.E.
CONSULTING ENGINEER
53 FAIRLAWN DRIVE
LATHAM, NEW YORK 12110

(518) 785-4908

August 17, 1999

Mr. Blair Dominiak
Manager, Regulatory Compliance
TPS Technologies Inc.
1964 South Orange Blossom Trail
Apopka
FL 32703

Dear Mr.Dominiak,

You have asked me to assess the dioxin potential for your proposed Buffalo NY Airport soil remediation project. You propose to use a directly-heated rotary thermal desorber operating at approximately 500-600F soil temperature, to process about 30-40 tons per hour of largely volatile organic compound, VOC contaminated soils, which also contain approximately 100 PPM on average of halogenated organics, e.g.trichloroethylene TCE, and trichloroethane, TCA.

Usually your thermal soil remediation desorption system is equipped with a fabric filtration system, baghouse operating at about 400-475F followed by a thermal afterburner, operating at about 1650F and 0.75 seconds residence time. You have told me that the afterburner for the Buffalo Airport project will have a greater residence time in excess of 2 seconds.

In my professional opinion this operational scenario has a minimum potential of creating dioxin/furan emissions for the following reasons: Dioxin formation usually occurs on particulates, with products of incomplete combustion, PIC's, hydrochloric acid gas, HCl, and is promoted by metal catalysts such as iron, copper, etc. This is why dioxins form in municipal and medical waste incinerators equipped with cast iron boiler tubes.

In your process system, the thermally stripped total organic halogens, TOX, pass through the baghouse which removes particulates before final combustion in the afterburner. The combustion of the VOC hydrocarbons and trace TOX gases takes place in a refractory, felt lined afterburner, where such gases would be converted to HCl below the RCRA 4 pound per hour emission limit, then vented to the outer air. These conditions do not correspond with those that would generate significant dioxin emissions.

I reviewed the text, "Innovative Site Remediation Technology, Design & Application, Thermal Desorption" by W.L. Troxler et al, 1997 American Academy of Environmental Engineers.

Chapter 5.9 Performance Data-Dioxin, sec. 5.9.2 summarizes the stack emissions of 2,3,7,8 TCDD TEQ for full-scale applications of directly heated thermal desorbers with destructive type systems (afterburners) and other types. Page 5.22 summarizes the average stack emission 2,3,7,8 TCDD TEQ concentrations for the directly heated system, analogous to your proposed system, as 0.0198ng/dscm corrected to 7% oxygen; concluding "that the average performance of directly heated systems with both destructive and recovery-type emission control systems is approximately one order of magnitude below the proposed (USEPA) MACT standard." (for hazardous waste incinerators).

On July 29, 1999 I called the lead author of this book, Mr. William Troxler to get his opinion on my conclusions, and more specific information about the above-cited cases. Mr. Troxler agreed with my assessment of the low dioxin potential for your system. He further said that the trace dioxin emissions noted in the above cases, were from treating soils contaminated with pesticides, which have chemical structures similar to dioxin precursors, e.g. aromatic halogens. He further believed that by processing soils with TCE and TCA averaging 100ppm, there would be far less dioxin emission potential, certainly less than 10% of the EPA MACT standard achieved with the directly fired units he cited in his book.

I also inquired about the temperature ranges of the afterburners on directly fired units cited in Mr. Troxler's book. He said that the units he referenced were operating at 1600-1800F and that 1650F seemed to be adequate for such operations.

I also found a June 1982 APCA technical paper "Revised Model For The Prediction Of The Time-Temperature Requirements For Thermal Destruction of Dilute Organic Vapors And It's Usage For Predicting Compound Destructibility" by K.C. Lee N. Morgan et al of the Union Carbide Corporation Research and Development Dept. Technical Center South Charleston WV. Table 1, Thermal Oxidation Parameters, shows that 1-2 Dichloroethane has a calculated 99.99%DRE destruction temperature of 1173F at 2 seconds residence time, and 1216F for 1 second, respectively. Chlorobenzene, a very thermally refractive compound, has a T99.99%destruction temperature at 2 seconds of 1372F and 1408F for 1 second. We can expect TCA and TCE to fall between these compounds.

Thus I can conclude that your proposed Buffalo Airport soil remediation system operating at the conditions described above, would have negligible dioxin emission potential, less than those trace emissions cited by Troxler, et al, and would pose negligible public health risk.

Sincerely,

Jack D. Lauber PEDEE

LICENSED PROFESSIONAL ENGINEER
JACK D. LAUBER
42689
STATE OF NEW YORK

TPS Technologies Inc.
A ThermoRetec Company
1964 S. Orange Blossom Trail
Apopka, FL 32703

ThermoRetec
Smart Solutions. Positive Outcomes.

(407) 886-2000 Phone
(407) 886-3300 Fax
www.thermoretec.com

August 3, 1999

New York State
Department of Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, NY 12233-7010

Attn: Mr. Mike Ryan, Environmental Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington, Environmental Engineer III
Bureau of Program Management

Re: **Authorized Permitting Representative**

Dear Messrs. Ryan and Harrington:

By this correspondence, TPS Technologies Inc. (TPST) hereby notifies the Department that E3-Killam Inc. of 80 Curtwright Drive, Buffalo, New York is authorized to act in TPST's behalf regarding all permitting and environmental matters pertaining to the thermal remediation of NYSDEC Inactive Hazardous Waste Site No. 9-15-066, Cheektowaga, NY.

If you have any questions pertaining to E3-Killam's responsibilities on this job, please contact me at (407) 886-2000.

Respectfully,

Blair W. Dominiak

Blair W. Dominiak
Manager, Regulatory Compliance

cc: L. Martin - IT Corp.
J. McGarry - E3-Killam
B. Hinton - TPST

A subsidiary of Thermo TerraTech Inc.,
a Thermo Electron company

New York State Department of Environmental Conservation
Air Permit Application

DEC ID
- -

P.E. Certification

I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments as they pertain to the practice of engineering. This is defined as the performance of a professional service such as consultation, investigation, evaluation, planning, design or supervision of construction or operation in connection with any utilities, structures, buildings, machines, equipment, processes, works, or projects wherein the safeguarding of life, health and property is concerned, when such service or work requires the application of engineering principles and data. Based on my inquiry of those individuals with primary responsibility for obtaining such information, I certify that the statements and information are to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

Name of P.E. James L. McGarry

Signature of P.E. McGarry

Date 08 / 18 / 99

NYS License No. 047232

Phone (716) 631-5858

State of New York
James L. McGarry
No. 047232
Licensed Professional Engineer

Purchase Order

P. O. Number: 90QA9607

NYS ENVIRONMENTAL
CONSERVATION
270 MICHIGAN AVENUE
BUFFALO, NY 14203
(716) 851-7206
Fax: (716) 851-7008

To: GRAINGER JAMES MASSAKER, GOVERNMENT SALES ASSOCIATE 50 MCKESSON PARKWAY BUFFALO, NY 14225	**Ship to (if different address):** Account No. 104-80-117-974-8 Contract No. P050427

P.O. DATE	PLACED BY	DATE EXPECTED	SHIP VIA	F.O.B.	TERMS
Oct 12, 1999	Pamela Frasier				

QTY.	DESCRIPTION	UNIT PRICE	TOTAL
2	D Size Mag-Lite - Item No. ~~3JL22~~ 3JL21	*20.89 ~~23.20~~	41.78 ~~46.40~~
1	Rain Jacket - Large - Item No. 5T918	18.90	18.90
1	Rain Jacket - Extra Extra Large - Item No. 5T920	20.83	20.83
1	Bib Overall - Large - Item No. 5T923	16.21	16.21
1	Bib Overall - Extra Extra Large - Item No. 5T925	17.81	17.81
1 Pk.	D Cell Alkaline Batteries - Item No. 4WT07	8.99	8.99
	Per David Szymanski		0.00
		SHIPPING & HANDLING	
		SUBTOTAL	129.14
		SALES TAX RATE	
		SALES TAX	0.00
		TOTAL DUE	~~$129.14~~

$124.52

Pamela Frasier
Authorized Signature

Change per Sale catalog pricing.
D. Szymanski

PART THREE SUBMISSION
DEMONSTRATION TEST PLAN

E3-Killam Inc.
environmental services

50 Curtwright Drive
Suite #1
Buffalo, NY 14221-7072
Telephone: 716-631-5858
Fax: 716-631-5864

Project #99023

September 8, 1999

Michael Ryan, P.E.
Environmental Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington
Environmental Engineer III
Bureau of Program Management

Division of Environmental Remediation
New York State
Dept. of Environmental Conservation
50 Wolf Rd.
Albany, NY 12233-7010

Re: **Westinghouse Plant Soil Remediation Project - Operable Unit No. 1**
Documents for DEC Review for Approval to Install and Operate
Soil Remediation Unit (SRU) - Part 3 Demonstration Test Plan

Dear Mr. Ryan and Mr. Harrington:

TPS Technologies (TPST) has engaged E$_3$-Killam, Inc. to assist in obtaining NYSDEC approval for installation and operation of a soil remediation unit (SRU) of low temperature thermal desorber design. E$_3$-Killam has already submitted under cover letter dated August 6, 1999, Phase I (Part 1) of the documents required for your office to evaluate the impact of the air emissions on the environment in the area of the remediation site. Part 2 of these documents was submitted by E$_3$-Killam under cover letter dated August 18, 1999.

Regarding the Part 1 submission, we want to clarify an assumption on Page 2 of the Estimated Air Emission Section. The last sentence in Item 2 is a theoretical statement which distorts reality and will not be encountered in practice. This sentence should be deleted. The next to last sentence in Item 2 is also misleading. Therefore, please modify this sentence as follows: When required, soil of appropriate quality will be blended to achieve a maximum HCl emission rate of 4.0 lbs/hr.

E$_3$-Killam has reviewed the discrepancy mentioned in item 4 of your letter dated September 1, 1999 to Mr. Barry Hinton of TPS Technologies. We find that an incorrect computer run was joined with the correct summary table. In developing the ambient impact analysis, we performed studies on both the TPST soil remediation unit and the Soil Pure, Inc. (SPI) soil remediation unit. The computer run for the TPST unit was inadvertently joined with the summary table for the SPI unit as the documents comprising the Part 1 analysis. The information on the summary table in Part 1 is correct and the maximum impact based on a unit emission is 8.770 $\mu g/m^3$. The correct ambient impact analytical results are included within this Part 3 submission.

A response to the remainder of your comments dated September 1, 1999 on Part 1 and Part 2 submissions is currently being prepared and will be submitted at a later date.

We are herewith submitting Part 3 of the required documents for your evaluation. Part 3 contains the information you require regarding soil sampling and SRU emission testing during the Demonstration Test Program.

We have included in this submittal an Authorized Agent letter and a P.E. Certification.

We thank you for your patience in this matter and expect that this submission is satisfactory. If you have any questions or comments please contact me at (716) 631-5858 or Mr. Blair Dominiak of TPST at (407) 886-2000.

Sincerely,

E_3-Killam, Inc.

James L. McGarry, MS, P.E.
Environmental Engineer

JLM/mac
H:\PROJECTS\TPS_TECH\CORRES\CVRLTR2.DOC
Enclosure
cc: TPST/ Blair Dominiak (2)
B. Hinton (2)
IT/ L. Martin (1)
E_3-Killam/ E. Nesselbeck

TPS Technologies Inc.
A ThermoRetec Company
1964 S. Orange Blossom Trail
Apopka, FL 32703

ThermoRetec
Smart Solutions. Positive Outcomes.

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August 3, 1999

New York State
Department of Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, NY 12233-7010

Attn: Mr. Mike Ryan, Environmental Engineer
Bureau of Western Remedial Action

Mr. Jim Harrington, Environmental Engineer III
Bureau of Program Management

Re: Authorized Permitting Representative

Dear Messrs. Ryan and Harrington:

By this correspondence, TPS Technologies Inc. (TPST) hereby notifies the Department that E3-Killam Inc. of 80 Curtwright Drive, Buffalo, New York is authorized to act in TPST's behalf regarding all permitting and environmental matters pertaining to the thermal remediation of NYSDEC Inactive Hazardous Waste Site No. 9-15-066, Cheektowaga, NY.

If you have any questions pertaining to E3-Killam's responsibilities on this job, please contact me at (407) 886-2000.

Respectfully,

Blair W. Dominiak

Blair W. Dominiak
Manager, Regulatory Compliance

cc: L. Martin - IT Corp.
J. McGarry - E3-Killam
B. Hinton - TPST

A subsidiary of Thermo TerraTech Inc.,
a Thermo Electron company

New York State Department of Environmental Conservation
Air Permit Application

DEC ID
☐-☐☐☐☐-☐☐☐☐☐

P.E. Certification

I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments as they pertain to the <u>practice of engineering</u>. This is defined as the performance of a professional service such as consultation, investigation, evaluation, planning, design or supervision of construction or operation in connection with any utilities, structures, buildings, machines, equipment, processes, works, or projects wherein the safeguarding of life, health and property is concerned, when such service or work requires the application of engineering principals and data. Based on my inquiry of those individuals with primary responsibility for obtaining such information, I certify that the statements and information are to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

Name of P.E. James L. McGarry

Signature of P.E. J McGarry

Date 09 / 07 / 99

NYS License No. 047232

Phone (716) 631-5858

STATE OF NEW YORK
JAMES L. McGARRY
No. 047232
LICENSED PROFESSIONAL ENGINEER

DEMONSTRATION TEST PLAN

EMISSION TESTING
WESTINGHOUSE PLANT
Buffalo Airport Site
SOIL REMEDIATION PROJECT

TPS Technologies Inc.

Cheektowaga, NY

Project No. 99023.0000

September 8, 1999

PREPARED BY

E_3-KILLAM, INC.
80 CURTWRIGHT DRIVE, SUITE #1
BUFFALO, NY 14221-7072

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1. INTRODUCTION

1.1 Test Program Description

TPS Technologies Inc. (TPST) has contracted E_3-Killam, Inc[1]. (E_3-Killam) to conduct emission testing on a Mobile Soil Remediation Unit (MSRU) transported to the Westinghouse Plant located next to the Buffalo Airport in Cheektowaga, New York. Proof of process performance testing will be performed to show that the process will operate in a manner that is protective of human health and the environment.

The primary contact for TPST is Mr. Blair W. Dominiak. Mr. Dominiak is the Manager of Regulatory Compliance for TPST, and can be reached at (407) 886-2000, or by fax at (407) 886-8300. The primary contact at E_3-Killam is Mr. James L. McGarry. Mr. McGarry is a Professional Engineer with E_3-Killam, and can be reached at (716) 631-5858, or by fax at (716) 631-5864.

1.2 Objectives

The objective of this Demonstration Test Plan is to determine the emissions from the MSRU for particulate matter (PM) and carbon monoxide (CO). The exhaust gas will also be monitored for percent oxygen (%O_2) and percent carbon dioxide (%CO_2). In addition to the aforementioned parameters, there are five target volatiles that are listed in the March 1995 Record of Decision, released by the New York State Department of Environmental Conservation. The five target compounds are: 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), toluene, ethylbenzene, and total xylenes. Of the five target compounds, two "constituents of concern" will be selected for sampling. One chlorinated organic compound and one non-chlorinated organic compound will be selected, once the soil to be processed has been determined.

---

[1] All field crew associated with this project will be Hazwoper trained.

In addition to the emissions testing, samples will be collected from the pre-treated and post-treated soil to determine the concentrations of all five target compounds listed above.

Emission tests will be conducted in accordance with United States Environmental Protection Agency (USEPA) reference methods outlined in the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60) Appendix A. Soil samples will be collected in accordance with USEPA Reference Method 8260B as presented in SW846, "Test Methods for Evaluating Solid Waste". A summary of the sampling and analytical methods is presented in Table 1-1.

Table 1-1: Summary of Sampling and Analytical Procedures

Demonstration Testing on MSRU
Westinghouse Plant – Buffalo Airport Site
Soil Remediation Project
TPS Technologies Inc.
Cheektowaga, NY

PARAMETER	SAMPLING METHOD	ANALYTICAL METHOD
Stack Flow	EPA Methods 1 & 2	Pitot & Manometer
O_2/CO_2	EPA Method 3A	CFM-NDIR[2]/ Magnetopneumatic
Stack Moisture	EPA Method 4	Volumetric/Gravimetric
Particulate Matter	EPA Method 5	Gravimetric
CO	EPA Method 10	CFM-NDIR
Volatiles in Emissions: either 1,1,1-trichloroethane or trichloroethylene; and one of the following: toluene ethylbenzene or total xylenes	EPA Method 18	Gas Chromatography
Volatiles in Soil: 1,1,1-trichloroethane trichloroethylene toluene ethylbenzene total xylenes	EPA SW846 Method 8260B	Gas Chromatography/ Mass Spectrometry

---

[2] Cross-Flow Modulated- Non Dispersive Infrared

2. SAMPLING AND ANALYTICAL PROCEDURES

2.1 EPA Reference Method 1: Sample Location

The stack on the MSRU is a round duct with an inside diameter of 48". The overall stack height (above ground level) is 37.5 feet. Two four-inch test ports are located 90° apart. The ports are located 7.5 feet from the top of the stack. The overall dimensions of the stack do not provide enough straight run to meet the "ideal" 8 and 2 diameter criteria for a sample location. As a result, the maximum number of sample points will be used during all "isokinetic" sampling. A total of 24 points will be sampled, 12 per traverse. The distances from the stack wall (in inches) to each sample point will be as follows:

Point #	Distance in inches	Point #	Distance in inches
1	1.0	7	30.9
2	3.2	8	36.0
3	5.7	9	39.5
4	8.5	10	42.3
5	12.0	11	44.8
6	17.1	12	47.0

Representative measurements of pollutant emissions and the volumetric flow rate from a stationary source requires a measurement site where the effluent stream is flowing in a known direction and "cyclonic" flow is not present. A "cyclonic" flow determination will be performed prior to the performance test.

2.2 EPA Reference Method 2: Determination of Stack Gas Velocity & Volumetric Flow Rate

The gas velocity in the stack is determined from the measurement of an average velocity head, gas density, stack temperature and stack pressure following the procedures of EPA Reference Method 2. The average velocity head is determined by using an inclined manometer, and a type S pitot tube with a known coefficient of 0.84 which is determined geometrically by standards set forth in EPA Reference Method 2. Stack temperatures are taken at each traverse point using a type K thermocouple. Static pressure is determined by using a straight tap and an inclined manometer. The standard field procedure for Method 2 is included in Appendix B.

2.3 EPA Reference Method 3A: Gas Analysis for Carbon Dioxide, Oxygen and Dry Molecular Weight

A gas sample will be continuously extracted from the effluent stream (consistent with Reference Methods 3A). A portion of the sample stream will be conveyed to instrumental analyzers for determination of O_2 and CO_2 concentrations. A Horiba MPA-510 magnetopneumatic O_2 analyzer operating on the 0-25% (dry) range will determine oxygen concentrations. Carbon dioxide concentrations will be determined using a Horiba Model VIA510 (CFM-NDIR) analyzer with an operational range of 0-20% volume (dry). Data will be recorded on a data acquisition system (DAS) at one-minute intervals. The standard field procedure for Method 3A is included in Appendix B.

2.4 EPA Reference Method 4: Moisture Determination

The moisture content at the test location will be measured according to the procedures in EPA Reference Method 4. Moisture gain will be determined from the EPA Reference Method 5 sample train. The standard field procedure for Method 4 is included in Appendix B.

2.5 EPA Reference Method 5: Determination of Particulate Matter (PM) Emissions from Stationary Sources

The PM concentration of the exhaust gas stream will be measured "isokinetically" according to the procedures outlined in EPA Reference Method 5. This method incorporates gas velocity and volumetric flow measurements (EPA Reference Method 2), and percent moisture determinations (EPA Reference Method 4). Three 1-hour samples will be collected for PM determination. The E_3-Killam field procedure for EPA Reference Method 5 is included in Appendix B.

2.6 EPA Reference Method 10: Determination of Carbon Monoxide (CO) Emissions from Stationary Sources

EPA Reference Method 10 will be used to determine the concentration of CO from the exhaust gas. Analysis will be performed continuously on a HORIBA Model VIA510 cross flow modulated non-dispersive infrared (CFM-NDIR) CO analyzer. The analyzer's output will be recorded at 1-minute intervals on a data acquisition system (DAS). The analyzer will be set on a range appropriate for the CO concentrations determined in the exhaust gas. This range will be determined during the setup day prior to performance sampling.

Instrument calibrations are documented and will be performed with certified gases prepared via EPA Protocol #1 at concentrations of zero, approximately 30% and 60% of span, and a known concentration near the span limit. Three 1-hour continuous CO determinations will be performed during this performance test program. The E_3-Killam field procedure for EPA Reference Method 10 is included in Appendix B.

2.7 EPA Reference Method 18: Determination of Gaseous Organic (Volatiles) Compounds by Gas Chromatography

2.7.1 General

As stated in the objectives in section 1.2, there are five target volatiles that are listed in the Record of Decision, released by the New York State Department of Environmental Conservation in March 1995. The five target compounds are: 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), toluene, ethylbenzene, and total xylenes. Of the five target compounds, two "constituents of concern" are to be selected for sampling. One compound will be a chlorinated organic and one a non-chlorinated organic compound.

The concentrations of these two "constituents of concern" will be measured according to the procedures outlined in EPA Reference Method 18. Stack gas is sampled through sorbent tubes and returned to the laboratory. During analysis, the two "constituents of concern" are separated by a gas chromatograph (GC), and individually quantified by flame ionization, photo-ionization, electron capture, or other appropriate detection principle.

2.7.2 Specific Compounds

Once the soil to be processed has been determined, the two "constituents of concern" will be selected. The chlorinated organic compound will be either 1,1,1-trichloroethane or trichloroethylene. The non-chlorinated organic compound will be toluene, ethylbenzene or total xylenes.

Section 7.4 of EPA Reference Method 18 refers to the National Institute of Occupational Safety and Health's (NIOSH) sampling and analytical methods for the specific organics of concern. The appropriate NIOSH Methods for this test program are as follows:

NIOSH 1003 – 1,1,1-trichloroethane
NIOSH 1022 – trichloroethylene
NIOSH 1501 – toluene, ethylbenzene, xylene

The recommended sample volumes, sample rates, and estimated detection limits for each compound are listed in Table 2-2 (on page 2-12). All sample rates and volumes are taken directly from each target compounds respective NIOSH Method. Copies of the NIOSH methods incorporated in this test program are located in Appendix C of this test protocol.

2.7.3 EPA Reference Method 18: Detection Limits

The in-stack detection limits for the five target compounds are as follows:

For 1,1,1-trichloroethane and toluene = 3.3 mg/M^3. This is calculated by

$$\frac{0.01\,mg}{\left(\frac{0.05\,L}{\text{min.}} \times 60 \times \frac{0.001\,M^3}{L}\right)} = 3.3\frac{mg}{M^3}$$

where

0.01 mg = instrument detection limit
0.05 L/min = sample rate
60 = sample duration (minutes)

For trichloroethylene, ethylbenzene and xylene = 0.83 mg/M^3. This is calculated by

$$\frac{0.01\,mg}{\left(\frac{0.2\ L}{\text{min.}} \times 60 \times \frac{0.001\ M^3}{L}\right)} = 0.83\frac{mg}{M^3}$$

where:

Typo 0.01 ~~0.1~~ mg = instrument detection limit
0.2 L/min = sample rate
60 = sample duration (minutes)

With these calculated minimum detectable limits, and an estimated stack gas flow rate of 16,000 dry standard ft³/min., the lowest measurable emission rate is as follows:

$$Flow: \frac{16000\ ft^3}{\text{min.}} \times \frac{1 M^3}{35.315\ ft^3} = \frac{453\ M^3}{\text{min.}}$$

For 1.1.1-trichloroethane and toluene:

$$\frac{3.3\ mg}{M^3} \times \frac{453\,M^3}{\text{min.}} = \frac{1500\,mg}{\text{min.}}$$

$$\frac{1500\,mg}{\text{min.}} \times \frac{1\,g}{1000\,mg} \times \frac{1\,\text{min.}}{60\,\text{sec}} = \frac{0.025\,g}{\text{sec.}}$$

For trichloroethylene, ethylbenzene and total xylenes:

$$\frac{0.83\ mg}{M^3} \times \frac{453\,M^3}{\text{min.}} = \frac{380\,mg}{\text{min.}}$$

$$\frac{380\,mg}{\text{min.}} \times \frac{1\,g}{1000\,mg} \times \frac{1\,\text{min.}}{60\,\text{sec}} = \frac{0.0063\,g}{\text{sec.}}$$

Using the ambient air quality analysis (Screen 3 Model Analysis – Air Guide 1 included in Appendix D) for a unit emission rate of 1g/sec., the maximum 1-hour ambient concentration was 8.8 ug/M^3. Therefore, the maximum ambient concentration if non-detects (ND) are encountered is as follows:

For 1.1.1-trichloroethane and toluene:

$$\frac{8.8\,\frac{ug}{M^3}}{1\,\frac{g}{\text{sec.}}} \times \frac{0.025\,g}{\text{sec.}} = \frac{0.22\,ug}{M^3} \quad 1\,hour$$

For trichloroethylene, ethylbenzene and total xylenes:

$$\frac{8.8\,\frac{ug}{M^3}}{1\,\frac{g}{\text{sec.}}} \times \frac{0.0063\,g}{\text{sec.}} = \frac{0.055\,ug}{M^3} \quad 1\,hour$$

Using the short term to long term average rule of thumb – annual average concentration = 10% of maximum 1-hour concentration:

For 1.1.1-trichloroethane and toluene:

$$\frac{0.22\,ug}{M^3} \times 0.1 = \frac{0.022\,ug}{M^3} \quad Annual\ Average$$

For trichloroethylene, ethylbenzene and total xylenes:

$$\frac{0.055\,ug}{M^3} \times 0.1 = \frac{0.0055\,ug}{M^3} \quad Annual\ Average$$

Based on these calculations, the maximum 1-hour ambient concentration and average annual concentrations of these five target compounds are well below the AGC and SGCs for them as presented in Air Guide 1. Table 2-1 below shows the comparison.

Table 2-1: Comparison of Annual Concentration vs. Ambient Concentrations

Compound	Air Guide 1		Sample Collected at Detection Limit	
	AGC	SGC	Annual	1-hour
	ug/M^3	ug/M^3	ug/M^3	ug/M^3
1,1,1-trichloroethane	6.1×10^{-2}	13000	$< 2.2 \times 10^{-2}$	$< 2.2 \times 10^{-1}$
Trichloroethylene	4.1×10^{-1}	33000	$< 5.5 \times 10^{-3}$	$< 5.5 \times 10^{-2}$
Toluene	400	45000	$< 2.2 \times 10^{-2}$	$< 2.2 \times 10^{-1}$
Ethylbenzene	1000	100000	$< 5.5 \times 10^{-3}$	$< 5.5 \times 10^{-2}$
Total xylene	300	100000	$< 5.5 \times 10^{-3}$	$< 5.5 \times 10^{-2}$

Therefore EPA Reference Method 18 and its corresponding detection limits are sufficient enough to sample for the "constituents of concern", because at the detection limit or below, emissions at those levels will not harm human health or the environment.

2.7.4 EPA Reference Method 18: Pre-survey

In order to determine the target compounds and estimate their concentrations, EPA Reference Method 18 suggests a pre-survey of the source. However, all of the target compounds have been identified in the soil, and it therefore is not necessary to identify them in the exhaust gas stream. Another reason that a pre-survey would be performed, would be to determine the concentrations of each target compound. This information is also already known, as it is anticipated that each target compound will be at or below the method detection limit. The calculations presented above have estimated the concentrations as well as the lowest measurable emission rate for each target compound. As a result, a pre-survey would not provide any additional information that would be of benefit to this demonstration test plan, and will not be performed.

2.7.5 Performance Test

The performance test for EPA Reference Method 18 will consist of three 60-minute samples.

2.7.5.1 Sampling Equipment

The sample train used to collect the samples will consist of a length of "unheated" stainless steel tubing. The probe will not be heated for this test program, due to the elevated temperature of the stack (approximately 1650°F). Connected to the probe will be a short length of Teflon™ tubing. The tubing will connect the probe to two[3] 1040/260 mg silica gel tubes (in series) which in turn will be attached to three[4] 800/200 mg charcoal tubes (also in series). Silica gel tubes are used to remove moisture from the exhaust gas. All tubes will be kept in a vertical position during sampling. A length of flexible tubing will connect the tubes to a calibrated sampling pump. Each pump will be calibrated to the appropriate sampling rate for the target compound being collected. Depending on the soil selected for processing, the two "constituents of concern", may require different sampling rates and volumes. If this is the case, two sample pumps will be utilized. The pumps will be calibrated for the proper sample rates as follows: 0.05 liters/min., for 1,1,1-trichloroethane and total xylenes, and 0.2 liters/min. for the other three compounds. See Figure 2-1 for a diagram of the EPA Reference Method 18 sample train.

2.7.5.2 Sampling

The probe will be placed at or near the centroid of the stack, the ends of each tube (which are pre-sealed) are broken and connected in series. The silica gel tubes will precede the charcoal tubes. As mentioned earlier, the silica gel tubes are placed in-line to prevent moisture from the exhaust gas from entering the charcoal tubes. The sample pumps are turned on, and the sample flow rate is recorded every five minutes. The total duration of the sample will be sixty minutes. Barometric pressure and ambient temperature readings will also be recorded.

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[3] The number of silica gel tubes in series may increase if the moisture content of the stack warrants it.
[4] Three tubes are used to eliminate the potential for sample breakthrough.

After sampling is complete, the charcoal tubes will be labeled and sealed for transport to the laboratory. The silica gel tubes will be discarded.

2.7.6 EPA Reference Method 18: Recovery Study Requirement

The recovery study discussed in the method will not be performed. The five known volatiles for this test program, 1,1,1-trichloroethane, trichloroethylene, ethylbenzene, toluene and xylene, are commonly sampled by charcoal tubes and have repeatedly shown good recovery.

2.8 EPA Method 8260B: Soil Sample Collection

The soil chosen for the demonstration test program, which will be selected at a later date, will be the most contaminated soil on site. So as not to exceed the 4.0 lb/hr HCl emission limit, the blended soil to be processed will not contain more than 60 ppm (corresponding to a production rate of 40 TPH) of 1,1,1-trichloroethane and trichloroethylene combined. Samples will be collected and analyzed prior to the actual demonstration testing to one: confirm that it is the "most" contaminated, and two: to re-confirm the "constituents of concern".

A stainless steel scoop will be utilized in the collecting of samples. Following each sample, the scoop will be rinsed with distilled water and allowed to air dry. All samples collected will be placed in airtight wide-mouth glass sample jars. All jars will be filled to the top (no head-space). All samples collected will be labeled, documented and stored in a cooler maintained at 4°C. The samples will remain in the cooler until their arrival at a New York State certified laboratory for analysis.

During the actual performance test, discreet sampling of the soil will be performed. Soil samples will be collected from both pre-processed soil and processed soil. Pre-processed samples will be taken as safely as possible before the soil enters the MSRU. Specifically, it will occur at a transfer point between conveyors and prior to the weigh-belt. Processed sampling will occur from within the processed soil pile (a minimum of six inches deep into the side of the pile), as soon as possible after treatment. As soon as possible means immediately upon sufficient cool down to allow sampling to occur.

During each 1-hour EPA Reference Method 18 test, three samples of each soil will be collected (processed soil will be collected 10-minutes following the collection of the pre-processed soil due to a residence time of approximately 7-10 minutes in the MSRU). Samples will be analyzed for the compounds listed in Section 2.7.2. Analysis will be by EPA Method 8260B, Gas Chromatography/Mass Spectrometry.

2.9 Destruction Efficiency

The control efficiency of the MSRU is expressed in terms of destruction/removal efficiency (DRE), which is the ratio of the contaminant prevented from release through the stack compared to the amount of contaminant in the feed. Therefore, a DRE will be calculated for each constituent of concern for each one-hour trial run.

DRE = 100 * (Mass of waste IN feed – Mass of waste OUT (at stack)) / Mass of waste IN feed

This method of determining the % destruction/removal efficiency complies with 6 NYCRR Subpart 373-2.15(d)(1)(i).

2.10 Process Parameters

During the demonstration test, the afterburner will be set at 1650°F. The processed soil is anticipated to be treated in the range of 350-600°F. The production feed rate will be between 30–40 tons/hour, and will be optimized during the setup and shakedown of the MSRU. During the operation of the unit, a process data log sheet will be filled out at fifteen- minute intervals. Table 2-3 is an example of the log sheet to be completed during the demonstration test.

items that will be recorded during the demonstration test will be a summary of the retreated soil, soil sampling events, downtimes and operational problems.

2.11 Soil Cleanup Standards

Each target compound has an associated soil cleanup standard as stated in the Record of Decision (March 1995). They are as follows:

Trichlorothylene – 1.05 mg/kg
1,1,1-trichloroethane – 1.14 mg/kg
toluene – 2.25 mg/kg
ethylbenzene – 8.25 mg/kg
total xylenes – 1.8 mg/kg

All required soil cleanup standards will be met during this demonstration test program.

Table 2-2: Summary of Sample Volumes, Sample Rates and Detection Limits

Demonstration Testing on MSRU
Westinghouse Plant - Buffalo Airport Site
Soil Remediation Project
TPS Technologies Inc.
Cheektowaga, NY

ANALYTE	NIOSH METHOD	MINIMUM SAMPLE VOLUME (Liters)	MAXIMUM SAMPLE VOLUME (Liters)	FLOW RATE (Liters/min)	ESTIMATED DETECTION LIMIT (mg/M^3)
1,1,1-trichloroethane	1003	3	3	0.05	3.3
Trichloroethylene	1022	1 @ 100 ppm	30	0.2	0.83
Ethylbenzene	1501	1	24	0.2	0.83
Toluene	1501	1	8	0.05	3.3
Xylene	1501	2	23	0.2	0.83

Note: Sample Durations will be 60 minutes.

Table 2-3: Process Data Log Sheet

Demonstration MSRU
Westinghouse Plant - Buffalo Airport Site
Soil Remediation Project
TPS Technologies Inc.
Cheektowaga, NY

Process Data Log Sheet
Project #99023.0000

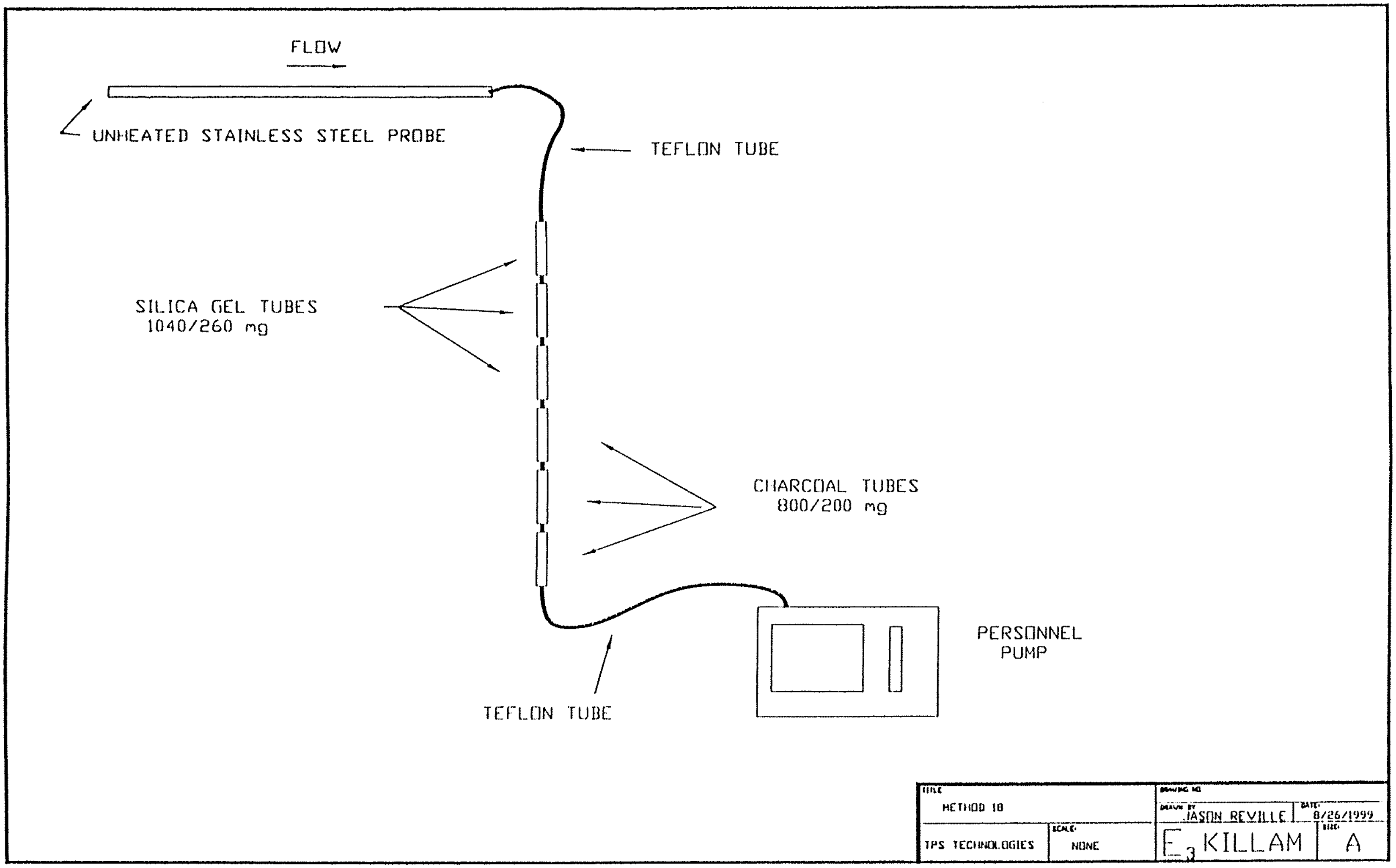
Data Points

SoilPure, Inc.
Project:
Client:

		Sample:									
Date	**Time**	**Degrees F Soil Temp**	**Degrees F Stack Temp**	**TPH Bell Scale**	**InWc Diff Pressure**	**InWc Neg Pressure**	**Desorber Exit Temp**	**Bag Collector Temp**	**Baghouse Outlet Temp**	**CEM % O_2**	**CEM CO (ppm)**
09/08/1998	11:30:00										
09/08/1998	11:45:00										
09/08/1998	12:00:00										
09/08/1998	12:15:00										
09/08/1998	12:30:00										
09/08/1998	12:45:00										
09/08/1998	13:00:00										
09/09/1999	14:15:00										
09/09/1999	14:30:00										
09/09/1999	14:45:00										
09/09/1999	15:00:00										
09/17/1999	15:15:00										
09/17/1999	15:15:00										
09/17/1999	16:30:00										
09/17/1999	15:45:00										
09/18/1999	16:00:00										
09/18/1999	11:45:00										
09/18/1999	12:00:00										
09/18/1999	12:15:00										
09/19/1999	12:30:00										
09/19/1999	12:45:00										
09/19/1999	14:15:00										
09/19/1999	14:30:00										
09/19/1999	14:45:00										

h:\projects\tps_tech\proto\Log_shet.xls

Figure 2-1: Method 18 Sample Train Configuration
Demonstration Testing on MSRU
Westinghouse Plant - Buffalo Airport Site
Soil Remediation Project
TPS Technologies Inc.
Cheektowaga, NY



3. QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

Sampling equipment is cleaned, checked and calibrated according to the QA/QC procedures outlined in each appropriate reference method and the "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III, Stationary Source-Specific Methods" (EPA/600/R-94/038c). This section outlines the QA/QC procedures performed prior to, during and after field sampling activities.

3.1 EPA Reference Method 5: QA/QC Specifics

Prior to field use and sample recovery, glassware is cleaned according to a five-step procedure. Sample equipment calibration data sheets for a typical test program are included in Appendix A.

Leak checks will be performed before and after each sample run on all train components including vacuum sample trains and pitot lines. The pre-test and post-test leak checks for all tests will be within acceptable criteria.

3.2 EPA Reference Method 18: QA/QC Specifics

The recovery efficiency of each target compound will be determined. The primary and backup portions of the charcoal tubes will be analyzed separately to determine this. According to Section 7.4.4.2 of EPA Reference Method 18, the backup portion cannot exceed 10% of the total amount (primary portion + backup portion). To eliminate this potential, E_3-Killam will place two charcoal tubes in series. The first tube will be analyzed as stated. If the backup portion does exceed the 10 percent, the second tube will be analyzed such that the primary portion of the second tube will be combined with the primary and secondary portions of the first tube. The sample collection efficiency will then be determined based upon those three fractions, and the backup portion of the second tube. If necessary, the third charcoal tube in series will be analyzed.

All pumps will be calibrated before and after the test series. If the flow rate differs between the two calibrations by greater than 5% but less than 20%, an average flow rate determination will be made and used for all sample volume determinations.

3.3 Calculations

Various spreadsheets are used by E_3-Killam in determining emission rates from data collected during the test program. Samples of these spreadsheets are included in Appendix A of this test protocol.

A. SAMPLE FIELD DATA SHEETS AND CALCULATIONS

A.1 Sample ECS Data Sheets

GENERAL TEST INFORMATION

Client:		Stack Dia. or D_e., (in.):	78.13	Area of Stack (ft^2):	80.7769
Project No.:	95008.0032	No. of Ports:	5	Port Location from Upstream Disturbance (D_e):	0.29
Site:	xyz Plant	Points/Port:	5		
Address:		Runs/Test:	3	Port Location from Dnstream Disturbance (D_e):	0.27
City/State:	Somewhere USA				
Test Of:	PM				

Source Type:	D-5 Mixing Chamber	t_{std} (°F) :	68	Rectangular Ducts	
Control Equip.:		T_{std} (°R) :	528	Length (in.):	251.50
Test Location:	Outlet			Width (in.):	46.25

SUMMARY OF STACK PARAMETERS

Test Date Run No.	01/30/99 13A	01/30/99 14A	01/30/99 15A	Avg.
t_s - Stack Temperature, °F	108.2	107.2	104.7	106.7
P_s - Stack Absolute Pressure, in. Hg.	29.43	29.46	29.48	29.46
V_s - Stack Velocity, ft/sec.	20.59	20.32	23.39	21.43
Q_a - Volumetric Flow Rate/Actual Conditions, ACFM	99791.8	98483.2	113362.3	103879.1
Q_s - Volumetric Flow Rate/Dry Standard Conditions, DSCFM	83646.8	83050.6	96608.7	87768.7
CO_2 , %	0.00	0.00	0.00	0.00
O_2 , %	20.90	20.90	20.90	20.90
CO, %	0.00	0.00	0.00	0.00
N_2 , %	79.10	79.10	79.10	79.10
M_d - Dry Molecular Weight, lb/lb-mole	28.84	28.84	28.84	28.84
M_s - Wet Molecular Weight, lb/lb-mole	27.94	27.97	28.03	27.98
$V_{m(std)}$ - Sample Volume - Dry Standard Conditions, DSCF	31.382	32.377	36.141	33.300
Stack Moisture Content, %	8.30	8.00	7.50	7.93
Isokinetic, %	100.1	102.6	97.2	100.0

SUMMARY OF PARTICULATE EMISSIONS

P_{mrf} - Pollutant Mass Rate, Front Half, lb/hr.	20.08	20.04	21.20	20.44
C_{sf} - Stack Concentration, Front Half, gr/DSCF	0.0280	0.0282	0.0256	0.0273
P_{mrt} - Pollutant Mass Rate, Total, lb/hr.	22.26	23.39	23.25	22.97
C_{st} - Stack Concentration, Total, gr/DSCF	0.0311	0.0329	0.0281	0.0307

E_3-Killam Inc.

SPECIFIC RUN INFORMATION

Project: 95008.0032
Run: 13A
Test Date: 01/30/1999

Location: Outlet
Test Of: PM
Runs/Test: 3

Operator: MJT

Isokinetic Sampling - Data Summary

Amb. Temp. (°F):	58	Filter I.D. No.:	Q376A	Meter Box I.D. No.:	E1	%CO_2 :	0.00
Pbar. (in. Hg.):	29.45	Thimble I.D. No.:	n/a	Meter Y:	0.995	%O_2 :	20.90
Pstatic (in. H_2O):	-0.25	Pitot I.D. No.:	4P-6	ΔH @:	1.8549	%CO :	0.00
Dn :	0.2980	T-Couple I.D. No.:	4T-6	Time/Point:	0:02:30	%N_2 :	79.10
Cp :	0.84	Nozzle I.D. No.:	D-3	Total Time (Θ):	62.5		

Leak	Meter Pre:	0	cfm @	10.0	in. Hg.	Pitot(-):	ok	@	6.2	in. H_2O
Checks	Meter Post:	0	cfm @	8.0	in. Hg.	Pitot(+):	ok	@	4.8	in. H_2O

Trvs.	Time	ΔP	ΔH	Meter	Temperatures (°F)						Vac.
Pt. No.	(24Hr.)	(in. H_2O)	(in. H_2O)	Vm(cf)	Stack	Meter In	Meter Out	Filter	Probe	Exit	(in. Hg.)
D5	8:22:00	0.17	1.24	680.782	107	67	66	249	251	63	2.0
4	8:24:30	0.17	1.24	682.300	110	68	68	249	245	52	2.0
3	8:27:00	0.17	1.24	683.900	110	68	68	249	248	50	2.0
2	8:29:30	0.07	0.51	685.400	110	69	68	248	245	49	2.0
1	8:32:00	0.03	0.22	686.400	107	69	68	249	243	50	2.0
	8:34:30			687.036							
E5	8:37:00	0.21	1.53	687.036	110	68	68	249	248	54	2.0
4	8:39:30	0.21	1.53	688.700	110	69	68	248	243	49	3.0
3	8:42:00	0.19	1.38	690.400	111	69	68	249	243	49	3.0
2	8:44:30	0.16	1.16	691.900	111	70	67	249	247	50	3.0
1	8:47:00	0.16	1.17	693.400	111	71	68	249	246	51	3.0
	8:49:30			694.890							
A5	8:52:00	0.20	1.47	694.890	107	70	68	249	249	57	3.0
4	8:54:30	0.18	1.32	696.600	107	71	68	249	250	55	3.0
3	8:57:00	0.14	1.03	698.100	106	72	68	248	248	56	3.0
2	8:59:30	0.13	0.96	699.500	106	72	68	249	235	57	3.0
1	9:02:00	0.03	0.22	701.000	105	74	68	249	227	57	1.0
	9:04:30			701.569							
B5	9:07:00	0.18	1.32	701.569	107	72	69	249	240	60	4.0
4	9:09:30	0.17	1.25	703.000	107	74	69	250	236	56	4.0
3	9:12:00	0.13	0.96	704.600	107	75	69	248	230	56	4.0
2	9:14:30	0.03	0.22	705.900	107	76	70	249	234	56	3.0
1	9:17:00	0.03	0.22	706.600	106	76	71	250	237	57	2.0
	9:19:30			707.265							
C5	9:22:00	0.14	1.03	707.265	109	74	71	249	237	60	4.0
4	9:24:30	0.15	1.11	708.600	110	77	72	248	242	58	4.0
3	9:27:00	0.12	0.89	710.000	109	77	72	250	246	57	3.0
2	9:29:30	0.04	0.30	711.400	108	78	73	249	236	57	2.0
1	9:32:00	0.03	0.22	712.200	108	78	73	250	236	57	2.0
	9:34:30			712.907							
		Avg.	Avg.	Sum	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
		0.13	0.95	32.125	108.2	72.2	69.0	249.0	241.7	54.9	2.8
		Avg. Sqrt.					Avg. Tm				Max.
		0.345					70.6				4.0

E3-Killam Inc.

SPECIFIC RUN INFORMATION

Project: 95008.0032
Run: 13A

Test Of: PM
Location: Outlet

Analytical Information

Moisture Determination - Data Summary

		Imp. 1	Imp. 2	Imp. 3	Imp. 4	Imp. 5	Imp. 5	Imp. 6	Silica Gel or Train	
Final	(ml)	146.0	106.0	2.0	0.0	0.0	0.0	0.0	(g)	880.0
Initial	(ml)	100.0	100.0	0.0	0.0	0.0	0.0	0.0	(g)	872.0
Gain	(ml)	46.0	6.0	2.0	0.0	0.0	0.0	0.0	(g)	8.0
									ts	108
									SVP	2.4500

Blank Correction - Data Summary

Reagent		Acetone	Water
Blank Volume	(ml)	100.0	200.0
Gross Wt.	(g)	96.7609	111.8222
Tare Wt.	(g)	96.7607	111.8220
Blank Weight Gain	(g)	0.0002	0.0002
Blank Concentration	(g/ml)	2.00E-06	1.00E-06

Blank Weight Gain = Gross Wt. - Tare Wt.

Blank Concentration = Blank Weight Gain / Blank Volume

Particulate Weight Determination - Data Summary

Front Half

Back Half

		Filter	Acetone	Water	Total Gain	Water	Total Gain
	I.D.	Q376A	B-1162	B-917		B-928	
Beaker Vol.	(ml)	n/a	50.0	40.0		200.0	
Gross Wt.	(g)	0.3995	109.5967	109.0268		110.3541	
Tare Wt.	(g)	0.3489	109.5924	109.0246		110.3477	
Blank Corr.	(g)	0.0000	0.0001	0.0000		0.0002	
Gain	(g)	0.0506	0.0042	0.0022	0.0570	0.0062	0.0062
	(lbs/hr.)	17.8246	1.4795	0.7750	20.0791	2.1840	2.1840
	(gr/DSCF)	0.0249	0.0021	0.0011	0.0280	0.0030	0.0030

Blank Corr. = Beaker Vol. x Blank Concentration

Gain = (Gross Wt. - Tare Wt.) - Blank Corr.

E3-Killam Inc.

SPECIFIC RUN INFORMATION

Project: 95008.0032
Run: 13A
Test Of: PM
Location: Outlet

Reference Method No. 2 Calculations

Average Stack Velocity	$V_s = K_p\ C_p\ \mathrm{SQRT}\ \Delta P_{avg}\ \mathrm{SQRT}\ (T_s / (P_s\ M_s))$	V_s=	20.59	ft/sec.
Average Stack Volumetric Flow Rate	$Q_a = 60\ V_s\ A_s$	Q_a=	99791.8	ACFM
Average Stack Volumetric Flow Rate	$Q_s = 60\ V_s\ A_s\ (1\text{-}B_{ws})\ ((T_{std}\ P_s) / (P_{std}\ T_s))$	Q_s=	83646.8	DSCFM

Reference Method No. 3 Calculations

Molecular Weight, Dry	$M_d = 0.44\ \%CO_2 + 0.32\ \%O_2 + 0.28\ (\%CO + N_2)$	M_d=	28.84	lb/lb-mole
Molecular Weight, Wet	$M_s = M_d\ (1\text{-}B_{ws}) + 18\ B_{ws}$	M_s=	27.94	lb/lb-mole

Reference Method No. 4 Calculations

Sample Volume, Standard Conditions	$V_{m(std)} = V_m\ Y\ ((T_{std}\ P_m) / (T_m\ P_{std}))$	$V_{m(std)}$ =	31.382	DSCF
Water Vapor Volume Collected	$V_{wc(std)} = .04707\ (V_f - V_i)$	$V_{wc(std)}$ =	2.542	ft^3/ml
Water Vapor Volume Collected	$V_{wsg(std)} = .04715\ (W_f - W_i)$	$V_{wsg(std)}$=	0.377	ft^3/g
Moisture Volume Fraction of Stack Gas	$B_{ws} = (V_{wc(std)} + V_{wsg(std)})/(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})$	B_{ws}=	0.085	
Vapor Pressure of Stack H_2O	$VP=SVP\text{-}.000367\ (P_s)\ (1+(ts-32/1571))$	VP=	2.439	
Bws VP	$B_{ws}VP=VP / P_s$	$B_{ws}VP$=	0.083	
Min B_{ws} or B_{ws} VP	If $B_{ws} > B_{ws}VP$, then $B_{ws}VP$	MIN B_{ws} or $B_{ws}VP$=	0.083	

Reference Method No. 5 Calculations

Percent Isokinetic	$\%I = ((T_s\ V_{m(std)}\ P_{std})/(1\text{-}B_{ws})/(A_n\ \Theta\ V_s\ P_s\ T_{std}\ 60))\ 100$	%I=	100.1	
Mass Emissions Rate - Front Half	$p_{mrf} = (m_f / V_{m(std)})\ Q_s\ 0.13216$	P_{mrf}=	20.0791	lbs/hr.
Stack Concentration - Front Half	$C_{sf} = 15.43\ m_f / Vm_{(std)}$	C_{sf}=	0.0280	gr/DSCF
Mass Emissions Rate - Total (Front+Back Half)	$p_{mrt} = (m_f / V_{m(std)})\ Q_s\ 0.13216$	P_{mrw}=	22.2631	lbs/hr.
Stack Concentration - Total (Front+Back Half)	$C_{st} = 15.43\ m_f / Vm_{(std)}$	C_{sw}=	0.0311	gr/DSCF

A.2 Sample Calibration Sheets

E$_3$-Killam inc.
environmental services

Client:	
Project #	
Report:	
Project:	

Barometer Calibration

Barometer ID B-3

Pre-test Calibration

Barometer Pressure 29.25 in. Hg

Date 23-Mar-99

NWS Pressure 29.18 in. Hg

Time 11:00

Calibrator RCS

If the barometer differs from the national weather service it is set to the correct reading.

Post-test Calibration

Barometer Pressure 29.51 in. Hg

Date 20-Jul-99

NWS Pressure 29.39 in. Hg

Time 10:50

Calibrator RCS

Post-test Results

X	The barometer passed the post-test calibration.
	The barometer failed the post-test calibration. No correction necessary.
	The barometer failed the post-test calibration. Field data correction required.

Notes on barometer calibration:

Elevation at E$_3$-Killam: 704'   Elevation at National Weather Service: 714'

Due to the closeness in elevation between E$_3$-Killam and the National Weather Service (located at the Buffalo Niagara International Airport) a correction in barometric pressure due to altitude is not required.

Before a test is conducted in the field, the E$_3$-Killam barometer is adjusted to the value obtained by the National Weather Service. After field work has been completed the barometer is again compared to that of the National Weather Service. A difference of +/- 0.2 in Hg is acceptable. A difference outside this range results in the lower value being used. No correction is necessary if the field barometer is the lower of the two. If the field barometer is the higher of the two then the difference is subtracted from the field data readings.

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Nozzle Calibration Report

Client:	Sample
Project #:	
Report:	0.000
Project:	0

Nozzle ID	Measured Diameters (in.) D1	D2	D3	Average Diameter	Largest Variance	Calibration Date	Calibrator
GE-3	0.376	0.377	0.376	0.376	0.001	01/13/99	RCS
GE-8	0.380	0.380	0.380	0.380	0.000	01/13/99	RCS
GE-20	0.375	0.375	0.374	0.375	0.001	01/13/99	RCS

The Calibration of Nozzles:

All nozzles are calibrated at the time of purchase and again on an annual basis. Furthermore a nozzle that shows damage due to field use is calibrated after repairs. Calibration of a nozzle is accomplished by measuring the width of the nozzle's orifice along three different diameters. The measurements are made to within 0.001 inch. A variance of 0.004 inches or greater requires that the nozzle be repaired or disposed of. The average of the three diameters is used in sampling calculations.

E$_3$-Killam inc.
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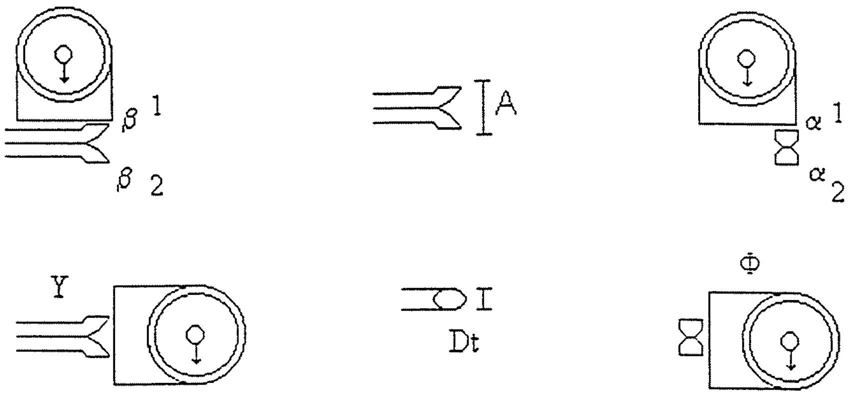
Pitot Tube Calibration

Client:	Sample
Project #:	
Report:	0
Project:	0

Post-Test Report

		Measurements								
Pitot ID	Calibration Date	α1 (°)	α2 (°)	β1 (°)	β2 (°)	Y (°)	Φ (°)	A (in.)	Dt (in.)	Calibrator's Initials
4P-15	21-Apr-99	0.5	0.0	1.0	1.0	0.5	0.5	0.942	0.372	RCS
4P-6	21-Apr-99	0.0	1.0	1.5	1.0	0.5	0.0	0.935	0.392	RCS
4P-8	21-Apr-99	1.0	1.5	1.0	1.5	0.0	1.0	0.952	0.378	RCS

The diagram below depicts the various measurements listed above.



<u>The following criteria must be met in order to assume an S-type pitot tube has a pitot coefficient of 0.84.</u>

Parameter	Criteria	How Determined	Net Results for Pitot tubes Listed above.			
α_1	$\alpha_1 > -10^\circ, \alpha_1 < +10^\circ$	Measurement	X	Pass	☐	Fail
α_2	$\alpha_2 > -10^\circ, \alpha_2 < +10^\circ$	Measurement	X	Pass	☐	Fail
β_1	$\beta_1 > -5^\circ, \beta_1 < +5^\circ$	Measurement	X	Pass	☐	Fail
β_2	$\beta_2 > -5^\circ, \beta_2 < +5^\circ$	Measurement	X	Pass	☐	Fail
P	1.05 Dt < P < 1.50 Dt	P=A/2	X	Pass	☐	Fail
W	W < 1/32 in. (0.08 cm)	W=AsinΦ	X	Pass	☐	Fail
Z	Z<1/8 in. (0.32 cm)	Z=AsinY	X	Pass	☐	Fail

All S-type pitot tubes above may be assumed to have a pitot coefficient of 0.84 ☒

One or more of the S-type pitot tubes above (in bold) does not meet the criteria to assume a pitot coefficient of 0.84. ☐

E3-Killam inc.
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Thermocouple Calibration

Client:	Sample
Project#:	
Report:	0
Project:	0

Pre-Test Calibration

Thermo. ID	Date	Thermo. Ambient	Reference Ambient	Reference ID	Calibrator's Initials
4T-12	23-Mar-1999	67	67	WBDB	RCS
4T-15	23-Mar-1999	68	67	WBDB	RCS
4T-8	04-Feb-1999	61	62	WBDB	RCS

Post-Test Calibration

Thermo. ID	Date	Thermo. Ambient	Reference Ambient	Reference ID	Calibrator's Initials
4T-12	21-Apr-1999	67	67	WBDB	RCS
4T-15	21-Apr-1999	66	67	WBDB	RCS
4T-8	21-Apr-1999	68	67	WBDB	RCS

Thermocouple calibration: Thermocouples are calibrated as per EMTIC GD-28. Each thermocouple is calibrated against a standard thermocouple. A difference greater than 2 deg. C results in a failed calibration. Thermocouples that fail calibration prior to field use are discarded.

Post-test calibration results:

All thermocouples used have passed the post calibration test. X

One or more thermocouples (**bolded**) have not passed the post-test calibration: ______

B. E_3-KILLAM FIELD PROCEDURES

E$_3$-Killam Inc.
environmental services

FIELD PROCEDURE - REFERENCE METHOD 3A/10 (1FP3A/10)
Oxygen and Carbon Dioxide/Carbon Monoxide
Multi-Point, Integrated Sampling, Instrumentation Analysis

A. Preparation

1. Carbon Monoxide (CO)
   a) Use "Protocol 1" calibration gases (CO in N_2), certified by the manufacturer to be within ±2% of the specified concentration, as follows:
      (1) Span. < 1.5 times the applicable standard.
      (2) High-Range. About 90% of span.
      (3) Mid-Range. About 60% of span.
      (4) Low-Range. About 30% of span.
      (5) Zero. Pre-purified grade of N_2.

2. Oxygen and Carbon Dioxide (O_2 and CO_2)
   a) Use "Protocol 1" calibration gases (O_2 and CO_2 in N_2), certified by the manufacturer to be within ±2% of the specified concentration, as follows:
      (1) High-Range. 80 to 100% of span.
      (2) Mid-Range. 40 to 60% of span.
      (3) Zero. <0.25% of span.

3. Setup and calibrate the gas analyzer(s). Adjust system components as necessary.

4. Setup the sampling system as shown in Figure F3A/10-1.

B. System Performance Pre-Test Procedures

1. Analyzer Calibration Error

   *Conduct this test **initially and each time** the system exceeds the system bias and drift specifications.*

   a) Introduce the zero, mid-range and high-range gases to the measurement system at any point upstream of the analyzer. Do not make any adjustments to the system except those necessary to adjust the calibration gas flow to the analyzer.
   b) Record the analyzer responses to each calibration gas.
   c) Confirm calibration error is within +/- 2% of span.

D. Sampling Procedures

1. Leak-check the flexible bag
   a) Inflate flexible bag to maximum capacity.
   b) Allow the bag to stand for 24 hours.
   c) A deflated or semi-deflated bag indicates a leak.
   d) Deflate all acceptable sample bags. Discard any that leak.

2. Leak check the train.
   a) Plug probe inlet.
   b) Pull a vacuum ≥ 10 in. Hg.
   c) Turn off sampling pump.
   d) Note vacuum and monitor for 1-minute. No fluctuation in the initial vacuum reading indicates an acceptable leak check.
   e) Carefully release the probe inlet.

FIELD PROCEDURE - REFERENCE METHOD 3A/10 (1FP3A/10)
Oxygen and Carbon Dioxide/Carbon Monoxide
Multi-Point, Integrated Sampling, Instrumentation Analysis

3. Locate the probe at the first traverse point.
4. Purge the sample system, with the flexible bag disconnected.
5. Connect the bag, and commence sampling.
6. Sample at each traverse point at a constant rate.

E. Analysis

1. Within 8 hr after the sample is taken, analyze for % CO2, % O2, and CO concentration. Introduce the sample into the instruments until a stable reading is obtained for each desired constituent

F. System Performance Post-Test Procedures

1. Following the analysis of the "integrated" bag samples, determine the Analytical Bench Drift. Do not make any adjustments to the measurement system until after the drift checks are completed. Record the system responses. Introduce the calibration gases at the calibration valve installed at the inlet to the analyzers.

2. Confirm Analytical Bench Drift check is within +/-3% of span.

3. If the sampling system does not pass the Analytical Bench Drift check, repeat the calibration error and reanalyze the samples.

FIELD PROCEDURE - REFERENCE METHOD 3A/10 (1FP3A/10)
Oxygen and Carbon Dioxide/Carbon Monoxide
Multi-Point, Integrated Sampling, Instrumentation Analysis

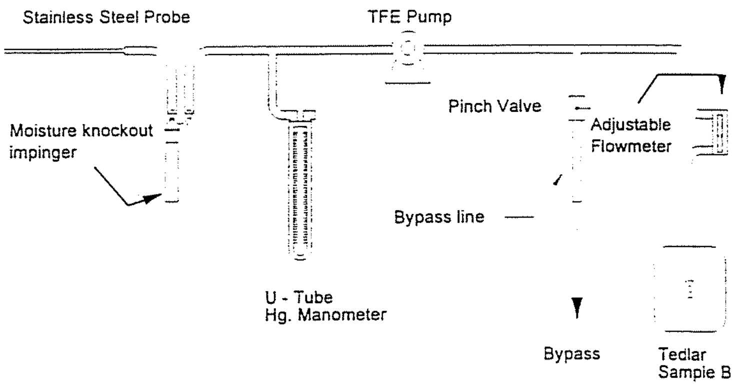


Figure 3A/10-1 Integrated Bag-Sampling System

FIELD PROCEDURE - REFERENCE METHOD 4 (FP4)
Moisture Determination

A. Pretest Preparation

1. Weigh several 200- to 300-g portions of silica gel in air-tight containers to ± 0.5g. Record the total weight of the silica gel plus container on each container.
2. Check filters visually against light for irregularities and flaws or pinhole leaks. Label the filters on the back side near the edge using numbering machine ink.

B. Preliminary Determinations

1. Select the sampling site and the number of sampling points according to USEPA Reference Method 1.
2. Set up pitot tube/manometer apparatus.
3. Leak-check the pitot tube setup.
   a. Blow into the pitot impact opening until at least 3 in. H_2O velocity pressure registers on the manometer, and close off impact opening.
   b. Observe the time (pressure must remain stable for at least 15 seconds).
   c. Do the same for the static pressure side, except use suction to obtain -3in. H_2O.
4. Level and zero the manometer.
5. Determine the stack pressure, temperature, and the range of velocity heads by previous test data or follow Steps B.6 - B.8.
6. Measure the velocity head and temperature.
7. Measure the static pressure in the stack.
8. Determine the atmospheric pressure.
9. Determine the moisture content by previous test data or measurement.
10. Determine or estimate the dry molecular weight.
11. Select a nozzle size based on preliminary stack data. Do **NOT** change nozzle size during the sampling run.
12. Select a suitable probe liner and probe length such that all traverse points can be sampled.
13. Select the total sampling time and standard sample volume specified in the test procedures for the specific industry. Select equal sampling times of ≥ 2 min per point.

C. Preparation of Collection Train

1. During the preparation and assembly of the sampling train, keep all openings covered to avoid contamination. Use parafilm to close the openings.
2. Prepare impingers according to Figure 1.
3. Weigh the entire impinger train.
4. Using a tweezer or clean disposable surgical gloves, place filter in the filter holder. Check the filter for tears after assembly.
5. Mark the probe with heat resistant tape (or other) to denote the proper distance into the stack or duct for each sampling point.
6. Set up the train. Turn on and set probe and filter box heaters. Place crushed ice around the impingers.
7. Leak-Check the sampling train
   a. Allow time for train temperatures to stabilize.
   b. Plug the nozzle. Fully open the bypass valve and close the coarse adjust valve. Then start the pump.
   c. Slowly close the bypass valve until the desired vacuum is reached (≥ 15 in. Hg or ≥ maximum vacuum reached during the test run.) Do not reverse direction of bypass valve; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check as shown in Step 7e, and start over.
   d. Allow the flow rate to stabilize, then determine the leakage rate using DGM readings and a watch. Record the leakage rate. Leakage rate must be ≤ 0.02 cfm or ≤ 4% of average sampling rate, whichever is less.
   e. End the leak-check as follows: first slowly remove the plug from the inlet to the prove, and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica gel from being entrained backward into the third impinger.

FIELD PROCEDURE - REFERENCE METHOD 4 (FP4)
Moisture Determination

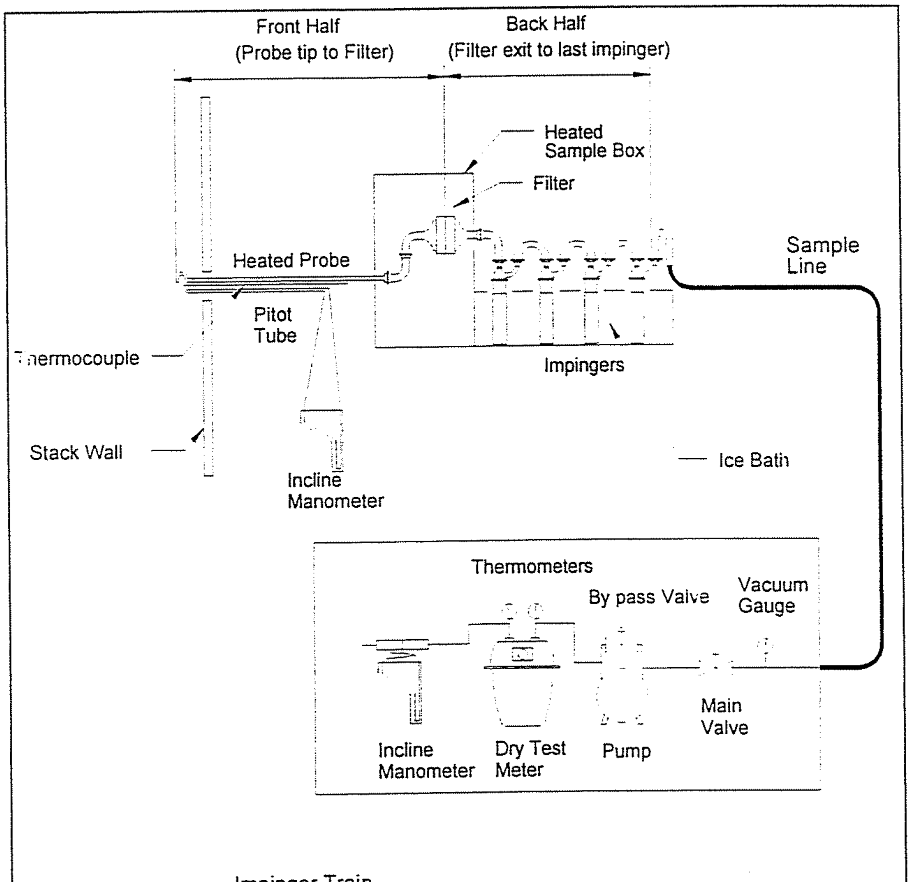
D. Sampling

1. Record data shown on field data sheet. Record the initial dry gas meter (DGM) reading.
2. Clean the portholes.
3. Remove the nozzle cap, verify that the filter and probe heating systems are up to temperature, and check pitot tube, temperature gauge, and probe alignments and clearances.
4. Close the coarse adjust valve. If necessary to overcome high negative stack pressure, turn on the pump. Position the nozzle at the first traverse point. Immediately start the pump, and adjust the flow to isokinetic conditions.
5. When the probe is in position, block off the openings around the probe and porthole.
6. Traverse the stack cross-section. *Do not bump the probe nozzle into the stack walls.*
   a. Keep the temperature around the filter holder (probe outlet or filter outlet, if applicable) at the proper level.
   b. Add more ice and, if necessary, salt to maintain a temperature of <68°F at the condenser / silica gel outlet.
   c. Periodically check the level and zero of the manometer.
   d. Record DGM readings at the beginning and end of each sampling time increment, before and after each leak-check, and when sampling is halted.
   e. Take other readings shown in field data sheet at least once at each sample point during each time increment and additional readings when significant changes (20% variation in Δp readings) necessitate additional adjustments in flow rate.
   f. If train components are replaced, conduct leak-check according to Step C.7.
7. At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final DGM meter reading.
8. Leak-check the sampling train (see Step C.7).
9. Leak-check the pitot lines (see Step B.3).
10. Allow the probe to cool. Then, wipe off all external PM near the tip of the probe nozzle, and place a cap over it.
11. Before moving the sampling train to the cleanup site, remove the probe from the sampling train, wipe off the silicone grease, if used, and cap the open outlet of the probe. Do not lose any condensate that might be present. Wipe off the silicone grease from the filter inlet, and cap it.
12. Remove the umbilical cord from the last impinger, and cap the impinger. After wiping off the silicone grease, if used, cap off the filter holder outlet and impinger inlet.
13. Transfer the probe and filter-impinger assembly to the cleanup area that is clean and protected from the wind.

E. Sample Recovery

1. <u>Container No. 3</u> (Silica Gel)
   a. Determine whether silica gel has been completely spent, and note on field data sheet its condition.
   b. Weigh the silica gel impinger with the other impingers to the nearest 0.5 g.
2. <u>Impinger Water</u>
   a. Note on field data sheet any color or film in the liquid catch.
   b. Weigh Impingers 1, 2, 3 and the silica gel impinger to within ±0.5g [or measure the liquid volume in impingers 1, 2 and 3 to within ± 1 mL (with a graduated cylinder)].
   c. Discard the liquid, unless analysis of the impinger catch is required. Store as is appropriate.

FIELD PROCEDURE - REFERENCE METHOD 4 (FP4)
Moisture Determination



Impinger Train

1 - Modified Greenburg Smith, 100ml of Distilled Water
2 - Standard Greenburg Smith, 100ml of Distilled Water
3 - Modified Greenburg Smith, Empty
4 - Modified Greenburg Smith, Silica Gel (200-300g)

Figure 1. Particulate Sampling Train

FIELD PROCEDURE - REFERENCE METHOD 5 (FP5)
Particulate Matter Isokinetic Sampling

A. Pretest Preparation

1. Weigh several 200- to 300-g portions of silica gel in air-tight containers to ± 0.5g. Record the total weight of the silica gel plus container on each container.

2. Check filters visually against light for irregularities and flaws or pinhole leaks. Label the filters on the back side near the edge using numbering machine ink.

3. Desiccate the filters at 20 ± 5.6 °C and ambient pressure for $\geq$ 24 hr, and weigh at intervals of $\geq$ 6 hr to a constant weight, i.e., $\leq$ 0.5 mg change from previous weighing; record results to ±0.1 mg. During each weighing, do not expose the filter to the laboratory atmosphere for > 2 min and a relative humidity > 50%.

B. Preliminary Determinations

1. Select the sampling site and the number of sampling points according to USEPA Reference Method 1.

2. Set up pitot tube/manometer apparatus.

3. Leak-check the pitot tube setup.

   a. Blow into the pitot impact opening until at least 3 in. H_2O velocity pressure registers on the manometer, and close off impact opening.
   b. Observe the time (pressure must remain stable for at least 15 seconds).
   c. Do the same for the static pressure side, except use suction to obtain -3in. H_2O.

4. Level and zero the manometer.

5. Determine the stack pressure, temperature, and the range of velocity heads by previous test data or follow Steps B.6 - B.8.

6. Measure the velocity head and temperature.

7. Measure the static pressure in the stack.

8. Determine the atmospheric pressure.

9. Determine the moisture content by previous test data or measurement.

10. Determine or estimate the dry molecular weight.

11. Select a nozzle size based on preliminary stack data. Do **NOT** change nozzle size during the sampling run.

12. Select a suitable probe liner and probe length such that all traverse points can be sampled.

13. Select the total sampling time and standard sample volume specified in the test procedures for the specific industry. Select equal sampling times of $\geq$ 2 min per point.

FIELD PROCEDURE - REFERENCE METHOD 5 (FP5)
Particulate Matter Isokinetic Sampling

C. Preparation of Collection Train

1. During the preparation and assembly of the sampling train, keep all openings covered to avoid contamination. Use parafilm to close the openings.

2. Prepare impingers according to Figure 1.

3. Tare the sample train by either

    a. Weighing the entire impinger train.
    b. Volumetrically measuring the liquid in each impinger and gravimetrically weighing the silica gel impinger.

4. Using a tweezer or clean disposable surgical gloves, place filter in the filter holder. Check the filter for tears after assembly.

5. Mark the probe with heat resistant tape (or other) to denote the proper distance into the stack or duct for each sampling point.

6. Set up the train. Turn on and set probe and filter box heaters. Place crushed ice around the impingers.

7. Leak-Check the sampling train

    a. Allow time for train temperatures to stabilize.
    b. Plug the nozzle. Fully open the bypass valve and close the coarse adjust valve. Then start the pump.
    c. Slowly close the bypass valve until the desired vacuum is reached (≥ 15 in. Hg or ≥ maximum vacuum reached during the test run.) Do not reverse direction of bypass valve; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check as shown in Step 7e, and start over.
    d. Allow the flow rate to stabilize, then determine the leakage rate using DGM readings and a watch. Record the leakage rate. Leakage rate must be ≤ 0.02 cfm or ≤ 4% of average sampling rate, whichever is less.
    e. End the leak-check as follows: first slowly remove the plug from the inlet to the prove, and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica gel from being entrained backward into the third impinger.

D. Sampling

1. Record data shown on field data sheet. Record the initial dry gas meter (DGM) reading.

2. Clean the portholes.

3. Remove the nozzle cap, verify that the filter and probe heating systems are up to temperature, and check pitot tube, temperature gauge, and probe alignments and clearances.

4. Close the coarse adjust valve. If necessary to overcome high negative stack pressure, turn on the pump. Position the nozzle at the first traverse point. Immediately start the pump, and adjust the flow to isokinetic conditions.

5. When the probe is in position, block off the openings around the probe and porthole.

6. Traverse the stack cross-section. *Do not bump the probe nozzle into the stack walls.*

    a. Keep the temperature around the filter holder (probe outlet or filter outlet, if applicable) at the proper level.
    b. Add more ice and, if necessary, salt to maintain a temperature of <68°F at the condenser / silica gel outlet.
    c. Periodically check the level and zero of the manometer.

d. Record DGM readings at the beginning and end of each sampling time increment, before and after each leak-check, and when sampling is halted.

e. Take other readings shown in field data sheet at least once at each sample point during each time increment and additional readings when significant changes (20% variation in Δp readings) necessitate additional adjustments in flow rate.

f. If train components are replaced, conduct leak-check according to Step C.7.

7. At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final DGM meter reading.

8. Leak-check the sampling train (see Step C.7).

9. Leak-check the pitot lines (see Step B.3).

10. Allow the probe to cool. Then, wipe off all external PM near the tip of the probe nozzle, and place a cap over it.

11. Before moving the sampling train to the cleanup site, remove the probe from the sampling train, wipe off the silicone grease, if used, and cap the open outlet of the probe. Do not lose any condensate that might be present. Wipe off the silicone grease from the filter inlet, and cap it.

12. Remove the umbilical cord from the last impinger, and cap the impinger. After wiping off the silicone grease, if used, cap off the filter holder outlet and impinger inlet.

13. Transfer the probe and filter-impinger assembly to the cleanup area that is clean and protected from the wind.

E. Sample Recovery

1. Place 200 mL acetone from the wash bottle being used for cleanup in a glass sample container labeled "acetone blank."

2. Inspect the train prior to and during disassembly, and note any abnormal conditions.

3. <u>Container No. 1</u> (Filter)

   a. Using a pair of tweezers and/or clean disposable surgical gloves, carefully remove the filter from the filter holder, and place it in its identified petri dish container. If necessary, fold the filter such that the PM cake is inside the fold.
   b. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to the petri dish any PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

4. <u>Container No. 2</u> (Acetone Rinses)

Recover particulate matter from the probe nozzle, Swagelok™ fitting, probe liner (use a funnel to aid in transferring liquid washes to the container), front half of the filter holder, and (if applicable) the cyclone, and recover all rinses in a glass container as follows;

a. Before cleaning the front half of filter holder, wipe clean all joints of silicone grease (if applicable).
b. Rinse with acetone, brush with a Nylon bristle brush, and rinse with acetone until there are no visible particles. Make a final acetone rinse.
c. For probe liner, repeat rinse, brush, rinse sequence at least three times for glass liners, and six times for metal liners.
d. Make a final rinse of the brush with acetone.
e. After completing the rinse, tighten the lid on the sample container. Mark the height of the fluid level. Label the container.

FIELD PROCEDURE - REFERENCE METHOD 5 (FP5)
Particulate Matter Isokinetic Sampling

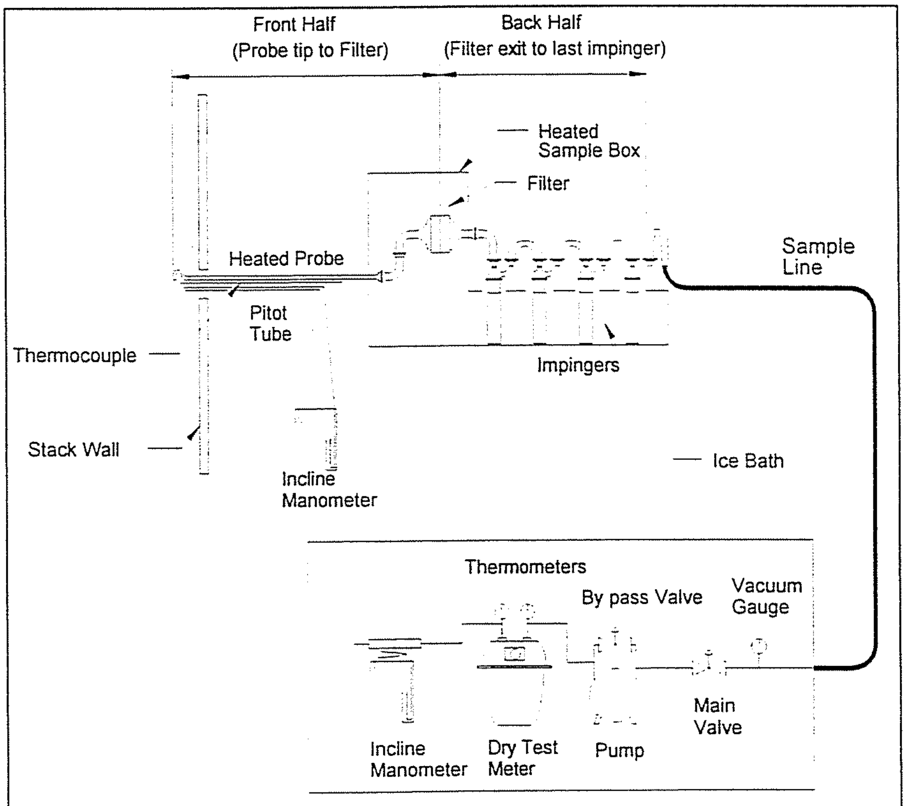
5. Container No. 3 (Silica Gel)

   a. Determine whether silica gel has been completely spent, and note on field data sheet its condition.
   b. Weigh the silica gel impinger with the other impingers to the nearest 0.5 g.

6. Impinger Water

   a. Note on field data sheet any color or film in the liquid catch.
   b. Weigh impingers 1, 2, 3 and the silica gel impinger to within ±0.5g [or measure the liquid volume in impingers 1, 2 and 3 to within ± 1 mL (with a graduated cylinder)].
   c. Discard the liquid, unless analysis of the impinger catch is required. Store as is appropriate.

7. Whenever possible, ship sample containers in an upright position.



Impinger Train

1 - Modified Greenburg Smith, 100ml of Distilled Water
2 - Standard Greenburg Smith, 100ml of Distilled Water
3 - Modified Greenburg Smith, Empty
4 - Modified Greenburg Smith, Silica Gel (200-300g)

Figure 1. Particulate Sampling Train

FIELD PROCEDURE - REFERENCE METHOD 18 (FP18)
Gaseous Organic Compound Sampling

A. Pretest Preparation

1. Gather together the test media as required for the testing. This will require a minimum of four 800/200 mg charcoal sorbent tubes per test run, and as many 1040/260 mg silica gel tubes as determined as necessary for the sources gas stream moisture content. Also needed will be a leakless sample pump capable of adjustment and calibration from approximately 10 to 100 cc/min. Flexible tubing of a material that exhibits minimal sample adsorption will be needed to connect the probe to the adsorption tubes. The probe shall be either glass or stainless steel with a plug of glass wool in the end to remove particulate matter.

B. Preliminary Determinations

1. Select the sampling site and prepare for the pretest survey. This is required in order to determine the levels of pollutants so the analyzing laboratory can spike the set of tubes for the recovery study.

2. Set up the sampling train. This requires the probe, connected to the silica gel tubes (if required due to high moisture content) and the adsorption tubes by flexible tubing. Care will be taken to minimize the run of tubing between the probe and sample media. Several adsorption tubes may be connected in line if it is determined that extra adsorptive capacity is required. See figure 1.

3. Start the pump and sample at the required sample rate. Obtain a total sample volume commensurate with the expected concentrations. Record the total time and sample flow rate, the barometric pressure, and the ambient temperature. After sampling is complete, cap the ends of the adsorption tubes, and clearly label them. These must then be shipped to the laboratory for analysis. Using the data collected during this presurvey, the laboratory will spike half of the adsorption tubes for the emission runs with the appropriate concentrations of the target analytes.

C. Preparation of Collection Train

1. During the preparation and assembly of the sampling train, keep all openings of the adsorption tubes covered until assembly to avoid contamination. Use caps to close the openings, or do not break ends until assembly.

2. Set up the sampling train. This requires the probe, connected to the silica gel tubes (if required due to high moisture content) and the adsorption tubes by flexible tubing. Care will be taken to minimize the run of tubing between the probe and sample media. Several adsorption tubes may be connected in line if it is determined that extra adsorptive capacity is required. See Figure 1.

3. Two complete sampling trains must be assembled for each test run. One train has unspiked adsorption tubes for determination of the target analyte emissions. The second train utilizes the pre-spiked tubes prepared by the laboratory. These tubes will be used in the recovery study, for determination of recovery accuracy.

D. Sampling

1. Insert the probe into the centroid of the stack, and begin sampling. Sample at the predetermined sample rate for the predetermined time. Record the start and stop times for both trains, the sample flow rate, the barometric pressure, and the ambient temperature.

FIELD PROCEDURE - REFERENCE METHOD 18 (FP18)
Gaseous Organic Compound Sampling

E. **Sample Recovery**

1. At the completion of the sampling run, carefully disassemble the sampling train. Tightly cap off the ends of all the adsorption tubes and clearly label each one with the project information, test run number, and position of the tube in the train, if multiple tubes are used.

2. Inspect the train prior to and during disassembly, and note any abnormal conditions.

3. Ship all of the sample tubes to the laboratory providing the analysis.

3. **Container No. 1** (Filter)

   a. Using a pair of tweezers and/or clean disposable surgical gloves, carefully remove the filter from the filter holder, and place it in its identified petri dish container. If necessary, fold the filter such that the PM cake is inside the fold.
   b. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to the petri dish any PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

4. **Container No. 2** (Acetone Rinses)

Recover particulate matter from the probe nozzle, Swagelok™ fitting, probe liner (use a funnel to aid in transferring liquid washes to the container), front half of the filter holder, and (if applicable) the cyclone, and recover all rinses in a glass container as follows;

   a. Before cleaning the front half of filter holder, wipe clean all joints of silicone grease (if applicable).
   b. Rinse with acetone, brush with a Nylon bristle brush, and rinse with acetone until there are no visible particles. Make a final acetone rinse.
   c. For probe liner, repeat rinse, brush, rinse sequence at least three times for glass liners, and six times for metal liners.
   d. Make a final rinse of the brush with acetone.
   e. After completing the rinse, tighten the lid on the sample container. Mark the height of the fluid level. Label the container.

5. **Container No. 3** (Silica Gel)

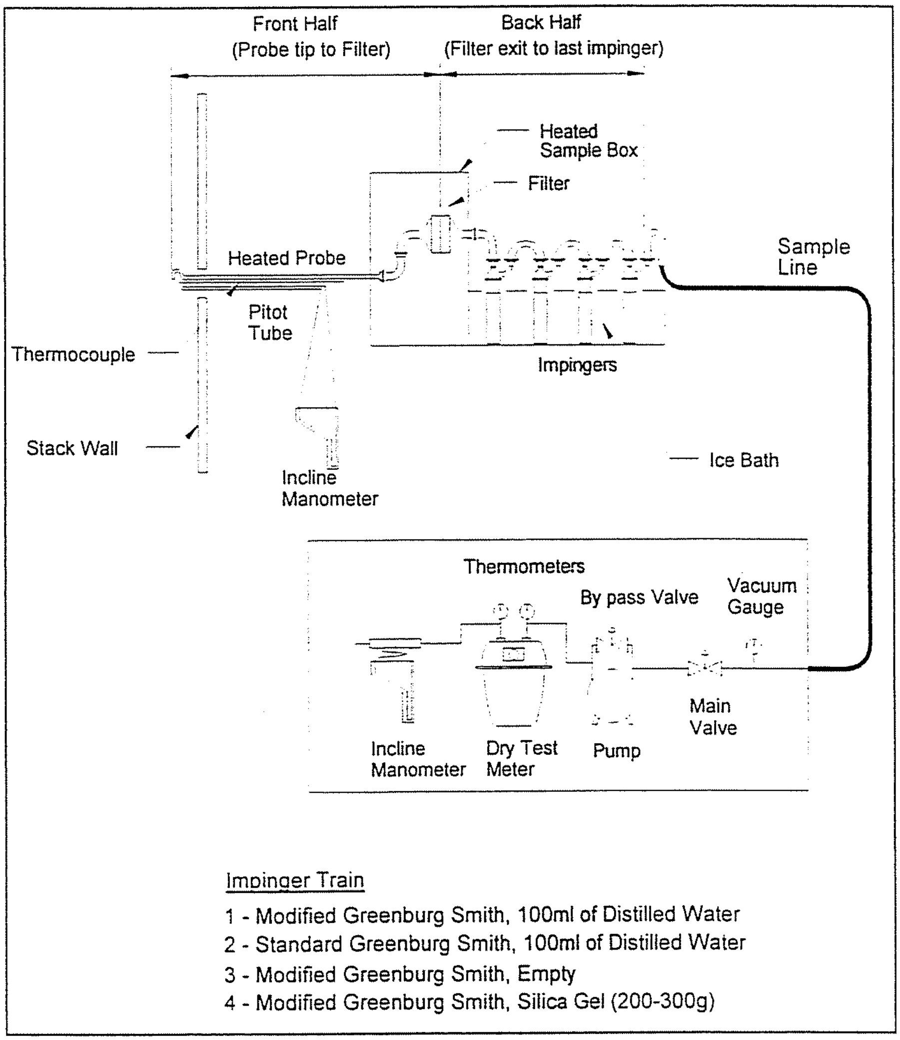
   a. Determine whether silica gel has been completely spent, and note on field data sheet its condition.
   b. Weigh the silica gel impinger with the other impingers to the nearest 0.5 g.

6. Impinger Water

   a. Note on field data sheet any color or film in the liquid catch.
   b. Weigh impingers 1, 2, 3 and the silica gel impinger to within ±0.5g [or measure the liquid volume in impingers 1, 2 and 3 to within ± 1 mL (with a graduated cylinder)].
   c. Discard the liquid, unless analysis of the impinger catch is required. Store as is appropriate.

7. Whenever possible, ship sample containers in an upright position.

FIELD PROCEDURE - REFERENCE METHOD 18 (FP18)
Gaseous Organic Compound Sampling



Impinger Train

1 - Modified Greenburg Smith, 100ml of Distilled Water
2 - Standard Greenburg Smith, 100ml of Distilled Water
3 - Modified Greenburg Smith, Empty
4 - Modified Greenburg Smith, Silica Gel (200-300g)

Figure 1. Particulate Sampling Train

C. NIOSH METHODS

HYDROCARBONS, AROMATIC

1501

FORMULA: Table 1 MW: Table 1 CAS: Table 1 RTECS: Table 1

METHOD: 1501, Issue 2

EVALUATION: PARTIAL

Issue 1: 15 February 1984
Issue 2: 15 August 1994

OSHA : Table 2
NIOSH: Table 2
ACGIH: Table 2

PROPERTIES: Table 1

COMPOUNDS: (Synonyms in Table 1) benzene, p-tert-butyltoluene, cumene, ethylbenzene, α-methylstyrene, naphthalene, styrene, toluene, vinyltoluene, xylene

SAMPLING

SAMPLER: SOLID SORBENT TUBE (coconut shell charcoal, 100 mg/50 mg)

FLOW RATE, VOLUME: Table 3

SHIPMENT: routine

SAMPLE STABILITY: not determined

BLANKS: 2 to 10 field blanks per set

BULK SAMPLE: desirable, 1 to 10 mL; ship in separate containers from samples

ACCURACY

RANGE STUDIED: Table 3

BIAS: Table 3

OVERALL PRECISION ($\hat{S}_{rT}$): Table 3

ACCURACY: Table 3

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTE: hydrocarbons listed above

DESORPTION: 1 mL CS_2; stand 30 min

INJECTION VOLUME: 5 µL

TEMPERATURE-INJECTION: 225 °C
-DETECTOR: 225 °C
-COLUMN: see step 11

CARRIER GAS: N_2 or He, 25 mL/min

COLUMN: glass, 3.0 m x 2-mm, 10% OV-275 on 100/120 mesh Chromosorb W-AW or equivalent (Table 4)

CALIBRATION: analytes in CS_2

RANGE AND PRECISION ($\hat{S}_r$): Table 4

ESTIMATED LOD: 0.001 to 0.01 mg per sample with capillary column [1]

APPLICABILITY: This method is for peak, ceiling and TWA determinations of aromatic hydrocarbons. It may be used for simultaneous measurements, though there is the possibility that interactions between analytes may reduce the breakthrough volumes and change desorption efficiencies.

INTERFERENCES: Use of the recommended column will prevent interference by alkanes ($\leq C_{10}$). Under conditions of high humidity, the breakthrough volumes may be reduced by as much as 50%. Other volatile organic solvents, e.g., alcohols, ketones, ethers, and halogenated hydrocarbons, are possible interferences. If interference is suspected, use a less polar column or change column temperature.

OTHER METHODS: This method is based on and supercedes Methods P&CAM 127, benzene, styrene, toluene and xylene [2]; S311, benzene [4]; S22, p-tert-butyltoluene [3]; S23, cumene [3]; S29, ethylbenzene [3]; S26, α-methylstyrene [3]; S292, naphthalene [4]; S30, styrene [3]; S343, toluene [4]; S25, vinyltoluene [3]; S318, xylene [4].

REAGENTS:

1. Eluent: Carbon disulfide*, chromatographic quality containing (optional) suitable internal standard.
2. Analytes, reagent grade.*
3. Nitrogen or helium, purified.
4. Hydrogen, prepurified.
5. Air, filtered.
6. Naphthalene calibration stock solution, 0.40 g/mL in CS_2.

* See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6-mm OD, 4-mm ID, flame-sealed ends, containing two sections of activated (600 °C) coconut shell charcoal (front = 100 mg, back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available.
2. Personal sampling pumps, 0.01 to 1 L/min (Table 3), with flexible connecting tubing.
3. Gas chromatograph, FID, integrator, and column (page 1501-1).
4. Vials, glass, 1-mL, with PTFE-lined caps.
5. Pipet, 1-mL, and pipet bulb.
6. Syringes, 5-, 10-, 25- and 100-µL.
7. Volumetric flasks, 10-mL

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and extremely flammable (flash point = -30 °C); benzene is a suspect carcinogen. Prepare samples and standards in a well-ventilated hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min (to 1 L/min for naphthalene or styrene) for a total sample size as shown in Table 3.
4. Cap the samplers with plastic (not rubber) caps and pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL eluent to each vial. Attach crimp cap to each vial immediately.
7. Allow to stand at least 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least six working standards over the appropriate range (ca. 0.01 to 10 mg analyte per sample; see Table 4).
    a. Add known amounts of analyte (calibration stock solution for naphthalene) to eluent in 10-mL volumetric flasks and dilute to the mark.
    b. Analyze together with samples and blanks (steps 11 through 13).
    c. Prepare calibration graph (peak area of analyte vs. mg analyte per sample).
9. Determine desorption efficiency (DE) at least once for each batch of charcoal used for sampling in the calibration range (step 8). Prepare three tubes at each of five levels plus three media blanks.

a. Remove and discard back sorbent section of a media blank sampler.
b. Inject a known amount of analyte (calibration stock solution for naphthalene) directly onto front sorbent section with a microliter syringe.
c. Cap the tube. Allow to stand overnight.
d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11 through 13).
e. Prepare a graph of DE vs. mg analyte recovered.

10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1501-1. Select appropriate column temperature:

	Approximate Retention Time (min), at Indicated Column Temperature			
Substance [a]	50 °C	100 °C	150 °C	Programmed [b]
benzene	2.5			2.5
toluene	4.3	1.1		4.2
xylene (para)	7.0	1.4		5.2
ethylbenzene	7.0	1.4		5.5
xylene (meta)	7.2	1.5		5.6
cumene	8.3	1.6		6.0
xylene (ortho)	10	1.9		6.5
styrene	16	2.6		7.6
α-methylstyrene		3.2	1.0	8.1
vinyltoluene (meta)		3.8	1.2	8.5
naphthalene		25	4.3	12

---

[a] Data not available for p-tert-butyltoluene and p-vinyltoluene.
[b] Temperature program: 50 °C for 3 min, then 15 °C/min to 200 °C.

NOTE: Alternatively, column and temperature may be taken from Table 4.

12. Inject sample aliquot manually using solvent flush technique or with autosampler.
NOTE: If peak area is above the linear range of the working standards, dilute with eluent, reanalyze and apply the appropriate dilution factor in calculations.
13. Measure peak area.

CALCULATIONS:

14. Determine the mass, mg (corrected for DE) of analyte found in the sample front (W_f) and back (W_b) sorbent sections, and in the average media blank front (B_f) and back (B_b) sorbent sections.
NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
15. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Precisions and biases listed in Table 3 were determined by analyzing generated atmospheres containing one-half, one, and two times the OSHA standard. Generated concentrations were independently verified. Breakthrough capacities were determined in dry air. Storage stability was not assessed. Measurement precisions given in Table 4 were determined by spiking sampling media with amounts corresponding to one-half, one, and two times the OSHA standard for nominal air volumes. Desorption efficiencies for spiked samplers containing only one compound exceeded 75%. Reference [9] provides more specific information.

REFERENCES:

[1] User check, UBTL, NIOSH Sequence #4121-S (unpublished, December 7, 1983).
[2] NIOSH Manual of Analytical Methods, 2nd. ed., V. 1, P&CAM 127, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1977).
[3] Ibid, V. 2, S22, S23, S25, S26, S29, S30, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-B (1977).
[4] Ibid, V. 3, S292, S311, S318, S343, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).
[5] R. D. Dreisbach. "Physical Properties of Chemical Compounds"; Advances in Chemistry Series, No. 15; American Chemical Society, Washington (1955).
[6] Code of Federal Regulations; Title 29 (Labor), Parts 1900 to 1910; U.S. Government Printing Office, Washington (1989); 29 CFR 1910.1000.
[7] NIOSH Recommendations for Occupational Safety and Health. U.S. Department of Health and Human Services. DHHS (NIOSH) Publicvation No. 92-100 (1992).
[8] 1992-1993 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH, Cincinnati, OH (1992).
[9] Documentation of the NIOSH Validation Tests, S22, S23, S25, S26, S29, S30, S292, S311, S318, S343, U.S. Department of Health, Education, and Welfare; Publ. (NIOSH) 77-185 (1977).

METHOD REVISED BY:

R. Alan Lunsford, Ph.D., based on results of NIOSH Contract CDC-99-74-45.

TABLE 1. SYNONYMS, FORMULA, MOLECULAR WEIGHT, PROPERTIES [5].

Name/Synonyms	Empirical Formula	Molecular Weight	Boiling Point (°C)	Vapor Pressure @ 25 °C (mm Hg)	(kPa)	Density @ 20 °C (g/mL)
benzene CAS #71-43-2 RTECS CY1400000	C_6H_6	78.11	80.1	95.2	12.7	0.879
p-tert-butyltoluene CAS #98-51-1 1-tert-butyl-4-methylbenzene RTECS XS8400000	$C_{11}H_{16}$	148.25	192.8	0.7	0.09	0.861
cumene CAS #98-82-8 isopropylbenzene RTECS GR8575000	C_9H_{12}	120.20	152.4	4.7	0.63	0.862
ethylbenzene CAS #100-41-4 RTECS DA0700000	C_8H_{10}	106.17	136.2	9.6	1.28	0.867
α-methylstyrene CAS #98-83-9 isopropenylbenzene (1-methylethenyl)-benzene RTECS WL5075300	C_9H_{10}	118.18	165.4	2.5	0.33	0.911
naphthalene CAS #91-20-3 RTECS QJ0525000	$C_{10}H_8$	128.18	80.2[a]	0.2	0.03	1.025
styrene CAS #100-42-5 vinylbenzene RTECS WL3675000	C_8H_8	104.15	145.2	6.1	0.81	0.906
toluene CAS #108-88-3 methylbenzene RTECS XS5250000	C_7H_8	92.14	110.6	28.4	3.79	0.867
vinyltoluene[b]	C_9H_{10}	118.18	167.7	1.6	0.22	0.898
CAS #25013-15-4	(meta)		171.6	1.9	0.26	0.911
methylstyrene (p-vinyltoluene)	(para)		172.8	1.8	0.24	0.911
methylvinylbenzene	(ortho)		169.8	1.8	0.24	0.904
RTECS WL5075000						
xylene[c]	C_8H_{10}	106.17				
CAS #1330-20-7	(ortho)		144.4	6.7	0.89	0.880
dimethylbenzene (p-xylene)	(meta)		139.1	8.4	1.12	0.864
RTECS ZE2100000	(para)		138.4	8.8	1.18	0.861

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[a] Melting point.

[b] Commercial mixture of meta and para isomers.

[c] Mixture of isomers.

TABLE 2. PERMISSIBLE EXPOSURE LIMITS, PPM [6-8].

	OSHA	NIOSH			ACGIH		mg/m^3
Substance	TWA	TWA	C	STEL	TLV	STEL	per ppm
benzene	1	0.1[c]	1		10[f]		3.19
p-tert-butyltoluene	10	10		20	1		6.06
cumene	50 (skin)	50 (skin)			50 (skin)		4.91
ethylbenzene	100	100		125	100	125	4.34
α-methylstyrene	100		50			100	50 100
4.83							
naphthalene	10	10[d]		15	10	15	5.24
styrene	100	50		100	50**	100 (skin)	4.26
toluene	200	100		150	50 (skin)		3.77
vinyltoluene	100	100			50	100	4.83
xylene	100	100[e]		150	100	150	4.34

[a] Maximum duration 10 min in 8 h.

[b] Maximum duration 5 min in any 3 h.

[c] Potential carcinogen

[d] Group III Pesticide

[e] Group I Pesticide

[f] Suspect carcinogen

TABLE 3. SAMPLING FLOWRATE[a], VOLUME, CAPACITY, RANGE, OVERALL BIAS AND PRECISION [3,4,9].

	Sampling			Breakthrough Volume @ Concentration		Range at	Overall		
	Flowrate	Volume[b] (L)				VOL-MIN	Bias	Precision	Accuracy
Substance	(L/min)	MIN	MAX	(L)	(mg/m^3)	(mg/m^3)	(%)	($\hat{S}_{rT}$)	(±%)
benzene	≤0.20	5	30	>45	149	42- 165	-0.4	0.059	11.4
p-tert-butyltoluene	≤0.20	1	29	44	112	29- 119	-10.3	0.071[d]	20.7
cumene	≤0.20	1	30	>45	480	120- 480	5.6	0.059	15.2
ethylbenzene	≤0.20	1	24	35	917	222- 884	-7.6	0.089[d]	17.1
α-methylstyrene	≤0.20	1	30	>45	940	236- 943	-7.6	0.061[d]	16.9
naphthalene[e]	≤1.0	100	200	>240	81	19- 83	-2.6	0.055	11.5
styrene	≤1.0	1	14	21	1710	426-1710	-7.9	0.058[d]	16.7
toluene	≤0.20	1	8	12	2294	548-2190	1.6	0.052	10.9
vinyltoluene	≤0.20	1	24	36	952	256- 970	-7.0	0.061[d]	16.3
xylene	≤0.20	2	23	35	870	218- 870	-1.2	0.060	12.2

[a] Minimum recommended flow is 0.01 L/min.

[b] V_{Min} = minimum sample volume @ OSHA TWA;
V_{Max} = maximum sample volume @ OSHA TWA

[c] 10-min sample.

[d] Corrected value, calculated from data in Reference 9.

[e] Naphthalene shows poor desorption efficiency at low loading; 100-L minimum volume is recommended.

[f] 15-min sample.

[g] 5-min sample.

TABLE 4. MEASUREMENT RANGE, PRECISION AND CONDITIONS[a] [3,4,9].

Substance	Desorption Volume (mL)	Measurement Range (mg)	Measurement Precision ($\bar{S}_r$)	Carrier Flow (mL/min)	Column Parameters[b] t (°C)	Column Parameters[b] Length (m)	Column Parameters[b] Packing[c]
benzene	1.0	0.09- 0.35	0.036	50	115	0.9	A
p-tert-butyltoluene	0.5	0.27- 1.09	0.021[d]	50	115	3.0	B
cumene	0.5	0.86- 3.46	0.010	50	99	3.0	B
ethylbenzene	0.5	2.17- 8.67	0.010	50	85	3.0	B
α-methylstyrene	0.5	0.69- 3.57	0.011	50	115	3.0	B
naphthalene	1.0	4.96-19.7	0.019	30	125	3.0	C
styrene	0.5	2.17- 8.49	0.013[d]	50	109	3.0	B
toluene	1.0	1.13- 4.51	0.011	50	155	0.9	D
vinyltoluene	0.5	2.41- 9.64	0.008	50	120	3.0	B
xylene	1.0	2.60-10.4	0.010	50	180	0.9	D

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[a] Injection volume, 5.0 µL; nitrogen carrier gas.

[b] All columns stainless steel, 3.2-mm outside diameter.

[c] A, 50/80 mesh Porapak P; B, 10% FFAP on 80/100 mesh Chromosorb W AW-DMCS; C, 10% OV-101 on 100/120 mesh Supelcoport; D, 50/80 mesh Porapak Q.

[d] Corrected value, calculated from data in [9].

HYDROCARBONS, HALOGENATED 1003

Table 1 MW: Table 1 CAS: Table 1 RTECS: Table 1

METHOD: 1003, Issue 2 **EVALUATION:** PARTIAL

Issue 1: 15 February 1984
Issue 2: 15 August 1994

OSHA : See TABLE 1
NIOSH: See TABLE 1
ACGIH: See TABLE 1

PROPERTIES: See TABLE 2

COMPOUNDS: (synonyms in Table 1)

benzyl chloride
bromoform
carbon tetrachloride
chlorobenzene
chlorobromomethane
chloroform
o-dichlorobenzene
p-dichlorobenzene
1,1-dichloroethane
1,2-dichloroethylene
ethylene dichloride
hexachloroethane
1,1,1-trichloroethane
tetrachloroethylene
1,1,2-trichloroethane
1,2,3-trichloropropane

SAMPLING

SAMPLER: SOLID SORBENT TUBE (coconut shell charcoal, 100 mg/50 mg)

FLOW RATE: 0.01 to 0.2 L/min

VOL-MIN: Table 3
-MAX: Table 3

SHIPMENT: routine

SAMPLE STABILITY: not determined

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: see EVALUATION OF METHOD [1]

BIAS: see EVALUATION OF METHOD [1]

OVERALL PRECISION ($\hat{S}_{rT}$): see EVALUATION OF METHOD [1]

ACCURACY: see EVALUATION OF METHOD [1]

MEASUREMENT

TECHNIQUE: GAS CHROMATOGRAPHY, FID

ANALYTE: compounds above

DESORPTION: 1 mL CS_2, stand 30 min

INJECTION VOLUME: 5 µL

TEMPERATURES: Table 4

CARRIER GAS: N_2 or He, 30 mL/min

COLUMN: Table 4; alternates are SP-2100, Sp-2100 with 0.1% Carbowax 1500 or DB-1 fused silica capillary column

CALIBRATION: standard solutions of analyte in CS_2

RANGE: Table 4

ESTIMATED LOD: 0.01 mg per sample [2]

PRECISION ($\hat{S}_r$): see EVALUATION OF METHOD

APPLICABILITY: See Table 3 for working ranges. This method can be used for simultaneous determination of two or more substances suspected to be present by changing gas chromatographic conditions (i.e., temperature program). High humidity during sampling will prevent organic vapors from being trapped efficiently on the sorbent and greatly decreases breakthrough volume.

INTERFERENCES: None identified. The chromatographic column or separation conditions may be changed to circumvent interferences.

OTHER METHODS: This method combines and replaces P&CAM 127 [3], S101 [4], S110 [5], S113 [6], S114 [7], S115 [8], S122 [9], S123 [10], S126 [11], S133 [12], S134 [13], S135 [14], S281 [15], S314 [16], S328 [17], S335 [18], S351 [19], and Method 1003 (dated 2/15/84).

REAGENTS:

1. Carbon disulfide, chromatographic quality.*
2. Analyte, reagent grade.
3. Calibration stock solutions:
    a. benzyl chloride, 10 mg/mL in n-heptane.
    b. bromoform, 10 mg/mL in n-hexane.
    c. o-dichlorobenzene, 200 mg/mL in acetone.
    d. p-dichlorobenzene, 300 mg/mL in acetone.
    e. hexachloroethane, 25 mg/mL in toluene.
4. Decane, n-undecane, octane or other internal standards (see step 6).
5. Nitrogen or helium, purified.
6. Hydrogen, prepurified.
7. Air, filtered.

* See SPECIAL PRECAUTIONS.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and a serious fire and explosion hazard (flash point = -30 °C). Work with it only in a hood. Several of the analytes are suspect carcinogens (Table 1). n-Heptane, n-hexane, and acetone are fire hazards.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6-mm OD, 4-mm ID, flame-sealed ends with plastic caps, containing two sections of 20/40 mesh activated (600 °C) coconut shell charcoal (front = 100 mg; back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available (e.g., SKC #226-01).
2. Personal sampling pump, 0.01 to 0.2 L/min, with flexible connecting tubing.
3. Gas chromatograph, FID, integrator and column (see Table 3).
4. Vials, 2-mL, glass, PTFE-lined septum crimp caps.
5. Volumetric flasks, 10-mL.
6. Syringes, 10-µL, readable to 0.1 µL.
7. Pipet, TD, 1-mL, with pipet bulb.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size between the limits shown in Table 2.
4. Cap the samplers. Pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL CS_2 to each vial. Cap each vial.
    NOTE: A suitable internal standard, such as decane [16], n-undecane [6,19], or octane [9,13,17] at 0.1% (v/v) may be added at this step and step 8.
7. Allow to stand 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least six working standards over the appropriate range (Table 3).
    a. Add known amounts of neat analyte or calibration stock solution to CS_2 in 10-mL volumetric flasks and dilute to the mark.
    b. Analyze with samples and blanks (steps 11 and 12).
    c. Prepare calibration graph (peak area vs. mg analyte).
9. Determine desorption efficiency (DE) at least once for each lot of charcoal used for sampling in the range of interest. Prepare three tubes at each of five concentrations plus three media blanks.

a. Remove and discard back sorbent section of a media blank sampler.
b. Inject a known amount (2 to 20 µL) of pure analyte, or calibration stock solution (see REAGENTS, 3.), directly onto front sorbent section with a microliter syringe.
c. Cap the tube. Allow to stand overnight.
d. Desorb (steps 5 through 7) and analyze together with working standards (steps 11 and 12).
e. Prepare a graph of DE vs. mg analyte recovered.

10. Analyze three quality control blind spikes and three analyst spikes to insure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1003-1 and in Table 3. Inject sample aliquot either manually using solvent flush technique or with autosampler.
NOTE: If peak area is above the linear range of the working standards, dilute with CS_2, reanalyze and apply the appropriate dilution factor in calculations.

12. Measure peak area.

CALCULATIONS:

13. Determine the mass, mg (corrected for DE), of analyte found in the sample front (W_f) and back (W_b) sorbent sections and in the average media blank front (B_f) and back (B_b) sorbent sections.
NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.

14. Calculate concentration, C, of analyte in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \ mg/m^3.$$

EVALUATION OF METHOD:

Laboratory testing was performed with spiked samples and generated atmospheres using SKC Lot 105 coconut shell charcoal [1]. Results were:

Compound	Range mg/m^3	Sample Size	Bias %	Precision		Accuracy ±%	Desorption Efficiency	Ref.
				Overall	Measurement			
Benzyl chloride	2-8	10 L	-8.4	0.096	0.031	25.6	0.90 @ 0.03-0.1 mg	[8]
Bromoform	3-10	10 L	-1.3	0.071	0.043	14.0	0.80 @ 0.025 mg	[7]
Carbon tetrachloride	65-299	15 L	-1.6	0.092	0.037	18.0	0.96 @ 1.3-4.8 mg	[16]
Chlorobenzene	183-736	10 L	0.3	0.056	0.025	11.0	0.91 @ 1.8-7.1 mg	[12]
Chlorobromomethane	640-2655	5 L	3.4	0.061	0.051	14.0	0.94 @ 3.3-13 mg	[6]
Chloroform	100-416	15 L	1.3	0.057	0.047	11.6	0.97 @ 1.8-7.4 mg	[19]
o-Dichlorobenzene	150-629	3 L	-1.9	0.068	0.013	13.7	0.86 @ 0.5-1.9 mg	[14]
p-Dichlorobenzene	183-777	3 L	-4.3	0.052	0.022	12.5	0.91 @ 0.7-2.7 mg	[15]
1,1-Dichloroethane	212-838	10 L	2.6	0.057	0.011	12.4	1.01 @ 1.9-8 mg	[10]
1,2-Dichloroethylene*	475-1915	3 L	-2.9	0.052	0.017	11.3	1.00 @ 2.4-9.5 mg	[5]
Ethylene dichloride	195-819	3 L	-2.0	0.079	0.012	15.7	0.96 @ 0.6-2.5 mg	[9]
Hexachloroethane	5-25	10 L	-6.6	0.121	0.014	25.4	0.98 @ 0.05-0.2 mg	[4]
1,1,1-Trichloroethane	904-3790	3 L	-0.6	0.054	0.018	10.6	0.99 @ 2.9-11 mg	[17]
Tetrachloroethylene	655-2749	3 L	-7.2	0.052	0.013	15.1	0.96 @ 2.1-8 mg	[18]
1,1,2-Trichloroethane	26-111	10 L	-9.0	0.057	0.010	17.5	0.97 @ 0.3-1.2 mg	[13]
1,2,3-Trichloropropane	163-629	10 L	2.1	0.068	0.027	14.2	0.95 @ 1.5-6 mg	[11]

*isomer used (i.e., cis- or trans-) in evaluation unknown.

REFERENCES:

[1] Documentation of the NIOSH Validation Tests, S101, S110, S113, S114, S115, S122, S123, S126, S133, S134, S135, S281, S314, S328, S335, S351, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977), available as Stock No. PB 274-248 from NTIS, Springfield, VA 22161.

[2] User check, UBTL, NIOSH Sequences #3990-T, 3990-U and 3990-W (NIOSH, unpublished, November 3, 1983) and 4304-J (NIOSH, unpublished, April 3, 1984).

[3] NIOSH Manual of Analytical Methods, 2nd ed., V. 1., P&CAM 127, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1977).

[4] Ibid., V. 2., S101, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-B (1977).

[5] Ibid., S110.

[6] Ibid., S113.

[7] Ibid., S114.

[8] Ibid., S115.

[9] Ibid., S122.

[10] Ibid., S123.

[11] Ibid., S126.

[12] Ibid., S133.

[13] Ibid., S134.

[14] Ibid., V. 3, S135, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).

[15] Ibid., S281.

[16] Ibid., S314.

[17] Ibid., S328.

[18] Ibid., S335.

[19] Ibid., S351.

[20] NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, U.S. Department of Health and Human Services, Publ. (NIOSH) 81-123 (1981), available as Stock #PB83-154609 from NTIS, Springfield, VA 22161.

[21] NIOSH Current Intelligence Bulletin 27, Chloroethanes: Review of Toxicity, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-181 (1978).

[22] NIOSH Current Intelligence Bulletin 20, Tetrachloroethylene (Perchloroethylene), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-112 (1978).

[23] Criteria for a Recommended Standard...Occupational Exposure to Benzyl Chloride, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-182 (1978).

[24] Criteria for a Recommended Standard...Occupational Exposure to Carbon Tetrachloride, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-133 (1976).

[25] Criteria for a Recommended Standard...Occupational Exposure to Chloroform, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 75-114 (1975).

[26] Criteria for a Recommended Standard...Occupational Exposure to Ethylene Dichloride, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-139 (1976).

[27] Criteria for a Recommended Standard...Occupational Exposure to 1,1,1-Trichloroethane, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-184 (1976).

[28] Criteria for a Recommended Standard...Occupational Exposure to Tetrachloroethylene (Perchloroethylene), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 76-185 (1976).

METHOD REVISED BY:

G. David Foley and Yvonne T. Gagnon, NIOSH/DPSE; methods originally validated under NIOSH Contract CDC-99-74-45.

TABLE 1. GENERAL INFORMATION.

Compound RTECS	Synonyms	OSHA/NIOSH/ACGIH (ppm)
Benzyl chloride[a] ($C_5H_5CH_2Cl$); XS8925000	(chloromethyl) benzene; α-chlorotoluene; CAS #100-44-7	1/C 1.0/1
Bromoform ($CHBr_3$); PB5600000	tribromomethane; CAS #75-25-2	0.5 (skin)/0.5 (skin)/0.5 (skin)
Carbon tetrachloride[ab] (CCl_4); FG4900000	tetrachloromethane; CAS #56-23-5	10, C 25/STEL 2 (1 h)/5 (skin)
Chlorobenzene (C_5H_5Cl); CZ0175000	monochlorobenzene; phenyl chloride; CAS #108-90-7	75/--/10
Chlorobromomethane (CH_2BrCl); PA5250000	bromochloromethane; Halon 1011; CAS #74-97-5	200/200/200
Chloroform[ab] ($CHCl_3$); FS9100000	trichloromethane; CAS #67-66-3	C 50/STEL 2/10
o-Dichlorobenzene[c] ($1,2\text{-}C_6H_4Cl_2$); CZ4500000	1,2-dichlorobenzene; CAS #95-50-1	50/C 50/25 (skin); STEL 50
p-Dichlorobenzene[ac] ($1,4\text{-}C_6H_4Cl_2$); CZ45500000	1,4-dichlorobenzene; CAS #106-46-7	75/1.7 (LOQ)/75, STEL 110
1,1-Dichloroethane (CH_3CHCl_2); KI0175000	ethylidene chloride; CAS #75-34-3	100/100/100
1,2-Dichloroethylene ($ClCH{=}CHCl$); KV9360000	acetylene dichloride; 1,2-dichloroethene; CAS #540-59-0	200/200/200
Ethylene dichloride[ab] ($ClCH_2CH_2Cl$); KI0525000	1,2-dichloroethane; CAS #107-06-2	50, C 100/1, STEL 2/10
Hexachloroethane[ac] (CCl_3CCl_3); KI4025000	perchloroethane; CAS #67-72-1	1 (skin)/1/1 (skin)
1,1,1-trichloroethane (CH_3CCl_3); KJ2975000	methyl chloroform; CAS #71-55-6	350/C 350/350, STEL 450
Tetrachloroethylene[ab] ($Cl_2C{=}CCl_2$); KX3850000	perchloroethylene; CAS #127-18-4	100, C 200, P 300/0.4 (LOQ)/ 25, STEL 100
1,1,2-Trichloroethane[ad] (Cl_2CHCH_2Cl); KJ3150000	vinyl trichloride; CAS #79-00-5	10 (skin)/10 (skin)/10 (skin)
1,2,3-Trichloropropane[a] ($CH_2ClCHClCH_2Cl$); TZ9275000	allyl trichloride; glycerol trichlorohydrin; CAS #96-18-4	50/10 (skin)/10 (skin)

[a] Suspect carcinogen [20,21,22]; [b] Group I Pesticide; [c] Group II Pesticide; [d] Group III Pesticide

TABLE 2. PHYSICAL PROPERTIES

Compound RTECS	M.W.	mg/m^3 = 1 ppm @ NTP	Synonyms	Properties
Benzyl chloride ($C_6H_5CH_2Cl$)	126.58	5.17	(chloromethyl) benzene; -chlorotoluene	liquid; BP 179 °C; MP -48 to -43 °C; d 1.100 @ 20 °C; flash pt. 67 °C
Bromoform ($CHBr_3$)	252.75	10.33	tribromomethane	liquid, d 2.887; BP 148 °C; nonflammable
Carbon tetrachloride (CCl_4)	153.84	6.29	tetrachloromethane	liquid; d 1.585; BP 76.7 °C; FP -23.0 °C; VP 91.3 mm @ 20 °C; vapor density (air = 1) 5.3
Chlorobenzene (C_6H_5Cl)	112.56	4.60	monochlorobenzene; phenyl chloride	liquid; d 1.105 @ 25 °C; BP 131.6 °C; MP -45 °C; flash pt. 29.4 °C (CC)
Chlorobromomethane (CH_2BrCl)	129.39	5.29	bromochloromethane; Halon 1011	liquid; d 1.93 @ 20 °C; BP 68 °C; MP -88 °C; nonflammable
Chloroform ($CHCl_3$)	119.39	4.88	trichloromethane	liquid, d 1.485 @ 20 °C; BP 61.2 °C; FP -63.5 °C
o-Dichlorobenzene ($1,2-C_6H_4Cl_2$)	147.00	6.01	1,2-dichlorobenzene	liquid; d 1.284; BP 172 to 179 °C; FP -17 °C; flash pt. 65.5 °C
p-Dichlorobenzene ($1,4-C_6H_4Cl_2$)	147.00	6.01	1,4-dichlorobenzene	solid crystals; d 1.458; BP 173.7 °C; MP 53 °C; sublimes; flash pt. 65.5 °C
1,1-Dichloroethane (CH_3CHCl_2)	98.95	4.05	ethylidene chloride	liquid, d 1.174 @ 20 °C; BP 57 to 59 °C; FP -98 °C
1,2-Dichloroethylene ($ClCH=CHCl$)	96.94	3.96	acetylene dichloride; 1,2-dichloroethene	liquid; transisomer; d 1.257; BP 47 to 49 °C; MP -57°C; cis-isomer; d 1.282; BP 58 to 60 °C; flash pt. 3.9 °C; FP -80 °C
Ethylene dichloride ($ClCH_2CH_2Cl$)	98.96	4.05	1,2-dichloroethane	liquid; d 1.2554 @ 20 °C; BP 83.5 °C; FP -35.5 °C; flash pt. 13 °C; explosive limits in air 6 to 16%
Hexachloroethane (CCl_3CCl_3)	236.74	9.66	perchloroethane	solid; d 2.091; MP 185 °C; BP sublimes at 187 °C
1,1,1-trichloroethane (CH_3CCl_3)	133.42	5.45	methyl chloroform	liquid; d 1.325; BP 75 °C; FP -30.4 °C; nonflammable
Tetrachloroethylene ($Cl_2C=CCl_2$)	165.83	6.78	perchloroethylene	liquid; d 1.625 @ 20 °C; BP 121 °C; FP -22.4 °C
1,1,2-Trichloroethane (Cl_2CHCH_2Cl)	133.41	5.45	vinyl trichloride	liquid; d 1.4432 @ 20 °C; BP 113.7 °C; FP -36.4 °C; VP 19 mm Hg @ 20 °C
1,2,3-Trichloropropane ($CH_2ClCHClCH_2Cl$)	147.43	6.03	allyl trichloride; glycerol trichlorohydrin	liquid; d 1.3888 @ 20 °C; BP 156.2 °C; FP -15 °C; flash pt. 82.2 °C (OC)

TRICHLOROETHYLENE

1022

$CCl_2{=}CHCl$ MW: 131.39 CAS: 79-01-6 RTECS: KX4550000

METHOD: 1022, Issue 2 **EVALUATION:** PARTIAL

Issue 1: 15 August 1987
Issue 2: 15 August 1994

OSHA :	100 ppm; C 200 ppm; P 300 ppm	**PROPERTIES:**	liquid; d 1.46 g/mL @ 20 °C; BP 87 °C; MP -86 °C; VP 9.9 kPa (74 mm Hg; 9.8% v/v) @ 25 °C; explosive range 11 to 41% v/v in air
NIOSH:	25 ppm; C 2 ppm/1 h (waste anesthetic); suspect carcinogen; Group 1 Pesticide		
ACGIH:	50 ppm; STEL 200 ppm; suspect carcinogen (1 ppm = 5.37 mg/m^3 @ NTP)		

SYNONYMS: trichloroethene; ethylene trichloride; triclene

SAMPLING

SAMPLER:	SOLID SORBENT TUBE (coconut shell charcoal, 100 mg/50 mg)
FLOW RATE:	0.01 to 0.2 L/min
VOL-MIN:	1 L @ 100 ppm
-MAX:	30 L
SHIPMENT:	routine
SAMPLE STABILITY:	not determined
BLANKS:	2 to 10 field blanks per set

ACCURACY

RANGE STUDIED:	477 to 2025 mg/m^3 (3.4-L samples) [1]
BIAS:	- 7.19%
OVERALL PRECISION ($\hat{S}_{rT}$):	0.082 [1]
ACCURACY:	± 19.78%

MEASUREMENT

TECHNIQUE:	GAS CHROMATOGRAPHY, FID
ANALYTE:	trichloroethylene
DESORPTION:	1 mL CS_2; stand 30 min
INJECTION VOLUME:	5 µL
TEMPERATURE-INJECTION:	225 °C
-DETECTOR:	250 °C
-COLUMN:	70 °C
CARRIER GAS:	N_2, 30 mL/min
COLUMN:	3 m x 3-mm OD stainless steel, packed with 10% OV-101 on 100/200 mesh Chromosorb WHP
CALIBRATION:	standard solutions of trichloroethylene in CS_2
RANGE:	0.5 to 10 mg per sample
ESTIMATED LOD:	0.01 mg per sample [2]
PRECISION ($\bar{S}_r$):	0.038 @ 1.6 to 6.4 mg per sample [1]

APPLICABILITY: The working range is 27 to 875 ppm (150 to 4700 mg/m ^{3}) for a 3.4-L air sample. The method is applicable to STEL determinations. The method was used for samples containing 0.5 to 5 mg trichloroethylene from a tool-degreasing operation [2].

INTERFERENCES: None studied. Alternate columns which have been used are stainless steel, 6 m x 3 mm OD, packed with 10% SP-1000 on 80/100 mesh Supelcoport [2] and fused silica capillary, 60 m x 0.32 mm, coated with 0.25 µm OV-351 [3].

OTHER METHODS: This combines and revises methods S336 [4] and P&CAM 127 [5]. The criteria document method is similar [6]. NIOSH Method 3701 uses a portable gas chromatograph for field readout.

REAGENTS:

1. Carbon disulfide (CS_2), chromatographic quality.*
2. Trichloroethylene (TCE), reagent grade.*
3. Nitrogen, purified.
4. Hydrogen, prepurified.
5. Air, filtered, compressed.

* See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: glass tube, 7 cm long, 6-mm OD, 4-mm ID, flame-sealed ends with plastic caps, containing two sections of 20/40 mesh activated (600 °C) coconut shell charcoal (front = 100 mg; back = 50 mg) separated by a 2-mm urethane foam plug. A silylated glass wool plug precedes the front section and a 3-mm urethane foam plug follows the back section. Pressure drop across the tube at 1 L/min airflow must be less than 3.4 kPa. Tubes are commercially available.
2. Personal sampling pump, 0.01 to 0.2 L/min, with flexible connecting tubing.
3. Gas chromatograph, flame ionization detector, integrator, and column (see page 1022-1).
4. Vials, 2-mL, PTFE-lined septum caps.
5. Syringes, 10-µL, readable to 0.1 µL.
6. Volumetric flasks, 10-mL.
7. Pipet, TD, 1-mL.

SPECIAL PRECAUTIONS: Carbon disulfide is toxic and a serious fire and explosion hazard (flash point = -30 °C). Trichloroethylene is a suspect carcinogen and a narcotic [6,7,8]. Work with these substances only in a hood.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line.
2. Break the ends of the sampler immediately before sampling. Attach sampler to personal sampling pump with flexible tubing.
3. Sample at an accurately known flow rate between 0.01 and 0.2 L/min for a total sample size of 1 to 30 L.
4. Cap the samplers. Pack securely for shipment.

SAMPLE PREPARATION:

5. Place the front and back sorbent sections of the sampler tube in separate vials. Discard the glass wool and foam plugs.
6. Add 1.0 mL CS_2 to each vial. Cap each vial.
   NOTE: A suitable internal standard, such as ethylbenzene [1], undecane [2], or octane [3] at 0.1% (v/v) may be added at this step.
7. Allow to stand 30 min with occasional agitation.

CALIBRATION AND QUALITY CONTROL:

8. Calibrate daily with at least six working standards.
   a. Add known amounts of TCE to CS_2 in 10-mL volumetric flasks and dilute to the mark. Use serial dilutions as needed to obtain TCE concentrations in the range 0.01 to 10 mg/mL.
   b. Analyze with samples and blanks (steps 11 and 12).
   c. Prepare calibration graph (peak area vs. mg TCE).

9. Determine desorption efficiency (DE) at least once for each lot of sorbent used for sampling in the range of interest. Prepare three tubes at each of five concentrations plus three media blanks.
   a. Remove and discard back sorbent section of a media blank sampler.
   b. Inject a known amount (2 to 20 µL) of TCE, or a standard solution thereof in CS_2, directly onto front sorbent section with a microliter syringe.
   c. Cap the tube. Allow to stand overnight.
   d. Desorb (steps 5 through 7) and analyze with working standards (steps 11 and 12).
   e. Prepare a graph of DE vs. mg TCE recovered.
10. Analyze three quality control blind spikes and three analyst spikes to ensure that the calibration graph and DE graph are in control.

MEASUREMENT:

11. Set gas chromatograph according to manufacturer's recommendations and to conditions given on page 1022-1. Inject sample aliquot manually using solvent flush technique or with autosampler.
    NOTE: If peak area is above the linear range of the working standards, dilute an aliquot of the desorbed liquid with CS_2, reanalyze, and apply the appropriate dilution factor in calculations.
12. Measure peak area.

CALCULATIONS:

13. Determine the mass, mg (corrected for DE) of TCE found in the sample front (W_f) and back (W_b) sorbent sections and in the average media blank front (B_f) and back (B_b) sorbent sections.
    NOTE: If $W_b > W_f/10$, report breakthrough and possible sample loss.
14. Calculate concentration, C, of TCE in the air volume sampled, V (L):

$$C = \frac{(W_f + W_b - B_f - B_b) \cdot 10^3}{V}, \text{ mg/m}^3.$$

EVALUATION OF METHOD:

Method S336 was issued on June 6, 1975 [4], and validated with generated atmospheres using a calibrated syringe drive [1]. Average recoveries were 92 to 94% (16 samples) in the range 477 to 2025 mg/m^3 for 3.4-L samples. Breakthrough volume of 18.5 L (effluent = 5% of test concentration) occurred after sampling for 99 min at 0.187 L/min from an atmosphere containing 2266 mg/m^3 trichloroethylene in dry air. Desorption efficiency for SKC Lot 105 activated coconut charcoal in the range 1.6 to 6.4 mg per sample averaged 96.4% with $\bar{S}_r$ = 0.7% (18 samples). n-Octane was used as an internal standard in the chromatographic measurements. The semi-quartile ranges of desorption efficiencies in two rounds of the Proficiency Analytical Testing (PAT) program were 0.97 to 1.0 for charcoal tubes spiked with 0.6 to 1.1 mg trichloroethylene [9].

REFERENCES:

[1] Documentation of the NIOSH Validation Tests, S336, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-185 (1977), available at Stock No. PB 274-248 from NTIS, Springfield, VA 22161.
[2] UBTL Report for NIOSH Sequence #4266-R (NIOSH, unpublished, March 26, 1984).
[3] UBTL Report for NIOSH Sequence #4266-N (NIOSH, unpublished, March 14, 1984).

[4] NIOSH Manual of Analytical Methods, 2nd ed., Vol. 3, S336, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-C (1977).
[5] Ibid., Vol. 1., P&CAM 127, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 77-157-A (1977).
[6] Criteria for a Recommended Standard...Occupational Exposure to Trichloroethylene, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 73-11025 (1973).
[7] NIOSH Current Intelligence Bulletin 2, Trichloroethylene (TCE), NIOSH (June 6, 1975), U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-127 (1978).
[8] Special Occupational Hazard Review with Control Recommendations -- Trichloroethylene, U.S. Department of Health, Education, and Welfare, Publ. (NIOSH) 78-130 (1978).
[9] Groff, J. Personal communication, NIOSH (July, 1985).

METHOD REVISED BY:

G. David Foley, NIOSH/DPSE.

D. SCREEN 3 MODEL ANALYSIS

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                                                                  08/03/99
                                                                  09:45:27
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 95250 ***

 TPS Technologies Soil Remediation Unit

 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE              =        POINT
    EMISSION RATE (G/S)      =      1.00000
    STACK HEIGHT (M)         =      11.4000
    STK INSIDE DIAM (M)      =       1.2200
    STK EXIT VELOCITY (M/S)=        29.4872
    STK GAS EXIT TEMP (K)    =    1171.9000
    AMBIENT AIR TEMP (K)     =     293.0000
    RECEPTOR HEIGHT (M)      =       1.5000
    URBAN/RURAL OPTION       =        URBAN
    BUILDING HEIGHT (M)      =       4.1150
    MIN HORIZ BLDG DIM (M) =         3.5050
    MAX HORIZ BLDG DIM (M) =        18.2880

    STACK EXIT VELOCITY WAS CALCULATED FROM
    VOLUME FLOW RATE =    73038.000     (ACFM)

 BUOY. FLUX =   80.694 M**4/S**3;  MOM. FLUX =   80.891 M**4/S**2.

 *** FULL METEOROLOGY ***
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 *** CAVITY CALCULATION - 1 ***          *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)       =    .0000          CONC (UG/M**3)       =    .0000
  CRIT WS @10M (M/S) =    99.99          CRIT WS @10M (M/S) =    99.99
  CRIT WS @ HS (M/S) =    99.99          CRIT WS @ HS (M/S) =    99.99
  DILUTION WS (M/S)  =    99.99          DILUTION WS (M/S)  =    99.99
  CAVITY HT (M)      =     6.29          CAVITY HT (M)      =     4.14
  CAVITY LENGTH (M)  =    19.74          CAVITY LENGTH (M)  =     5.06
  ALONGWIND DIM (M)  =     3.51          ALONGWIND DIM (M)  =    18.29

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S.  CONC SET = 0.0

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION       MAX CONC    DIST TO   TERRAIN
  PROCEDURE       (UG/M**3)    MAX (M)    HT (M)
--------------   -----------   -------   -------
SIMPLE TERRAIN     8.771        1576.        0.

***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
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