SITE PROGRAM DEMONSTRATION
ECO LOGIC INTERNATIONAL
GAS-PHASE CHEMICAL REDUCTION PROCESS
BAY CITY, MICHIGAN

TECHNOLOGY EVALUATION REPORT

prepared for
Foster Wheeler Enviresponse, Inc.
Edison, New Jersey 08837

by
Energy and Environmental Research Corporation
Irvine, California 92718

Under Foster Wheeler Enviresponse Inc. Purchase Order Numbers
VN1-330-480000 and VN5-740-480000
EPA Contract No. 68-C9-0033

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July 15, 1994

NOTICE

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FOREWORD

The Superfund Innovative Technology Evaluation (SITE) Program was authorized in the 1986 Superfund amendments. The program is a joint effort between EPA's Office of Research and Development and Office Solid Waste and Emergency Response. The purpose of the program is to assist the development of hazardous waste treatment technologies necessary to implement new cleanup standards which require greater reliance on permanent remedies. This is accomplished through technology demonstrations that are designed to provide engineering and cost data on selected technologies.

The SITE Program funded a field demonstration to evaluate the Eco Logic Gas-Phase Chemical Reduction Process developed by ELI Eco Logic International Inc. (ELI), Ontario, Canada. The Demonstration took place at the Middleground Landfill in Bay City, Michigan using landfill waste. The Demonstration effort assessed the technology's ability to treat hazardous wastes, based on performance and cost. Three reports contain the results of the Demonstration: this Technology Evaluation Report, which describes the field activities and presents the results including a performance evaluation; an Applications Analysis Report, which interprets the data and discusses the applicability of the technology to liquid feedstocks; and an independent Applications Analysis Report, which interprets the data and discusses the applicability of the thermal desorption unit (TDU) to soil feedstocks. Two independent demonstration bulletins, previously published by EPA, presented preliminary information on the reactor and TDU tests, respectively.

Additional copies of this report may be obtained at no charge from EPA's Center for Environmental Research Information, 26 West Martin Luther King Drive, Cincinnati, Ohio, 45268. Requests should include the EPA document number found on the report's front cover. When this supply is exhausted, additional copies can be purchased from the National Technical Information Service, Ravensworth Bldg., Springfield, VA, 22161, (702) 487-4600. Reference copies will be available at EPA libraries in their Hazardous Waste Collection. To inquire about the availability of other reports, call the SITE Clearinghouse Hotline at 1-800-424-9396 or (202) 382-3000 in Washington, DC.

E. Timothy Oppelt, Director
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ABSTRACT

The SITE Program demonstration of the ELI Eco Logic Gas-Phase Chemical Reduction Process was conducted to obtain reliable performance and cost data required to evaluate the applicability of the technology for remediating hazardous waste sites. The Demonstration took place at the Middleground Landfill in Bay City, Michigan.

The ELI process reacts complex high-molecular-weight organic contaminants, such as polychlorinated biphenyls (PCBs), with hydrogen-rich gas at high temperatures to produce simpler compounds such as methane, hydrogen chloride and water vapor. The SITE Demonstration of the ELI Process consisted of three test conditions. The process treated PCB-contaminated water, soil, and oil during test conditions 1, 2, and 3, respectively. A comprehensive sampling and analysis program was conducted during the Demonstration to characterize process air emissions, residuals and effluents; it also determined destruction efficiency and destruction and removal efficiency of the system.

This report presents the results of the Demonstration. It includes a process description, a performance evaluation, a summary of the sampling and analytical program and a quality assurance/quality control evaluation of the data.

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ABBREVIATIONS AND SYMBOLS

µg	microgram
%	percent
<	less than; average analytical results includes both detected and non-detected data
>	greater than; average analytical results includes data above linear range of analyzer
AAR	Applications Analysis Report
ACCUM	accumulative stream
acf	actual cubic feet
acm	actual cubic meters
Ag	silver
ALR	above linear range
As	arsenic
ASTM	American Society for Testing and Materials
B	lab method blank contamination
B.H.	back half (components of sampling train downstream of filter)
Ba	barium
Be	beryllium
BOR	beginning of run
BQL	below quantitation limit
Btu	British thermal unit
C	carbon
C_2Cl_4	perchloroethylene; also tetrachloroethylene or tetrachloroethene
C_2H_4	ethylene
C_6Cl_6	hexachlorobenzene
C_6H_6	benzene
$Ca(OH)_2$	calcium hydroxide (lime)
CAA	Clean Air Act
CARB	California Air Resources Board
CB	chlorobenzenes
cc	cubic centimeter
CCl_4	carbon tetrachloride
Cd	cadmium
CEL	Calscience Environmental Laboratory Inc.
CEM	continuous emissions monitoring
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cf	cubic foot
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CH_4	methane
CIMS	chemical ionization mass spectrometer
Cl	chlorine
cm	centimeter
cm^2	square centimeter

CO	carbon monoxide
CO_2	carbon dioxide
CP	chlorophenols
Cr	chromium
Cr(VI)	hexavalent chromium
Cu	copper CV-AAScold vapor atomic absorption spectroscopy
CWA	Clean Water Act
DE	destruction efficiency
DI	deionized
DNAPL	dense nonaqueous-phase liquid
DOT	Department of Transportation
dP	differential pressure (e.g., velocity head)
DRE	destruction and removal efficiency
dscf	dry standard cubic feet at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
dscm	dry standard cubic meters at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
Dup	duplicate
E	estimated maximum possible concentration
EER	Energy and Environmental Research Corporation
ELI	ELI Eco Logic International, Incorporated
EMPC	estimated maximum possible concentration
EOR	end of run
EPA	U.S. Environmental Protection Agency
excl.	excluding
F	fluorine; or as flag meaning laboratory blank was 20 percent of measured value or greater (result not statistically significant)
F.H.	front half (filter and upstream components of sampling train)
FB	field blank
FID	flame ionization detector
FPD	flame photometric detector
FS	field spike
ft	feet
ft^2	square foot
ft^3	cubic foot
FWEI	Foster Wheeler Enviresponse Incorporated
g	gram
gal	gallon
GC	gas chromatography
GF-AAS	graphite furnace atomic absorption spectroscopy
gpm	gallons per minute
gr	grains
H	hydrogen (atomic)
H_2	hydrogen (molecular)
H_2SO_4	sulfuric acid
HCB	hexachlorobenzene
HCl	hydrogen chloride
Hg	mercury
HpCDD	heptachlorodibenzodioxin
HpCDF	heptachlorodibenzofuran

hr	hour
HRGC	high resolution gas chromatography
HRMS	high resolution mass spectrometry
HSL	hazardous substances list HWhazardous waste
HxCDD	hexachlorodibenzodioxin
HxCDF	hexachlorodibenzofuran
IC	ion chromatography
ICAP	inductively coupled argon plasma spectroscopy
IN	input stream
in. WC	inches of water column (pressure)in.inch
in^2	square inch
incl.	including
INT	interferences prevented quantification of substance
kg	kilogram
$KMnO_4$	potassium permanganate
KW	kilowatt
L	liter
lb	pound
lbm	pound mass
LC	laboratory control
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
m	meter
m^2	square meter
m^3	cubic meter
MBC	mass balance closure
MDNR	Michigan Department of Natural Resources
mg	milligram
MGD	million gallons per day
min	minute
Mn	manganese
MS	matrix spike (in context of QA)
MS	mass spectrometry (in context of analytical methods)
MS	monitoring station (in context of process monitoring)
MSD	matrix spike duplicate
MW	molecular weight
n	neglected
N	normality of solution
NA	not available or not analyzed
NAAQS	National Ambient Air Quality Standards
NaOH	sodium hydroxide (caustic soda)
NC	could not be calculated
ND	not detected
NDIR	non-dispersive infrared
NDUV	non-dispersive ultraviolet
ng	nanogram
Ni	nickel
nn	not needed for computations

NO_x	oxides of nitrogen ($NO + NO_2$)
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NS	not spiked
O	oxygen (atomic)
O&M	operating and maintenance
O_2	oxygen (molecular)
OCDD	octachlorodibenzodioxin
OCDF	octachlorodibenzofuran
ORD	EPA Office of Research and Development
OSHA	Occupational Safety and Health Act
OSWER	EPA Office of Solid Waste and Emergency Response
OUT	output stream
P	phosphorus
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo[p]dioxins
PCDF	polychlorinated dibenzofurans
PCE	perchloroethylene; also tetrachloroethylene or tetrachloroethene
PEA	performance evaluation audit
PeCDD	pentachlorodibenzodioxin
PeCDF	pentachlorodibenzofuran
pH	negative log of hydrogen ion concentration in solution - a measure of acidity/alkalinity
PIC	product of incomplete combustion
PIR	product of incomplete reduction
POHC	principal organic hazardous constituent
POTW	publicity owned treatment works
ppb	parts per billion
PPE	personnel protection equipment
ppm	parts per million
ppmv	parts per million by volume
ppmw	parts per million by weight
PSD	prevention of significant deterioration
psi	pounds per square inch
psig	pounds per square inch, gage
QA	quality assurance
QAPP	quality assurance project plan QAPjP quality assurance project plan
QC	quality control
QS	quantified with secondary ion
R&D	research and development
RCRA	resource conservation and recovery act
RF	radio frequency
RPD	relative percent difference
RREL	Risk Reduction Engineering Laboratory
RSD	relative standard deviation
S	sulfur
SARA	Superfund Amendments and Reauthorization Act

ABBREVIATIONS AND SYMBOLS (CONTINUED)

SAT	data estimated based on saturated instrument response
Sb	antimony
scf	standard cubic foot at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
scfm	standard cubic feet per minute at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
scm	standard cubic meter at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
Se	selenium
sec	second
SI	International System of Units (Le Systeme International d Unites)
SITE	Superfund Innovative Technology Evaluation Program
sL	standard liter
Sn	tin
SO_2	sulfur dioxide
SPCC	system performance check compound
SS	sampling station
SSHO	site safety and health officer
stdev	standard deviation
Surr	surrogate
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzodioxin
TCDF	tetrachlorodibenzofuran
TCLP	Toxicity Characteristic Leachate Procedure
TCT	Twin City Testing Inc.
TDU	thermal desorption unit
TER	Technology Evaluation Report
THC	total hydrocarbons
Tl	thallium
TLI	Triangle Laboratiories, Inc.
TSA	technical systems audit
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSR	technical system review
U.S.	United States
VOC	volatile organic compounds
vol. %	percent, volume basis
VOST	volatile organic sampling train
wt. %	percent, weight basis
x	analyzed
yd	yard
Zn	zinc
°C	degrees centigrade
°F	degrees Fahrenheit

SI CONVERSION FACTORS

	Multiply	English (US)units	by	Factor	to get	Metric (SI) Units
Area:		1 ft^2		0.0929		m^2
		1 in^2		6.452		cm^2
Flow Rate:		1 gal/min		6.31×10^{-5}		m^3/s
		1 gal/min		0.0631		L/s
		1 MGD		43.81		L/s
Length:		1 ft		0.3048		m
		1 in		2.54		cm
Mass:		1 lb		453.59		g
		1 lb		0.45359		kg
Volume:		1 ft^3		28.316		L
		1 ft^3		0.028317		m^3
		1 gal		3.785		L
		1 gal		0.003785		m^3
Temperature:		°F - 32		0.55556		°C
Concentration:		1 gr/ft^3		2.2884		g/m^3
		1 gr/gal		0.0171		g/L
		1 lb/ft^3		16.03		g/L
Pressure:		1 lb/in^2		0.07031		kg/cm^2
		1 lb/in^2		6894.8		$Newton/m^2$
Heating value:		Btu/lb		2326		Joules/kg
		Btu/scf		37260		Joules/scm

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SECTION 1
EXECUTIVE SUMMARY

SITE DEMONSTRATION TEST

Under the auspices of the Superfund Innovative Technology Evaluation (SITE) Program, the U.S. Environmental Protection Agency (EPA) conducted a field demonstration to develop reliable performance and cost data for the Eco Logic Gas-Phase Chemical Reduction Process developed by ELI Eco Logic International Inc. (ELI), Ontario, Canada. The demonstration was conducted in cooperation with the City of Bay City, Michigan, Environment Canada, and the Ontario (Canada) Ministry of the Environment and Energy. The data collected from the SITE Demonstration will provide the basis for decisions regarding the applicability of the process for remediation of sites. Specifically, the information from this demonstration can be used for the following purposes:

- Characterize the efficiency of the process;
- Evaluate potential uses of the process in remedial actions;
- Identify pretreatment requirements;
- Isolate operational problems and determine potential solutions;
- Characterize process residues;
- Identify any need for secondary treatment;
- Develop operating costs for the pilot scale unit and for a full commercial unit;
- Identify pertinent government policy and regulatory requirements;
- Provide a basis for process comparison to competitive technologies.

The Demonstration was conducted at the Middleground Landfill in Bay City, Michigan. The site had been an active commercial and industrial landfill until 1984, when it was closed and capped. Buried contaminants are migrating through the island, threatening to pollute the Saginaw River that bounds the landfill.

A pilot-scale process demonstration unit was erected at the site. The main components of the pilot-scale demonstration unit are an electrically-heated reactor, a scrubber system, an auxiliary boiler, and a

waste preheating vessel. Ancillary equipment included feed systems for the materials to be treated and for other process consumables, fans, compressors, and process controls. In addition, a separate thermal desorption unit (TDU) was added for one test condition. The electrically-heated reactor, where destruction of organic compounds occurs in a reducing hydrogen atmosphere, is the heart of the system. The scrubber removes acid gases such as hydrogen chloride and particulate matter from the reactor products. The gaseous reactor products are stored for future use or burned in the auxiliary boiler.

The Demonstration took place in October and December 1992; it lasted a total of 45 days. The unit processed a total of 2,632 kg (713 gal) of contaminated water, 180 kg (48 gal) of oil and 963 kg of soil during this period. The test program evaluated three process conditions:

- Treatment of oil and water containing polychlorinated biphenyls (PCBs) to simulate contaminated water (Condition 1);
- Treatment of soil containing PCBs (Condition 2 - a proof of concept test);
- Treatment of oil containing high levels of PCBs (Condition 3).

Three test runs were performed under Conditions 1 and 3. Two test runs were performed under Condition 2. Samples of the feed materials and all key gaseous, solid, and liquid streams were collected and analyzed for each run. For each test run, a surrogate tracer compound was added to the system to enable determination of destruction efficiency (DE). An additional 72-hour test provided equipment reliability information.

SUMMARY OF RESULTS AND CONCLUSIONS

The Demonstration confirmed the feasibility of the process for treatment of materials contaminated with PCBs and other organic compounds in an environmentally acceptable manner. The test program results are compared to the primary and secondary objectives of the SITE Demonstration in Table 1-1.

WASTE CHARACTERISTICS AND PROCESS APPLICABILITY

Three different contaminated feed materials recovered from the site were processed in this Demonstration: waste water, oil, and soil. The first test condition was designed to simulate treatment of waste water contaminated with low levels of PCBs. Because the concentration of PCBs in the waste

TABLE 1-1. SUMMARY OF DEMONSTRATION OBJECTIVES AND RESULTS

Objective	Result
Demonstrate at least 99.9999 percent (6 nines) destruction and removal efficiency (DRE) of PCBs for each test run	Achieved for all runs, except Condition 2 Run 2 (sample contamination or PCBs in the auxiliary boiler combustion air may have caused low DRE for this run)
Demonstrate at least 99.99 percent (4 nines) DE for tracer compounds added to the waste for each test condition	Achieved for all runs, except for Condition 2 Run 1 (due to poor desorption efficiency rather than poor destruction within the reactor)
Ensure that no polychlorinated dibenzo[p]dioxins and dibenzofurans (PCDD/PCDF) are formed	Net destruction of PCDD/PCDF contained in the feed was demonstrated
Characterize products of incomplete combustion (PICs) emissions	Characterized PICs in the air emissions
Characterize hydrogen chloride (HCl) emissions	Emissions of HCl at the stack were low compared to permit and typical regulatory limits
Document compliance with Michigan Department of Natural Resources (MDNR) air permit conditions	Achieved the MDNR air permit conditions, except for allowable stack concentrations of benzene during Condition 1 and Condition 3 and chlorobenzene emissions (due to high detection limits) during Condition 2
Characterize criteria air pollutant emissions	Air emissions of nitrogen oxides (NO_x), sulfur dioxide (SO_2), and particulate matter were low compared to permit and typical regulatory limits
Document compliance with Toxic Substances Control Act (TSCA) permit requirements	Achieved TSCA permit conditions for Condition 1 and Condition 3 (TSCA permit conditions did not apply to Condition 2)
Validate key cost assumptions used to process economic analyses	Identified key cost factors and calculations
Characterize effluents and residual streams relative to disposal requirements	Characterized the residual streams for disposal
Determine the suitability of the reformed gases for reuse/resale	Generated a low Btu gas suitable for use as a fuel
Demonstrate system reliability	Demonstrated a pilot-scale system on-line capacity factor of 50 percent
Develop a system mass balance, including metals	Achieved good total mass balance closure and generally good elemental mass balance closure
Characterize critical process scale-up parameters	Documented key parameters likely to be used in scale-up of the pilot-scale system
Validate the chemical ionization mass spectrometer (CIMS)	Identified that the CIMS may reflect data trends which could be useful for process control
Document system operation during test runs	Documented process operating conditions and correlated them with the test results

water recovered from the site was very low (below detection limits of approximately 0.02 ppm), waste oil was co-injected into the process to achieve an equivalent PCB concentration in the total feed of 3,757 ppm (mean of three runs, mono- through deca- congeners). The second test condition evaluated the ability to treat contaminated soil containing 627 ppm PCBs (mean of two runs, mono- through deca-congeners). Because water is a process feedstock, relatively small amounts of clean water also were

injected to the system. In the third test condition, waste oil containing 25.4 percent PCBs (mono- through deca- congeners) was fed to the process.

Test results show that the process met nearly all performance goals when feeding the waste water and oil. Thus the suitability of this process for treating these liquid wastes was demonstrated. For tests with soil feed, the pilot-scale system was augmented with a TDU. The TDU did not perform to design specifications. As a proof-of-concept test, the TDU did demonstrate desorption efficiencies of 99 percent for PCBs, and in the TDU's second test, 99.99 percent for the hexachlorobenzene tracer compound. The balance of the system did meet performance goals in operation with the TDU. Based on these tests, further development of the TDU is required before treatment of contaminated soil should be considered.

COSTS

Process operating parameters necessary for an economic analysis of the system were documented during the demonstration:

- Process feed rates (water, soil, oil);
- Utilities (electricity);
- Consumables (hydrogen, propane, nitrogen, scrubber caustic, etc.);
- Residuals yields (scrubber effluent, waste water, etc.);
- Disposal requirements (residuals characteristics);
- Process operating labor;
- Availability.

The results of the economic evaluation are presented in the Applications Analysis Reports.

SECTION 2
INTRODUCTION

THE SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION PROGRAM

In 1986, the EPA's Office of Solid Waste and Emergency Response (OSWER) and Office of Research and Development (ORD) established the SITE Program to promote the development and use of innovative technologies to clean up Superfund sites across the country. Now in its seventh year, the SITE Program is helping to provide the treatment technologies necessary to implement new federal and state cleanup standards aimed at permanent remedies. The SITE Program is composed of three elements: the Demonstration Program, the Emerging Technologies Program, and an Analytical Methods Development Program.

The major focus has been on the Demonstration Program, which is designed to provide engineering and cost data on selected technologies. EPA and developers participating in the program share the cost of the demonstration. Developers are responsible for demonstrating their innovative systems at chosen sites, usually Superfund sites. EPA is responsible for sampling, analyzing, and evaluating all test results. The result is an assessment of the technology's performance that can be used in conjunction with other data to select the most appropriate technologies for the cleanup of Superfund and other contaminated sites.

Developers of innovative technologies apply to the Demonstration Program by responding to EPA's annual solicitation. EPA also accepts proposals at any time when a developer has scheduled a treatment project with Superfund waste. To qualify for the program, a new technology must be at the pilot-scale or full-scale stage of development and offer some advantage over existing technologies. Mobile technologies are of particular interest.

Once the EPA has accepted a proposal, the EPA and the developer work with the EPA regional offices and state agencies to identify a site containing waste suitable for testing the capabilities of the technology. EPA then prepares a detailed sampling and analysis plan designed to thoroughly evaluate the technology and to ensure that the resulting data are reliable. The duration of a demonstration varies

from a few days to several months depending on the type of process and quantity of waste needed to assess the technology.

On completion of the demonstration, EPA prepares a Technology Evaluation Report (TER) and an Applications Analysis Report (AAR). The TER compiles and summarizes the results of the SITE demonstration including the vendor's design and test data, provides a detailed technology description, describes the site and waste used for the demonstration, and presents the sampling and analysis protocols used during the test. The report discusses the factors that have a major impact on costs and performance, such as site and waste characteristics. The AAR more briefly explains the technology and the results obtained. The report strives to evaluate the application of the vendor's technology to other sites and other wastes. Ultimately, the TER and the AAR provide an analysis of the technology's overall applicability to Superfund problems.

SITE DESCRIPTION

The Middleground Landfill is situated on the westward margin of Middleground Island in the Saginaw River within the corporate limits of Bay City, Michigan (Figures 2-1 and 2-2). It is bounded by Cass Road on the south, the Saginaw River on the West, Evergreen Drive on the east, and is 1,500 ft north of Cass Ave. The landfill was closed in 1984.

A remedial investigation conducted by ELI between November 1990 and April 1991, prior to the current project, found elevated levels of trichloroethene, PCBs, 1,2-dichloroethene, methylene chloride, toluene, and ethylbenzene in the liquid samples collected in the area of Monitoring Well 8 at the Middleground Landfill[1]. The liquid contained lesser concentrations of benzidine, benzene, vinyl chlorobenzenes, polynuclear aromatic hydrocarbons (PAHs), Lindane, Dieldrin, Chlordane, and DDT metabolites. The soil removed during well drilling and excavation was contaminated with up to 1,000 ppm PCB. The groundwater fraction of the liquid removed during drilling contained 5,900 ppm of methylene chloride and was mildly contaminated with other typical leachate contaminants. The other fraction of the liquid waste was a dense, nonaqueous phase liquid (DNAPL) that was present as an immiscible liquid phase. ELI's analysis of the DNAPL from this early study indicated a PCB content of approximately 39 percent.

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1 "Phase II Remedial Investigation Middle Ground Landfill, Bay City, Michigan." prepared for the City of Bay City, Michigan, by ELI Eco Logic International, Inc., Rockwood, Ontario, Canada (1991).

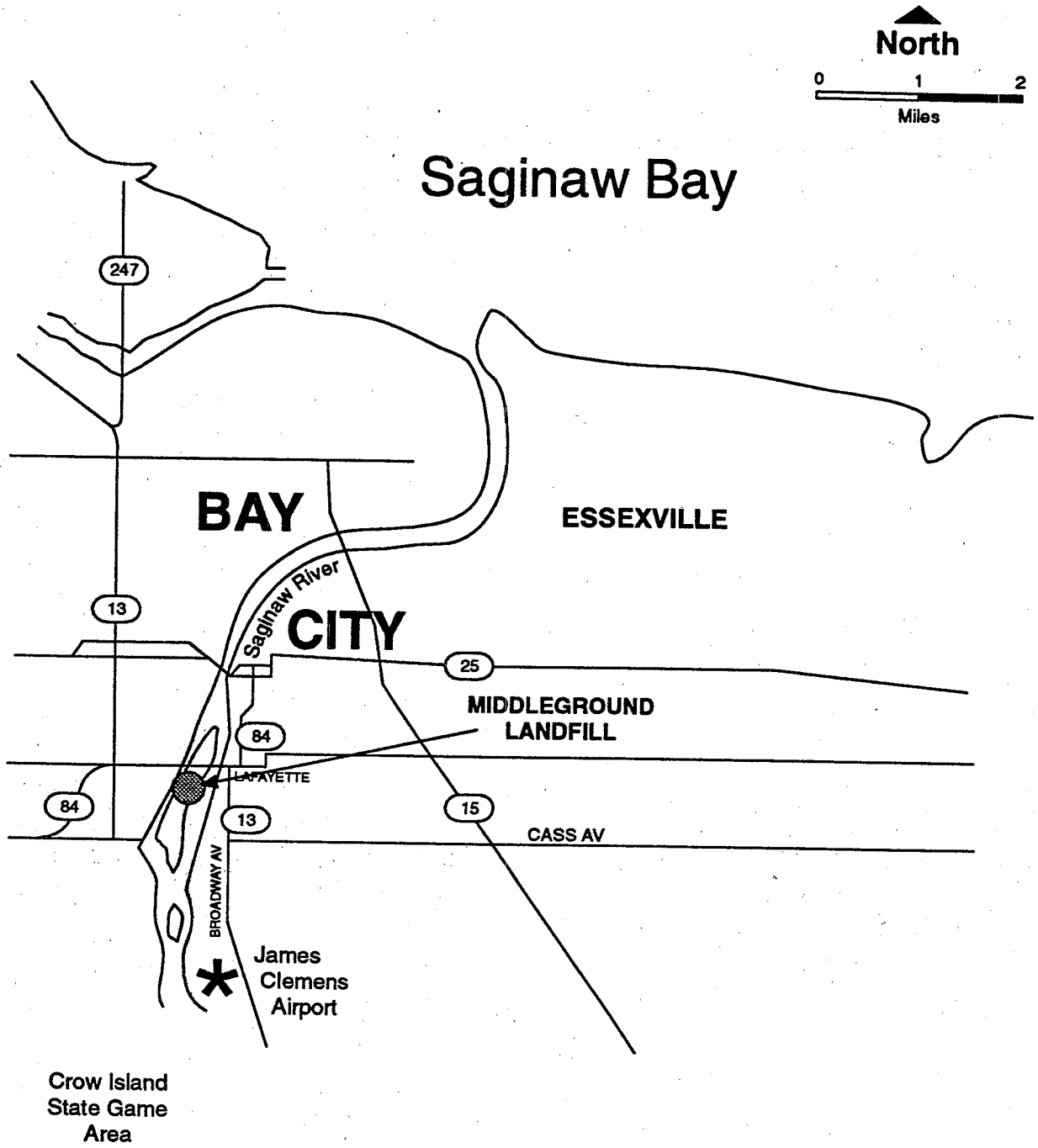

Figure 2-1. Location of the landfill.

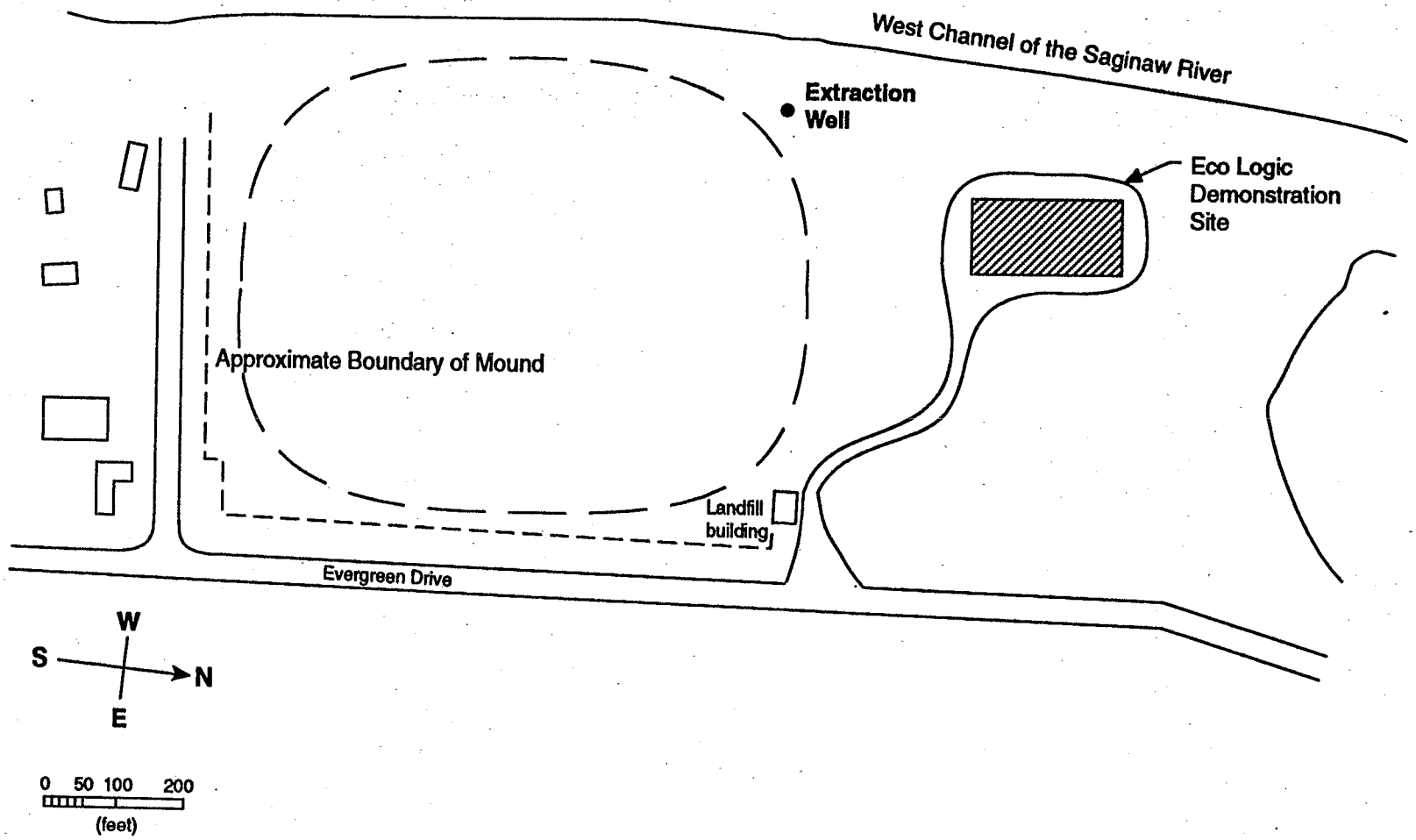

Figure 2-2. Demonstration site.

OBJECTIVES OF THE DEMONSTRATION

The objectives of the Demonstration were divided into primary and secondary objectives. The primary objectives of the Demonstration were as follows:

- Demonstrate at least 99.9999 percent DRE for PCBs for each test run.
- Demonstrate at least 99.99 percent DE for tracer compounds added to the waste for each test condition.
- Ensure that no dioxins or furans were formed.
- Characterize PIC emissions.

The secondary objectives of the demonstration were as follows:

- Characterize HCl emissions.
- Document compliance with MDNR air permit conditions.
- Characterize criteria air pollutant emissions.
- Document compliance with TSCA permit requirements.
- Validate key cost assumptions used to process economic analyses.
- Characterize effluents and residual streams relative to disposal requirements.
- Determine the suitability of the reformed gases for reuse/resale.
- Demonstrate system reliability.
- Develop a system mass balance, including metals.
- Characterize critical process scale-up parameters.
- Validate the CIMS.
- Document system operation during test runs.

TEST APPROACH

Test Conditions

The goal of the Demonstration was to determine if the ELI Gas-Phase Chemical Reduction Process can handle the complex waste matrices encountered in large scale remediation programs. To achieve this goal, the ELI process was demonstrated under three different test conditions distinguished by the principal waste matrix: waste water, site soil, and waste oil. Each of these three conditions also differed by the PCB concentrations in the waste feed. Condition 1 treated 2,058 kg (557 gal) of waste water with

co-injection of DNAPL containing 23.8 percent PCBs to achieve an equivalent PCB concentration in the total waste feed of 3,757 ppm (mean of three runs, mono- through deca- congeners). Condition 2 treated 963 kg of soil contaminated with 627 ppm of PCBs (mean of two runs, mono- through deca- congeners). Condition 3 treated 150 kg (40 gal) of DNAPL containing 25.4 percent of PCBs.

Target process operating conditions were established prior to the test based on information provided by ELI. ELI based their selection of target operating conditions on a previous experience during a demonstration of the process treating harbor sediment.

Surrogate compounds were added to the feed to enable the DE of the process to be quantified. For Conditions 1 and 3, perchloroethylene (PCE), also known as tetrachloroethylene or tetrachloroethene, was metered separately into the process. Hexachlorobenzene (HCB), a solid material, was added to the soil during Condition 2 tests. These compounds were selected based on their thermal stability characteristics[2], which are considered high relative to actual feed contaminants.

Sampling and Analysis

A detailed plan was developed prior to the test according to EPA guidelines for Category II Quality Assurance Project Plans. The plan contains detailed descriptions of the sampling and analysis procedures and process data collection procedures to be employed. EPA test methods were applied for all samples where such methods exist. All key input and output streams as well as selected intermediate streams were sampled and analyzed for physical properties (flow rate, density, moisture, etc.); PCBs, PCDD/PCDF, PAHs; chlorobenzenes and chlorophenols (CB/CP); volatile organic compounds (VOC); 13 trace metals; HCl; O_2, CO_2, CO, SO_2, NO_x, total hydrocarbons; and other selected compounds. Samples were collected from 19 different solid, liquid, and gaseous process streams during the test program.

Test Chronology

The Demonstration chronology is summarized in Table 2-1. In preparation for the Demonstration, ELI first processed clean water to adjust the system to peak performance, followed by a tracer material pretest to adjust the sampling equipment and sampling trains. Beginning on October 12, 1992, operations at test conditions 1 and 3 were conducted, continuing over the next 17 days. Operations at

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2 Taylor, P.H., B. Dellinger, and C.C. Lee, "Development of a Thermal Stability Based Ranking of Hazardous Organic Compound Incinerability," Environ. Sci. Technol., Vol 24, No. 3 (1990).

TABLE 2-1. TEST CHRONOLOGY

Condition	Run No.	Event	Date (1992)
Preliminaries		Setup Tracer pretest	September 28 October 7
1- waste water	1 1 2 2 3 3	Test Process sample recovery Test Process sample recovery Test Process sample recovery	October 12 October 13 October 17 October 18 October 19 October 20
3 - waste oil	1 1 2 2 3 3	Compression Stack test, sample recovery Compression, stack test Process sample recovery Compression, stack test Process sample recovery	October 23 October 24 October 26 October 27 October 28 October 29
2 - site soils	1 1 2 2	Test Process sample recovery Test Process sample recovery	December 1 December 2 December 7 December 8
		72-hour performance evaluation	December 5-8

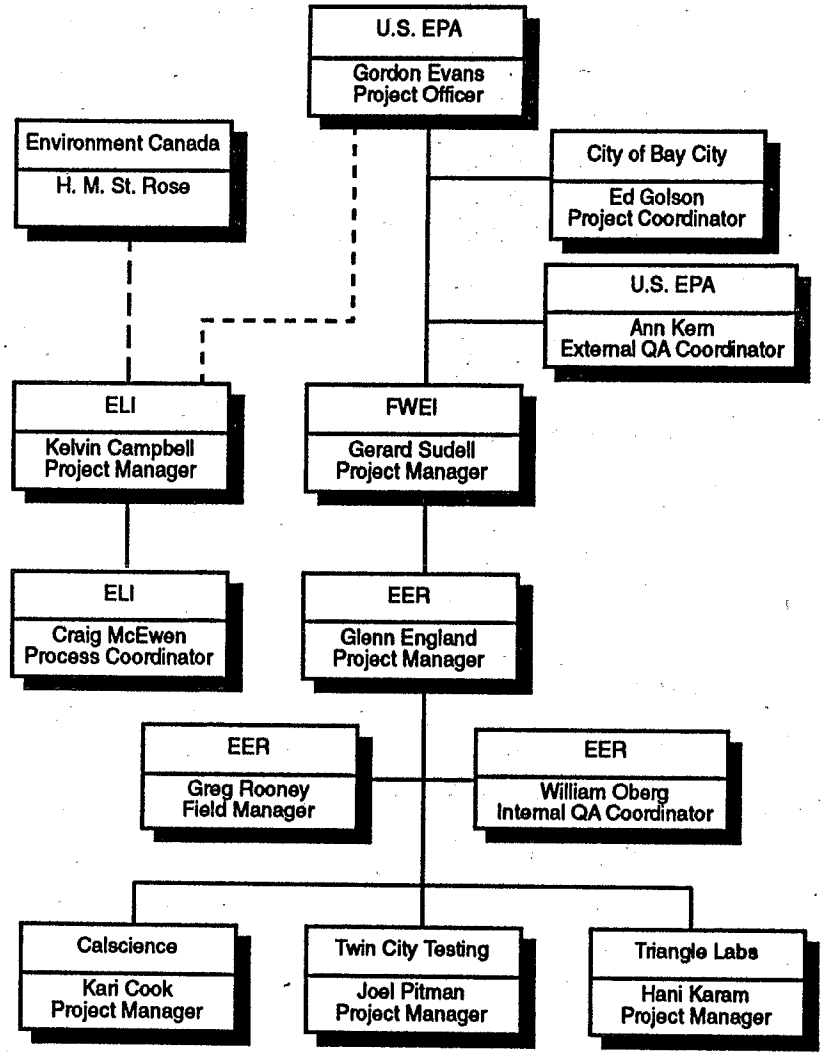
test Condition 2 were conducted during the first week of December, 1992. One test run was conducted on each test day. All solid and liquid samples were collected simultaneously with gas-phase sampling, to the extent possible. Due to the complexity and number of samples taken during the program, sample collection was performed on alternating days to allow complete sample recovery on the day following each test. This also allowed time to resolve any process operation problems prior to the next test run. Gaseous samples were recovered on the day they were collected.

During test Condition 3, the rate of reformed gas production was greater than the rate at which it could be fed safely to the auxiliary boiler. Therefore, the reformed gas was compressed and stored during waste processing. After waste processing, the compressed gas was fed from the storage tank to the auxiliary boiler. Flue gas samples from the auxiliary boiler stack were collected during this period.

PROJECT ORGANIZATION

Figure 2-3 illustrates the organization and responsibilities of each party for the key project activities. The principal organizations involved in the SITE activities were:

- U. S. Environmental Protection Agency;



Activity	EPA	FWEI	ELI	EER	Bay City
Site preparation	A	S	C	C	C
Permits	S	C	C	R	C
Equipment	A	C	S	C	R
Demonstration plan	A	D	C	C	R
Safety and Health Plan	A	D	C	C	R
SSHO	A	R	R	R	R
S&A plan	A	Co	C	D	R
QAPP	A	R	R	D	R
QA/QC	A	Co	C	S	R
QA/QC audit	S	C	R	R	R
Demonstration	A	C	S	C	C
Pre-test drum sampling	A	Co	S	R	R
Site management	A	Co	S	C	R
Sampling and analysis	A	Co	S	S	R
CEM	A	Co	S	S	R
CIMS	A	Co	S	C	R
Ambient air monitoring	A	A	Co	S	C
Post demonstration	A	C	C	C	R
Waste disposal	A	S	C	C	R
Reports					
Fact sheet	A	D	C	C	R
TER	A	C	C	D	R
AAR	A	D	C	R	R
Video	A	D	C	C	R

A-Approve
C-Contribute
Co-Consolidate/coordinate
D-Develop
R-Review
S-Supply

Figure 2-3. Project organization and responsibilities.

- City of Bay City, Michigan;
- Foster Wheeler Enviresponse, Inc. (FWEI);
- Eco Logic International Inc. (ELI);
- Energy and Environmental Research Corporation (EER).

EPA had the overall responsibility for conducting the sampling and analysis, test evaluation and program quality assurance. The City of Bay City provided access to the site and support in coordinating mobilization, demobilization and site preparation activities. FWEI was the prime contractor to EPA with responsibility for demonstration planning, reporting, and site preparation activities. ELI was responsible for process design, installing and operating the demonstration unit, process monitoring, and extraction of feed materials from the site. ELI received support from Environment Canada and the Ontario Ministry of the Environment and Energy for its responsibilities during the Demonstration. Their participation was coordinated through Environment Canada. EER was responsible for sampling and analysis activities, including Quality Assurance Project Plan preparation, sample collection and analysis, data reduction and analysis, and reporting. Sample analysis was subcontracted by EER to various laboratories.

REGULATORY CONSIDERATIONS

The Middleground Landfill is owned by the City of Bay City. It is not a National Priority List (NPL) site. Consequently, Bay City and ELI entered into an agreement to test the ELI process at the landfill under the auspices of the SITE Program. In addition, the Michigan Department of Natural Resources (MDNR) maintained oversight of the program. Regulatory permits necessary to perform the Demonstration included the following:

- MDNR air permit to allow processing of PCB-contaminated feedstock
- TSCA research and development demonstration permit
- EPA (TSCA) identification number to allow disposal of the test residues in accordance with Resource Conservation and Recovery Act (RCRA) requirements
- City of Bay City permit to discharge process waste water to the local publicly-owned treatment works.

KEY CONTACTS

These sources can provide additional information concerning the Demonstration:

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Risk Reduction Engineering Laboratory
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Cincinnati, OH 45219-0963
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Fax: (513) 569-7620

Craig Wardlaw
Wastewater Technology Center
867 Chemin Lakeshore Road
P.O. Box 5068
Burlington, Ontario L7R 4L7
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143 Dennis Street
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Fax: (517) 894-1070

REPORT ORGANIZATION

This TER is organized into six sections plus appendices:

1. **Executive Summary** - Provides an overall introduction to the SITE Program and discussion of the ELI process, as well as highlighting program conclusions and recommendations;

2. **Introduction** - Provides a discussion of the SITE Program, the Bay City Middleground Landfill site, demonstration test objectives, testing conditions, and demonstration organization;

3. **Process Description** - Contains a detailed description of the ELI process, waste handling, site preparation, and field operational procedures;

4. **Performance Evaluation** - Summarizes the test data and results;

5. **Sampling and Analytical Procedures** - Outlines the specific sampling and analytical procedures used during the demonstration;

6. **Quality Assurance** - Highlights the quality assurance and quality control (QA/QC) results and conclusions as they relate to the data.

The appendices are a compilation of detailed test data intended for reference only.

SECTION 3
PROCESS DESCRIPTION

PRETREATMENT AND PROCESSING REQUIREMENTS

The ELI Gas-Phase Chemical Reduction Process was originally designed to handle aqueous wastes such as contaminated harbor sediment and groundwater by direct introduction into the system. Aqueous and non-aqueous liquids could be processed from separate feed tanks or drums. During the Demonstration, the process was evaluated separately with waste water, oily dense non-aqueous phase liquid (DNAPL), and soil. The waste water and DNAPL were fed directly into the system with no pretreatment. The soil was pre-screened through a 2-inch mesh to remove large rocks and other items which would interfere with operation of the soil feed system. No other pretreatment of soils was performed prior to treatment.

PROCESS DESCRIPTION

The ELI Gas-Phase Chemical Reduction Process treats organic hazardous waste in a hydrogen-rich atmosphere at approximately 900°C (1620°F) and ambient atmospheric pressure. The reaction products include HCl from the reduction of chlorinated organics such as PCBs, and lighter hydrocarbons such as methane and ethylene from reduction of straight-chain and aromatic hydrocarbons. The absence of free oxygen in the reactor prevents the formation of PCDD/PCDF. Water acts as a hydrogen donor to enhance the reaction.

Figure 3-1 shows some of the reactions that theoretically lead to the major products and the major intermediate and final products of the process, according to ELI. The first five principal reactions are hydrogenation reactions that remove chlorine from the PCBs and reduce the higher molecular weight hydrocarbons to simpler, more saturated compounds. The final reforming reaction regenerates hydrogen.

The first of the six reactions is the dechlorination and hydrogenation of a PCB molecule to produce a benzene intermediate product and HCl. The second reaction is the reduction of PAH compounds, for example phenanthrene, to produce benzene and ethylene intermediate products. These are the most

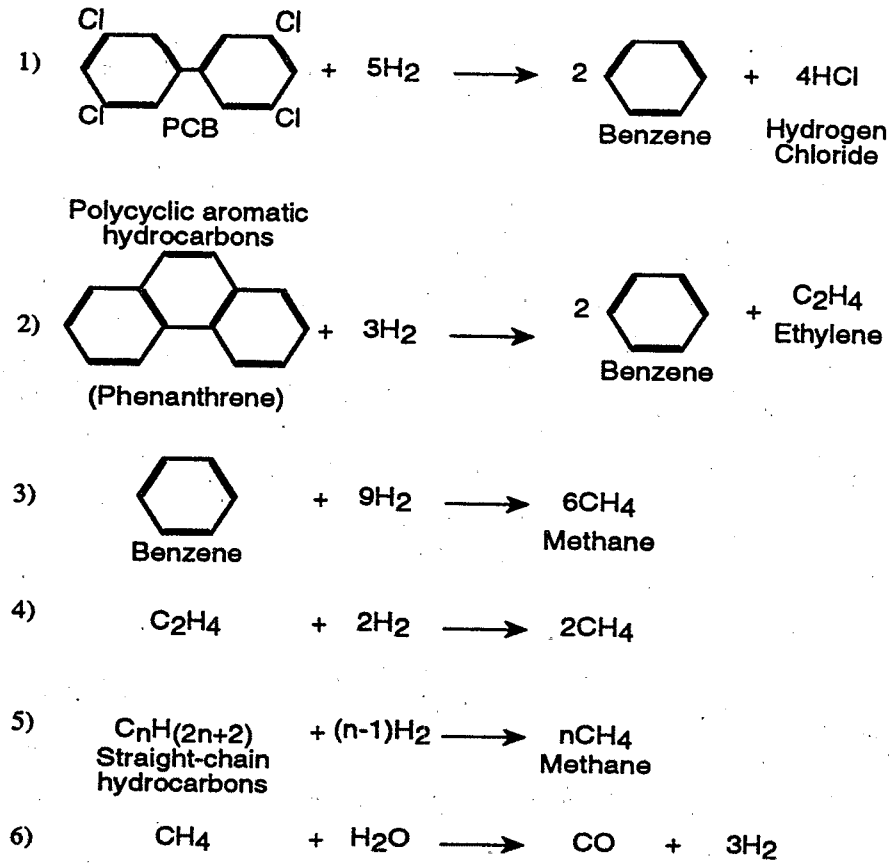

Figure 3-1. Principal reactions of the ELI Gas-Phase Chemical Reduction Process.

rapid reactions. The third reaction is the ring scission and the reduction of benzene to produce methane. The fourth reaction is the reduction of ethylene to produce methane. These reactions occur at approximately the same rate. The fifth reaction is the reduction of the straight chain hydrocarbons to produce methane. Equilibrium favors complete conversion of reactants in reactions 1 through 5, and conversion is expected to be essentially > 99.99 percent under the conditions in the reactor. The last important reaction is the water-gas shift reaction in which methane and water combine to produce carbon monoxide and hydrogen. Equilibrium favors both reactants and products in this reaction, so conversion of reactants is only about 20 percent.

Overall Arrangement

Figure 3-2 illustrates the process in a schematic diagram of the field demonstration unit. The demonstration-scale reactor is 2 m (6 ft) in diameter and 3 m (9 ft) tall, mounted on a 15 m (45 ft) drop-deck trailer. A scrubber system, recirculation gas system, and the electrical control center are also mounted on

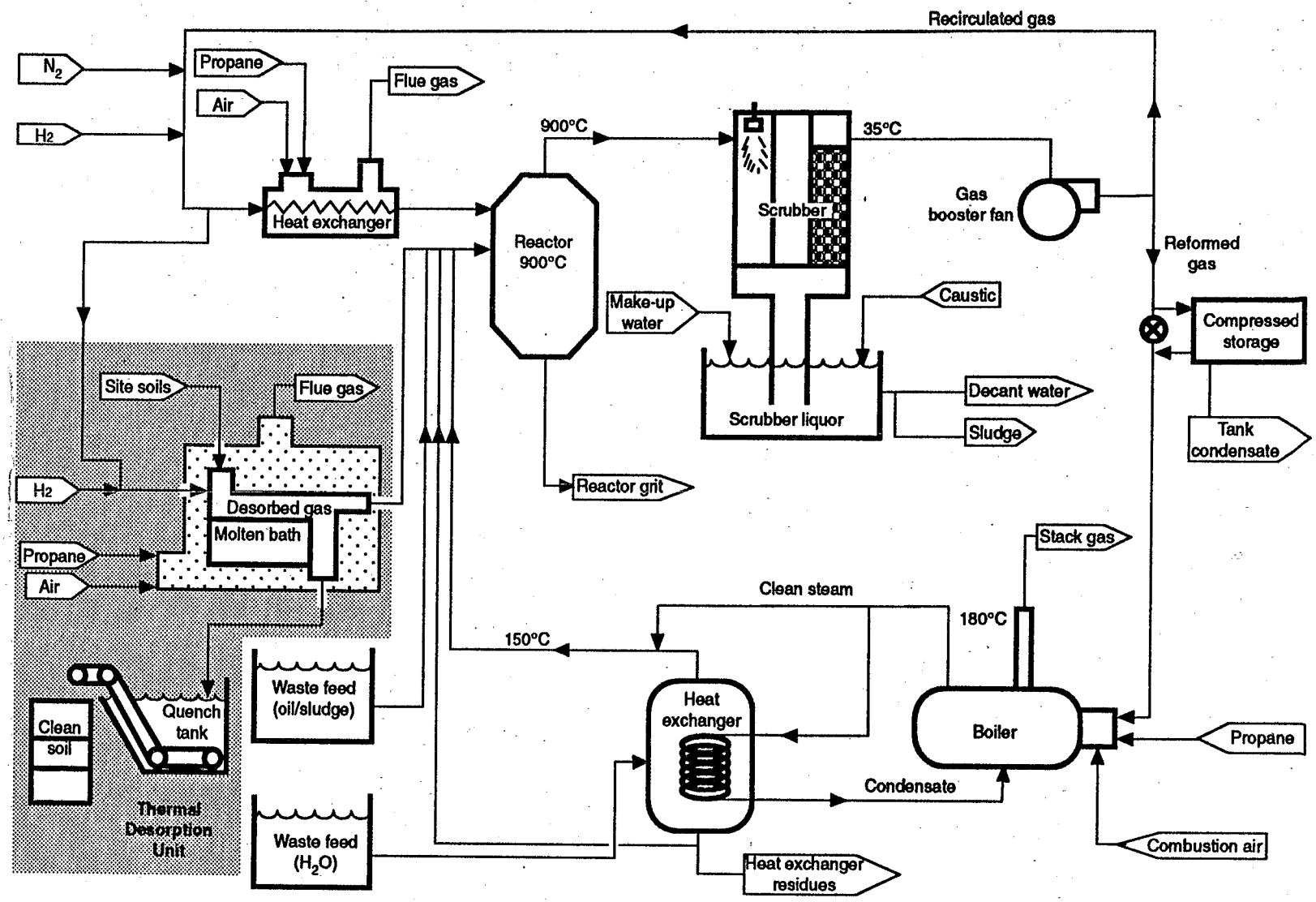

Figure 3-2. Process flow diagram of Eco Logic Gas-Phase Chemical Reduction Process.

the trailer. A second trailer holds a propane boiler, a waste preheating vessel and a waste storage tank. ELI designed the demonstration unit to process 4,000 kg/day of waste oil, 10,000 kg/day of waste water, and 25,000 kg/day of soil. The actual capacity of the system depends on the nature of the contaminants, their degree of chlorination, and their water content. The ELI TDU—designed to remove most volatile, most semivolatile, and some metallic contaminants—treats the soil.

Material Flow Through the Process

Aqueous wastes, organic liquid wastes, and solid waste are fed differently into the reactor. Aqueous wastes are preheated to produce steam and a concentrated liquid stream prior to injection into the reactor. Organic liquid wastes may be preheated or injected directly into the reactor. Soil is processed through the TDU where volatile and semivolatile organics are volatilized into a hydrogen carrier gas stream. The contaminant-laden stream is then injected into the reactor. Preheated hydrogen and recirculated product gases are also injected into the reactor.

The reactor mixes the feed streams, heats them to 900°C (1,650°F), and provides residence time for the reduction reactions to occur. Low molecular weight products exit the reactor and cool in the quench leg of the scrubber. The scrubber removes fine particulates and HCl, yielding a clean hydrogen-rich reformed gas. After scrubbing, most of the reformed gas recirculates to the reactor. The remainder is compressed for storage or sent to the boiler, which produces process steam. The only air emissions come from the boiler stack.

Process Components

The ELI demonstration unit consists of the following major components:

- Liquid waste handling system (including tanks, pumps, heat exchanger, etc.)
- TDU for soils
- Reactor
- Scrubber
- Boiler
- Product gas storage
- Process controls including a CIMS

The following paragraphs describe the function of each major component and show how it fits into the overall process.

Liquid Waste Handling—

Waste liquid and suspended solids are fed directly to the reactor, or through a heat exchanger vessel. For the SITE Demonstration, the contaminated aqueous feedstock was pumped into the heat exchanger. Steam from the boiler, fuelled by propane and reformed gas, provides the heat to the heat exchanger. The heat exchanger raises the temperature of the aqueous feed to about 150°C (300°F), producing vaporized waste and a concentrated organic-rich liquid stream. The organic-rich liquid stream and suspended solids stream flow to the reactor through atomizing nozzles. During the Demonstration, a separate pump provided PCB-rich oils directly to the reactor through the atomizing nozzle.

Thermal Desorption Unit—

The TDU, designed to remove most volatile, most semivolatile and some metal contaminants, treats the soil. A screw feeder delivers the contaminated soil into the TDU, which is swept with hydrogen gas to carry the volatile and semivolatile substances evolved during soil heating to the reactor vessel. Treated soil exits the TDU to a quench tank for subsequent disposal.

Reactor—

Figure 3-3 illustrates the reactor. Make-up hydrogen is added to the recirculation gas stream, which passes through a gas-fired heat exchanger prior to flowing into the top of the reactor at 500°C (930°F). The atomized liquid wastes and contaminant-laden gases from the TDU also enter the top of the reactor. Nozzles spray the atomized feed and gas streams tangentially, spiralling past the electric resistance heaters mounted around the central ceramic tube. The heaters raise the mixture temperature to 900°C (1,650°F). The heated mixture flows up the inside of the ceramic tube into a short section of refractory-lined duct. Large particles settle to the bottom of the reactor and are removed periodically. Fine particles remain entrained in the gas stream. The residence time from the bottom of the reactor to the exit of the duct is approximately 1 second.

Scrubber—

A wet scrubber removes HCl and particulate matter from the reformed gas. Gas from the reactor enters the scrubber at about 750°C (1380°F) and flows downward through a quench section. Water is introduced through spray nozzles at the entrance to the quench section. After

quenching, the gas travels upward through a counter-current packed bed. A large water-sealed vent, which acts as an emergency pressure relief duct, passes scrubber liquor to a tank below. The liquor is pumped from the tank through a heat exchanger for cooling, and then back to the top of the scrubber. Cooling water circulates through an evaporative cooling tower to the heat exchanger. Caustic soda (NaOH) and make-up water are added to the scrubber liquor to maintain HCl removal efficiency. Scrubber liquor overflows goes to a settling tank. The scrubber produces two effluent streams: sludge and decant water. The scrubber operates at a nominal liquid to gas (l/g) ratio of 70 L/acm (0.5 gal/acf).

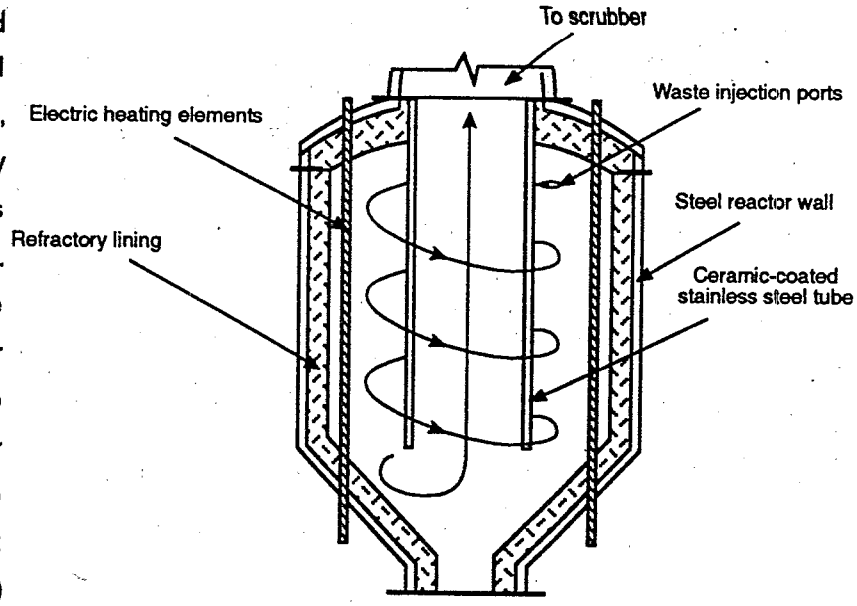

Figure 3-3. ELI gas-phase chemical reduction reactor.

Boiler—

Gases exiting the scrubber contain excess hydrogen, reduction products such as methane and ethylene, and a small amount of water vapor. Up to 95 percent of this gas recirculates back into the reactor, depending on the waste being processed; a propane fired boiler uses the rest of the hydrogen-rich gas as a supplementary fuel. The steam produced by the boiler is used to heat the waste liquid heat exchanger.

Product Gas Storage—

When treating high concentration organic wastes, the process generates excess reformed gas. The system can compress the reformed gas and store it for later use as a fuel in other parts of the process such as the boiler or TDU.

Process Control

The demonstration unit is controlled via 18 independent control loops using a personal computer-based data acquisition and control system. It adjusts various components in the process automatically or

it allows the operator to make adjustments if the data vary outside the set limits. Table 3-1 lists the monitored process variables, the measurement methods, the measurement frequencies, and the respective monitoring stations. The locations of these monitoring stations are shown in Figure 3-4. Temperatures, pressures, flow rates and operational (on/off) status of the pumps, motors, and fans are monitored at critical locations in the process through thermocouples, pressure transmitters, flow meters, gas analyzers, pH meters, and relays. The TDU employs a simple high-fire/ low-fire temperature control to maintain temperature.

TABLE 3-1. PROCESS CONTROL MONITORING STATIONS

Parameter	Monitoring stations	Frequency	Method
Temperature	2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 15, 16, 17, 18	Continuous	Thermocouple
Pressure	12, 13, 16 1, 4, 7 7, 10	Continuous Continuous 1/2 hour	Pressure transmitter Differential pressure transmitter Gauge
Flow rate	7, 10 13 8	Continuous Continuous Hourly	Differential pressure transmitter Vortex flow meter Orifice meter
Feed rate	13 14	Hourly 1/2 hour	Vortex flow meter Tracer injection
pH	5	Continuous	pH meter
Gas species	7	Continuous	Oxygen analyzer; CIMS

Process gases are sampled continually using an on-line chemical ionization mass spectrometer (CIMS) gas analyzer system. The CIMS monitors up to ten different organic compounds. One compound is selected as an indicator of destruction efficiency. The CIMS can specifically respond to chlorinated organics such as chlorobenzene, which may potentially serve as an indicator of PCB destruction. In the event of a process upset where total destruction of hazardous organic compounds is interrupted, the CIMS could be used to trigger the control system to automatically divert all gases into a recirculation mode and curtail waste feed until indicator concentrations fell back to normal levels, indicating a return to normal conditions.

FACTORS AFFECTING DEMONSTRATION

The chronology of events during the SITE Demonstration Program is summarized in Table 3-2. Because the initial installation and start-up of the demonstration unit required considerably longer than originally anticipated, the test program was delayed. Prior to the first full test run, preliminary tests were

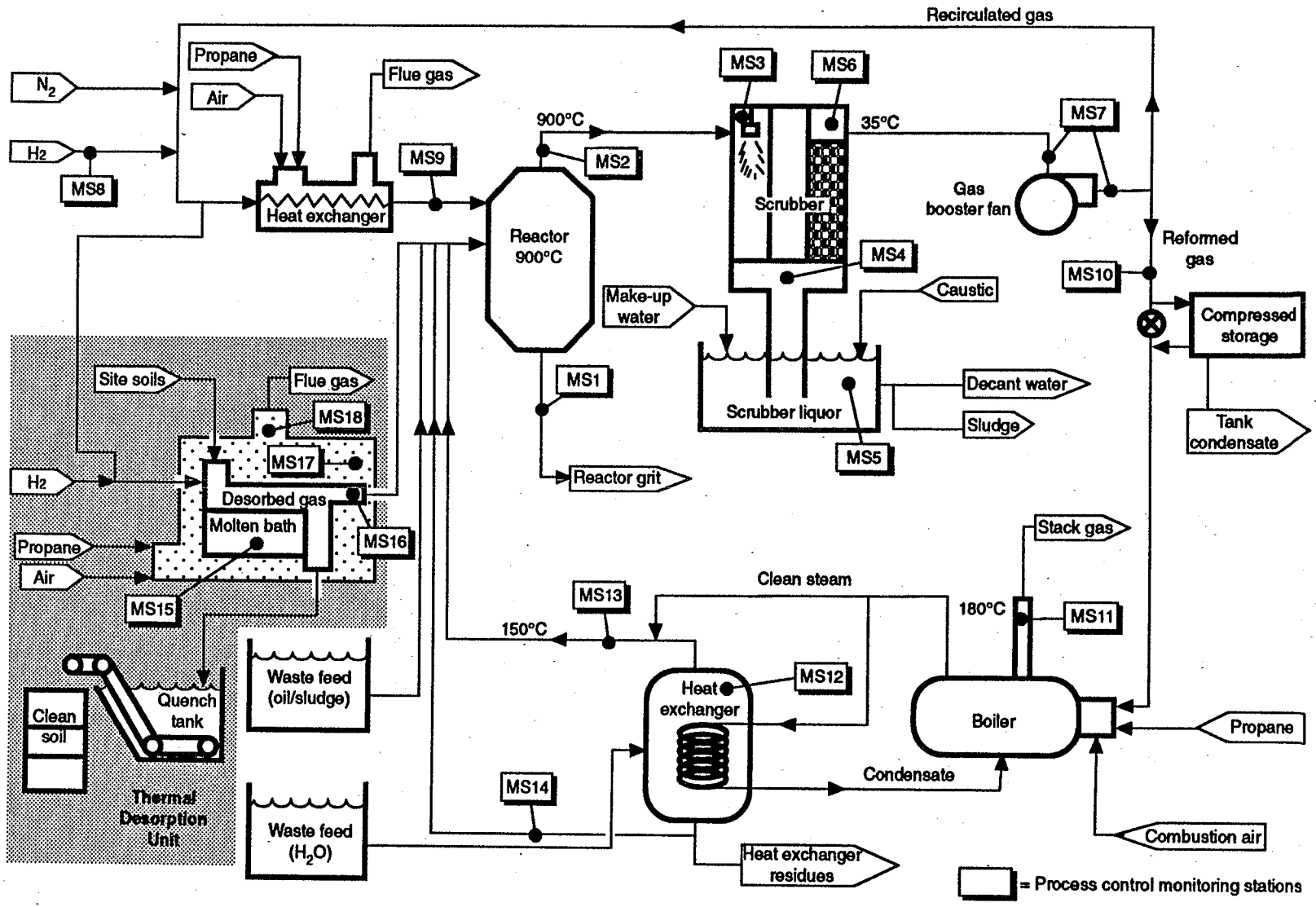

Figure 3-4. Process control monitoring locations.

performed to establish target sample volumes for volatile organic compound sampling and to check planned sampling procedures. The initial full test runs were affected by the same type of problems that had delayed the initial start-up, such as process instrumentation and control deficiencies. As the team gained more experience and these problems were resolved, the operation of the system improved. The improvement continued throughout Condition 1 and 3 tests.

The Condition 2 tests (soil treatment) were rescheduled to the end of the test period due to delays in construction and installation of the TDU. Start-up problems associated with the TDU were not fully resolved prior to the first test run. This resulted in different operating conditions for the two test runs which were completed. The final run for Condition 2 was canceled because feed problems could not be resolved in the time available. Because of these problems, the TDU tests are considered as "proof-of-concept" tests only.

The principal components of the ELI demonstration unit are the reactor, scrubber system, recirculating fan, boiler, heat exchanger, thermal desorption unit (TDU), materials handling, and process monitoring. Each of these components was a source of operating problems during the Demonstration. The key problems, the corrective actions taken to resolve them, and the result of these actions are described below.

Reactor

The operation of the steam flow control valve, used to regulate reactor pressure, was not stable. Control improved as the operators gained experience, undertook system modifications, and made program logic adjustments. During Condition 3 Run 1, reactor over-pressurization caused a complete system shutdown, highlighting the importance of reactor pressure control.

Scrubber System

Initially, entrainment of scrubber liquor in the gas leaving the scrubber occurred due to foaming caused by a piping error during scrubber installation. This interfered with the CIMS, the recirculating fan, and the oxygen analyzer. After ELI made a piping modification, the foaming stopped and the scrubber operated efficiently. The pH meter used to control caustic addition required frequent adjustment and replacement, but never performed satisfactorily. Scrubber foaming may have affected the pH meter. ELI was able to manually measure and adjust the scrubber pH, allowing the demonstration to continue.

TABLE 3-2. ECO LOGIC SITE DEMONSTRATION CHRONOLOGY

7/29/92	FWEI arrives on-site to begin site preparation.
8/11/92	First ELI personnel arrive on-site.
8/12/92	First EER personnel arrive on-site.
8/14/92	Major ELI equipment trailer (reactor) arrives.
8/17/92	Boiler trailer arrives.
9/09/92	Visitors day held.
10/7/92	Tracer pretest to calibrate stack trains conducted. PCE causes EER tracer pump tubing to deteriorate. Tubing replaced. pH meter not functioning. Tested pH manually. Steam flowmeter not working properly. Reactor pressure fluctuations cause steam flow to shut down.
10/12/92	Begin Condition 1 Run 1. Dry gas propane meter removed from boiler fuel line; not functioning properly. Steam flow control fluctuations minimized by control system adjustment. Boiler frequently cycling between low- and high-fire; EER particulate train filters tearing due to stack pressure cycling ("chuffing"). Vaporizer liquid flow problems; metering valve not adequate. O_2 analyzer not functioning. Transfer from clean steam to dirty steam is very erratic, ELI adjusts flow. Complete Condition 1 Run 1.
10/13/92	Replacement O_2 analyzer sensor installed. Begin Condition 1 Run 2 (later aborted).
10/14/92	"Chuffing" reduced by adjusting boiler combustion air damper linkage. EER particulate train filters still tearing. Unit heater air fan inoperative; ELI will replace it. Power failure shuts off PCE pump; testing interrupted. Gas booster fan getting water in it; Condition 1 Run 2 aborted.
10/15/92	Booster fan disassembled. ELI discovers that scrubber internal piping is incorrect, resulting in water in sampling lines, affecting CIMS, O_2 analyzer, and gas booster fan.
10/16/92	ELI attempts to get system ready for next run; run postponed; system ramped up and down using clean steam. H_2 regulator malfunction. H_2 and N_2 regulators checked and serviced.
10/17/92	Restart Condition 1 Run 2. Problems still exist with the O_2 analyzer, pH reliability, vaporizer flow. Boiler cycling between high- and low-fire interrupts sampling. Complete Condition 1 Run 2.

TABLE 3-2. (continued)

10/19/92	Begin Condition 1 Run 3. Vaporizer hot liquid metering valve plugged; ELI fabricates a blow-back valve. Complete Condition 1 Run 3.
10/21/92	ELI purchases compressors and begins piping.
10/22/92	EPA auditors arrive. Compressor piping continues.
10/23/92	Begin Condition 3 Run 1 (compression). EER adds additional PCE because of short run period. Gas being stored in compression trailer. Reactor overpressure event; sampling was long enough to be accepted. Complete compression phase of Condition 3 Run 1.
10/24/92	Begin Condition 3 Run 1 (stack sampling phase). EER indicates that the stack flow rate is much higher than Condition 1.
10/25/92	ELI installing compressor piping changes to avoid reactor overpressure. ELI experiencing RF interferences with computer data acquisition system. Complete stack sampling phase of Condition 3 Run 1.
10/26/92	Begin Condition 3 Run 2 (compression and stack sampling). Control computer moved inside boiler room to reduce RF interference. All computer information lost for this run due to reinitialization of system. Complete Condition 3 Run 2.
10/27/92	Booster fan temperature overload, ELI investigates; cause unknown. High concentration of organics in waste caused high naphthalene (suspected) production, causing plugging of instrument ports; ELI cleans system.
10/28/92	Begin Condition 3 Run 3 (compression and stack sampling). H_2 feed was reduced during Run 2 due to faulty differential pressure gauge reading (ELI using booster fan pressure rise to determine H_2 content). This may have caused inadequate H_2 and inability to reduce all of the gas to methane. Now using H_2 feed line pressure to determine H_2 content, although this is not as accurate. O_2 analyzer gummed up, cleaned. EPA auditor arrives to complete audit. Complete Condition 3 Run 3.

10/29/92 through to 11/29/92 - ELI assembling TDU.

11/28/92	Tin release.
11/29/92	Begin Condition 2 Run 1 (later aborted). ELI has TDU feed hopper auger (feed rate) problems. ELI decides to change out auger motor. Scrub Condition 2 Run 1.

TABLE 3-2. (continued)

12/1/92	Restart Condition 2 Run 1. Auger clogged then cleaned out. Hopper feed rate very low. ELI not satisfied with treated soil condition (indication of poor desorption). Complete Condition 2 Run 1.
12/2/92	ELI modifies TDU system to increase residence time.
12/3/92	Begin Condition 2 Run 2 (later aborted). TDU hopper problems caused Condition 2 Run 2 to be aborted.
12/4/92	Restart Condition 2 Run 2 (later aborted). ELI found TDU feed hopper plugged, hopper cleaned. Reformed gas line frozen. ELI aborts Condition 2 Run 2, undesorbed materials passing through the TDU.
12/5/92	Decision to consider the TDU tests as "proof of concept" only. Frozen water lines delay testing. 72-hour operational reliability test begins.
12/6/92	TDU bath heat-up slowed by cold weather.
12/7/92	Restart Condition 2 Run 2. TDU feed hopper auger problems continue. Complete Condition 2 Run 2. TSCA permit expires at midnight.
12/8/92	ELI decides to cancel Condition 2 Run 3 - inadequate destruction. 72-hour operational test concludes—processing non-contaminated material.
12/9/92	Demobilization begins, concludes on 12/18/92.

Recirculating Fan

Scrubber problems, mentioned above, introduced excessive moisture into the fan casing. Eventually this condition adversely affected the fan's operation, requiring shutdown, cleaning, and motor winding replacement.

Boiler

Under normal operation, the boiler cycles between high- and low-fire, depending on the system requirements. However, the demonstration tests showed increased hydrocarbon emissions during low-fire operation, as described later in this report. During low fire operation, the stack gas flow rate was too

low for accurate isokinetic sampling, and the boiler cycling made stack sampling difficult. Therefore, steam was vented in subsequent tests to maintain the boiler on high-fire. During Condition 1 tests, the boiler stack static pressure was fluctuating from a slightly negative pressure to positive pressure ("chuffing"). This caused filters in the flue gas sampling trains to tear. This was resolved in subsequent tests by placing two Teflon strips across the filters and by adjusting the boiler combustion air control damper linkage, which greatly reduced the chuffing.

Liquid Feed System

Particulate in the hot waste water feed caused plugging of the metering valve, requiring frequent adjustment. ELI fabricated a blow-back system that enhanced reliability, but further design work is needed to improve reliability of the hot waste water feed system.

Thermal Desorption Unit (TDU)

The TDU was a source of several problems. During the initial trials at the design soil feed rate, charred pieces of paper and plastic in the treated soil indicated that the feed probably had not reached a sufficiently high temperature to desorb the organic contaminants. Therefore, the soil feed rate was decreased substantially until the treated soil appeared to be free of such materials. The first test at the target feed rate of 10 kg/min (22 lb/hr) was aborted because of these problems. The first valid test run for Condition 2 was conducted at a feed rate of 2.12 kg/min (4.67 lb/hr). There still was concern over the effectiveness of the soil treatment so the soil feed rate was decreased further during the second run to 0.40 kg/min (0.88 lb/min). Due to these problems, the TDU test was considered "proof of concept" only.

The reactor and the TDU required long start-up periods to reach operating temperature during sub-zero weather conditions. Due to these continuing problems with the TDU and expiration of the TSCA permit, the third Condition 2 test run was canceled.

Materials Handling

Most materials handling problems were associated with the soil handling system during the Condition 2 tests. For the Demonstration, the material handling system consisted of a feed conveyor, live bottom feed hopper, a feed screw, and a treated soils drag conveyor. The TDU feed hopper and feed screw were plagued by frequent blockages caused by rags, wire, etc. ELI either had to force the material through the feed hopper, or pull the feed screw to remove the material causing blockage. To address

this problem during the Demonstration, the site soil was scooped onto a steel plate above the feed conveyor, problem material was manually removed, and the manually-sorted soil was pushed onto the conveyor belt. Frequent problems with the screw feeder contributed to the significantly reduced feed rates throughout the demonstration. Since material handling can greatly affect system performance and cost, ELI should consider various soil pretreatment steps, such as size reduction and classification to make the feedstock acceptable to the system, or consider an alternative feeder design.

Process Monitoring

The process monitoring system was also a source of a few operating problems. The oxygen analyzer did not operate reliably. This is an important consideration since elevated levels of O_2 in the system can create an explosive atmosphere. Apparently, blockages in the analyzer sampling line caused this problem.

The differential pressure gauge that was used to evaluate the hydrogen (H_2) content in the system is critical to ensure reduction of the organics. Insufficient hydrogen content will slow the reaction kinetics and favor incomplete reduction. During Condition 3 Run 2, this instrument gave a low reading, lowering the H_2 content and generating an oily residue that coated equipment and instrumentation. This caused sampling problems and unreliable operation. It also is suspected of producing elevated naphthalene levels in most samples analyzed for Condition 3.

Radio frequency (RF) interferences, which ELI later identified as emanating from the spark plug cables on the recirculated gas heater, caused a loss of data from the process control computer during Condition 3, Runs 2 and 3. Because the data files were not backed up on floppy disks, all electronically stored process operating data for these runs were lost. Manual data logs and estimates of key data were used to define process conditions. Therefore, the accuracy of these data was reduced.

PROCESS OPERATING CONDITIONS

All process operating parameters were measured directly, except for hydrogen content, recirculation flow rate, and residence time. The orifice meter designed to measure the recirculation flow rate did not provide accurate readings when the process was in normal operation. Therefore, recirculation flow rate was estimated by ELI, based on the position of the flow control valve and the flow rate measured when primarily nitrogen was being circulated. Recirculation flow rate is a factor in calculating residence time; therefore, the reported residence times are also estimates. The accuracy of these estimates is unknown.

This does not adversely impact achievement of the primary Demonstration objectives; however, reliability of scale-up information and conclusions involving reactor mass balances (Section 5) may be reduced.

Target and Actual Operating Conditions

Tables 3-3, 3-4, and 3-5 compare actual and target process operating conditions for Conditions 1, 2, and 3, respectively. Target process operating conditions were established prior to the test, based on anticipated waste characteristics and ELI's design criteria for the demonstration-scale unit. As shown in the tables, the most important process operating parameters (reactor temperature, residence time (calculated), gas booster differential pressure, and molten bath temperature) all were within the operational limits established prior to the test. However, ELI was unable to achieve the target waste input feed rates.

Table 3-6 compares target and actual waste feed conditions. The waste feed rate targets were based on 1990-1991 ELI site survey results, which found that the waste oil recovered from the site contained approximately 39 percent PCBs and the site soils contained approximately 1,000 ppm PCBs. Actual PCB concentration in the waste oil processed during this Demonstration was 24.6 percent (average of Conditions 1 and 3, mono- through deca- congeners). During Condition 1 tests, the waste water feed rate fell below the target because of unresolved feed system problems. The low feed rate was only discovered after the test because the instantaneous water feed rate could not be measured during the test. However, the target PCB input concentration was achieved for Condition 1. During Condition 2 tests, soil feed rate was limited by soil feed system problems and by apparent "short-circuiting" of soil in the TDU (some untreated material was visible exiting the TDU during Run 1). PCB concentration in the soils was somewhat lower than the planned level. Also, clean steam from the boiler was used as a process feedstock for Condition 2 instead of waste water. During Condition 3 tests, the waste oil feed rate was lower than planned due to the capacity of the peristaltic pump. The PCB input concentration and rate were substantially below target due to this and the lower-than-expected PCB concentration in the waste oil. It should be noted that the waste oil feed rates achieved for Condition 3 were sustained for a maximum of 2.8 hours (Run 2) before reaching the capacity of the compressed storage system for the reformed gas product. Reformed gas was not fed to the boiler while processing waste oil during Condition 3 to facilitate flue gas sampling. The time required to completely consume the compressed reformed gas in the boiler was 4.5 to 9 times that required for waste processing.

TABLE 3-3. CONDITION 1 SUMMARY OF PROCESS OPERATION

Parameter	Monitoring Station	Units	Oct 12, 1992 Run 1	Oct 17, 1992 Run 2	Oct 19, 1992 Run 3	Target condition	Operational limits
Waste water feed rate	–	kg/min	1.44	2.75	1.01	5	+/- 10%
Waste oil feed rate	–	kg/min	0.027	0.026	0.020	0.05	+/- 10%
PCE (spike) injection rate	–	g/min	6.49	6.50	6.35	6.51	–
Vaporizer pressure	12	psig	55.4	48.9	51.2	55	40-60
Vaporizer temperature	12	°C	150	147	148	–	–
Reactor temperature	2	°C	900	893	884	900	850-1000
Recirculation heater exit temperature	9	°C	487	482	474	500	450-550
Reactor pressure	1	in. WC	2.1	1.3	2.0	0	-10 to +10
Gas booster differential pressure	7	in. WC	12.7	10.4	11.6	–	<16
Recirculation flowrate **	–	cfm	110	110	110	100	80-120
Scrubber inlet gas temperature	3	°C	559	484	595	–	–
Scrubber exit temperature	6	°C	30	36	32	–	–
Scrubber liquor pH	5	–	9.20	7.92	9.24	9	9-10
Scrubber inlet water temperature	5	°C	†	†	45.6	>35	—
System oxygen	10	%	0.067	0.053	0.031	0	<0.04
Oxygen - boiler stack	11	%	7.9	6.6	6.2	–	–
Residence time**	–	sec	8.2	6.2	9.5	–	>3
Reformed gas pressure	10	in. WC	8.7	6.7	4.0	–	–
Recirculation vacuum	7	in. WC	0 to -3	<0	<0 to 5	–	–
Monochlorobenzene*	10	ppm	3.59	1.98	6.15	–	<100
Dichlorobenzene*	10	ppm	5.51	1.22	6.30	–	–
Trichlorobenzene*	10	ppb	37	88	223	–	–

*Based on CIMS.

**ELI estimate based on a manual valve setting.

†Not recorded.

TABLE 3-4. CONDITION 2 SUMMARY OF PROCESS OPERATION

Parameter	Monitoring Station	Units	Dec 1, 1992 Run 1	Dec 7, 1992 Run 2	Target condition	Operational limits
Contaminated soil feed rate	–	kg/min	2.12	0.40	10	+/- 10%
Clean steam	13	kg/min	1.89	1.38	1	+/- 10%
Hexachlorobenzene (spike) feed rate	–	g/min	16.8	9.87	41	–
TDU bath temperature	15	°C	616	632	–	–
TDU dome temperature	16	°C	614	610	–	–
TDU combustion gas temperature	17	°C	662	653	–	–
TDU exhaust gas temperature	18	°C	398	500	–	–
TDU pressure	16	in. WC	2.0	2.5	–	–
Reactor temperature	2	°C	890	890	900	850-1000
Recirculation heater exit temperature	9	°C	480	481	500	450-550
Reactor pressure	1	in. WC	2.23	2.69	0	-10 to +10
Gas booster differential pressure	7	in. WC	10.2	8.09	–	<16
Recirculation flow rate **	–	cfm	110	110	100	80-120
Scrubber inlet gas temperature	3	°C	506	502	–	–
Scrubber exit temperature	6	°C	32	32	–	–
Scrubber liquor pH	5	–	8.42	8.42	–	–
Scrubber inlet water temperature	5	°C	44.9	37.2	>35	—
System oxygen	10	%	0.020	0.010	0	<0.04
Oxygen - boiler stack	11	%	6.10	7.57	–	–
Residence time**	–	sec	5.8	9.6	–	>3
Reformed gas pressure	10	in. WC	8	2.45	–	–
Recirculation vacuum	7	in. WC	3	<0	–	–
Monochlorobenzene*	10	ppm	0.03	0.22	–	<100
Dichlorobenzene*	10	ppm	12.0	12.8	–	–
Trichlorobenzene*	10	ppb	569	83	–	–
Hexachlorobenzene*	10	ppb	453	1	–	–

*Based on CIMS.

**ELI estimate based on a manual valve setting.

TABLE 3-5. CONDITION 3 SUMMARY OF PROCESS OPERATION

Parameter	Monitoring Station	Units	Oct 23, 1992 Run 1	Oct 26, 1992 Run 2	Oct 28, 1992 Run 3	Target condition	Operational limits
Waste water feed rate	–	kg/min	4.74	1.04	0.88	1	+/- 10%
Waste oil feed rate	–	kg/min	0.355	0.447	0.353	1	+/- 10%
PCE (spike) injection rate	–	g/min	13.0	13.1	13.2	13.02	–
Vaporizer pressure	12	PSI	53.1	50.0	51.0	55	40-60
Vaporizer temperature	12	°C	149	***	***	–	–
Reactor temperature	2	°C	901	903	994	900	850-1000
Recirculation heater exit temperature	9	°C	470	***	***	500	450-550
Reactor pressure	1	in. WC	2.1	1.5	1.8	0	-10 to +10
Gas booster differential pressure	7	in. WC	8.8	9.1	5.5	–	<16
Recirculation flow rate **	–	cfm	110	110	110	100	80-120
Scrubber inlet gas temperature	3	°C	492	526	562	–	–
Scrubber exit temperature	6	°C	31	32	32	–	–
Scrubber liquor pH	5	–	9.45	8.80	9.70	9	9-10
Scrubber inlet water temperature	5	°C	38.7	44.0	42.0	>35	—
System oxygen	10	%	0.058	***	***	0	<0.04
Oxygen - boiler stack	11	%	7.9	8.1	7.9	–	–
Residence time	–	sec	3.7	7.0	7.5	–	>3
Reformed gas pressure	10	in. WC	2	0	0	–	–
Recirculation vacuum	7	in. WC	***	***	***	–	–
Monochlorobenzene*	10	ppm	22.0	25.1	5.63	–	<100
Dichlorobenzene*	10	ppm	8.33	6.42	4.83	–	–
TriChlorobenzene*	10	ppb	555	313	18	–	–

*Based on CIMS.

**ELI estimate based on a manual valve setting.

***No valid data obtained due to computer data acquisition system fault (see page 3-14).

TABLE 3-6. COMPARISON OF TARGET AND ACTUAL WASTE FEED CONDITIONS

Condition	Parameter	Units	Target value	Actual value				
				Run 1	Run 2	Run 3	Total	Mean
Condition 1 Waste water	Waste water feed rate	kg/min	5.0	1.44	2.75	1.01		1.73
	Waste oil feed rate	kg/min	0.05	0.027	0.026	0.020		0.024
	PCB* concentration in waste water	ppmw	–	<0.023	<0.027	<0.021		<0.023
	PCB* concentration in waste oil	wt. %	–	23.8	–	–		23.8
	PCB* concentration in total feed	ppmw	4,000	4,365	2,217	4,689		3,757
	Total waste processed	kg	8,000	569	1047	472	2,088	
Condition 2 Soil	Soil feed rate	kg/min	10	2.12	0.40	–		–
	Waste water feed rate	kg/min	1	–	–	–		–
	PCB* concentraton in feed	ppmw	1000	<538	<716	–		<627
	Total waste processed	kg	17,500	767	196	–	963	
Condition 3 Waste oil	Waste water feed rate**	kg/min	1	4.74	1.04	0.88		2.22
	Waste oil feed rate**	kg/min	1	0.355	0.447	0.353		0.385
	PCB* concentration in waste water	ppmw	–	<0.037	<0.025	<0.016		<0.026
	PCB* concentration in waste oil	wt. %	–	25.4	–	–		25.4
	PCB* concentration in total feed	wt. %	20	1.77	7.65	7.25		5.56
	Total waste processed	kg	800	280	251	193	724	

< = includes detection limits for non-detected congeners
*PCB concentrations are sum of mono through deca congeners
**Feed rates are based on actual waste processing time

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SECTION 4
SAMPLING AND ANALYTICAL PROCEDURES

SAMPLING LOCATIONS

Table 4-1 provides a summary of the sampling locations. Figure 4-1 shows each sampling location relative to the process. The procedures are briefly summarized in this section.

TABLE 4-1. SAMPLING LOCATIONS

Stream	Description	Location
SS1	Waste water	Feed line before pump
SS2	Waste oil	DNAPL drum
SS3	Contaminated soil	Feed drum
SS4	Caustic	Caustic reservoir tank
SS5	Scrubber make-up water	Valve off of feed line
SS6	Propane	Valve off of feed line
SS7	Hydrogen	Valve off of feed line
SS8	(deleted)	
SS9	Combustion air	Inlet to boiler
SS10	Treated soil	Treated soil collection drum
SS11	Reactor grit	Reactor grit catchpot
SS12	Scrubber sludge	Scrubber effluent tank
SS13	Scrubber decant	Scrubber effluent tank
SS14	Reformed gas	Tee after gas booster fan
SS15	Tank condensate	Valve off the bottom of tank
SS16	Stack gas	Boiler stack
SS17	(deleted)	
SS18	Heat exchanger	Heat exchanger residue waste drum
SS19	TDU gas	Valve off of TDU to reactor feed line
SS20	TDU molten bath	Bath vessel
SS21	(deleted)	
SS22	Scrubber liquor	Scrubber tank
SS23	(deleted)	
SS24	Quench water	Quench tank water

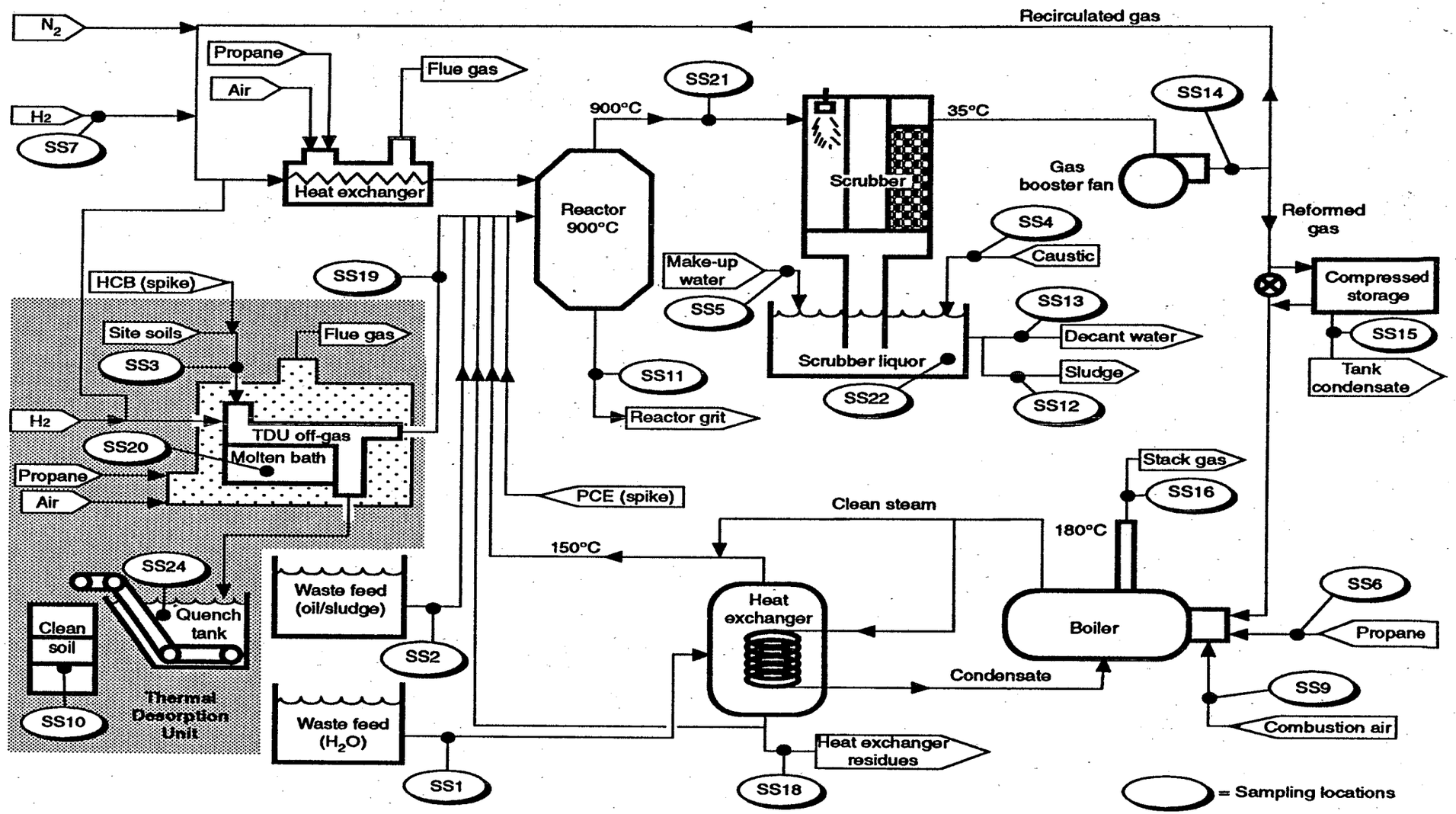

Figure 4-1. Sampling locations .

GAS STREAMS

Six gas streams were sampled, one flue gas stream and five process streams. These were SS16 (boiler flue gas), SS14 (reformed gas), SS19 (TDU off-gas), SS7 (hydrogen), SS6 (propane), and SS9 (combustion air). Table 4-2 summarizes the gas sampling methods employed for these tests.

TABLE 4-2. GAS STREAM SAMPLING AND ANALYTICAL METHODS

Analyte	Sampling principle	Reference	Analtyical principle	Reference
PCBs	XAD-2 adsorption	EPA 0010 (SW-846)	HRGC/HRMS	EPA 680 (SW-846)
Dioxins	XAD-2 adsorption	EPA 0010 (SW-846)	HRGC/HRMS	EPA 23 (40 CFR 60)
Furans	XAD-2 adsorption	EPA 0010 (SW-846)	HRGC/HRMS	EPA 23 (40 CFR 60)
PAH	XAD-2 adsorption	EPA 0010 (SW-846)	GC/MS	EPA 8270 (SW-846)
CB-CP	XAD-2 adsorption	EPA 0010 (SW-846)	GC/MS	EPA 8270 (SW-846)
Volatile organics	Tenax adsorption	EPA 0030 (SW-846)	GC/MS	EPA 5041 (SW-846)
Metals	Impinger absorption	EPA 29 (draft)	GF-AAS,CV-AAS,ICAP	EPA 29 (draft)
HCl/HF	Impinger absorption	EPA 26 (40 CFR 60)	IC	EPA 26 (40 CFR 60)
Particulate	Filter	EPA 5 (40 CFR 60)	Gravimetric	EPA 5 (40 CFR 60)
NO_x	CEMS	EPA 7E (40 CFR 60)	Chemiluminescence	EPA 7E (40 CFR 60)
SO_2	CEMS	EPA 6C (40 CFR 60)	NDUV	EPA 6C (40 CFR 60)
O_2	CEMS	EPA 3A (40 CFR 60)	Paramagnetic	EPA 3A (40 CFR 60)
CO_2	CEMS	EPA 3A (40 CFR 60)	NDIR	EPA 3A (40 CFR 60)
CO	CEMS	EPA 10 (40 CFR 60)	NDIR	EPA 10 (40 CFR 60)
THC	CEMS	EPA 25A (40 CFR 60)	FID	EPA 25A (40 CFR 60)
Fixed gases	Tedlar bag	EPA 18 (40 CFR 60)	GC	MASA 133
Sulfur compounds	Tedlar bag	EPA 18 (40 CFR 60)	GC/FPD	EPA 15 (40 CFR 60)
Heating value	Tedlar bag	EPA 18 (40 CFR 60)	GC	ASTM 2620M

Boiler Flue Gas(SS16)

The exhaust for the boiler was a round 8-inch diameter stack fitted with 10 ports (4 pairs, plus 2 single ports). The ports were installed to comply with EPA Method 1A guidelines; all of the sampling trains were able to operate simultaneously.

PAH, PCB, CB/CP, and PCDD/PCDF—

Semivolatile organics including PAH, PCB, CB/CP, and PCDD/PCDF were sampled using EPA Method 0010 (SW-846). The sample was obtained isokinetically from the boiler flue gas, filtered at 121°C (250°F), and passed through a condenser and XAD-2 sorbent trap maintained below 20°C (68°F), where semivolatile organics were stripped from the sample. The sample was then passed through impingers placed in an ice bath to remove additional organics which may escape the sorbent trap. Sampling periods

were typically 4 hours. The filter, condensate, sorbent, and impinger solutions were extracted and analyzed by high resolution gas chromatography/high resolution mass spectroscopy (HRGC/HRMS). The sorbent trap preparation and analysis using EPA Methods 23 and 8290 was modified by using additional standards and making appropriate splits and recombinations of sample extracts to allow determination of PCDD/PCDF, PAH, PCB, and CB/CP from a single sample. The PCB analysis using EPA Method 680 was modified to incorporate HRGC/HRMS analysis for improved speciation of congener groups.

Volatile Organics–

Volatile organics were sampled using the Volatile Organic Sampling Train (VOST) procedure of EPA Method 0030 (SW-846). The sample was obtained non-isokinetically from the boiler flue gas and passed through two chilled condenser and Tenax sorbent trap sets in series. The condensers cooled the sample to less than 20°C (68°F). The second sorbent trap contained Tenax resin followed by charcoal. Sampling periods were typically 50 minutes. The sorbent traps and condensate were analyzed by GC/MS according to EPA Method 5041.

Trace Metals and Particulate–

Trace metals and particulate matter were determined according to combined EPA Methods 29 (draft) and 5. The sample was obtained isokinetically from the boiler stack, filtered at 121°C (250°F), and passed through a series of impingers containing nitric acid/hydrogen peroxide followed by acidified potassium permanganate. Sampling periods were generally 4 hours. Particulate matter collected on the filter and in the probe was determined gravimetrically according to EPA Method 5. The samples then were digested in acid and analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, nickel, phosphorus, selenium, silver, thallium, zinc, and tin by inductively coupled argon plasma emission spectroscopy (ICAP) and graphite furnace atomic absorption spectroscopy (GF-AAS). Mercury was determined by cold vapor atomic absorption spectroscopy (CV-AAS). The only modification to the methods was the determination of 5 additional trace metals from the sample.

HCl and HF–

HCl and HF were determined using EPA Method 26. The sample was collected non-isokinetically from the boiler flue gas, filtered at 121°C (250°F), and passed through a series of impingers placed in an ice bath. The impingers contained dilute sulfuric acid absorbing solution to dissolve HCl and HF into chloride and fluoride ions followed by sodium hydroxide scrubbing solution. The method was modified to employ full-size impingers instead of midget impingers. Sampling periods were generally 120 minutes. The samples were analyzed by ion chromatography (IC).

Opacity–

Opacity was determined by visual observation following EPA Method 9.

NO_X, SO_2, THC, O_2, CO_2–

A continuous emissions monitoring system was used to characterize NO_X, SO_2, THC, O_2, CO_2 concentrations in the flue gas. The flue gas sample was extracted from the stack non-isokinetically and transported through heated lines and through a heated filter and flow regulator. A separate heated line was used for THC monitoring and the sample was not dried. The balance of the sample was dried in a refrigeration chiller, and distributed to the other analyzers. The response of the analyzers was recorded on a strip chart recorder and a computer data acquisition system. Average concentrations for each run were calculated after each test.

Process Gas Streams-SS14, SS19, SS6, SS7, SS9

Samples were obtained from these streams and analyzed using methods similar to those described above for boiler flue gas sampling, with additional modifications to facilitate safe sampling of hydrogen atmospheres by reintroducing the sample train exhaust into the process stream. These streams were not sampled isokinetically either because they contained no particulate matter or because of safety considerations (high temperature hydrogen atmospheres). Fixed gases (O_2, CO_2, CO, NO_x, H_2, CH_4), VOC, heating value, and sulfur compounds were sampled from SS6 (propane feed), SS9 (combustion air), and SS14 (reformed gas) using Tedlar bags according to EPA Method 18. SVOC sampling was modified to eliminate the filter and impingers for clean, dry process streams (e.g., SS6 - propane) and dirty streams were filtered using a heated quartz wool plug instead of the heated quartz fiber filter. Sorbent trap preparation and analysis procedures for these streams were generally similar to those for boiler flue gas, with modifications depending on the target analytes.

SOLID STREAMS

Samples of contaminated soil were taken as soil was transferred from the drums to the feed conveyer periodically (30 - 60 minute intervals) during each test. Samples of treated soil were taken from the quench tank conveyer periodically during each test at approximately the same frequency as contaminated soil. The individual grab samples were divided into a single composite sample by the "cone and quarter" technique. Reactor grit and scrubber sludge samples were collected only at the end of the final run for

each test condition. Grab samples were collected following recommended EPA procedures[1], and analytical procedures were generally similar to those used for flue gas sampling to enhance comparability of data. Table 4-3 summarizes the sampling and analytical methods used for solids samples.

TABLE 4-3. SOLIDS SAMPLING AND ANALYTICAL METHODS

Analyte	Sampling principle	Analytical principle	Reference
PCBs	Grab	GC/MS	EPA 680 (SW-846)
Dioxins	Grab	HRGC/HRMS	EPA 8290 (SW-846)
Furans	Grab	HRGC/HRMS	EPA 8290 (SW-846)
CB/CP	Grab	GC/MS	EPA 8270 (SW-846)
Pah	Grab	GC/MS	EPA 8270 (SW-846)
Volatile organics	Grab	GC/MS	EPA 8260 (SW-846)
Metals	Grab	CV-AAS, ICAP	EPA 6010, 7471 (SW-846)
Organic halogens	Grab	IC	EPA 9020 (SW-846)
Inorganic halogens	Grab	IC	ASTM E776
Hexavalent chromium	Grab	colorimetrically	EPA 7196 (SW-846)
Total sulfur	Grab	gravimetric	ASTM D3177
TCLP volatiles	Grab	GC MS	EPA 8240 (SW-846)
TCLP metals	Grab	CV-AAS, ICAP	EPA 6010, 7470 (SW-846)
Ash	Grab	combustion/gravimetric	ASTM D482
Heating value	Grab	bomb calorimeter	ASTM D240
Ultimate analysis	Grab	combustion	ASTM D3176
Total organic carbon	Grab	GC	EPA 9060 (SW-846)
Density	Grab	hydrometer	ASTM D1298

LIQUID STREAMS

Grab samples were collected following the general guidelines provided in EPA SW-846 and analytical procedures were generally similar to those described above. A sample of the waste oil was taken from the drum at the beginning of Conditions 1 and 3 (all waste oil came from the same drum during each condition). Waste water was sampled periodically from the feed line during each run. A sample of scrubber make-up water and scrubber caustic was obtained for each test condition. Samples of the scrubber liquor, heat exchanger residue, and TDU quench water were obtained at the beginning and end of each test condition in which they were generated. Scrubber decant water and reformed gas tank condensate samples were collected after each run. Individual waste water grab samples were placed in sample containers, sealed with zero headspace, and stored at 4°C (39°F) to prevent loss of VOCs. These were combined after each test in a Tedlar-lined bucket and a single sample was extracted from the bucket for analysis. All liquid samples for volatile and semivolatile organics analysis were stored in sealed sample containers with zero headspace at 4°C (39°F) until analyzed. Individual grab samples for other

1 "Test Methods for Evaluating Solid Waste" (SW-846), Third Edition, Volume II, Chapter Nine (November, 1986).

analyses were composited by mixing them in a large dedicated Tedlar-lined container. *Table 4-4* summarizes the sampling and analytical methods used for liquid samples.

TABLE 4-4. LIQUIDS SAMPLING AND ANALYTICAL METHODS

Analyte	Sampling principle	Analytical principle	Reference
PCBs	Grab	GC/MS	EPA 680 (SW-846)
Dioxins	Grab	HRGC/HRMS	EPA 8290 (SW-846)
Furans	Grab	HRGC/HRMS	EPA 8290 (SW-846)
CB/CP	Grab	GC/MS	EPA 8270 (SW-846)
PAH	Grab	GC/MS	EPA 8270 (SW-846)
Volatile organics	Grab	GC/MS	EPA 8260 (SW-846)
Metals	Grab	CV-AAS, ICAP	EPA 6010, 7470 (SW-846)
Organic halogens	Grab	IC	EPA 9020 (SW-846)
Inorganic halogens	Grab	IC	EPA 325.2
Hexavalent chromium	Grab	colorimetry	EPA 7196 (SW-846)
Total sulfur	Grab	ICAP	EPA 6010 (SW-846)
TCLP volatiles	Grab	GC/MS	EPA 8240 (SW-846)
TCLP metals	Grab	CV-AAS, ICAP	EPA 6010, 7470 (SW-846)
Ash	Grab	combustion/gravimetric	EPA 160.4
Heating value	Grab	bomb calorimeter	ASTM D240
Ultimate analysis	Grab	combustion	ASTM D3176
Total organic carbon	Grab	GC	EPA 9060 (SW-846)
Density	Grab	hydrometer	ASTM D1298
pH	Grab	pH meter	EPA 9040 (SW-846)

SAMPLE STREAM FLOW RATE DETERMINATION

Whenever possible, EER directly measured the flow rate of each sample stream. Average flow rates for several streams were based on pre- and post-test weights of containers on a calibrated scale (SS2, SS3, SS10, SS11, SS12, SS13, SS15, SS18, SS22, and SS24). Flow rates for streams SS5, SS6, and SS7 were based on process flow meters. A calibrated S-type pitot tube was used to measure gas flow rates at SS9 and SS16. Changes in tank level over the sample period and density were used for streams SS1 and SS24. Due to the nature of the sampling locations, EER was unable to directly measure the mass flow rate of reformed gas (SS14), TDU off-gas (SS19), and the molten bath (SS20). Reformed gas flow rate was estimated from the flow control valve position and pre-test flow data provided by ELI. TDU off-gas were estimated based on mass balances around the TDU. The mass of metal in the flow rates of individual substances in the molten bath was based on the weight of a single metal bar and the total number of bars added to the system. See Section 5 for additional details of flow rate determination procedures.

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SECTION 5
PERFORMANCE EVALUATION

MASS BALANCE AND ORGANIC DESTRUCTION

Because of the complexity of the ELI process, one of the objectives of this project was to establish mass balances for the process streams, metals, carbon, hydrogen, oxygen, chlorine, and sulfur. These balances indicate the overall quality of the sampling and analysis procedures and establish the fate of key substances. Ideally, the sum of mass measured in the output streams should equal the sum of mass measured in the inputs. However, due to sampling and analytical errors inherent in the methods, complete closure is seldom achieved. Another objective of the project was to evaluate the organic destruction capability of the process. Organic destruction is indicated by the destruction efficiency (DE) and destruction and removal efficiency (DRE) of key organics including PCBs, dioxins/furans, PCE, and HCB. The DRE indicates the quantity of a substance input to the system which does not exit the system from the boiler stack, while the DE indicates the amount of substance input to the system which is destroyed. PCBs, PCE, and HCB entered the system at levels sufficient to provide accurate evaluations of the system's organic destruction potential.

MBC, DE, and DRE Computations and Assumptions

The term mass balance closure (MBC) is defined in this report as the deviation from perfect closure. Perfect closure means the sum of outputs is equal to the sum of inputs, and the MBC equals zero. Quantifying MBC, DE, and DRE for the ELI reduction process was an involved task, due to the number of streams flowing in and out of the system. In addition, several process streams accumulated in the system during the test and required special sampling and data reduction techniques. To determine the MBC, DRE, and DE required four key steps:

(1) Defining "control volumes" and identifying each process stream entering, exiting, or accumulating inside the control volumes.

(2) Identifying the monitoring and sampling procedures for each process stream.

(3) Determining which substances and parameters needed to be quantified for each process stream and how these substances and parameters would be determined.

(4) Defining the equations and assumptions.

Control Volumes—

The primary control volume for the ELI reduction process is illustrated within the dotted line in Figure 5-1. Only those streams which are circled cross the control volume and are included in the computations. Other streams such as the combustion air, propane, and flue gas for the TDU do not mix with the reactor process streams and are not included in the calculations. Streams which are circled and underlined are internal to the control volume; they do not flow in and out of the system. These internal streams have an initial mass which either increases or decreases as the test proceeds. For instance, the scrubber liquor tank is clean at the beginning of the test; organics and inorganics accumulate there as waste streams are processed.

The control volume described above is used to evaluate the MBC, DRE, and DE critical objectives. To determine the effectiveness of the reactor itself at reducing organics, DE and DREs also were calculated based on sampling the TDU off-gas input and reformed gas output, excluding the boiler and the TDU from the calculations. The reactor control volume is illustrated in Figure 5-2.

Process Monitoring and Sampling Procedures—

An extensive matrix of monitoring and sample collection activities to support mass balances was planned as shown in Table 5-1. The sample collection frequency and procedures were chosen to provide the best representation of the flow rate for substances entering and exiting the system as well as the collection of substances within the system. In most cases, the weight or volume of the stream was measured directly. However, suitable instrumentation was not available for the propane and combustion air streams. For these streams, combustion calculations based on the stack gas flow rate and nitrogen level, reformed gas nitrogen content, and propane composition were used to compute the flow rates.

Sample Analyses—

The sample analyses required for the MBC, DE, and DRE computations for each stream are shown in Table 5-2. Density is required to convert analytical results reported on a volume basis to a mass basis. Moisture content is used to convert results reported on a dry basis to a wet basis. In addition, moisture analysis is used to determine the hydrogen and oxygen content of wet streams. In most cases, the concentrations and densities for the analytes shown in Table 5-2 were determined by sampling and

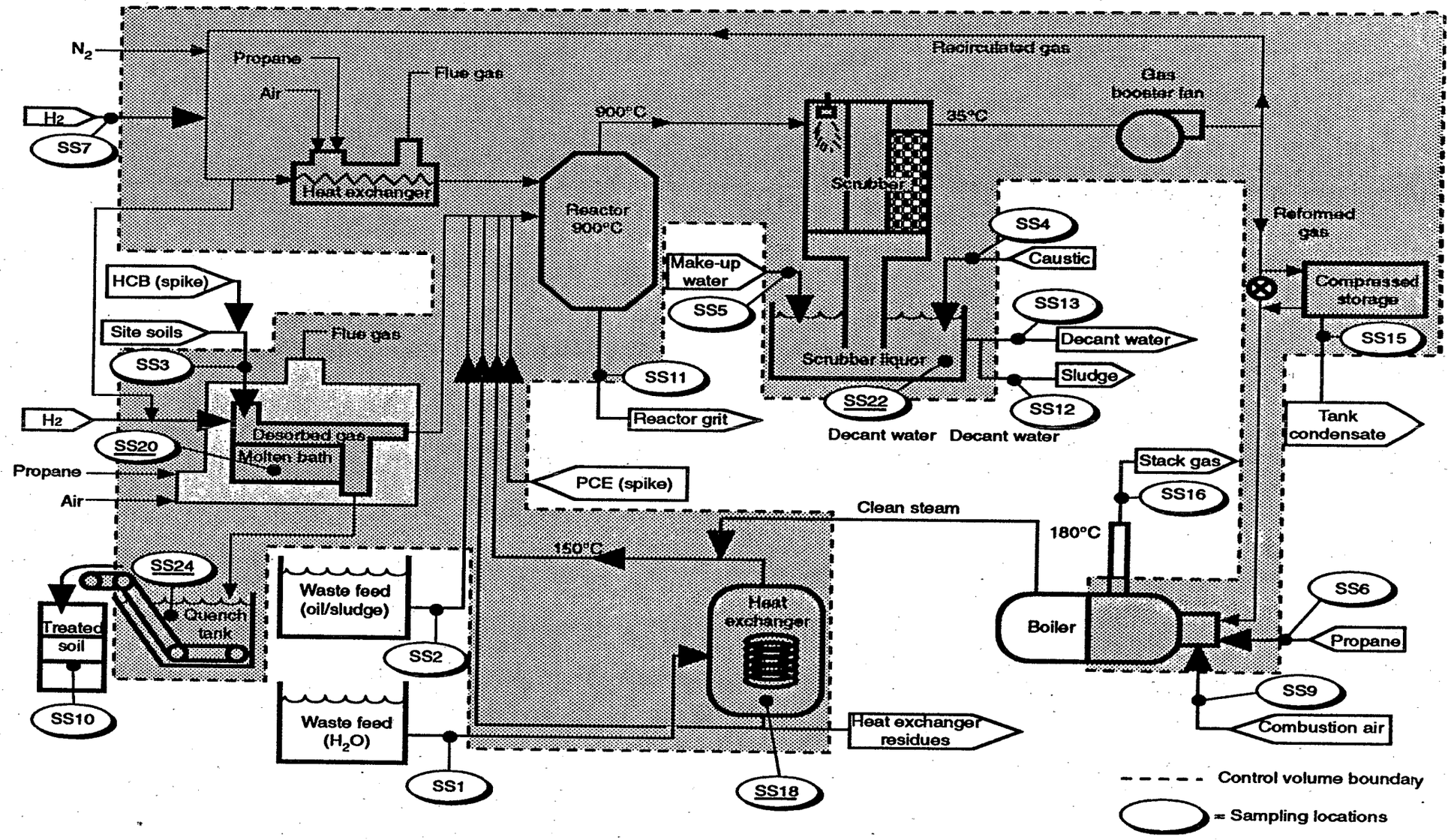


Figure 5-1. Control volumes and sampling locations for complete system mass balance.

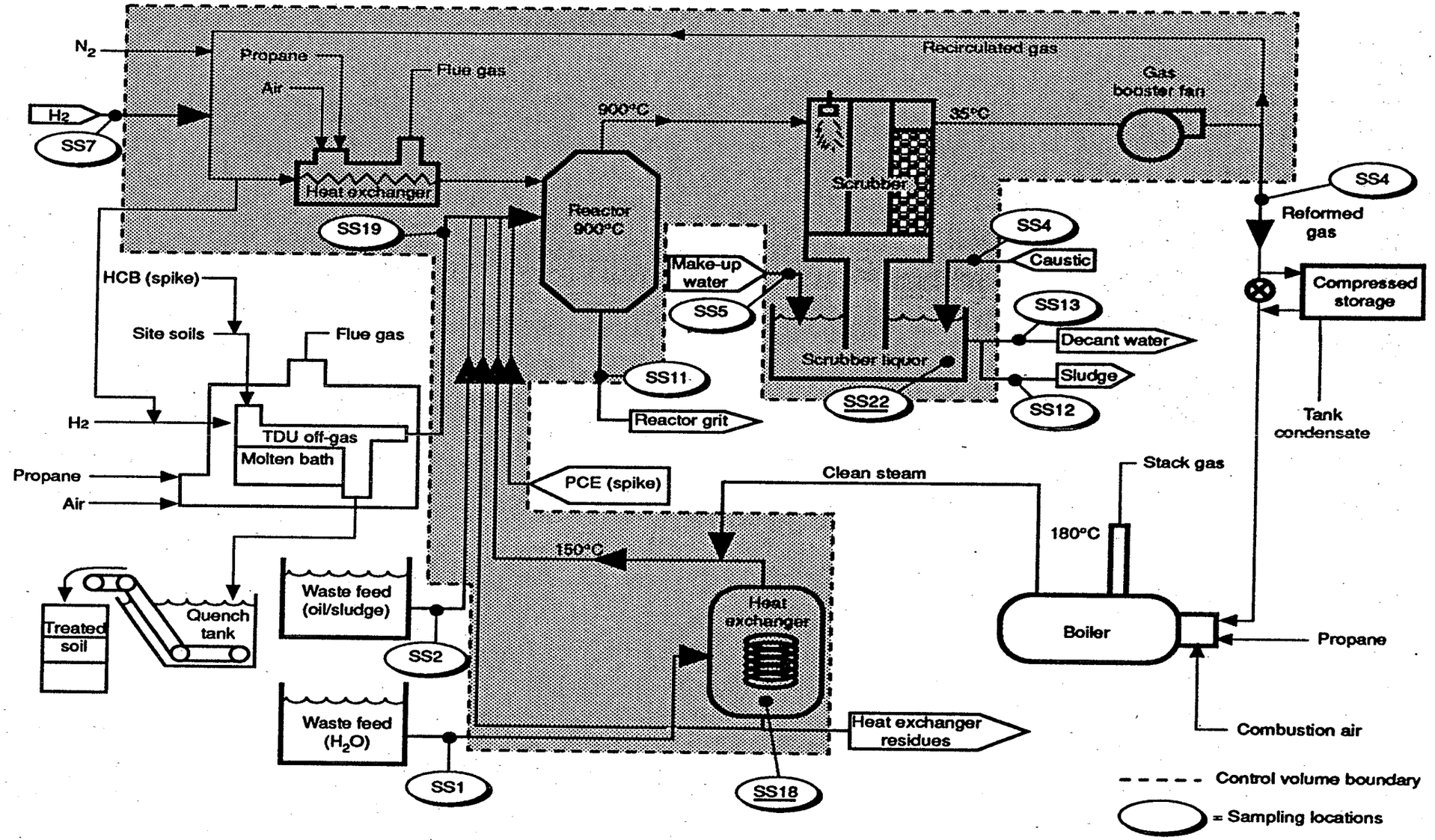


Figure 5-2. Control volumes and sampling locations for reactor mass balance.

TABLE 5-1. MASS BALANCE, DRE, AND DE SAMPLE COLLECTION AND ANALYSIS SUMMARY

Process stream	Sampling location	Mass flow rate determination		Sample collection	
		Monitoring method	Reporting frequency	Collection frequency	Analytical frequency
Heat exchanger					
Input					
Waste water feed	SS1	Weight of waste water used	At end of run	Four times per run	Run composite
Internal					
Residual waste	SS18	Weight of residual	Before and after run	Before and after run	Before and after condition composites
Reactor					
Input					
Waste feed oil/sludge	SS2	Weight of oil used	At end of run	Once per drum	Condition composite
Hydrogen	SS7	Volume of gas used	At end of run	Once per lot	Each lot
Output					
Residual grit	SS11	Weight of grit collected	At end of condition	After condition	Condition sample
Thermal desorber					
Input					
Contaminated soil	SS3	Weight of soil used	At end of run	Once per drum	Run composite
Hydrogen	SS7	Volume of gas used	At end of run	Once per lot	Each lot
TDU off-gas	SS19	Volume flow rate	At end of run	Integrated sample	Integrated sample
Output					
Clean soil	SS10	Weight of soil collected	At end of run	Once per drum	Run composite
Internal					
Quench water	SS24	Volume of water	Before and after run	Before and after run	Run samples
Desorber bath	SS20	Volume of tin	Before and after condition	Before and after condition	Condition samples
Scrubber					
Input					
Scrubber lime water	SS4	Volume of lime water used	At end of run	Once per lot	Each lot
Scrubber make-up water	SS5	Volume of water used	At end of run	Once per condition	Condition samples
Internal					
Scrubber liquor	SS22	Volume of liquor	Before and after run	Before and after run	Run samples
Output					
Reformed gas	SS14	Volume flow rate	At end of run	Integrated sample	Integrated sample
Scrubber sludge	SS12	Volume of sludge collected	At end of run	After run	Run samples
Scrubber decant water	SS13	Volume of decant water collected	At end of run	After run	Condition composite
Boiler					
Input					
Propane	SS6	F-factor	At end of run	Once per lot	Each lot
Combustion air	SS9	Stack N2 and reformed gas N2	At end of run	One run per condition	Condition sample
Output					
Flue gas	SS16	Volume flow rate	At end of run	Integrated sample	Integrated sample
Compressed storage					
Output					
Condensate	SS15	Weight of condensate collected	At end of run	After run	Condition composite

TABLE 5-2. MASS BALANCE ANALYSIS SUMMARY

Process stream	Sampling location	Parameters											
		Density	H2O	C	H	O	Cl	S	PCB	PCDD/ PCDF	PCE	HCB	Metals
Heat exchanger													
Input													
Waste water feed	SS1	x	(12)	x	(7)	(7)	x	x	x	x	x	nn	x
Internal													
Residual waste	SS18	(3)	(12)	x	(7)	(7)	x	x	x	x	x	nn	x
Reactor													
Input													
Waste feed oil/sludge	SS2	nn	x	x	x	x	x	x	x	x	x	nn	x
Hydrogen	SS7	(4)	n	n	(8)	n	n	n	x	n	x	x	n
Output													
Residual grit	SS11	nn	x	x	n	n	x	x	x	x	x	x	x
Thermal desorber													
Input													
Contaminated soil	SS3	nn	x	x	(7)	(7)	x	x	x	x	nn	x	x
Hydrogen	SS7	(4)	n	n	(8)	n	n	n	x	n	x	x	n
Output													
TDU off-gas	SS19	nn	nn	(15)	(14)	(14)	(14)	(14)	(15)	(15)	(15)	(15)	(14)
Clean soil	SS10	nn	x	x	(7)	(7)	x	x	x	x	nn	x	x
Internal													
Quench water	SS24	(3)	(12)	x	(7)	(7)	x	x	x	x	nn	x	x
Desorber bath	SS20	(5)	n	n	n	n	n	n	n	n	nn	n	x
Scrubber													
Input													
Scrubber caustic	SS4	x	n	n	(9)	(9)	x	x	n	n	n	n	x
Scrubber make-up water	SS5	x	(12)	n	(7)	(7)	x	x	n	n	n	n	x
Output													
Reformed gas	SS14	(4)	nn	x	(14)	(14)	(14)	(14)	x	x	x	x	(14)
Scrubber sludge	SS12	(6)	x	(13)	(7)	(7)	(13)	(13)	x	x	x	x	(13)
Scrubber decant water	SS13	x	(12)	x	(7)	(7)	x	x	x	x	x	x	x
Internal													
Scrubber liquor	SS22	x	(12)	x	(7)	(7)	x	x	x	x	x	x	x
Boiler													
Input													
Propane	SS6	(4)	n	(10)	(10)	n	n	n	x	n	x	x	n
Combustion air	SS9	(4)	n	n	n	(11)	n	n	x	n	x	x	n
Output													
Flue gas	SS16	(4)	x	(2)	(2)	(2)	(2)	(2)	x	x	x	x	x
Compressed storage													
Output													
Condensate	SS15	(3)	(12)	x	n	n	x	x	x	x	x	nn	x

(1) - Ultimate analysis includes carbon, hydrogen, nitrogen, oxygen.
(2) - Used combustion gas CO, O2, CO2, SO2, NOx, H2O, and THC analyses.
(3) - Used density of water 62.4 lbm/cf (based on observations in field)
(4) - Used ideal gas law.
(5) - Used density of tin 358 lbm/cf.
(6) - Used density of ash 137.3 lbm/cf.
(7) - Used moisture content, and hydrogen and oxygen content of water 11%H and 89%O.
(8) - 100% hydrogen.
(9) - Used oxygen and hydrogen content of NaOH.
(10) - Used carbon and hydrogen content of C3H8.
(11) - Used oxygen content of air.
(12) - Assumed to be 100% water.
(13) - Not analyzed because no sample available (sample used for critical analytes).
(14) - No mass balance conducted.
(15) - Determined by mass balance around TDU.

n - neglected
nn - not needed for computations
x - analyzed

analyzing each stream directly. However, some concentrations and densities were estimated using the ideal gas law, assumed densities, or assumed or measured stream compositions. Notes in Table 5-2 provide the specific estimation techniques for each stream and substance.

To ensure complete MBCs and accurate DE and DRE computations, substances expected to be present in significant amounts in each stream were quantified. The following substances were not quantified:

Stream	Substance
Scrubber caustic:	C, PCB, PCDD/PCDF, PCE, HCB
Scrubber make-up water:	C, PCB, PCDD/PCDF, PCE, HCB
Boiler propane :	O, Cl, S, PCDD/PCDF, metals
Hydrogen feed:	C, O, Cl, S, PCDD/PCDF, metals
Boiler combustion air:	C, H, Cl, S, PCDD/PCDF, metals
Reactor grit:	H, O
Scrubber sludge:	C, Cl, S, metals
Tank condensate:	H, O
TDU molten bath:	C, H, O, Cl, S, PCB, PCDD/PCDF, HCB

The concentrations of these substances were assumed to be zero in their respective streams. For all streams except the scrubber sludge and molten bath, these assumptions will not impact the MBC, DE, and DRE calculations. However, the scrubber sludge may have high concentrations of carbon, chlorine, sulfur, and metals. Because of the small amount of scrubber sludge generated, only critical substances (PCB, PCDD/PCDF, PCE, and HCB) could be quantified. The molten bath matrix limited quantification to metals. However, residual organics may remain after the test is complete.

While the TDU off-gases were sampled and analyzed, these analyses were not used to evaluate the DRE and DE for the reactor control volume for Condition 2. In general, the confidence in the TDU off-gas sampling procedures was low because of the difficulty in obtaining a representative sample. In addition, many of the target analyte detections were well above the linear calibration range of the instruments. Under these conditions, the accuracy of laboratory analyses is poor. The carbon, PCB, PCDD/PCDF, PCE, and HCB gas emission rates from the TDU were based on a mass balance around the TDU which included the contaminated soil, treated soil, and quench tank streams.

MBC, DE, and DRE Equations—

In general, the computation of MBC, DE, and DRE involves the calculation of either the mass rate or mass of each substance entering, exiting, or accumulating in the system. Mass rate of a particular substance is simply the product of the total process stream rate and substance concentration, while mass is the product of the total process stream mass and substance concentration. Because different components of the reduction process did not operate simultaneously, the DRE, DE, and MBC were based on mass instead of mass rates.

The non-simultaneous operation was particularly apparent during Condition 3, where the reactor gases were stored in a tank and then burned in the boiler after the tank was filled. In general, the time required to fill the tank was much shorter than the time required to empty the tank. For example, during Condition 3 Run 3, only 150 minutes were required to fill the tank while 1,400 minutes were required to empty the tank. The impact of this lag in processing the reformed gas is explained below. The reformed gas contains products of incomplete reduction (PIRs) which undergo further reaction during the combustion step in the boiler. Partially combusted PIRs are emitted from the boiler stack. Emissions from the ELI process are not completely characterized until the stored reactor gases have been processed. A DRE based on the rates of the boiler stack emissions would indicate greater destruction than actually occurred.

The MBC, DE, and DRE computations also were based on total mass because of the number of streams that were measured as total quantities. Only the boiler propane, combustion air, and flue gas were measured as rates. These rates were converted to quantities using the total process time for Conditions 1 and 2 and the total time to empty the reformed gas tank for Condition 3. Using the total mass for each substance in each stream, MBC, DE and DRE were computed as discussed below.

MBC for total mass of a particular substance is defined as the <u>deviation</u> from perfect closure as follows:

$$\text{MBC} = 100 \times \frac{(\text{total mass in input streams}) - (\text{total mass in output streams})}{1/2[(\text{total mass in input streams}) + (\text{total mass in ouput streams})]}$$

The MBC is zero for perfect closure (i.e, inputs are equal to outputs). If MBC is negative, the outputs are greater than the inputs. This expresses the deviation from perfect closure. The average of the total input and total output mass is used since the measurement uncertainty is similar for input and output streams.

The DRE is defined as follows:

$$DRE = 100 \times \left(1 - \frac{\text{(total substance mass at the boiler stack)}}{\text{(total substance mass in input streams)}}\right)$$

The DRE indicates the quantity of a substance input to the system which does not exit the system by the stack. The DRE does not necessarily indicate that the substance was destroyed.

The DE of a particular substance is defined as follows:

$$DE = 100 \times \left(1 - \frac{\text{(total substance mass in output streams)}}{\text{(total substance mass in input streams)}}\right)$$

The DE indicates the amount of a substance input to the system which is destroyed in the system.

Detection Limits—

To provide a conservative evaluation of the ELI process, several key assumptions were made for the treatment of data below the detection limit and interpolating condition-composite concentrations to estimate individual run concentrations. In general, if the concentration of a substance was not detected, a value between zero and the detection limit was used to estimate emissions. To estimate the DE and DRE, the most conservative approach is to use zero for the detection limit for input streams and the full detection limit for output streams. For MBC computations, however, it is best to assume the full detection limit on both the input and output streams. In summary:

- For the DE and DRE calculations, detection limits for the input streams were set to zero while the full value of the detection limit was used for the output streams.

- For the MBC calculations, the full value of the detection limit was used for both input and output streams.

Interpolating Composite Concentrations to Determine Run Concentrations—

Since DE calculations were required for each run, conservative assumptions were adopted for interpolating condition-composite concentrations to estimate individual run concentrations. If the condition concentration was a composite of three runs, the estimated concentration for each run was three times the condition concentration. This assumes that the condition-composite concentration was a result of one

sample whose concentration was three times the composite concentration and two samples with zero concentrations. Since it is not known which sample had the high concentration, the high concentration is applied to each of the samples or runs. This procedure is conservative since it is not likely that all of the material would have accumulated over a single run in a continuous process. It is more likely that some amounts of material would have accumulated over each run. However, the objective of the organic destruction computations was to provide a conservative process evaluation. The condition-to-run interpolating procedure described above was only applied to the following output streams for the DE computations:

Reactor grit:	PCDD/PCDF, PCB, HCB, PCE
Scrubber sludge:	PCDD/PCDF, PCB (Condition 2 and Condition 3 Run 3 only), HCB, PCE
Scrubber decant:	PCDD/PCDF, PCB, HCB, PCE (Condition 3 only)
Tank condensate:	PCDD/PCDF, PCB (Condition 3 Run 2 and Condition 3 Run 3 only)

The interpolating procedure did not affect the DRE computations because the stack gas was the only output and a sample of this stream was analyzed for each run. The MBC computations were not affected because the calculations were performed on a condition basis and estimating procedures were not required. It should be noted that the test program was designed with this approach in mind. Spiking quantities, sample quantities, and method detection limits commensurate with the project objectives were selected accordingly. In summary:

- For the DE computations, output stream condition-composite concentrations were multiplied by 3 or 2, depending on the number of runs combined to estimate the run concentrations. For the input streams, run concentrations were assumed to equal the condition-composite concentration.

- No interpolating procedures were necessary for the MBC or DRE calculations.

"Best Case" Analysis—

While the calculation procedures described above provide conservative or "worst case" estimates of the organic destruction potential, it also is useful to determine "best case" DRE and DEs. To this end, DRE and DEs also were computed assuming the values of nondetected analytes were zero. In addition, for composite streams the estimated run values were assumed to equal the composite value. Computing both worst and best case DE and DREs provides a range in which the true destruction potential of the unit lies.

Mass Balance Results

MBCs for the process streams, trace metals, and major elements including carbon, chlorine, hydrogen, oxygen, and sulfur, are shown in Table 5-3 and Table 5-4. These tables also show primary input and output streams for each condition. The MBC objective was ±50 percent for the process streams and elements. The process and major element MBCs were excellent. In general, the trace metal mass balance was not as successful due to the low levels of metals present and unquantifiable sources such as metal pipes, refractory linings in the reactor and ducts, and paint in the scrubber tank. However, the trace metals mass balance did provide very useful information on the partitioning of metals within the reduction process.

Overall Process Mass Balance—

As shown in Table 5-3, the process MBC of total mass entering and leaving the process was well within the objective of ±50 percent for all runs. For all runs except Condition 1 Run 2, the MBC was less than ±10 percent. This excellent closure indicates that the process masses are accurate; therefore, substance emission rates and masses based on these data are reliable, provided the measured substance concentrations also are accurate.

Key streams were identified by comparing the magnitudes of the process flows. For all test conditions, the bulk of the boiler stack gases resulted from the boiler combustion air, as expected. During Condition 1 and 3, another key mass flow was the transfer of mass from the waste water to the scrubber decant water. The scrubber make-up water and caustic also made significant contributions to the scrubber decant water for Condition 3. During Condition 2 the contaminated soil passed into the TDU, received treatment, and exited into the quench tank. There was little change in the overall mass of the soil.

Major Element Mass Balance—

As shown in Table 5-3, 12 out of 15 of the major element MBCs for the complete system (see Figure 5-1) satisfy the objectives. Only the MBCs for chlorine in Condition 2, hydrogen in Condition 1, and sulfur in Condition 3 are outside the objective of ±50 percent. The hydrogen balance is very close to the objective. However, the sulfur and chlorine balances indicate that all of the input mass was not accounted for in the output streams for these elements. Due to the number of significant streams in the chlorine and sulfur mass balance it is difficult to definitively identify the cause of the incomplete MBCs. However, one or more of the following considerations may be responsible:

TABLE 5-3. PROCESS AND MAJOR ELEMENT MASS BALANCE SUMMARY

Substance	Mass balance closure[a] (%)								Key streams					
	Condition 1			Condition 2		Condition 3			Condition 1		Condition 2		Condition 3	
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 1	Run 2	Run 3	Input	Output	Input	Ouput	Input	Ouput
Process	4.3	20.1	-4.3[b]	9.1	6.1	3.9	3.0	1.1	SS1 SS9	SS13 SS16	SS1 SS3 SS4 SS9	SS10 SS13 SS16	SS1 SS4 SS5 SS9	SS13 SS16
Carbon	-2.1[b]		-(41)[b]	0.3	(26)	14.7		(98)	SS6 (SS2)	SS16 (SS14)	SS6 (SS19)	SS16 (SS14)	SS6 (SS2)	SS16 (SS14)
Chlorine	6.67			98		-0.5[b]			SS1 SS2	SS13 SS18 SS22	SS3	SS10 SS13 SS22 SS24	SS2	SS13 SS22
Hydrogen	-53.8[b]			14.8		-8.6[b]			SS1	SS13	SS1	SS13	SS1 SS5 SS6	SS13 SS16
Oxygen	17.6			9.37		-6.66[b]			SS1 SS9	SS13 SS16	SS1 SS9	SS13 SS16	SS5 SS9	SS13 SS16
Sulfur	29.1			-44.9[b]		129			SS1 SS2	SS13 SS16 SS18 SS22	SS3	SS10 SS13 SS16 SS22	SS2	SS16 SS18 SS22

[a] Balance includes complete system unless noted. See Figure 5-1.

[b] Negative balance indicates output greater than input.

() Balance for reactor control volume. See Figure 5-2.

SS1	– Waste water	SS12	– Scrubber sludge
SS2	– Waste oil	SS13	– Scrubber decant
SS3	– Contaminated soil	SS14	– Reformed gas
SS4	– Scrubber caustic	SS15	– Tank condensate
SS5	– Scrubber make-up water	SS16	– Boiler stack gas
SS6	– Propane	SS18	– Heat exchanger residue
SS7	– Hydrogen	SS20	– TDU molten bath
SS9	– Boiler combustion air	SS22	– Scrubber liquor
SS10	– Treated soil	SS24	– TDU quench water
SS11	– Reactor grit		

TABLE 5-4. TRACE METAL MASS BALANCE SUMMARY [a]

Substance	Mass balance (%) [c]			Key streams					
	Condition			Condtion 1		Condition 2		Condition 3	
	1	2	3	Input	Output	Input	Ouput	Input	Ouput
Antimony	d	d	d	d	d	d	d	d	d
Arsenic	d	32	d	d	d	SS3	SS10	d	d
Barium	47.1	1.31	77.4	SS1 SS2	SS18	SS3	SS10	SS1 SS2	SS18 SS22
Beryllium	d	30.8	d	d	d	SS3	SS10	d	d
Cadmium	d	-37.5 [b]	138	d	d	SS3	SS10	SS2	SS16
Chromium	-71.9 [b]	-150 [b]	-71.5 [b]	SS2	SS22	SS3	SS10 SS20	SS2	SS22
Copper	175	21.1	-64.9 [b]	SS2 SS4 SS22	SS13	SS3	SS10	SS2 SS4	SS22
Lead	165	109.6	32	SS2	SS13	SS3 SS20	SS10	SS2	SS22
Manganese	27.6	30.2	-153 [b]	SS1 SS22	SS16 SS18	SS3	SS10	SS1 SS18	SS22
Mercury	d	5.25	82.9	d	d	SS3	SS10	SS2	SS22
Nickel	-117 [b]	-132 [b]	-136 [b]	SS2	SS13 SS22	SS3	SS10 SS20	SS2	SS13 SS22
Phosphorus	140	-89 [b]	163	SS2	SS22	SS3	SS10	SS2	SS22
Selenium	d	d	d	d	d	d	d	d	d
Silver	d	d	d	d	d	d	d	d	d
Thallium	d	29.9	d	d	d	SS3	SS10	d	d
Tin	d	-196 [b]	-23.6 [b]	d	d	SS3	SS10	SS2	SS22
Zinc	-94.7 [b]	-16.3 [b]	-139 [b]	SS1 SS2	SS13 SS18 SS22	SS3	SS10	SS2	SS18 SS22

[a] Balance includes complete system see Figure 5-1.

[b] Negative balance indicates output greater than input.

[c] Acceptance limit +/-50

[d] Most emission data below detection limit.

SS1 - Waste water
SS2 - Waste oil
SS3 - Contaminated soil
SS4 - Lime water
SS5 - Scrubber make-up water
SS6 - Propane
SS7 - Hydrogen
SS9 - Boiler combustion air
SS10 - Treated soil
SS11 - Reactor grit
SS12 - Scrubber sludge
SS13 - Scrubber decant
SS15 - Tank condensate
SS16 - Boiler stack gas
SS18 - Heat exchanger residue
SS20 - TDU molten bath
SS22 - Scrubber liquor
SS24 - TDU quench water

- **Unaccounted for output streams**—The scrubber sludge was not analyzed for chlorine and hydrogen during any of the conditions. If this was the reason, it is unlikely that the balances for these elements in Conditions 1 and 3 would have been complete. During Condition 2, the molten bath was not analyzed for chlorine. If chlorine was present, this may represent a significant stream, especially since the TDU was not operating effectively during Condition 2 Run 1.

- **Unrepresentative sampling**—For Condition 2, a large quantity of heterogenous treated soil was generated; a representative sample may not have been collected.

A carbon balance also was conducted for the reactor control volume (see Figure 5-2). Conditions 1 and 2 satisfy the reactor carbon MBC objective. However, for Condition 3 the reactor MBC objective was not satisfied. For this condition, only one-third of the carbon entering the reactor was accounted for in the outputs. No definitive reason for the poor reactor carbon balance for Condition 3 could be identified. Poor recovery of the sooty carbonaceous material noted in some of the samples and in the system for this condition may have contributed to poor reactor carbon MBC.

As part of the mass balance evaluation, major process streams and flows were identified for each major element. Appendix 3 provides graphs which illustrate the partitioning of the major elements. Table 5-3 summarizes the significant streams for each condition. Key observations from the partitioning analysis are summarized below for each major element.

- **Carbon**—For the complete system, the bulk of the stack gas carbon came from the propane, as expected. The waste oil and contaminated soil also were significant sources. Since a key object of the study was to determine the fate of the waste carbon in the reactor, a carbon balance was conducted from the reactor input to the reformed gas inlet of the boiler. Figure 5-3 illustrates the mass of carbon at each input and output stream. The ratio of carbon in each input stream to the total carbon input and the corresponding ratio for output streams also are provided in Figure 5-3. While the overall MBC is not complete, the figure does illustrate the partitioning of the waste carbon matter. For Condition 1 and 3 the waste oil was a major source of carbon to the reactor; for Condition 2 the TDU off-gas was a major source. The TDU off-gas flow rate was determined by mass balance around the TDU. For all three conditions, the major output source was the reformed gas whose major components were methane, carbon monoxide, and carbon dioxide. Toxic components measured in the reformed gas (including benzene, PAHs, and PCBs) were not significant carbon sources for Condition 1, 2, and 3. This observation, coupled with the fact

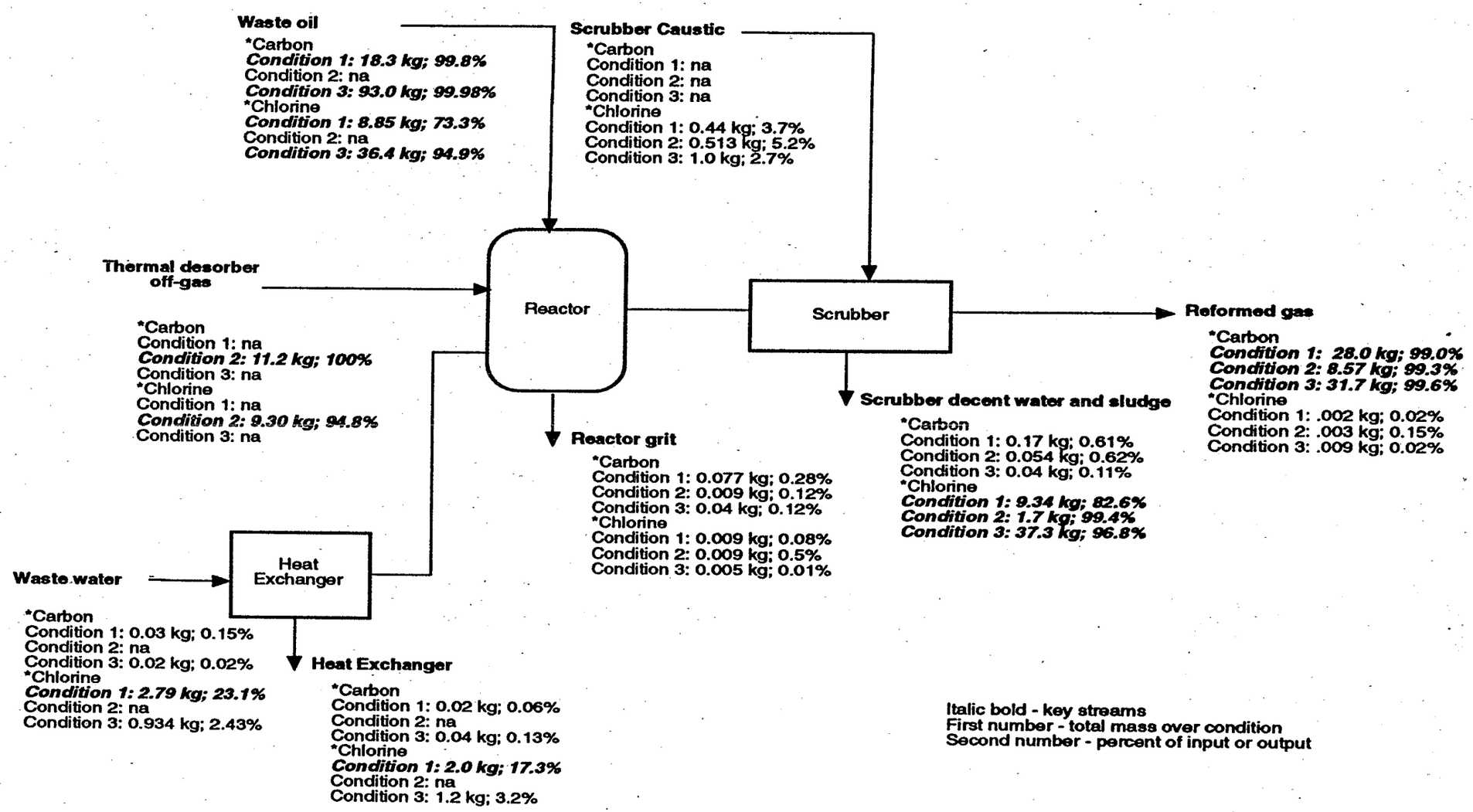


Figure 5-3. Reactor carbon and chlorine mass balance and partitioning.

that the waste oil PCB content was approximately 25 percent, indicates that PCBs were effectively reduced by the process for Condition 1 and Condition 3. While the contaminated soil PCB content was much lower than the waste oil, good conversion of these PCBs to methane, carbon monoxide, and carbon dioxide was achieved during Condition 2.

- **Chlorine**—Figure 5-3 also illustrates the mass of chlorine and the partitioning of chlorine at each reactor stream. For both Condition 1 and 3, chlorine entered the system with the waste oil and PCE spike; it exited the system in the scrubber blowdown tank and decant water. For Condition 2, HCB was the main source of chlorine in the input while the TDU quench water, treated soil, scrubber decant water, and scrubber liquor were the main output streams.

- **Sulfur**—For both Condition 1 and Condition 3, sulfur entered the system with the waste oil and exited the system in the scrubber liquor and decant water, and the heat exchanger residue. For Condition 2 the contaminated soil was the input source while the treated soil was the output source. Very little transfer of the sulfur from the contaminated soil to the reactor occurred.

- **Hydrogen**—Since the hydrogen balance included water, the hydrogen flowed from the waste water to the scrubber decant water for all three conditions. The make-up water was also a key source for Condition 3.

- **Oxygen**—For Condition 1, 2 and 3, the bulk of the stack gas oxygen resulted from the combustion air, as expected. During Condition 1, 2 and 3 another key oxygen mass flow was the transfer of mass from the waste water to the scrubber decant water. The scrubber make-up water also significantly contributed to the scrubber decant water for Condition 3.

Trace Metals Mass Balance—

As shown in Table 5-4, 13 out of 33 trace metal MBCs satisfy the stated objectives. MBCs that were based only on data below the detection limit are not compared to the MBC objective. Condition 2 had the best closure of the three conditions, with 9 out of 14 metals meeting the MBC objective. It produced better closures because the metals concentrations in the contaminated soil and treated soil, which were the main input and output streams for most of the metals, were relatively high (compared to the other wastes) and the flow rate of these streams was also high. The metals in Condition 2 entered the TDU with the contaminated soil and exited with the treated soil. The reduced number of variables in the Condition 2 computations provided better MBCs. For Conditions 1 and 3, however, several streams had significant metals concentrations relative to the total system throughput. Therefore, the complexity of

the analysis increased, increasing the uncertainty of the MBCs. Potential causes for some of the incomplete MBCs are:

- **Unaccounted-for streams**—Some of the positive metal MBCs (input greater than output) may have been improved if the scrubber sludge had been analyzed for metals. Although only a small quantity of scrubber sludge was collected, the metal concentrations may have been high, resulting in a significant metal output mass.

  Some potential sources of metals were not quantified due to the difficulty obtaining representative samples—i.e., contributions from the ceramic reactor core, metal process pipes, and paint on the scrubber tank surfaces. These potential sources may have resulted in the negative MBCs for chromium, nickel, copper (Condition 3 only), zinc, and manganese (Condition 3 only). Table 5-5 compares the distribution of metals in the earth's crust to key streams within the process. The only stream which has a comparable distribution is the reactor grit. This is reasonable, since loses from the reactor core would have collected in the reactor grit. Some material also may have been entrained and collected in the scrubber, resulting in negative MBCs for some metals. Table 5-5 clearly shows that metals with higher concentrations in the earth's crust also had negative MBCs. Only barium and phosphorus did not have negative MBCs. These elements, however, had significant sources within the system which may have reduced the impact of entrained material from the reactor. Losses from metallic and painted surfaces in the system also may have impacted the chromium and nickel results.

- **TDU molten bath sampling**—Due to the configuration of the TDU it was not practical to accurately determine the weight of molten metal before and after the Condition 2 runs. Therefore, it was assumed that the mass of metal in the bath remained constant throughout the program. The quantity of metal in the bath, however, did change during the tests and the contribution was not reflected in the MBC computations for tin. This resulted in the high negative MBC for tin in Condition 2. The difficulty in getting representative molten bath samples also may have contributed to the poor MBCs for chromium, nickel, and lead for Condition 2.

- **Condition 1 Run 1 scrubber malfunction**—During Condition 1 Run 1 the scrubber was not properly setup which may have resulted in the unusual metal capture efficiencies which occurred. For example, no chromium or nickel was detected in the scrubber liquor; copper, lead, manganese, mercury, zinc, and barium decreased significantly in the scrubber tank liquor during the run. Typically each of these elements would collect over the period of a run as the reactor

TABLE 5-5. COMPARISON OF EARTH CRUST ELEMENT DISTRIBUTION TO ELI REDUCTION PROCESS STREAM ELEMENT DISTRIBUTIONS

Substance	Distribution (%)					
	Earth	Reactor grit	Waste oil	Contaminated soil	Waste water	Scrubber liquor
P	40.1	36.2	52.5	27.0	11.8	2.8
Mn*	34.0	36.8	0.0	0.0	7.9	13.0
Ba	8.5	3.9	1.2	4.7	34.6	0.8
Cr*	6.8	4.4	3.1	3.2	3.9	3.4
Zn*	4.5	3.9	19.2	15.4	23.6	57.9
Ni*	2.7	7.4	0.8	2.8	3.9	3.4
Cu*	2.4	3.1	1.6	4.2	2.4	5.3
Pb	0.5	1.4	21.4	11.6	3.9	11.4
Be	0.2	0.0	0.0	0.0	0.0	0.0
As	0.2	2.8	0.0	0.9	7.9	1.9
Hg	0.0	0.0	0.1	8.6	0.0	0.0
Cd	0.0	0.1	0.2	0.0	0.0	0.0
Se	0.0	0.0	0.0	21.5	0.0	0.0

*Elements with greater output than input (copper and manganese Condition 3 only)

off-gases were processed. By neglecting Condition 1 Run 1 the MBC is improved for barium, cadmium, lead, manganese, and mercury. The other elements do not improve because the effect of the TDU molten bath source discussed above, is greater without the Condition 1 Run 1 data.

- **Data close to the detection limit**—The cadmium and mercury detections for Condition 3 the waste oil are very close to the detection limit, which may have caused the poor MBCs for these metals in Condition 3. Generally, as the sample detections approach the detection limit, the uncertainty of the data increases.

Partitioning of Trace Metals—

Even though many of the MBCs in Table 5-4 were not complete, the partitioning information—i.e., the paths of metals entering and leaving the system—is still valid and important. The partitioning results for each element are presented graphically in the appendices. The partitioning behavior for elements which were detected can be summarized as follows:

- **Contaminated soil to treated soil (Condition 2 only)**—arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, phosphorus, thallium, and zinc.

- **Waste water to heat exchanger residue (Condition 1 only)**—manganese.

- **Waste oil to scrubber (Conditions 1 and 3 only)**—chromium, copper, lead, mercury, nickel, phosphorus, and tin.

- **Waste water to heat exchanger residue and waste oil to scrubber (Condition 1 and 3 only):** barium, and zinc.

Internal sources such as the ceramic reactor core and metals pipes also may be significant sources for some metals.

Organic Destruction

A key objective of this project evaluated the efficiency of the process in destroying several critical organics including PCBs, HCB, and PCE. Another goal of the project was to determine if products of incomplete reduction (PIR), such as PCDD/PCDF, could be formed as by-products. To evaluate organic destruction potential, PCBs, PCE and HCB were introduced to the system at high levels. The amounts of these compounds in each of the output streams were then measured, enabling calculation of DE and DRE. To evaluate the formation potential of PCDD/PCDF, the input and output masses of these substances were measured in key process streams. Formation was quantified by computing the DE for each test run. A DE was greater than zero indicates no net formation of PCDD/PCDF.

Table 5-6 summarizes worst case or conservative DEs and DREs for each of the target substances. It also lists the primary input and output streams. Appendix 3 contains the substance flow rates and total masses for each process stream and run. Partitioning results which indicate the paths of these organic substances in and out of the system are presented graphically in the appendices. Overall, the process was a very effective destructor of PCBs, PCE and HCB; there was no net formation of PCDD/PCDF. All of the objectives were satisfied except for the PCB DRE for Condition 2 Run 2 and the HCB DE for Condition 2 Run 1. These failures were due in part to the performance of the TDU and possible interferences in the boiler analyses.

PCB Destruction—

One of the critical objectives for the project was to achieve a 99.9999 percent PCB DRE for each run (based on mono- through deca- PCB congeners in the input and output streams). Seven out of eight runs achieved this objective at worst case or conservative conditions (i.e., full detection limit for

TABLE 5-6. SUMMARY OF PCB, PCE, HCB, AND PCDD/PCDF DESTRUCTION

		DRE [a]	Destruction Efficiency			
Substance		PCB	PCE	HCB	Dioxin	Furan
Target		>99.9999	>99.99	>99.99	> 0	> 0
Condition 1	Run 1	99.99998	99.997	NA	70.78	99.93
	Run 2	99.999997	99.9987	NA	68.24	99.92
	Run 3	99.99999	99.993	NA	63.05	99.91
	Key input streams	SS2	SS2[b]	NA	SS2	SS2
	Key output streams	SS16	SS13[c]	NA	SS12	SS12 SS13[c]
Condition 2	Run 1	99.99996	NA	72.13	42.5	54.6
	Run 2	99.997	NA	99.998	99.45	98.12
	Key input streams	SS3	NA	SS3[d]	SS3[d]	SS3[d]
	Key output streams	SS16	NA	SS10 SS12 SS13[c]	SS10 SS12	SS10 SS12
Condition 3	Run 1	99.99996	99.9987	NA	89.45	99.92
	Run 2	99.99996	99.998	NA	98.36	99.988
	Run 3	99.999996	99.996	NA	97.61	99.98
	Key input streams	SS2	SS2[b]	NA	SS2	SS2
	Key output streams	SS16	SS13 SS15 SS16	NA	SS12 SS22	SS12 SS22

a - DRE and DE based on complete system (see Figure 5-1). DREs and DEs based on the reactor control volume (see Figure 5-2) are included in Tables 5-7, 8, and 9.

b - SS2 spike.

c - Most emission data below detection limit.

d - SS3 spike

Nondetects = detection limit; run results based on condition composite = composite value times the number of runs composited.

Less conservative (Nondetects = zero; run results based on condition composite=composite value) DE and DREs are provided in Tables 5-7, 8, and 9

SS2	- Waste oil	SS13	- Scrubber decant
SS3	- Contaminated soil	SS15	- Tank condensate
SS10	- Treated soil	SS16	- Boiler stack gas
SS12	- Scrubber sludge	SS22	- Scrubber blowdown

nondetected substances and run values equal to three times the composite value for composite samples) as shown in Table 5-6. The main input streams were waste oil for Conditions 1 and 3 and the contaminated soil for Condition 2. By definition, the stack gas was the only output stream considered for DRE. From 30 to 96 percent of the total PCB mass at the stack was detected in each run. As a result, the PCB DREs provided in Table 5-6 are conservative because the full value of the detection limit was used for congeners that were not detected.

For Condition 2 Run 2, the DRE for the complete system was 99.997. To determine if the TDU or boiler impacted the DRE, it was also calculated without these components. Figure 5-2 (presented earlier) illustrates the control volume considered, termed the reactor control volume. For this control volume, the DRE is based on the TDU off-gas as the primary input and the reformed gas after scrubbing as the primary output. The reactor control volume DRE is 99.9999 percent, as shown in Table 5-7. Since the PCB input to the complete system and reactor are on the same order of magnitude, elimination of the TDU from the calculation has little effect on the DRE value. Therefore, either PCBs had to be formed in the boiler or were present at higher levels in the combustion air. It is unlikely that PCBs were formed in the boiler because:

- The boiler provides high flame temperatures (>1300°C) to destroy PCBs or inhibit their formation; and

- Over 99 percent of the chlorine has been removed in the scrubber, and trace amounts of chlorine that occur in the fuel gas should react with hydrogen to form HCl. This leaves little chlorine to form PCB.

An alternative hypothesis is that the reduced DRE may have resulted from PCBs in the combustion air bypassing the flame. After examination of the data, it was found that the combustion air PCB input mass and concentration were approximately equal to the stack gas PCB output mass and concentration. However, it is unlikely that the combustion air and stack gas have the same concentration. A final possibility is that both samples may have been contaminated. Review of the field and analytical procedures and QC results did not yield any conclusive evidence of contamination or analytical interferences. Even if contamination of the stack and combustion air samples did not occur, the high amount of PCBs found in the combustion air are sufficient to invalidate the PCB emission and system DRE data for this run.

TABLE 5-7. DESTRUCTION OF PCB - SYSTEM EVALUATION

Condition	Run	Control volume	DRE (%)		DE (%)	
			Best Case [a]	Worst Case [b]	Best Case [a]	Worst Case [b]
Condition 1	Run1	Complete system	99.9999899	99.99998	99.989	99.95
		Reactor	100 [c]	99.999998	99.989	99.95
	Run 2	Complete system	99.999998	99.999997	99.996	99.97
		Reactor	99.99998	99.99998	99.995	99.97
	Run 3	Complete system	99.999992	99.99999	99.998	99.97
		Reactor	99.9999986	99.999998	99.998	99.97
Condition 2	Run 1	Complete system	99.999988	99.99996	93.5	93.5
		Reactor and boiler	99.999988	99.99996	99.998	99.96
		Reactor	99.99997	99.99996	99.998	99.96
	Run 2	Complete system	99.997	99.997	98.98	98.87
		Reactor and boiler	99.997	99.997	99.991	99.88
		Reactor	99.99992	99.99991	99.994	99.88
Condition 3	Run 1	Complete system	99.99996	99.99996	99.9998	99.998
		Reactor	99.999998	99.999997	99.9998	99.998
	Run 2	Complete system	99.99996	99.99996	99.99995	99.998
		Reactor	99.99996	99.99996	99.99994	99.998
	Run 3	Complete system	99.9999986	99.999996	99.99997	99.998
		Reactor	99.99999899	99.9999987	99.99997	99.998

[a] Nondetects = zero; run results based on condition composite = composite value.

[b] Nondetects = detection limit; run results based on condition composite = composite value times the number of runs composited

[c] No detections in output stream.

In an effort to better understand the ELI reduction process's ability to destroy PCBs, DEs and DREs were computed for the complete system, with and without the boiler and TDU, at best and worst case conditions (Table 5-7).

- **Complete system DE (all conditions)**—The complete system includes the reactor, boiler, and TDU (Condition 2 only) as shown in Figure 5-1. Condition 3 provided the best destruction of PCBs, while Condition 2 provided the least. For the worst case, only Condition 3 had 99.99 percent DE, which was the objective established for tracer compounds added to the system. For the best case, Condition 1 Runs 2 and 3 also had >99.99 percent DE. For Condition 2, the contaminated soil was the main PCB input stream and for Conditions 1 and 3 the waste oil was the main PCB input stream. Assuming worst case conditions, key output streams listed in order of decreasing magnitude and indicating detection of PCBs were: Condition 1—the reactor grit (detected), scrubber decant (not detected), and scrubber sludge (some detections); Condition 2—treated soil (detected), scrubber decant (not detected), and scrubber sludge (some detections); and Condition 3—scrubber decant (some detections), scrubber sludge (some detections), tank condensate (some detections), and scrubber tank liquor (detected). A complete listing of PCB process masses and rates is provided in the appendices.

- **Reactor and boiler DE (Condition 2)**—One of the key PCB output streams for the complete system for Condition 2 was the treated soil. This indicated that the TDU did not effectively transfer PCBs to the reactor for reduction. To evaluate the reactor, not the TDU, the PCB input mass to the reactor from the TDU for Condition 2 was determined by difference between the treated soil output and contaminated soil input. As expected the reactor and boiler provided destruction comparable to the other conditions (Table 5-7). This suggests that if PCBs could be effectively removed from the contaminated soil in the TDU, the reactor should achieve DE similar to that achieved with waste oil feed.

- **Reactor process DE (all conditions)**—To determine the relative contributions of the reduction process and the boiler to overall system PCB DE, DEs were computed using the reformed gas PCB content and mass for each run (see Figure 5-2). Table 5-7 shows that similar destruction of PCBs could be obtained without the boiler. Since most of the undestroyed PCBs partition to residual streams other than the reformed gas, any contribution of the boiler to the PCB DE is expected to be small.

Due to differing toxicities of various PCB congeners, it is important to examine the impact of the reduction process on each congener. Figure 5-4 shows the congener distribution for total input and total output PCB streams for the reactor control volume. The distributions were generated by dividing the sum of each congener across all input or output streams by the total PCB input or output, respectively. Only detected congeners were considered and the reactor grit was excluded from the computation. Figure 5-4 clearly shows that the total PCB input and output masses used to compute the DEs were composed mainly of tri-, tetra-, and penta- congeners. Furthermore, there appears to be a shift from tetra- and penta- to tri-, di-, and mono- congeners.

HCB and PCE Destruction—

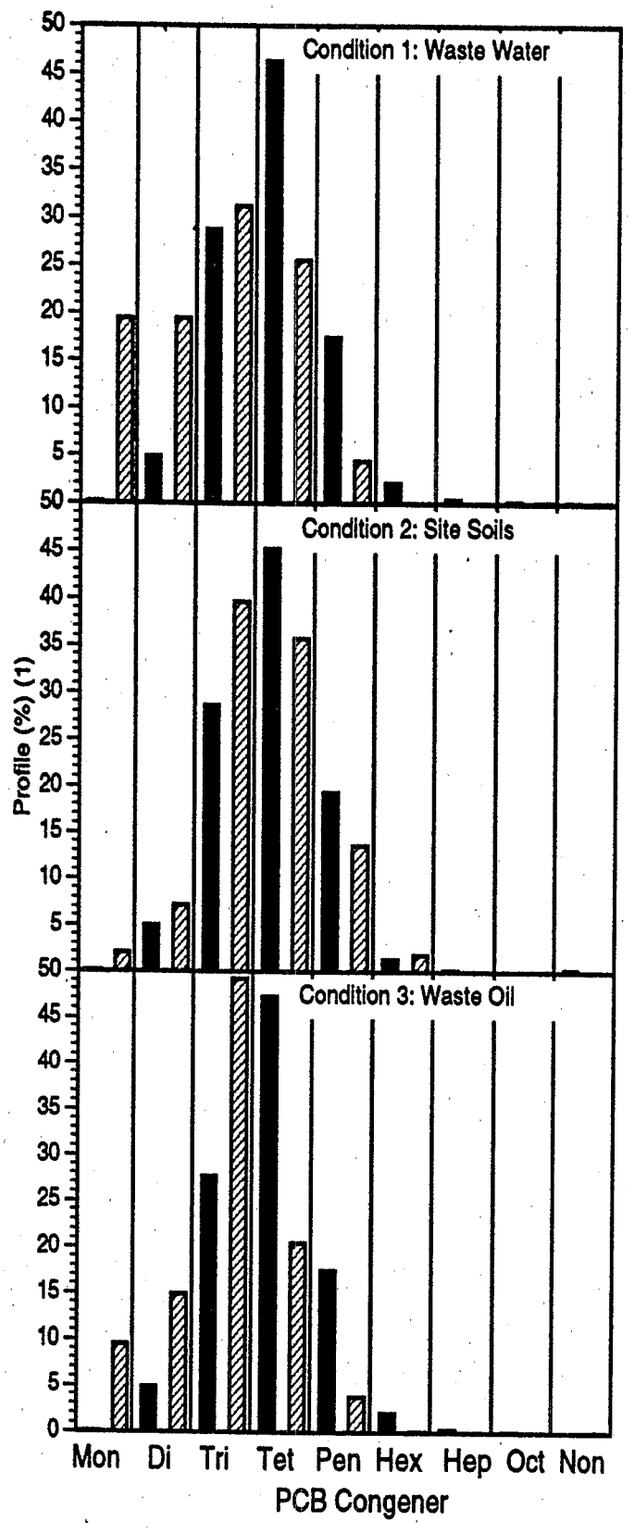
To evaluate the destruction capabilities of the ELI process for difficult-to-destroy substances, HCB and PCE were added to the waste feeds for Condition 2 and Conditions 1 and 3, respectively. The objective was to achieve 99.99 percent DE for each run. Seven out of eight runs achieved this objective at worst case or conservative conditions, as shown in Table 5-8. The results show:

- **PCE DE, Condition 1**—The scrubber decant was the key PCE output stream for Condition 1. Because the scrubber decant PCE concentration was based on detection limits, the Condition 1 PCE DEs are at the lower minimum bound.

- **HCB DE, Condition 2**—The treated soil contained a significant amount of HCB and was the main HCB output stream for Condition 2 Run 1. This indicates that the TDU did not effectively desorb HCB from the contaminated soil. For Condition 2 Run 2, the scrubber sludge and decant water were the main output streams. Since the scrubber sludge had detectable levels of HCB, the Condition 2 Run 2 DE is not an estimated amount. It provides an actual evaluation of the reactor process destruction potential.

- **PCE DE, Condition 3**—The scrubber sludge, decant water, and tank condensate were the main PCE output streams for Condition 3. All of the PCE concentrations in these streams were detected at similar levels.

The HCB DE of 72.13 percent for Condition 2 Run 1 failed to meet the objective of 99.99 percent. The HCB input mass to the reactor for Condition 2 Run 1 was estimated by difference between the mass in the treated soil and spiked contaminated soil. Table 5-8 shows that across the reactor alone, HCB DE during the soil condition and the PCE DE during the waste oil condition were similar. This confirms that the failure to meet the DE objective for Condition 2 Run 1 was caused by the



(1) - Total mass of congener in all input or output streams normalized by the total mass of all congeners in all input or output streams

Input streams

Output streams

Figure 5-4. PCB congener distributions (detected data only).

TABLE 5-8. DESTRUCTION OF PCE AND HCB - SYSTEM EVALUATION

Substance	Condition	Run	Control Volume	DRE (%)		DE (%)	
				Best Case[a]	Worst Case[b]	Best Case[a]	Worst Case[b]
Perchloroethylene	Condition 1	Run1	Complete system	99.9997	99.9997	99.9997	99.997
			Reactor	100[c]	99.999992	100[c]	99.997
		Run 2	Complete system	99.9999	99.9999	99.9999	99.9987
			Reactor	100[c]	99.99997	100[c]	99.9988
		Run 3	Complete system	99.9998	99.9998	99.9998	99.993
			Reactor	99.99995	99.99995	99.99995	99.993
Hexachlorobenzene	Condition 2	Run 1	Complete system	99.999992	99.999992	72.13	72.13
			Reactor and boiler	99.999989	99.999989	99.9996	99.99898
			Reactor	100[c]	99.999995	99.9997	99.99898
		Run 2	Complete system	100[c]	99.99997	99.9994	99.998
			Reactor and boiler	100[c]	99.99997	99.9994	99.998
			Reactor	100[c]	99.999992	99.9994	99.998
Perchloroethylene	Condition 3	Run 1	Complete system	99.9994	99.9994	99.99899	99.9987
			Reactor	99.988	99.988	99.988	99.988
		Run 2	Complete system	99.9994	99.9994	99.9987	99.998
			Reactor	100[c]	99.999991	99.9993	99.998
		Run 3	Complete system	99.998	99.998	99.997	99.996
			Reactor	99.97	99.97	99.97	99.97

[a] Nondetects = zero; run results based on condition composite = composite value.

[b] Nondetects = detection limit; run results based on condition composite = composite value times the number of runs composited.

[c] No detections in output stream.

ineffectiveness of the TDU, not the performance of the reactor. The TDU effectively removed HCB during Condition 2 Run 2.

The DE of PCE across the reactor control volume was less than 99.99 percent for Condition 3 Runs 1 and 3. The amount of PCE in the reformed gas was an order of magnitude greater than in the stack. Although there were no project objectives for reactor DE, this does indicate that additional PCE destruction took place in the boiler and that the project objective could not have been achieved without it. It should be emphasized, however, that the DE of PCBs across the reactor control volume did exceed 99.99 percent for these same conditions, as shown earlier. The low reactor DE for PCE could indicate that operating conditions during Condition 3 are approaching the limits of the process.

Dioxin and Furan Destruction—

One of the objectives of the project was to determine if PCDD/PCDF would be formed in the ELI reduction process. To evaluate the potential for formation, PCDD/PCDF were quantified in key input and output streams. The DE was then computed for each run to determine if PCDD/PCDF were formed. As shown in Table 5-6, the PCDD/PCDF DEs ranged from 42 to 99 and from 55 to 99.9, respectively. While some of the DEs did not make 1 nine, they all were positive indicating net destruction for each run. Table 5-6 shows the key streams for each run. The key input stream for Condition 2 was the HCB spike. It should be noted that the mass of dioxins and furans contained in the HCB spike was approximately 2 orders of magnitude greater than that in the contaminated soil.

In an effort to better understand the ELI reduction process's ability to destroy PCDD/PCDF, DEs and DREs were computed for the complete system and with and without the boiler and the TDU at worst and best case conditions as shown in Table 5-9. The PCDD/PCDF DEs for Condition 1 and Condition 3 were not impacted by the choice of control volume. This indicates that the boiler has no impact on the DE for PCDD/PCDF. Since most of the undestroyed PCDD/PCDF partition to residual streams other than the reformed gas, any contribution of the boiler to the PCDD/PCDF DE is expected to be small. A significant increase in the PCDD/PCDF DE was achieved by eliminating the TDU from Condition 2 Run 1. This confirms that the low DE for Condition 2 Run 1 was caused by the inability of the TDU to desorb contaminants, not the performance of the reactor.

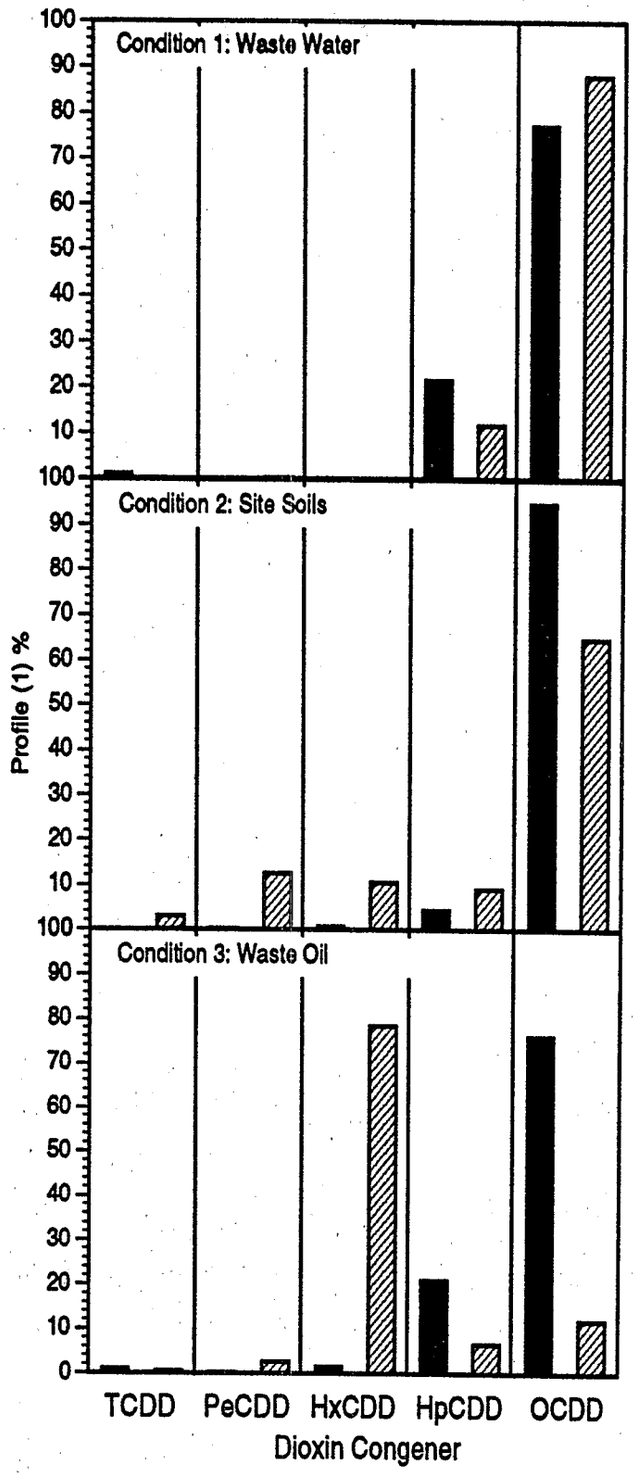
Due to differing toxicities of various PCDD/PCDF congeners, it is important to examine the impact of the reactor process on the congeners as well as the totals. Figures 5-5 and 5-6 show the congener distribution for total input and total output PCDD/PCDF streams for the reactor control volume. These distributions were generated by dividing the sum of each PCDD/PCDF congener across all input or

TABLE 5-9. DESTRUCTION OF DIOXINS AND FURANS - SYSTEM EVALUATION

Substance	Condition	Run	Control volume	DRE (%)		DE (%)	
				Best Case[a]	Worst Case[b]	Best Case[a]	Worst Case[b]
Dioxin	Condition 1	Run1	Complete system	99.4	99.4	91.77	70.78
			Reactor	99.98	99.98	92.37	71.38
		Run 2	Complete system	99.88	99.87	91.83	68.24
			Reactor	99.97	99.97	91.92	68.34
		Run 3	Complete system	99.897	99.89	90.54	63.05
			Reactor	99.985	99.985	90.63	63.14
	Condition 2	Run 1	Complete system	99.99995	99.99995	42.58	42.51
			Reactor and boiler	99.99988	99.99988	99.85	99.7
			Reactor	99.99998	99.99998	99.85	99.7
		Run 2	Complete system	99.99992	99.99991	99.63	99.5
			Reactor and boiler	99.99992	99.99991	99.83	99.7
			Reactor	99.999996	99.999996	99.83	99.7
	Condition 3	Run 1	Complete system	99.92	99.92	98.3	89.45
			Reactor	99.997	99.997	98.37	89.52
		Run 2	Complete system	99.97	99.97	99.59	98.36
			Reactor	99.9996	99.9996	99.61	98.39
		Run 3	Complete system	99.95	99.94	99.37	97.61
			Reactor	99.996	99.996	99.42	97.66
Furan	Condition 1	Run1	Complete system	99.993	99.993	99.98	99.93
			Reactor	99.9998	99.9998	99.985	99.93
		Run 2	Complete system	99.9995	99.9995	99.98	99.92
			Reactor	99.9996	99.9996	99.98	99.92
		Run 3	Complete system	99.999987	99.99996	99.98	99.91
			Reactor	99.9992	99.9992	99.98	99.91
	Condition 2	Run 1	Complete system	99.999895	99.999895	54.9	54.6
			Reactor and boiler	99.9998	99.9998	99.48	98.95
			Reactor	99.999995	99.999991	99.48	98.95
		Run 2	Complete system	99.99997	99.99995	98.9	98.1
			Reactor and boiler	99.99997	99.99995	99.22	98.43
			Reactor	99.99998	99.99998	99.22	98.43
	Condition 3	Run 1	Complete system	99.9996	99.9996	99.986	99.92
			Reactor	99.99998	99.99998	99.986	99.92
		Run 2	Complete system	99.9995	99.9995	99.997	99.988
			Reactor	99.9999989	99.9999985	99.997	99.988
		Run 3	Complete system	99.99996	99.99993	99.995	99.98
			Reactor	99.99999	99.99999	99.995	99.98

[a] Nondetects = zero; run results based on condition composite = composite value.

[b] Nondetects = detection limit; run results based on condition composite = composite value times the number of runs composited.

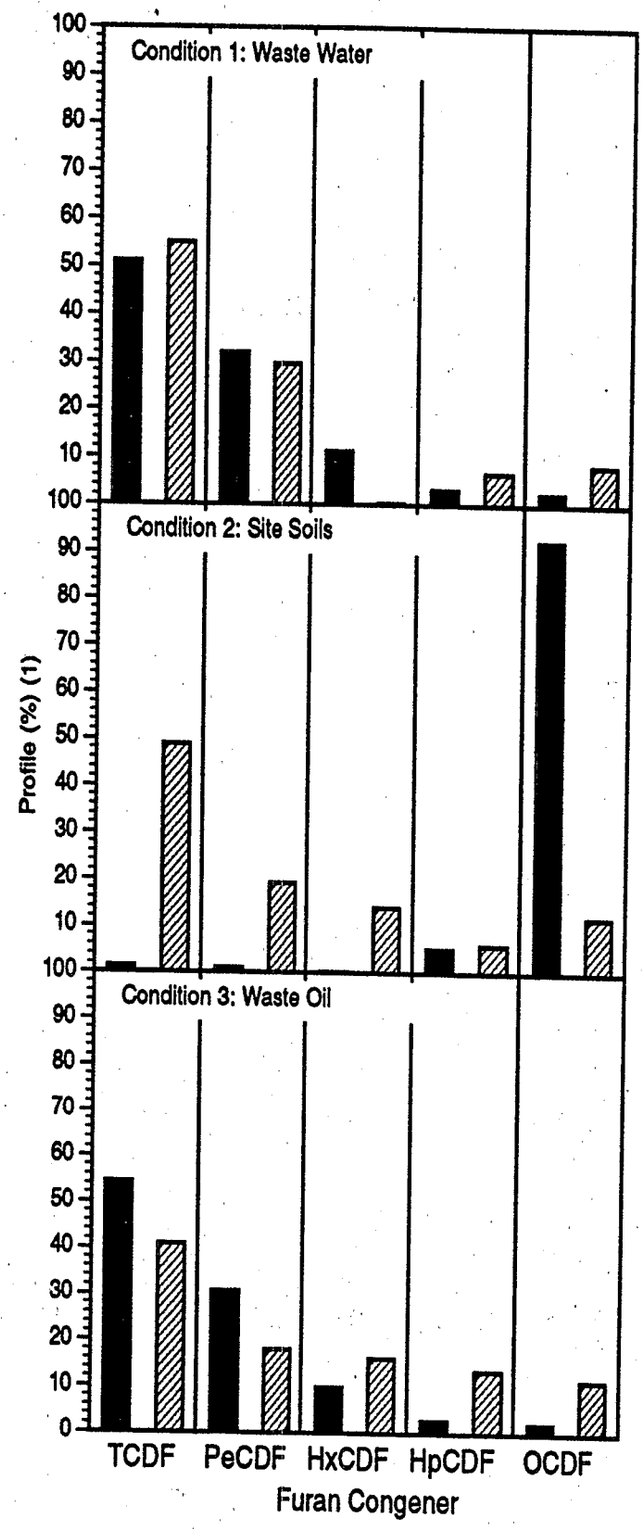


(1) - Total mass of congener in all input or output streams normalized by the total mass of all congeners in all input or output streams

Input streams

Output streams

Figure 5-5. Dioxin congener distributions (detected data only).



(1) - Total mass of congener in all input or output streams normalized by the total mass of all congeners in all input or output streams

Input streams

Output streams

Figure 5-6. Furan congener distributions (detected data only).

output streams by the total PCDD/PCDF input or output, respectively. Only detected congeners were considered. Figure 5-5 clearly shows that the total PCDD input and output masses used to compute the DEs were composed mainly of less toxic hexa- through octa- congeners. However, the PCDF profiles for Condition 1, 2, and 3 contained significant portions of tetra- congeners as shown in Figure 5-6. The congener shifts vary significantly from run to run and between PCDD/PCDF. Several observations include: (Condition 1, PCDD) shift from hepta- to octa-; (Condition 2, PCDD/PCDF) shift from octa- to tetra- through hepta- congeners; (Condition 3, PCDD) shift from octa- and hepta- to hexa- congeners; (Condition 1, PCDF) no significant PCDF shift; and (Condition 3, PCDF) shift from tetra- and penta- to hexa-, hepta-, and octa- congeners.

Products of Incomplete Combustion

CO and THC are often used as indicators of combustion efficiency. Table 5-10 shows the concentration and emission rates for PICs measured at the stack of the auxiliary boiler. The results are reported on a dry basis and corrected to 7 percent O_2. Significant amounts of THC and CO were measured during the first two test runs for Condition 1. PIC emission during the subsequent test runs were generally very low. Emissions of PAHs and benzene are also shown in the table for comparison. There were no significant correlations of PAHs and benzene emissions with either CO or THC.

TABLE 5-10. PRODUCTS OF INCOMPLETE COMBUSTION AT STACK (SS16)

	THC (dry, as methane)		CO (dry)		PAHs (dry)		Benzene (dry)	
	ppmv @7% O2	g/hr	ppmv @7% O2	g/hr	µg/dscm @7% O2	mg/hr	µg/dscm @7% O2	mg/hr
Condition 1								
Run 1	41.4	4.29	34	6.16	< 15.6	2.43	< 181	28.2
Run 2	3.5	0.392	32	6.26	< 47.9	8.53	30.4	5.10
Run 3	1.6	0.187	4	0.814	< 22.4	3.96	7.70	1.35
Average	15.50	1.62	23.3	4.41	< 28.63	4.97	< 73.1	11.54
Condition 2								
Run 1	0.9	0.121	8.20	1.93	< 4.36	0.907	BQL 1.93	0.391
Run 2	0.4	0.0703	13	3.99	< 2.35	0.697	< 6.08	1.60
Condition 3								
Run 1	1.1	0.239	4	1.52	ND 25.7	8.85	< 128	41.7
Run 2	1.1	0.154	1	0.244	ND 35.1	7.51	ALR 203	42.6
Run 3	2.4	0.360	2	0.524	< 11.3	2.62	8.48	1.91
Average	1.53	0.25	2.3	0.76	< 24.03	6.33	> 113.3	28.74

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

The high CO and THC emissions during the initial test runs were attributed to poor auxiliary boiler operation during these runs. Figure 5-7 compares oxygen, carbon monoxide, and total hydrocarbon trends during the first test run (Condition 1 Run 1) and during the fourth test run (Condition 3 Run 1). During the first test run, large oxygen excursions were observed. These excursions occurred whenever the boiler cycled from low- to high- fire or vice-versa. As discussed earlier, the excess capacity of the boiler caused this to occur frequently during the initial runs. The figure also shows that CO and THC excursions, as high as 900 ppm (or higher since readings were off-scale) occurred with these cycles. It was later found that the boiler combustion air damper linkage was out of adjustment, causing high excess oxygen during low-fire conditions. This probably caused quenching in the combustion chamber of the boiler, resulting in the escape of CO and hydrocarbons. ELI rectified the problem by adjusting the damper linkage—which reduced the excess oxygen excursions—and by venting steam which maintained the boiler at high-fire most of the time. The results of these changes in operation are apparent in the results of Condition 3 Run 1. Excess oxygen levels were much more uniform (at approximately 8 percent) and CO and THC excursions did not exceed 30 ppm and 3 ppm, respectively. The Condition 3 Run 1 results were much more typical of the later test runs.

AIR EMISSIONS

The stack of the auxiliary boiler is the sole point of air emissions from the process, except for any fugitive emissions. Fugitive emissions were not measured during this demonstration. Emissions of HCl, NO_x, SO_2, CO, THC, and particulate matter from the boiler stack were measured. In addition, opacity was determined.

HCl Emissions

HCl emissions (Table 5-11) were very low; they did not vary significantly from run to run. Throughout Conditions 1 and 2, HCl concentrations fell below the detection limit (ND) of the test method (approximately 0.5 ppm). HCl concentrations slightly above the detection limit were measured for one run of Condition 3. This likely was due to the higher chlorine input (caused by high PCB concentration in the waste oil) for this run. In any case, the results indicated that the HCl removal efficiency of the scrubber, which was not measured directly, was probably very good. This conclusion is corroborated by the chlorine mass balance discussed earlier. Mass emission rates of HCl are also shown in this table. For comparison, HCl emissions limits for RCRA regulated incinerators are 1.80 kg/hr (3.96 lb/hr). Emissions from the process are well below this limit.

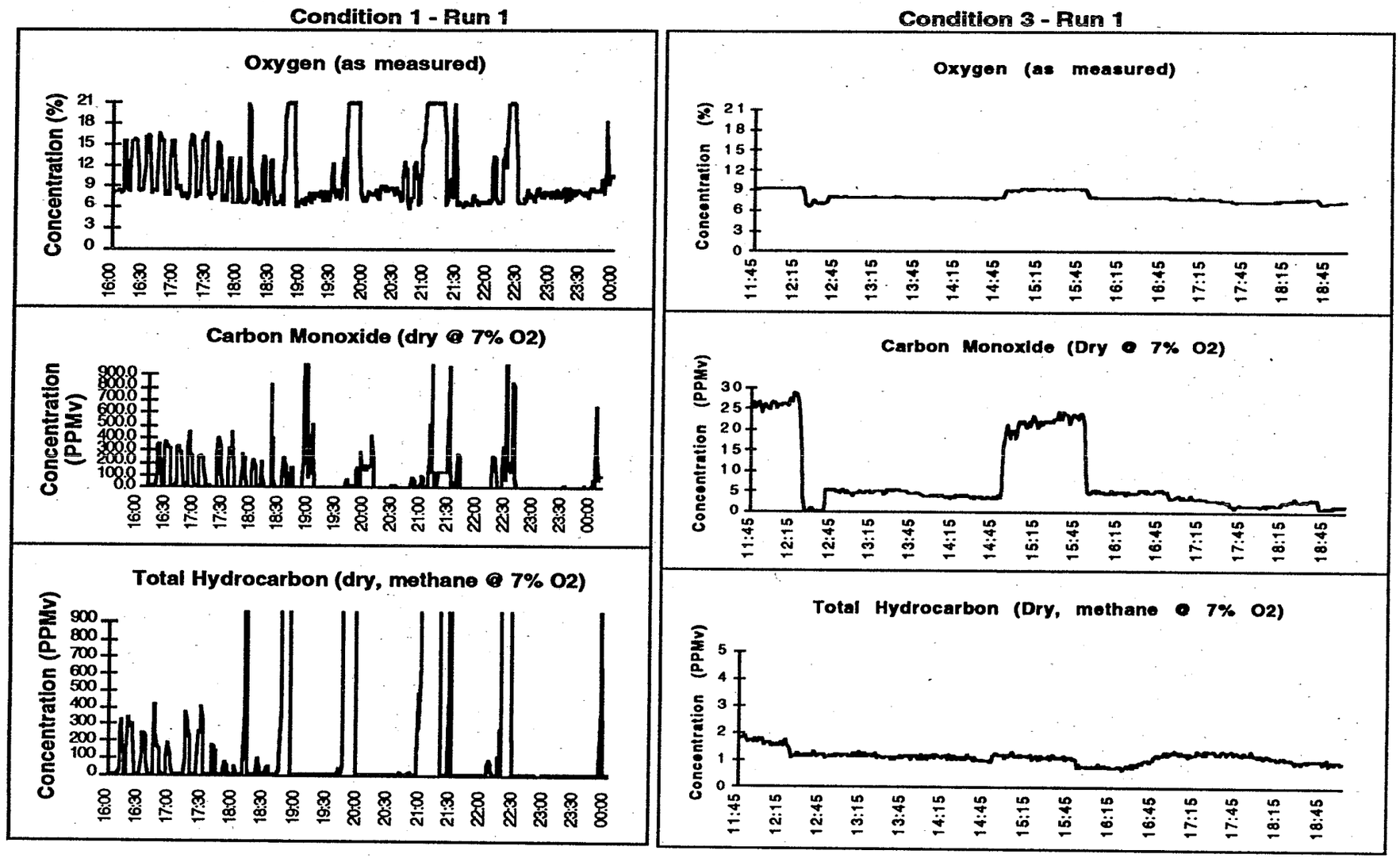


Figure 5-7. PIC trends during initial tests compared to later tests.

TABLE 5-11. HYDROGEN CHLORIDE EMISSION SUMMARY

	Concentration (dry, 7% O2)				Emission rate	
	mg/dscm		ppmv		mg/hr	
Condition 1						
Run 1	ND	0.75	ND	0.49	ND	116
Run 2	ND	0.55	ND	0.36	ND	92.2
Run 3	ND	0.68	ND	0.45	ND	119
Average	ND	0.659	ND	0.435	ND	109.1
Condition 2						
Run 1	ND	0.83	ND	0.55	ND	168
Run 2	ND	0.53	ND	0.35	ND	138
Condition 3						
Run 1	ND	0.59	ND	0.39	ND	193
Run 2	ND	0.67	ND	0.44	ND	140
Run 3		1.16		0.77		261
Average	<	0.807	<	0.533	<	197.8

Criteria Air Pollutants

Table 5-12 presents emissions of NO_x, SO_2, THC, CO, particulate matter, and opacity for each test run. NO_x and SO_2 emissions were independent of the test conditions. NO_x emissions were fairly typical of small natural gas or propane fired boilers. Trace amounts of SO_2 were measured due to small amounts of sulfur in the waste and the odorant used in the propane gas, which was the main fuel for the boiler. Particulate emissions and opacity also showed little dependence on conditions, except for Condition 3 Run 3, which had relatively high particulate emissions. This could not be attributed to any difference in operating conditions or any measurement error for this test run. THC and CO emissions also were considered very low and typical of gas fired boilers, with the exception of the initial runs discussed earlier.

Other Air Emissions

Table 5-13 summarizes average emissions of all substances measured at the stack for each test condition. Where possible, the level of emissions measured during this demonstration is placed in context of emissions limits established by other regulations or emissions from other types of thermal treatment systems. Table 5-14 presents established and potential emissions limits under several federal, state, and local regulations for many of the substances measured in this demonstration. By comparison to the levels shown in the table, emissions of volatile organic compounds, semivolatile organic compounds and trace metals generally were well below levels which might be of concern.

TABLE 5-12. CRITERIA AIR POLLUTANTS

	NOx (dry)		SO2 (dry)		Particulate (dry)		THC (dry)		CO (dry)		
	ppmv 7% O2	g/hr	ppmv 7% O2	g/hr	mg/dscm 7% O2	mg/hr	ppmv @7% O2	g/hr	ppmv @7% O2	g/hr	Opacity (%)
Condition 1											
Run 1	60.8	18.1	5.1	2.11	0.431	67.0	41.4	4.29	34	6.16	0
Run 2	60.0	19.3	1.1	0.49	0.036	6.01	3.5	0.39	32	6.26	0
Run 3	61.5	20.6	0.3	0.14	0.032	5.62	1.6	0.19	4	0.81	0
Average	60.8	19.3	2.17	0.915	0.1663	26.22	15.5	1.62	23.3	4.41	0
Condition 2											
Run 1	62.9	24.3	1.7	0.92	0.430	87.3	0.9	0.12	8.200	1.93	NA
Run 2	69.7	35.1	2.2	1.54	0.130	35.5	0.4	0.07	13.000	3.99	NA
Condition 3											
Run 1	62.8	39.1	2.3	1.99	0.017	5.5	1.1	0.24	4	1.52	0
Run 2	63.9	25.6	1.5	0.84	0.025	5.2	1.1	0.15	1	0.24	0
Run 3	63.9	27.5	0.5	0.30	2.916	656	2.4	0.36	2	0.52	0
Average	63.5	30.7	1.43	1.043	0.9860	222	1.53	0.251	2.3	0.761	0

PCB—

Total PCB concentrations, defined in the U. S. for air emissions as the sum of tri- through deca-congener groups, ranged from <0.08 µg/dscm to <1.24 µg/dscm[1]. Most of the results were below the detection limit, with the exception of Condition 2 Run 2, where PCBs were detected in the tri- through penta- congener groups. For comparison, these levels are much lower than risk-based air emissions limits for PCB established in California by the South Coast Air Quality Management District (SCAQMD) under Rule 1401/1201. This rule would limit emissions to of 3.35×10^{-4} kg/day (7.39×10^{-4} lb/day), which corresponds to a stack concentration of approximately 36 µg/dscm assuming 24-hour operation.

Chlorobenzenes and Chlorophenols—

The total CB/CP concentrations were below the method detection limits for all tests. The detection limits ranged from 4.48 µg/dscm to 12.6 µg/dscm for chlorobenzenes and from 8.26 µg/dscm up to 26.2 µg/dscm for chlorophenols. For comparison, Title III of the U.S. 1990 Clean Air Act Amendments (CAAA) proposes a risk-based standard of 5.17 kg/day (11.4 lb/day) for CB/CP, which corresponds to a concentration of approximately 550 mg/dscm, assuming 24-hour operation. The measured concentrations were well below this level.

PAH—

PAH emissions ranged from <2.34 µg/dscm to <28.6 µg/dscm. The majority of the results were below the analytical detection limit, except for naphthalene, which had detected levels throughout

1 The "less than" sign (<) indicates that some of the data are based on detection limits.

TABLE 5-13 SS16 — BOILER STACK GAS RESULTS SUMMARY

Substance	Units	Concentration (dry, corrected to 7% O2)							
		Condition 1 Waste water		Condition 2 - soil				Condition 3 Waste oil	
				Run1		Run 2			
Stack gas flow rate (total)	dscm/hr		182		208		297		263
Moisture (as measured, wet basis)	%		9.7		11.8		9.7		10.6
Semi-volatile organic compounds									
Poly-chlorinated biphenyls (PCBs)									
Monochlorobiphenyl (total)	µg/dscm	ND	0.002	ND	0.002	ND	0.008	ND	0.003
Dichlorobiphenyl (total)	µg/dscm		0.074	ND	0.002		0.13	<	0.085
Trichlorobiphenyl (total)	µg/dscm	<	0.054	ND	0.003		0.53	<	0.015
Tetrachlorobiphenyl (total)	µg/dscm	ND	0.005	ND	0.01		0.48	<	1.048
Pentachlorobiphenyl (total)	µg/dscm	<	0.008	EMPC	0.02		0.03	<	0.030
Hexachlorobiphenyl (total)	µg/dscm	ND	0.007	ND	0.01	ND	0.03	ND	0.007
Heptachlorobiphenyl (total)	µg/dscm	<	0.011	ND	0.01	ND	0.03	ND	0.006
Octachlorobiphenyl (total)	µg/dscm	ND	0.007	ND	0.01	ND	0.03	ND	0.007
Nonachlorobiphenyl (total)	µg/dscm	ND	0.009	ND	0.01	ND	0.01	ND	0.007
Decachlorobiphenyl (total)	µg/dscm	ND	0.035	ND	0.02	ND	0.10	ND	0.022
Total PCBs (tri-deca) including NDs	µg/dscm	<	0.137	<	0.08	<	1.24	<	1.141
Total PCBs (mono-deca) including NDs	µg/dscm	<	0.213	<	0.08	<	1.37	<	1.229
Total PCBs (tri-deca) excluding NDs	µg/dscm	>	0.110	>	0.02	>	1.04	>	1.080
Total PCBs (mono-deca) excluding NDs	µg/dscm	>	0.250	>	0.02	>	1.17	>	1.160
Chlorobenzenes and chlorophenols									
1,2 Dichlorobenzene	µg/dscm	ND	1.542	ND	0.91	ND	1.07	ND	0.457
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	1.034	ND	0.81	ND	0.88	ND	0.446
1,2,3,5-Tetrachlorobenzene	µg/dscm	NA	NA	ND	0.62	ND	0.86	NA	NA
1,2,3 - Trichlorobenzene	µg/dscm	ND	1.358	ND	1.00	ND	1.20	ND	0.471
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	1.043	ND	0.71	ND	0.73	ND	0.236
1,2,4 - Trichlorobenzene	µg/dscm	ND	1.412	ND	0.93	ND	1.11	ND	0.434
1,3 - Dichlorobenzene	µg/dscm	ND	1.442	ND	0.89	ND	1.06	ND	0.438
1,3,5 - Trichlorobenzene	µg/dscm	ND	1.396	ND	0.92	ND	1.08	ND	0.428
1,4 - Dichlorobenzene	µg/dscm	ND	1.400	ND	0.89	ND	1.09	ND	0.444
2,3 - Dichlorophenol	µg/dscm	ND	1.808	ND	1.42	ND	1.57	ND	0.486
2,3,4 - Trichlorophenol	µg/dscm	ND	1.597	ND	1.40	ND	1.41	ND	0.583
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	1.669	ND	1.13	ND	1.06	ND	0.482
2,3,5 - Trichlorophenol	µg/dscm	ND	1.711	ND	1.37	ND	1.32	ND	0.693
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	1.786	ND	1.12	ND	1.18	ND	0.761
2,3,6 - Trichlorophenol	µg/dscm	ND	1.571	ND	1.33	ND	1.44	ND	0.580
2,4 - Dichlorophenol	µg/dscm	ND	1.745	ND	1.11	ND	1.34	ND	0.399
2,4,5 - Trichlorophenol	µg/dscm	ND	1.563	ND	1.42	ND	1.34	ND	0.576
2,4,6 - Trichlorophenol	µg/dscm	ND	1.656	ND	1.38	ND	1.39	ND	0.637
2,5 - Dichlorophenol	µg/dscm	ND	1.811	ND	1.19	ND	1.21	ND	0.467
2,6 - Dichlorophenol	µg/dscm	ND	1.556	ND	1.09	ND	1.27	ND	0.164
2 - Chlorophenol	µg/dscm	ND	1.780	ND	0.97	ND	1.08	ND	0.473
3,4 - Dichlorophenol	µg/dscm	ND	1.333	ND	1.34	ND	1.01	ND	0.428
3,5 - Dichlorophenol	µg/dscm	ND	1.226	ND	1.22	ND	1.03	ND	0.171
3,4 - Chlorophenol	µg/dscm	ND	1.296	ND	0.49	ND	0.52	ND	0.098
Hexachlorobenzene	µg/dscm	ND	1.071	E	0.63	ND	0.64	ND	0.635
Pentachlorobenzene	µg/dscm	ND	0.935	ND	0.63	ND	0.76	ND	0.491
Pentachlorophenol	µg/dscm	ND	2.136	ND	1.34	ND	1.41	ND	1.265
Total chlorobenzenes	µg/dscm	ND	12.63	ND	8.05	ND	9.41	ND	4.481
Total chlorophenols	µg/dscm	ND	26.24	ND	19.3	ND	19.6	ND	8.263
Total CBs as 1,2,4 Trichlorobenzene	µg/dscm	ND	12.70	ND	8.85	ND	10.42	ND	4.205

TABLE 5-13. SS16 - BOILER STACK GAS RESULTS SUMMARY (continued)

Substance	Units	Concentration (dry, corrected to 7% O2)							
		Condition 1 Waste water		Condition 2 - soil				Condition 3 Waste oil	
				Run1		Run 2			
Poly-aromatic hydrocarbons (PAHs)									
Naphthalene	µg/dscm		20.35	E	2.5	E	1.5	<	2.363
2-Methylnaphthalene	µg/dscm	ND	0.816	ND	0.21	ND	0.10	ND	1.203
2-Cl-Naphthalene	µg/dscm	ND	0.555	ND	0.25	ND	0.12	ND	1.299
Acenaphthylene	µg/dscm	ND	0.436	ND	0.16	ND	0.07	ND	0.862
Acenapthene	µg/dscm	ND	0.664	ND	0.25	ND	0.12	ND	1.316
Fluorene	µg/dscm	ND	0.567	ND	0.21	ND	0.10	ND	1.147
Phenanthrene	µg/dscm	<	0.413	ND	0.12	ND	0.05	ND	0.763
Anthracene	µg/dscm	ND	0.368	ND	0.11	ND	0.05	ND	0.736
Fluoranthene	µg/dscm	<	0.557	ND	0.08	ND	0.04	ND	0.716
Pyrene	µg/dscm	<	0.416	ND	0.05	ND	0.02	ND	0.766
Benzo (a) anthracene	µg/dscm	ND	0.340	ND	0.05	ND	0.02	ND	1.058
Chrysene	µg/dscm	ND	0.360	ND	0.05	ND	0.02	ND	1.196
Benzo (b) fluoranthene	µg/dscm	ND	0.314	ND	0.04	ND	0.02	ND	1.341
Benzo (k) fluoranthene	µg/dscm	ND	0.328	ND	0.04	ND	0.02	ND	1.331
Benzo (e) pyrene	µg/dscm	ND	0.344	ND	0.04	ND	0.02	ND	1.306
Benzo (a) pyrene	µg/dscm	ND	0.334	ND	0.04	ND	0.02	ND	1.343
Perylene	µg/dscm	ND	0.345	ND	0.06	ND	0.03	ND	1.491
Indeno (1,2,3-cd) pyrene	µg/dscm	ND	0.382	ND	0.04	ND	0.02	ND	1.199
Dibenz (a,h) anthracene	µg/dscm	ND	0.397	ND	0.05	ND	0.02	ND	1.328
Benzo (g,h,i) perylene	µg/dscm	ND	0.366	ND	0.04	ND	0.02	ND	1.280
Total PAHs	µg/dscm	<	28.65	ND	4.4	ND	2.3	<	24.04
Dioxins and furans									
2378 TCDD	ng/dscm	ND	0.004	ND	0.002	ND	0.003	ND	0.002
12378 PeCDD	ng/dscm	ND	0.007		0.003	ND	0.004	ND	0.002
123478 HxCDD	ng/dscm	<	0.007	ND	0.003	ND	0.005	ND	0.002
123678 HxCDD	ng/dscm	<	0.008	ND	0.002	ND	0.004	<	0.002
123789 HxCDD	ng/dscm	<	0.010	ND	0.003	ND	0.004	<	0.002
1234678 HpCDD	ng/dscm		0.075	ND	0.02	EMPC	0.01	<	0.007
OCDD	ng/dscm	<	0.283	B	0.20	B	0.08		0.090
2378 TCDF	ng/dscm	<	0.008		0.003		0.001	<	0.002
12378 PeCDF	ng/dscm	<	0.008	ND	0.002	ND	0.003	<	0.002
23478 PeCDF	ng/dscm	<	0.010	ND	0.002	ND	0.003	<	0.002
123478 HxCDF	ng/dscm	<	0.025	ND	0.002	EMPC	0.003	<	0.003
123678 HXCDF	ng/dscm	<	0.011		0.003	ND	0.003	<	0.002
234678 HxCDF	ng/dscm	<	0.016		0.009	ND	0.003		0.003
123789 HxCDF	ng/dscm	<	0.006	ND	0.003	ND	0.004	ND	0.002
1234678 HpCDF	ng/dscm	<	0.039		0.033	EMPC	0.004	<	0.009
1234789 HpCDF	ng/dscm	<	0.021		0.009	ND	0.005	<	0.005
OCDF	ng/dscm	<	0.224		0.063	ND	0.010	<	0.079
TCDD (Total)	ng/dscm	<	0.011	ND	0.002	EMPC	0.003	<	0.002
PeCDD (Total)	ng/dscm	<	0.012	ND	0.003	ND	0.004	<	0.002
HxCDD (Total)	ng/dscm	<	0.067		0.003	EMPC	0.007	<	0.010
HpCDD (Total)	ng/dscm		0.125		0.042	EMPC	0.019		0.015
TCDF (Total)	ng/dscm	<	0.020		0.003		0.001	<	0.005
PeCDF (Total)	ng/dscm	<	0.041		0.01	EMPC	0.001	<	0.008
HxCDF (Total)	ng/dscm	<	0.080		0.03	EMPC	0.005		0.008
HpCDF (Total)	ng/dscm	<	0.094		0.06	EMPC	0.005	<	0.018
Total dioxins (by isomer)	ng/dscm	<	0.368	<	0.13	<	0.04	<	0.156
Total furans (by isomer)	ng/dscm	<	0.011	<	0.01	<	0.004	<	0.007
Total dioxins plus furans (by isomer)	ng/dscm	<	0.379	<	0.14	<	0.04	<	0.163

TABLE 5-13. SS16 - BOILER STACK GAS RESULTS SUMMARY (continued)

Substance	Units	Concentration (dry, corrected to 7% O2)							
		Condition 1 Waste water		Condition 2 - soil				Condition 3 Waste oil	
				Run1		Run 2			
Volatile organic compounds									
Vinyl chloride	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.01
Methyl chloride	µg/dscm	<	67.39	<	3	<	2	<	100.4
Trans-1,2-dichloroethene	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.006
Cis-1,2-Dichloroethene	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.006
Chloroform	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.115
1,1,1 - Trichloroethane	µg/dscm	<	1.100	<	2.66	<	1.05	<	1.721
Carbon tetrachloride	µg/dscm	ND	1.043	ND	0.98	ND	1.05	<	1.071
Benzene	µg/dscm	<	73.08	BQL	2	<	6	< **	113.0
1,2 - dichloroethane	µg/dscm	ND	1.043	ND	0.98	ND	1.05	<	1.039
Trichloroethene	µg/dscm	<	1.159	ND	0.98	ND	1.05	<	1.523
Toluene	µg/dscm	<	8.536	<	1.8	<	4.7	<	14.73
1,1,2 - Trichloroethane	µg/dscm	ND	1.043	ND	0.98	ND	1.05	<	1.185
Tetrachloroethene	µg/dscm	<	3.847	<	1.00	ND	1.05	<	4.507
1,2 - Dibromoethane	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.006
Chlorobenzene	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.006
Ethylbenzene	µg/dscm	ND	1.043	ND	0.98	ND	1.05	<	1.471
M-/P-xylene	µg/dscm	<	1.317	ND	1.96	ND	2.11	ND	1.006
O-xylene	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.006
1,3 - Dichlorobenzene	µg/dscm	ND	1.043	ND	0.98	ND	1.05	ND	1.006
1,4 - Dichlorobenzene	µg/dscm	ND	1.043	ND	0.98	<	1.14	ND	1.006
1,2 - Dichlorobenzene	µg/dscm	ND	1.043	<	1.10	<	1.28	ND	1.006
Trace metals									
Antimony	µg/dscm	<	8.657		3.7		1.9	<	5.133
Arsenic	µg/dscm	ND	7.403	ND	2.88	ND	1.35	ND	4.422
Barium	µg/dscm	<	2.266		1.61		0.57	<	1.170
Beryllium	µg/dscm	ND	0.170	ND	0.29	ND	0.13	ND	0.044
Cadmium	µg/dscm	<	1.691	ND	0.29		0.35	<	0.993
Chromium (total)	µg/dscm	<	1.220		0.72		0.69	<	0.934
Copper	µg/dscm		1.923		1.90		0.51	<	1.522
Lead	µg/dscm	<	7.956		4.6		2.7	<	3.945
Manganese	µg/dscm		51.66		3.5		0.3	<	2.125
Mercury	µg/dscm	<	0.087	ND	0.06	ND	6.00	<	0.065
Nickel	µg/dscm	<	1.134		0.55		0.32	<	0.755
Phosphorus	µg/dscm	<	9.529	ND	2.9	ND	1.3	<	6.309
Selenium	µg/dscm	ND	7.403	ND	2.88	ND	1.35	ND	4.422
Silver	µg/dscm	ND	0.740	ND	2.88	ND	1.35	ND	0.442
Thallium	µg/dscm	ND	7.403	ND	2.88	ND	1.35	ND	4.422
Tin	µg/dscm	ND	7.403	ND	2.88		1.75	<	4.422
Zinc	µg/dscm		21.46		9.2		2.7		24.45
Continuous emissions monitoring results									
Oxygen (as measured)	%		8.200		7.38		8.57		7.490
Carbon dioxide	%		8.890		8.71		9.11		8.933
Total hydrocarbons (as methane)	ppmv		15.50		0.9		0.4		1.53
Carbon monoxide	ppmv		23.3		8.2		13		2.3
Nitrogen oxides	ppmv		60.77		62.9		69.7		63.53
Sulfur dioxide	ppmv		2.17		1.7		2.2		1.43
Stack miscellaneous									
Particulate	mg/dscm		0.166		0.43	ND	0.13		0.986
Hydrogen chloride	mg/dscm	ND	0.659	ND	0.83	ND	0.53	<	0.807
Opacity (as measured)	%		0		NA		NA		0

**estimate due to benzene saturation

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

TABLE 5-14. SUMMARY OF SELECTED REGULATORY EMISSION LIMITS

Pollutant or Regulation	Possible CAA Title III Risk Based Standards (5) Section 112 (f) and (o)			SCAQMD Rule 1401/1201 Risk Based Standards (6)			TCLP Waste Leachate Standards (mg/L) 40 CFR 261
	Unit risk factor (10)	Ambient air con. limit/RAC (µg/dscm)	Emission limit estimate (8) (lb/day)	Unit risk factor (11)	Ambient air conc. limit (µg/dscm)	Emission limit estimate (8) (lb/day)	
PM							
Chromium							
Copper							
Lead		1.50E+00	2.8—0.24				5.0
Mercury		3.00E+01	0.57—0.05				0.2
Nickel		2.40E-01	0.46—0.04	4.80E-04	2.08E-02	0.04—3.39E-3	
Silver							5.0
Chromium (IV)				1.50E-01	6.67E-05	1.28E-4—1.08E-5	
NOx							
SOx							
HCl							
CO							
THC							
PCB	1.20E-03	8.33E-04	1.60E-3—1.35E-4	2.20E-03	4.54E-03	8.72E-3—7.39E-4	
Dioxins	5.00E+01	2.00E-08	3.84E-8—3.25E-9	38	2.63E-07	5.05E-7—4.28E-8	
Furans	5	2.00E-07	3.84E-7—3.25E-8				
Benzene	8.30E-06	1.20E-01	0.23-0.02	5.30E-05	1.89E-01	0.04-0.36	0.5
Vinyl chloride	7.10E-06	1.41E-01	0.27—0.02	7.80E-05	1.28E-01	0.25—0.02	0.2
Ethylbenzene							
Toluene		3.10E-01	0.59—0.05				
Perchloroethylene		3.50E+01	67.2—5.69	5.80E-07	1.72E+01	33.1—2.8	
Chlorophenol							
Chlorobenzene		7.00E+01	1.34E2—1.14E1				100
1,2,3 Trichorobenzene							
Hexachlorobenzene	4.90E-04	2.04E-03	3.91E-3—3.32E-4	4.90E-04	2.04E-02	0.04—3.32E-3	0.13
PAH's							
Benzo(a)anthracene				1.70E-03	5.88E-03	0.01—9.57E-4	
Benzo(a)pyrene	3.30E-03	3.03E-04	5.81E-4—4.9E-5	1.70E-03	5.88E-03	0.01—9.57E-4	
Benzo(b)fluoranthene				1.70E-03	5.88E-03	0.01—9.57E-4	
Benzo(k)fluoranthene				1.70E-03	5.88E-03	0.01—9.57E-4	
Chrysene				1.70E-03	5.88E-03	0.01—9.57E-4	
Dibenz(a,h)anthracene	1.40E-02	7.14E-05	1.37E-4—1.16E-5	1.70E-03	5.88E-03	0.01—9.57E-4	
Ideno(1,2,3-c,d)pyrene				1.70E-01	5.88E-01	0.01—9.57E-4	
Napthalene		1.40E+01	26.9—2.28				

TABLE 5-14. (continued)

Pollutant or Regulation	RCRA Incinerator 40 CFR 264 Subpart O (1)	RCRA BIF40 [CFR 264 Subpart H (2)]			NSPS MSW Incinerator 40 CFR 60 (3)	TSCA PCB Incinerator 40 CFR 761 (4)
		Tier II (7)	Tier III			
			Ambient air con. limit (µg/dscm)	Emission limit estimate (8) (lb/day except where noted)		
PM	0.08 gr/dscf @ 7% O2	.08 gr/dscf @ 7% O2		.08 gr/dscf @ 7% O2	.015 gr/dscf @ 7% O2	CEM
Chromium		3.8E-4—3.7	8.30E-04	1.6E-3—1.3E-4		
Copper						
Lead		0.19—406	9.00E-02	0.01—0.17		
Mercury		0.61—1.4E3	8.00E-02	0.01—0.15		
Nickel						
Silver		6.2—1.4E4	3	0.49—5.76		
Chromium (IV)						
NOx					180 ppmv	CEM
SOx					30 ppmv or 80% reduction	
HCl	<1.8 kg/hr or 99% RE	0.24-529 lb/day	7.00E+00	1.14-13.43	25 ppmv or 95% reduction	CEM
CO		<100 ppm or> 100 ppm CO and <20 ppm THC		<100 ppm or >100 ppm CO and <20 ppm THC	50-150 ppmv (9)	CEM
THC		see above		see above		
PCB						<0.001g PCB/kg of nonliquid PCB introduced into incinerator
Dioxins					30 ng/dscm	
Furans					30 ng/dscm	

Notes:

1. Applicability - HW incinerators where incinerator means any enclosed device using controlled flame combustion to solely destroy the input waste stream

2. Applicability - HW boiler and industrial furnace (BIF) where BIF means any enclosed devices that are integral components of manufacturing process and that use controlled flame to accomplish recovery of materials or energy

3. Applicability - HW incinerators

4. Applicability - PCB incinerators where incinerator means an engineered device using controlled flame combustion to thermally degrade PCB's and PCB items. Note: combustion criteria requirement; 2 sec dwell time @ 1200 C and 3 percent excess O2 in stack gas; 1-1/2 sec dwell time @ 1600 C and 2 percent excess O2 in stack gas

5. Applicability - A few proposed sources include; sewage sludge incinerators, HW incinerators, and industrial combustion boilers.

6. Applicability - Any new, relocated or modified unit that emits carcinogenic air contaminants. An acceptable risk of 1 x 10-5 was specified

7. Limits for HCl and metals will depend upon the facility location and the stack height. Values given are the range of possible limits as specified by the regulation

8. The values for HCl and metals are dependent upon the height of the stack (4-120m), urban or rural location, complex or noncomplex terrain and operation schedule (365 days/yr, 24 hr/day). Values given are an estimate of the possible range of limits for a typical facility (a 20 ft stack was assumed)

9. Limit will depend upon the type of facility: modular mass burn, RDF stokers, etc. Note: 7000 gr/lb

10. EPA specified unit risk factors obtainable from the Integrated Risk Information System (IRIS) data base.

11. SCAQMD specified unit risk factors per "Procedures for Preparing Risk Assessments to comply with Air Toxics Rules ofthe South Coast Air Quality Management District," April 1991.

Condition 1 of 20.35 µg/dscm. For comparison, Title III of the CAAA proposed a risk-based standard of 1.03 kg/day (2.28 lb/day) for naphthalene, which corresponds to a concentration of approximately 110 mg/dscm, assuming 24-hour operation. The measured levels were well below this level.

PCDD/PCDF—

The total PCDD and PCDF ranged from < 0.04 ng/dscm to < 0.156 ng/dscm and from < 0.004 ng/dscm to < 0.011 ng/dscm, respectively. For comparison, these values were well below U.S. New Source Performance Standards for municipal solid waste combustors (40 CFR 60 (3)), which limit the sum of total PCDD plus PCDF to 30 ng/dscm.

Volatile Organic Compounds—

The concentration of most volatile organic compounds was below the method detection limits except for benzene and toluene. Benzene concentrations ranged from < 2 µg/dscm to < 73.1 µg/dscm. Toluene concentrations ranged from < 1.8 µg/dscm to < 14.73 µg/dscm. These emissions levels were low in comparison to most risk-based emissions limits.

Trace Metals—

Trace metals may originate in the waste material or other process feedstocks. Metals emissions were generally very low and relatively insensitive to test conditions. Emissions of many metals were below the detection limits of the test methods. In comparison, emissions of chromium, lead, mercury and silver emissions were below Tier III emissions guidelines established for boilers and industrial furnaces under RCRA (40 CFR 264 Subpart H). Silver was not detected in any test, and mercury was detected in only a few test runs.

NO_X, SO_2, and THC—

Continuous emission monitoring (CEM) results were very consistent from run to run, except for Condition 1 Run 1 where the boiler was operating inefficiently. The concentration of NO_X ranged from 60.0 ppmv to 69.7 ppmv, while the concentrations for THC and SO_2 ranged from 0.4 ppmv to 41.4 ppmv and from 0.3 ppmv to 5.1 ppmv, respectively. For comparison, these values were well below New Source Performance Standards for municipal solid waste combustors (40 CFR 60 (3)).

Particulate Matter—

The particulate matter concentration was quite low. The particulate concentrations ranged from 0.13 mg/dscm up to 0.986 mg/dscm. For comparison, these concentrations were well below the limit

established for hazardous waste incinerators regulated under RCRA in 40 CFR 264 Subpart O. This limit is 0.08 gr/dscf (183 mg/dscm) concentration at 7 percent O_2.

HCl—

HCl concentrations were very low, generally below the method detection limit. The HCl concentrations ranged from 0.53 mg/dscm to <0.807 mg/dscm at 7 percent O_2. For comparison, HCl emissions limits established for boilers and industrial furnaces regulated under RCRA in 40 CFR 264 Subpart H (Tier II and Tier III) are 2.4 lb/day, or approximately 11 mg/dscm for the ELI process conditions. The measured emission levels were well below these limits.

RESIDUAL STREAMS AND EFFLUENTS

Table 5-15 shows the yield of process effluents and residual streams on a mass per unit of waste feed basis. The scrubber decant water is the largest output stream produced by the process, equalling or exceeding the mass of waste processed in most cases. The boiler flue gas (for all conditions) and the clean soil (for Condition 2) yields also were significant. The amount of other residual streams and effluents produced by the process is much smaller. To determine the potential ramifications of these by-products, the characteristics of each stream were isolated.

TABLE 5-15. YIELD OF PROCESS RESIDUALS AND EFFLUENTS PER UNIT OF WASTE FEED

Process stream	Yield (kg/kg waste feed)									
	Condition 1				Condition 2		Condition 3			
	Run 1	Run 2	Run 3	Average	Run 1	Run 2	Run 1	Run 2	Run 3	Average
Input streams										
SS1 - Waste water	0.982	0.991	0.980	0.984	0.472	0.778	0.930	0.699	0.714	0.781
SS2 - Waste oil	0.018	0.009	0.020	0.016	NA	NA	0.070	0.301	0.286	0.219
SS3 - Site soils	NA	NA	NA	NA	0.528	0.222	NA	NA	NA	NA
Residual streams										
SS11 - Reactor grit	0.002	0.0003	0.0002	0.001	0.0002	0.0004	0.0003	0.001	0.001	0.001
SS15 - Tank condensate	NA	NA	NA	NA	NA	NA	0.001	0.002	0.004	0.002
SS18 - Heat exchanger	0.000	0.000	0.000	0.000	NA	NA	0.000	0.000	0.000	0.000
SS22 - Scrubber liquor	-0.256	-0.030	-0.081	-0.122	0.024	-0.082	-0.125	0.139	0.000	0.005
Output streams										
SS10 - Clean soil	NA	NA	NA	NA	0.528	0.239	NA	NA	NA	NA
SS12 - Scrubber sludge	0.035	0.019	0.043	0.032	0.002	0.004	0.108	0.201	0.208	0.172
SS13 - Scrubber decant	1.109	0.606	1.576	1.097	0.366	0.762	0.771	4.221	5.986	3.659
SS16 - Stack*	0.777	0.608	0.830	0.738	0.555	0.814	0.956	0.976	1.017	0.98
SS24 - Quench water	NA	NA	NA	NA	0.011	-0.025	NA	NA	NA	NA

*Takes into account combustion air

Effluent and Residual Streams Characteristics

Table 5-16 presents the concentrations of semivolatile organics, volatile organics, and trace metals in the various process streams. The table shows the waste feed and intermediate stream characteristics in addition to effluent and residual stream characteristics. The flow rate of each stream also is given in the table. For condition 3, note that all flow rates correspond to waste processing periods except those for the propane (SS6), combustion air (SS9), and boiler flue gas (SS16). These rates correspond to flow rates during boiler stack tests when reformed gas was fed to the boiler from the compressed storage tank. The flow rate of reformed gas the boiler during stack tests averaged 2.13 kg/hr (4.70 lb/hr).

Major Output Streams—

Besides the boiler flue gas, which was discussed earlier, the major output streams are the decant water (all test conditions) and the treated soil (Condition 2 only). Compared to TCLP leachate standards shown earlier in Table 5-14, the decant water did not exceed any regulated limits; however, PAHs were found which are significantly above the drinking water standard. Hexachlorobenzene and vinyl chloride detection limits were below the TCLP leachate standard. PCBs were present at concentrations far below the allowable level in the original waste water. However, there was accumulation of benzene and PAHs in significant amounts in the decant water. Therefore, further treatment of the decant water is probably required prior to disposal or discharge to public water treatment systems.

The treated soil leaving the TDU contained significant amounts of PCBs, although at levels well below the contaminated soil feed. Benzene also was present in the treated soil. The level of PCBs in the treated soil exceeded the 2 ppm limit in the TSCA permit (29 and 8 ppm for Runs 1 and 2, respectively), and thus required disposal in accordance with TSCA requirements.

Minor Output Streams—

The other output streams from the process are the scrubber liquor, scrubber sludge, and reactor grit. The scrubber liquor would be separated and removed as scrubber decant water and scrubber sludge in a commercial application. The scrubber sludge contained approximately 15-18 ppm of PCBs, and thus would need disposal in the same manner as the treated soil. Significant amounts of other semivolatile organics and benzene also were measured in scrubber sludge samples. For Condition 2, the TDU quench water is also a process residual. The quench water contained approximately 0.1 to 3 ppm of PCBs and other semivolatile organics. However, levels for Run 2 were much lower than Run 1 which suggests that levels might ultimately be lower in an optimized TDU system. Reactor grit contained relatively large amounts of semivolatile organics including PCBs. This may be due to the method of

TABLE 5-16. CHARACTERIZATION OF PROCESS RESIDUAL STREAMS AND EFFLUENTS

Condition 1	Input streams						
Sampling location Description	SS1 Waste water	SS2 Waste oil	SS4 Scrubber Caustic	SS5 Scrubber make-up water	SS6 Propane	SS7 Hydrogen	SS9 Boiler combustion air
Total mass flow, kg/hr	104	1.46	17.6	0	7.62	0.138	225
Total mass flow, lb/hr	229	3.22	38.9	0	16.8	0.303	497
Density, g/L	977	1000	1050	980	1.76	0.0833	1.20
Volumetric flow, dscm/hr	–	–	–	–	4.32	1.65	187
Volumetric flow, L/hr	106	1.46	16.8	0	–	–	–
Moisture, wt. %	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS	µg/L	µg/kg	g/L	g/L	µg/dscm	µg/dscm	µg/dscm
Fluoranthene	ND 1.06	ND 9300	NA	NA	NA	NA	NA
Hexachlorobenzene	ND 1.06	ND 9300	NA	NA	ND 0.42	ND 1.98	ND 2.14
Naphthalene	ND 1.06	BQL 58000	NA	NA	NA	NA	NA
Phenanthrene	ND 1.06	ND 9300	NA	NA	NA	NA	NA
Pyrene	ND 1.06	ND 9300	NA	NA	NA	NA	NA
Total chlorobenzenes	ND 11.8	< 253500	NA	NA	ND 6.82	ND 37.9	ND 21.1
Total chlorophenols	ND 16	ND 139900	NA	NA	ND 14.2	ND 69.6	ND 43.1
Total PAH's	ND 21	< 320400	NA	NA	NA	NA	NA
Total PCB's (mono-deca)	< 22.8	2.38E+08	NA	NA	< 1.47	ND 0.11	ND 0.06
Total PCB's (tri-deca)	< 20.3	2.26E+08	NA	NA	< 1.44	ND 0.10	ND 0.03
Total PCDD/PCDF (by isomer)	< 0.00054	< 327	NA	NA	NA	NA	NA
1,2,4.-Trichlorobenzene	ND 1.06	100000	NA	NA	ND 0.68	ND 4.18	ND 2.34
VOLATILE ORGANICS	µg/L	g/L	g/L	g/L	µg/L	µg/L	ng/dscm
Benzene	< 3.7	BQL 3	NA	NA	ND 6.5	BQL 1040	9940
Methyl chloride	< 6	38	NA	NA	ND 0.8	< 1930	< 979
Tetrachloroethene	< 2	ND 2	NA	NA	ND 0.8	ND 554	BQL 964
Toluene	ND 2	15	NA	NA	ND 13	10700	< 557
Trichloroethene	< 2	180	NA	NA	ND 0.8	ND 554	ND 452
Vinyl chloride	ND 2	ND 2	NA	NA	ND 0.8	ND 554	ND 452
METALS	µg/L	mg/kg	g/L	g/L	µg/L		
Antimony	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Arsenic	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Barium	387	5.7	ND 10	14	NA	NA	NA
Beryllium	ND 10	ND 1	ND 10	ND 10	NA	NA	NA
Cadmium	ND 10	ND 1	ND 10	ND 10	NA	NA	NA
Chromium (total)	< 11	16	13	ND 10	NA	NA	NA
Copper	27	8.2	630	74	NA	NA	NA
Lead	54	110	ND 50	140	NA	NA	NA
Manganese	< 127	ND 1	16	11	NA	NA	NA
Mercury	ND 0.20	ND 0.1	ND 0.2	ND 0.2	NA	NA	NA
Nickel	ND 10	3.5	43	ND 10	NA	NA	NA
Phosphorus	203	270	ND 100	ND 100	NA	NA	NA
Selenium	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Silver	ND 10	ND 1	ND 10	ND 10	NA	NA	NA
Thallium	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Tin	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Zinc	290	88	460	13	NA	NA	NA

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

TABLE 5-16. (continued)

Condition 1	Intermediate Streams								Output Streams					
Sampling location	SS11		SS14		SS18 Heat ex-		SS22		SS12		SS13 Scrubber		SS16	
Description	Reactor grit		Reformed gas		changer residue		Scrubber liquor		Scrubber sludge		decant water		Boiler flue gas	
Total mass flow, kg/hr		0.0656		8.60		0		10.8		2.98		98.6		240
Total mass flow, lb/hr		0.145		19.0		0		23.9		6.57		217		529
Density, g/L		2200		0.748		1000		990		2200		990		1.19
Volumetric flow, dscm/hr		–		11.5		–		–		–		–		182
Volumetric flow, L/hr		–		–		0.0		11.0		1.35		99.5		–
Moisture, wt. %		85		–		–		–		81		–		6.12
SEMI-VOLATILE ORGANICS	µg/kg		µg/dscm		µg/L		µg/L		µg/kg		µg/L		µg/dscm	
Fluoranthene	BQL	69000		NA	BQL	0.4	<	357	BQL	2400000		210	<	0.56
Hexachlorobenzene	ND	430	ND	25.80	ND	0.25	ND	2.53	ND	13000	ND	5.1	ND	1.07
Naphthalene		160000		NA	ND	0.25	BQL	710	QS	660000		3900		20.40
Phenanthrene		93000		NA	ND	0.25		510	BQL	2600000	BQL	540	<	0.41
Pyrene	BQL	83000		NA	BQL	0.3	<	431		2900000		260	<	0.42
Total chlorobenzenes	ND	4740	ND	312.0	ND	2.76	ND	27.8	ND	144000	ND	55.9	ND	8.05
Total chlorophenols	ND	6460	ND	615.0	ND	3.76	ND	35.6	ND	196000	ND	71.2	ND	19.30
Total PAH's	<	655000		NA	<	5.25	<	2697	<	12800000	<	6640	<	28.70
Total PCB's (mono-deca)		2160000	<	2.84	<	8.67	<	31.5	<	15490	<	203	<	0.21
Total PCB's (tri-deca)		2100000	<	1.64	<	7.54	<	30.7	<	14700	<	195	<	0.14
Total PCDD/PCDF (by isomer)	<	0.179	<	0.0015	<	0.00021	<	0.0004	<	4.03	<	0.00063	<	0.0004
1,2,4 -Trichlorobenzene	ND	430	ND	38.3	ND	0.25	ND	2.53	ND	13000	ND	5.1	ND	1.41
VOLATILE ORGANICS	µg/kg		µg/dscm		µg/L		µg/L		µg/kg		µg/L		µg/dscm	
Benzene		430	SAT	521600	<	9.3	<	18.5	ND	22		7160	<	73.1
Methyl chloride	ND	14	ND	4.3	ND	2	<	5	BQL	73	ND	113	<	67.4
Tetrachloroethene	ND	14	<	8.89	ND	2	ND	2	ND	22	ND	113	<	3.85
Toluene	BQL	16	<	11960	ND	2	ND	2		1100	ND	113	<	8.5
Trichloroethene	ND	14	<	29.2	ND	2	ND	2	ND	22	ND	113	<	1.16
Vinyl chloride	ND	14	<	4.15	ND	2	ND	2	ND	22	ND	113	ND	1.04
METALS					µg/L		µg/L		µg/kg		µg/L		µg/dscm	
Antimony		NA		NA	ND	100	ND	100		NA	ND	100	<	8.66
Arsenic		NA		NA	ND	100	ND	100		NA	ND	100	ND	7.40
Barium		NA		NA		750		73		NA		11	<	2.27
Beryllium		NA		NA	ND	10	ND	10		NA	ND	10	ND	0.17
Cadmium		NA		NA	ND	10	ND	10		NA	ND	10	<	1.69
Chromium (total)		NA		NA		23	<	105		NA		22	<	1.22
Copper		NA		NA	ND	10		280		NA		33		1.92
Lead		NA		NA		80		785		NA		120	<	7.96
Manganese		NA		NA		260	<	264		NA		23		51.66
Mercury		NA		NA		1	ND	0.85		NA	ND	0.2	<	0.09
Nickel		NA		NA		10	ND	40.5		NA		39	<	1.13
Phosphorus		NA		NA		260		145		NA	ND	100	<	9.53
Selenium		NA		NA	ND	100	ND	100		NA	ND	100	ND	7.40
Silver		NA		NA	ND	10	ND	10		NA	ND	10	ND	0.74
Thallium		NA		NA	ND	100	ND	100		NA	ND	100	ND	7.40
Tin		NA		NA	ND	100	ND	100		NA	ND	100	ND	7.40
Zinc		NA		NA		900		2800		NA		260		21.5

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

TABLE 5-16. (continued)

Condition 2 Run 1	Input streams									
Sampling location	SS3		SS4 Scrubber		SS6		SS7		SS9 Boiler	
Description	Site soil		Caustic		Propane		Hydrogen		combustion air	
Total mass flow, kg/hr		127		38.5		9.53		0.0934		259
Total mass flow, lb/hr		280		84.9		21.0		0.206		572
Density, g/L		–		1050		1.76		0.083		1.20
Volumetric flow, dscm/hr		–		–		5.40		1.12		216
Volumetric flow, L/hr		–		36.7		–		–		–
Moisture, wt. %		33		–		–		–		–
SEMI-VOLATILE ORGANICS	µg/kg		g/L		µg/dscm		µg/dscm		µg/dscm	
Fluoranthene	BQL	2400		NA		NA	NA			NA
Hexachlorobenzene		6300		NA	ND	0.42	ND	1.98		NA
Naphthalene	BQL	1800		NA		NA		NA		NA
Phenanthrene	BQL	2900		NA		NA		NA		NA
Pyrene	BQL	1900		NA		NA		NA		NA
Total chlorobenzenes	<	16200		NA	ND	6.82	ND	37.9		NA
Total chlorophenols	ND	14900		NA	ND	14.2	ND	69.6		NA
Total PAH's	<.	24900		NA		NA		NA		NA
Total PCB's (mono-deca)	<	538000		NA	<	1.47	ND	0.11		NA
Total PCB's (tri-deca)	<	513000		NA	<	1.44	ND	0.10		NA
Total PCDD/PCDF (by isomer)	<	10.1		NA		NA		NA		NA
1,2,4 -Trichlorobenzene	ND	990		NA	ND	0.68	ND	4.18		NA
VOLATILE ORGANICS	µg/kg		g/L		µg/L		µg/L		ng/dscm	
Benzene	BQL	42		NA	ND	6.5	BQL	1040		42500
Methyl chloride	ALR	18000		NA	ND	0.8	<	1930	<	4660
Tetrachloroethene	ND	30		NA	ND	0.8	ND	554	<	4600
Toluene	ALR	9100		NA	ND	13		10700		2670
Trichloroethene	ALR	98000		NA	ND	0.8	ND	554	<	2200
Vinyl chloride	ALR	4900		NA	ND	0.8	ND	554	ND	210
METALS	µg/L		g/L		µg/L					
Antimony	ND	7.4	ND	100		NA		NA		NA
Arsenic		27	ND	100		NA		NA		NA
Barium		110	ND	10		NA		NA		NA
Beryllium		0.45	ND	10		NA		NA		NA
Cadmium		2.1	ND	10		NA		NA		NA
Chromium (total)		75		13		NA		NA		NA
Copper		99		630		NA		NA		NA
Lead		270	ND	50		NA		NA		NA
Manganese		0.26		16		NA		NA		NA
Mercury		410	ND	0.2		NA		NA		NA
Nickel		65		43		NA		NA		NA
Phosphorus		630	ND	100		NA		NA		NA
Selenium	ND	7.4	ND	100		NA		NA		NA
Silver	ND	0.74	ND	10		NA		NA		NA
Thallium		95	ND	100		NA		NA		NA
Tin		13	ND	100		NA		NA		NA
Zinc		360		460		NA		NA		NA

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

TABLE 5-16. (continued)

Condition 2 Run 1	Intermediate streams					Output streams				
Sampling location	SS11	SS14	SS19	SS20	SS22	SS10	SS12	SS13 Scrubber	SS16	SS24 TDU
Description	Reactor grit	Reformed gas	TDU off-gas	Molten bath	Scrubber liquor	Treated soil	Scrubber sludge	decant water	Boiler flue gas	Quench water
Total mass flow, kg/hr	0.0414	7.44	–	0	5.81	127	0.467	88.0	277	2.63
Total mass flow, lb/hr	0.0912	16.4	–	0	12.8	280	1.03	194	611	5.80
Density, g/L	2204	0.561	–	5750	985	–	2200	990	1.17	1000
Volumetric flow, dscm/hr	–	13.3	–	–	–	–	–	–	208	–
Volumetric flow, L/hr	–	–	–	–	5.89	–	0.212	88.9	–	2.63
Moisture, wt. %	1.0	–	–	–	–	28	54	100	7.55	–
SEMI-VOLATILE ORGANICS	µg/kg	µg/dscm	µg/dscm		µg/L	µg/kg	µg/kg	µg/L	µg/dscm	µg/L
Fluoranthene	120000	NA	NA	NA	630	ND 9000	11000000	550	ND 0.08	5500
Hexachlorobenzene	BQL 3100	ND 4.05	E 74369	NA	ND 20	4800000	BQL 18000	ND 20	E 0.63	ND 20
Naphthalene	BQL 17000	NA	NA	NA	410	ND 9000	BQL 59000	1000	E 2.5	14000
Phenanthrene	120000	NA	NA	NA	900	ND 9000	6900000	650	ND 0.12	7400
Pyrene	38000	NA	NA	NA	780	ND 9000	12000000	590	ND 0.05	7000
Total chlorobenzenes	< 21700	ND 74.2	< 394000	NA	ND 220	< 4900000	< 147000	ND 220	ND 8.05	ND 220
Total chlorophenols	< 28500	ND 152	< 15800	NA	ND 300	ND 135000	< 194000	ND 300	ND 19.3	ND 300
Total PAH's	< 354000	NA	NA	NA	< 4120	ND 180000	< 36300000	< 4460	ND 4.40	< 51100
Total PCB's (mono-deca)	< 4400	< 1.26	14700	NA	< 26.2	29200	< 16400	< 46.1	< 0.08	3220
Total PCB's (tri-deca)	< 3630	< 1.08	12300	NA	< 26.1	28000	< 16100	< 45.6	< 0.08	3070
Total PCDD/PCDF (by isomer)	< 0.504	< 0.0003	< 16.7	NA	< 0.001	< 634	< 331	< 0.83	< 0.00014	< 0.185
1,2,4 -Trichlorobenzene	BQL 1700	ND 9.86	34.5	NA	ND 20	ND 9000	ND 13000	ND 20	ND 0.93	ND 20
VOLATILE ORGANICS	µg/kg	µg/dscm	µg/dscm		µg/L	µg/kg	µg/kg	µg/L	µg/dscm	µg/L
Benzene	190	SAT	SAT	NA	340	ND 28	2400	4900	BQL 2	BQL 240
Methyl chloride	79	INT	INT	NA	ND 10	140	ND 44	ND 200	< 3	590
Tetrachloroethene	23	< 199	< 1880	NA	ND 10	ND 28	ND 44	ND 200	< 1	ND 100
Toluene	BQL 16	< 15900	SAT 7780000	NA	ND 10	BQL 36	ND 44	ND 200	< 1.8	BQL 450
Trichloroethene	90	INT	INT/SAT	NA	ND 10	220	ND 44	ND 200	ND 0.98	4200
Vinyl chloride	10	INT	INT	NA	ND 10	BQL 81	ND 44	ND 200	ND 0.98	ND 100
METALS	µg/L	g/L		ppm	µg/L	mg/kg		µg/L	µg/dscm	µg/L
Antimony	ND 5	NA	NA	ND 30	ND 100	9.6	NA	ND 100	3.7	ND 100
Arsenic	46	NA	NA	ND 20	ND 100	19	NA	ND 100	ND 2.88	ND 100
Barium	63	NA	NA	ND 1	15	88	NA	ND 10	1.61	250
Beryllium	ND 0.05	NA	NA	ND 0.02	ND 10	0.31	NA	ND 10	ND 0.29	ND 10
Cadmium	2.2	NA	NA	ND 1	ND 10	1	NA	ND 10	ND 0.29	ND 10
Chromium (total)	71	NA	NA	ND 2	37	26	NA	19	0.72	61
Copper	51	NA	NA	98	340	60	NA	550	1.90	93
Lead	23	NA	NA	160	130	170	NA	130	4.6	270
Manganese	600	NA	NA	ND 1	190	280	NA	100	3.5	580
Mercury	ND 0.1	NA	NA	ND 0.4	1.4	0.24	NA	0.31	ND 0.06	1.5
Nickel	120	NA	NA	ND 2	92	28	NA	140	0.55	76
Phosphorus	590	NA	NA	380	ND 100	1800	NA	ND 100	ND 2.9	1100
Selenium	ND 5	NA	NA	ND 20	ND 100	ND 7.4	NA	ND 100	ND 2.88	ND 100
Silver	ND 0.5	NA	NA	ND 1	ND 10	ND 0.74	NA	ND 10	ND 2.88	ND 10
Thallium	22	NA	NA	ND 30	ND 100	8.5	NA	ND 100	ND 2.88	ND 100
Tin	NA	NA	NA	* 40	250	6400	NA	1200	ND 2.88	1100
Zinc	64	NA	NA	12	1300	400	NA	740	9.2	750

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

*Iron instead of tin for SS20

TABLE 5-16. (continued)

Condition 2 Run 2	Input streams									
Sampling location	SS3		SS4 Scrubber		SS6		SS7		SS9 Boiler	
Description	Site soil		Caustic		Propane		Hydrogen		combustion air	
Total mass flow, kg/hr		23.7		23.8		13.8		0.0853		371
Total mass flow, lb/hr		52.3		52.4		30.5		0.188		819
Density, g/L		–		1050		1.76		0.083		1.20
Volumetric flow, dscm/hr		–		–		7.85		1.02		309
Volumetric flow, L/hr		–		22.7		–		–		–
Moisture, wt. %		27		–		–		–		–
SEMI-VOLATILE ORGANICS	µg/kg		g/L		µg/dscm		µg/dscm		µg/dscm	
Fluoranthene	ND	890		NA		NA	NA			NA
Hexachlorobenzene		13000		NA	ND	0.42	ND	1.98	EMPC	0.66
Naphthalene	ND	890		NA		NA		NA		NA
Phenanthrene	ND	890		NA		NA		NA		NA
Pyrene	ND	890		NA		NA		NA		NA
Total chlorobenzenes	<	21900		NA	ND	6.82	ND	37.9	<	2.19
Total chlorophenols	ND	13400		NA	ND	14.2	ND	69.6	<	2.78
Total PAH's	ND	17800		NA		NA		NA		NA
Total PCB's (mono-deca)	<	716000		NA	<	1.47	ND	0.11	<	1.23
Total PCB's (tri-deca)	<	682000		NA	<	1.44	ND	0.10	<	1.11
Total PCDD/PCDF (by isomer)	<	0.41		NA		NA		NA		NA
1,2,4 -Trichlorobenzene	ND	890		NA	ND	0.68	ND	4.18	ND	0.15
VOLATILE ORGANICS	µg/kg		g/L		µg/L		µg/L		ng/dscm	
Benzene	ND	28		NA	ND	6.5	BQL	1040	<	68300
Methyl chloride	ALR	2700		NA	ND	0.8	<	1930	<	3460
Tetrachloroethene	ND	28		NA	ND	0.8	ND	554	<	69700
Toluene	ALR	5900		NA	ND	13		10700	<	4230
Trichloroethene	ALR	62000		NA	ND	0.8	ND	554	<	1090
Vinyl chloride	ALR	2700		NA	ND	0.8	ND	554	ND	603
METALS	µg/L		g/L		µg/L					
Antimony	ND	7.4	ND	100		NA		NA		NA
Arsenic		13	ND	100		NA		NA		NA
Barium		50	ND	10		NA		NA		NA
Beryllium		0.27	ND	10		NA		NA		NA
Cadmium	ND	0.7	ND	10		NA		NA		NA
Chromium (total)		15		13		NA		NA		NA
Copper		30		630		NA		NA		NA
Lead		72	ND	50		NA		NA		NA
Manganese		250.00		16		NA		NA		NA
Mercury	ND	0	ND	0.2		NA		NA		NA
Nickel		20		43		NA		NA		NA
Phosphorus		340	ND	100		NA		NA		NA
Selenium	ND	7.4	ND	100		NA		NA		NA
Silver	ND	0.74	ND	10		NA		NA		NA
Thallium	ND	7	ND	100		NA		NA		NA
Tin		34	ND	100		NA		NA		NA
Zinc		490		460		NA		NA		NA

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

TABLE 5-16. (continued)

Condition 2 Run 2	Intermediate streams					Output streams				
Sampling location	SS11	SS14	SS19	SS20	SS22	SS10	SS12	SS13 Scrubber	SS16	SS24 TDU
Description	Reactor grit	Reformed gas	TDU off-gas	Molten bath	Scrubber liquor	Treated soil	Scrubber sludge	decant water	Boiler flue gas	Quench water
Total mass flow, kg/hr	0.0439	3.36	–	0	8.71	25.5	0.436	81.6	389	2.69
Total mass flow, lb/hr	0.0968	7.40	–	0	19.2	56.2	0.962	180	857	5.93
Density, g/L	2200	0.54	–	5750	990	–	2200	990	1.17	1000
Volumetric flow, dscm/hr	–	6.16	–	–	–	–	–	–	297	–
Volumetric flow, L/hr	–	–	–	–	8.79	–	0.198	82.4	–	0.00
Moisture, wt. %	1.0	–	–	–	–	41	54	–	6.11	–
SEMI-VOLATILE ORGANICS	µg/kg	µg/dscm	µg/dscm		µg/L	µg/kg	µg/kg	µg/L	µg/dscm	µg/L
Fluoranthene	120000	NA	NA	NA	630	BQL 76	11000000	550	ND 0.04	ND 20
Hexachlorobenzene	BQL 3100	ND 7.75	9792	NA	ND 19	ND 56	BQL 18000	ND 20	ND 0.64	790
Naphthalene	BQL 17000	NA	NA	NA	390	1100	BQL 59000	1000	E 1.5	BQL 34
Phenanthrene	120000	NA	NA	NA	730	BQL 180	6900000	650	ND 0.05	ND 20
Pyrene	38000	NA	NA	NA	790	BQL 79	12000000	590	ND 0.02	ND 20
Total chlorobenzenes	< 21700	ND 98.1	< 77400	NA	ND 210	< 1100	< 147000	ND 220	ND 9.41	< 804
Total chlorophenols	< 28500	ND 234	< 3660	NA	ND 286	< 841	< 194000	ND 300	ND 19.6	< 15.36
Total PAH's	< 354000	NA	NA	NA	< 3700	< 2400	< 36300000	< 4460	ND 2.30	414
Total PCB's (mono-deca)	< 4400	< 1.78	5690	NA	< 26.8	8260	< 16400	< 46.1	< 1.37	< 121
Total PCB's (tri-deca)	< 3630	< 1.49	4960	NA	< 26.7	7980	< 16100	< 45.6	< 1.24	< 114
Total PCDD/PCDF (by isomer)	< 0.504	< 0.0008	< 2.06	NA	< 0.001	< 6.04	< 331	< 0.83	< 0.00004	< 0.044
1,2,4 -Trichlorobenzene	BQL 1700	ND 9.01	5370	NA	ND 19	ND 56	ND 13000	ND 20	ND 1.11	ND 0.98
VOLATILE ORGANICS	µg/kg	µg/dscm	µg/dscm		µg/L	µg/kg	µg/kg	µg/L	µg/dscm	µg/L
Benzene	190	SAT	SAT 1E+07	NA	ALR 210	ALR 5100	2400	4900	< 6	ALR 260
Methyl chloride	79	< 266	< 11200	NA	ND 2	520	ND 44	ND 200	< 2	BQL 7
Tetrachloroethene	23	59.7	< 50.5	NA	ND 2	ND 34	ND 44	ND 200	ND 1.05	ND 2
Toluene	BQL 16	159000	< 262000	NA	ND 2	190	ND 44	ND 200	< 4.7	BQL 3
Trichloroethene	90	ND 2.08	< 147000	NA	ND 2	190	ND 44	ND 200	ND 1.05	24
Vinyl chloride	10	< 333	ND 23.8	NA	ND 2	ND 34	ND 44	ND 200	ND 1.05	ND 2
METALS	µg/L	g/L		ppm	µg/L	mg/kg		µg/L	µg/dscm	µg/L
Antimony	ND 5	NA	NA	ND 30	ND 100	16	NA	ND 100	1.9	ND 100
Arsenic	46	NA	NA	ND 20	ND 100	ND 7.4	NA	ND 100	ND 1.35	ND 100
Barium	63	NA	NA	ND 1	15	110	NA	ND 10	0.57	60
Beryllium	ND 0.05	NA	NA	ND 0.02	ND 10	0.31	NA	ND 10	ND 0.13	ND 10
Cadmium	2.2	NA	NA	ND 1	ND 10	9.4	NA	ND 10	0.35	ND 10
Chromium (total)	71	NA	NA	ND 2	37	440	NA	19	0.69	ND 10
Copper	51	NA	NA	99	340	70	NA	550	0.51	16
Lead	23	NA	NA	ND 10	130	110	NA	130	2.7	ND 50
Manganese	600	NA	NA	2	190	200	NA	100	0.3	64
Mercury	ND 0.1	NA	NA	ND 0.4	1.4	ND 0.15	NA	0.31	ND 6.00	ND 0.2
Nickel	120	NA	NA	110	92	27	NA	140	0.32	ND 10
Phosphorus	590	NA	NA	370	ND 100	130	NA	ND 100	ND 1.3	120
Selenium	ND 5	NA	NA	ND 20	ND 100	ND 7.4	NA	ND 100	ND 1.35	ND 100
Silver	ND 0.5	NA	NA	ND 1	ND 10	ND 0.74	NA	ND 10	ND 1.35	ND 10
Thallium	22	NA	NA	ND 30	ND 100	ND 7.4	NA	ND 100	ND 1.35	ND 100
Tin	NA	NA	NA	930	250	ND 14000	NA	1200	1.75	130
Zinc	64	NA	NA	6	1300	700	NA	740	2.7	68

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)
*Iron instead of tin for SS20

TABLE 5-16. (continued)

Condition 3	Input streams						
Sampling location	SS1	SS2	SS4 Scrubber	SS5 Scrubber	SS6	SS7	SS9 Boiler
Description	Waste water	Waste oil	caustic	make-up water	Propane	Hydrogen	combustion air
Total mass flow, kg/hr	133	23.1	117	178	12.9	0.0717	332
Total mass flow, lb/hr	294	50.9	257	393	28.5	0.158	732
Density, g/L	971	1000	1050	980	1.76	0.0833	1.20
Volumetric flow, dscm/hr	–	–	–	–	7.34	0.860	276
Volumetric flow, L/hr	137	23.1	111	182	–	–	–
Moisture, wt. %	–	–	–	–	–	–	–
SEMI-VOLATILE ORGANICS	µg/L	µg/kg	g/L	g/L	µg/dscm	µg/dscm	µg/dscm
Fluoranthene	< 1.73	ND 10000	NA	NA	NA	NA	NA
Hexachlorobenzene	ND 0.98	ND 10000	NA	NA	ND 0.42	ND 1.98	ND 0.83
Naphthalene	< 3.46	BQL 56000	NA	NA	NA	NA	NA
Phenanthrene	< 2.38	ND 10000	NA	NA	NA	NA	NA
Pyrene	< 1.5	ND 10000	NA	NA	NA	NA	NA
Total chlorobenzenes	ND 10.8	< 235000	NA	NA	ND 6.82	ND 37.9	ND 6.2
Total chlorophenols	ND 14.7	ND 150000	NA	NA	ND 14.2	ND 69.6	ND 12.38
Total PAH's	< 24.8	< 366000	NA	NA	NA	NA	NA
Total PCB's (mono-deca)	< 25.2	2.54E+08	NA	NA	< 1.47	ND 0.11	ND 0.15
Total PCB's (tri-deca)	< 22.3	2.41E+08	NA	NA	< 1.44	ND 0.10	ND 0.03
Total PCDD/PCDF (by isomer)	< 1.57	< 393	NA	NA	NA	NA	NA
1,2,4 -Trichlorobenzene	ND 0.98	BQL 95000	NA	NA	ND 0.68	ND 4.18	ND 0.56
VOLATILE ORGANICS	µg/L	g/L	g/L	g/L	µg/L	µg/L	ng/dscm
Benzene	< 8.7	ND 2	NA	NA	ND 6.5	BQL 1040	ALR 115800
Methyl chloride	< 2.3	30	NA	NA	ND 0.8	< 1930	< 1731
Tetrachloroethene	< 4.3	ND 2	NA	NA	ND 0.8	ND 554	BQL 1091
Toluene	< 4.3	BQL 7	NA	NA	ND 13	10700	4030
Trichloroethene	ND 2	200	NA	NA	ND 0.8	ND 554	ND 504
Vinyl chloride	ND 2	ND 2	NA	NA	ND 0.8	ND 554	ND 672
METALS	µg/L	mg/kg	g/L	g/L	µg/L		
Antimony	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Arsenic	ND 117	ND 10	ND 100	ND 100	NA	NA	NA
Barium	530	6	ND 10	ND 10	NA	NA	NA
Beryllium	ND 10	ND 1	ND 10	ND 10	NA	NA	NA
Cadmium	ND 10	1	ND 10	ND 10	NA	NA	NA
Chromium (total)	< 33	15	13	ND 10	NA	NA	NA
Copper	105	9	630	65	NA	NA	NA
Lead	187	120	ND 50	ND 50	NA	NA	NA
Manganese	< 632	ND 1	16	ND 10	NA	NA	NA
Mercury	ND 0	0.26	ND 0.2	ND 0.2	NA	NA	NA
Nickel	ND 33	4.30	43	ND 10	NA	NA	NA
Phosphorus	730	280	ND 100	ND 100	NA	NA	NA
Selenium	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Silver	ND 10	ND 1	ND 10	ND 10	NA	NA	NA
Thallium	ND 100	ND 10	ND 100	ND 100	NA	NA	NA
Tin	ND 100	11	ND 100	ND 100	NA	NA	NA
Zinc	1107	100	460	16	NA	NA	NA

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

TABLE 5-16. (continued)

Condition 3	Intermediate Streams												Output Streams					
Sampling location	SS11		SS14		SS15 - Reformed		SS18 Heat ex-		SS22		SS12		SS13 Scrubber		SS16	
Description	Reactor grit		Reformed gas		Gas condensate		changer residue		Scrubber liquor		Scrubber sludge		decant water		Boiler flue gas	
Total mass flow, kg/hr		0.101		16.5		0.440		0		8.57		22.0		352		347
Total mass flow, lb/hr		0.222		36.4		0.970		0		18.9		48.6		776		764
Density, g/L		2204		0.497		1000		1000		984		2200		990		1.19
Volumetric flow, dscm/hr		–		33.2		–		–		–		–		–		263
Volumetric flow, L/hr		–		–		0.440		–		8.71		10.0		355		–
Moisture, wt. %		2		–		–		–		–		96		–		6.77
SEMI-VOLATILE ORGANICS	µg/kg		µg/dscm		µg/L		µg/L		µg/L		µg/kg		µg/L		µg/dscm	
Fluoranthene		170000		NA	BQL	5700	ND	1.2		2410		4400000		59	ND	0.72
Hexachlorobenzene	ND	13000	ND	6.92	ND	960	ND	1.2	ND	21.3	ND	160000	ND	1.1	ND	0.64
Naphthalene	BQL	85000		NA		6100000		21		5160	QS	11000000		13000	<	2.36
Phenanthrene		220000		NA		17000	ND	1.2		3300		5200000	ALR	150	ND	0.76
Pyrene	BQL	93000		NA	BQL	5800	ND	1.2		2697		6300000		64	ND	0.77
Total chlorobenzenes	ND	144000	ND	18.8	ND	10540	ND	13.1	ND	235	ND	1760000	ND	12.2	ND	4.48
Total chlorophenols	ND	196000	ND	28.3	ND	14380	ND	17.9	ND	363	ND	2400000	ND	15.5	ND	8.26
Total PAH's	<	846000		NA	<	6420000	<	43.80	<	20300	<	40700000	<	15200	<	24.04
Total PCB's (mono-deca)	<	3310	<	32.6	<	16800	<	10.79	<	48.9	<	17665	<	40.6	<	1.23
Total PCB's (tri-deca)	<	1670	<	27.5	<	16750	<	9.82	<	48.4	<	17470	<	39.4	<	1.14
Total PCDD/PCDF (by isomer)	<	162	<	0.000162	ND	0.0034	<	0.00053	<	0.001	<	1.92	<	0.00013	<	0.0002
1,2,4 -Trichlorobenzene	ND	13000	ND	0.97	ND	960	ND	1.2	ND	21.3	ND	160000	ND	1.1	ND	0.43
VOLATILE ORGANICS	µg/kg		ug/dscm		mg/L		µg/L		µg/L		µg/kg		µg/L		µg/dscm	
Benzene	ALR	17000		1781000	ALR	819		120	<	347	ND	18	ALR	7700	<	113
Methyl chloride		210	<	116.5	ND	3.75	ND	2	<	4.7	ND	18	ND	2	<	100
Tetrachloroethene	ND	20	<	2481	BQL	7.75	ND	2	<	7	ND	18	BQL	4	<	4.51
Toluene	ND	20		69970	<	25.02	ALR	450	<	25.7	ND	18		220	<	14.7
Trichloroethene	ND	20	<	20.28	ND	3.75	ND	2	ND	4.7	ND	18	ND	2	<	1.52
Vinyl chloride	ND	20	<	33669	ND	3.75	ND	2	ND	4.7	ND	18	ND	2	ND	1.01
METALS	mg/kg				µg/L		µg/L		µg/L		µg/kg		µg/L		µg/dscm	µg/L
Antimony	ND	5		NA	ND	100	ND	100	ND	100		NA	ND	100	<	5.13
Arsenic		23		NA	ND	100	ND	100	<	110		NA	ND	100	ND	4.42
Barium		30		NA		43		640		33.7		NA		15	<	1.17
Beryllium	ND	0.5		NA	ND	10	ND	10	ND	10		NA	ND	10	ND	0.04
Cadmium	ND	0.5		NA		12	ND	10	ND	10		NA	ND	10	<	0.99
Chromium (total)		27		NA		16		18	<	130		NA	ND	10	<	0.93
Copper		10		NA		5300		61		213		NA		20	<	1.52
Lead		6.7		NA		4600		51		497		NA	ND	50	<	3.94
Manganese		330		NA		170		300		400		NA		16	<	2.12
Mercury	ND	0.1		NA		7.4		0.37	<	0.52		NA	ND	0.2	<	0.06
Nickel		100		NA		23		32		38		NA		190	<	0.76
Phosphorus		300		NA		520		640	<	199		NA	ND	100	<	6.31
Selenium	ND	5		NA	ND	100	ND	100	ND	100		NA	ND	100	ND	4.42
Silver	ND	0.5		NA	ND	10	ND	10	ND	10		NA	ND	10	ND	0.44
Thallium		8		NA	ND	100	ND	100	ND	100		NA	ND	100	ND	4.42
Tin		21		NA	ND	100	ND	100	<	137		NA	ND	100	<	4.42
Zinc		25		NA		8200		2200		3007		NA		120		24.4

(refer to Abbreviations and Symbols table at beginning of report for key to abbreviations)

sample collection, since the grit collector was not insulated for part of condition and condensation of organic compounds may have occurred. In any case this stream represented an extremely small quantity during this demonstration.

Reformed Gas Quality

The reformed gas produced by the reduction process was analyzed for fixed gases and common hydrocarbons to characterize its fuel value. Characteristics of the reformed gas are compared to other common gaseous fuels in Table 5-17. The fuels are ranked according to their volumetric heating value (Btu/scf). The reformed gas is a medium Btu gas. The gas produced during the Demonstration had an average heating value ranging from 269 to 376 Btu/scf, comparable to blue water gas. The high hydrogen content of the reformed gas, beneficial for flame stability, makes it a moderately attractive medium Btu fuel. The volumetric heating value of the reformed gas is 24 to 33 percent that of natural gas, which would likely preclude its use as a direct replacement for high Btu fuels such as propane, butane, or natural gas.

TABLE 5-17. COMPARISON OF REFORMED GAS QUALITY TO OTHER GASEOUS FUELS

Gaseous Fuels	Composition, percent by volume								Molecular weight of fuel	Higher heating value Btu/lbm	Higher heating value Btu/scf
	H_2	N_2	O_2	CH_4	CO	CO_2	C_2H_4	C_6H_6			
Natural gas- (15.8% C_2H_6)	-	0.8	-	83.4	-	-	-	-	18.3	24,100	1,136
Coke-oven gas	46.5	8.1	0.8	32.1	6.3	2.2	3.5	0.5	13.7	17,100	603
Coal gas	54.6	4.4	0.2	24.2	10.9	3.0	1.5	1.3	12.1	16,500	514
Eco Logic Condition 3 - average	**55.7**	**13.7**	**0.06**	**16.9**	**8.0**	**3.3**	**0.7**	**-**	**11.6**	**12,610**	**376**
Eco Logic Condition 2 - Run 1	**67.4**	**18.3**	**0.02**	**7.4**	**3.0**	**3.3**	**0.1**	**-**	**10.0**	**11,520**	**296**
Carb. water gas	40.5	2.9	0.5	10.2	34.0	3.0	6.1	2.8	18.3	11,350	535
Eco Logic Condition 2 - Run 2	**62.3**	**25.0**	**0.01**	**6.9**	**3.7**	**1.8**	**0.0**	**-**	**11.2**	**9,600**	**277**
Blue water gas	47.3	8.3	0.7	1.3	37.0	5.4	-	-	16.4	6,550	277
Eco Logic Condition 1 - Average	**41.1**	**33.7**	**0.05**	**12.2**	**5.1**	**6.7**	**0.4**	**-**	**16.7**	**6,250**	**269**
Producer gas	14.0	50.9	0.6	3.0	28.0	4.5	-	-	24.7	2,470	157
Blast furnace gas	1.0	60.0	-	-	27.5	11.5	-	-	29.6	1,170	89

Note: Typical values for other fuels taken from: "Engineering Experimentation", G.L. Tuve and L.C. Domholdt McGraw-Hill Book Company, 1966; and "The Internal Combustion Engine", 2nd Ed., C.F. Taylor and E.S. Taylor, International Textbook Co., 1961.

Trace organic substances were also measured to address possible contamination issues. The concentrations of organic contaminants, which were detected in the reformed gas, are presented in Table 5-18. Significant concentrations of benzene (522 mg/dscm and 1,780 mg/dscm for Conditions 1 and 3, respectively) and toluene (<12 mg/dscm to 159 mg/dscm) were measured. Benzene was present in

amounts sufficient to saturate the measurement method; therefore, *the maximum levels could not be* quantified. The appearance of significant quantities of benzene, a major intermediate product of the reduction process, is expected. Trace levels of vinyl chloride (< 4.15 µg/dscm and < 33,700 µg/dscm for Conditions 1 and 3) also were detected. The vinyl chloride results may be suspect due to analytical interferences.

TABLE 5-18. TRACE ORGANIC COMPOUNDS DETECTED IN REFORMED GAS

Substance	Units	Condition 1 Average	Condition 2 Run 1	Condition 2 Run 2	Condition 3 Average	SS6 Propane
PCBs (mono-deca)	µg/dscm	< 2.84	< 1.26	< 1.78	< 32.6	< 1.47
Dioxins/furans	ng/dscm	< 1.49	< 0.27	< 0.81	< 0.16	not analyzed
Total chlorobenzene	µg/dscm	ND 312	ND 74.2	ND 98.1	ND 18.8	ND 6.82
Ethylbenzene	µg/dscm	< 182	< 12.6	69.2	2950	BQL 2600
Benzene	mg/dscm	SAT 522	SAT	SAT	1780	ND 6.5
Toluene	mg/dscm	< 12.0	< 15.9	159	70.0	ND 13
Vinyl chloride	µg/dscm	< 4.15	INT	< 333	< 33700	ND 800
Perchloroethylene	µg/dscm	< 8.89	< 199	59.7	< 2480	ND 800

Note: This is a partial list of the compounds which were detected in the reformed gas. For a complete list please refer to Appendix 2.

PROCESS CONSIDERATIONS

Scale-Up Parameters

The Demonstration was conducted on a pilot-scale unit. Commercial applications are expected to require larger unit capacity than the Demonstration unit. Scale up of the process may affect performance. Therefore, selected process scale-up parameters were documented during this demonstration to provide a basis for comparing performance of a full-scale commercial unit with these Demonstration results:

- Reactor: residence time, temperature
- Scrubber: liquid-to-gas ratio, type
- Thermal Desorption Unit: Residence time, temperature.

Reactor Scale-Up—

The design of any chemical reactor in which reactions are kinetically limited involves specification of residence time, temperature, and mixing. In the Eco Logic reactor, mixing is dictated by the physical design of the reactor and gas inlet configuration. The details of the reactor design are proprietary.

Temperature in the reactor is a key operating parameter which was monitored via *direct measurement and* controlled throughout the tests. Residence time in the reaction zone from the reactor through insulated duct work up to the scrubber) is dictated by the volume of the zone, and the volumetric flow rate of the gases. Residence time was calculated from estimated gas flow rate and gas temperature during the tests. Residence time and temperature of the process were discussed earlier in Sections 3 and 4.

Scrubber Scale-Up—

The performance of wet scrubbers is mass-diffusion-limited and, therefore, primarily a function of liquid-gas contacting. Liquid-gas contacting is achieved in packed bed scrubbers by the design of the bed, packing material, and scrubber liquor flow rate. The packing material used in the scrubber was a standard C-type polypropylene packing material. The scrubber liquor flow rate, expressed as the liquid to gas mass ratio, ranged from 70 to 90 L/acm gal/acf (0.5 to 0.7) during the tests.

Thermal Desorption Unit Scale-Up —

Because of the developmental nature of the TDU, design details are proprietary and no process scale-up parameters were isolated.

Chemical Ionization Mass Spectrometer Validation

One of the program objectives was to validate the chemical ionization mass spectrometer (CIMS) as a viable tool to continuously evaluate the state of destruction within the reactor, to enable the operator to track reactor destruction performance, and to alert the operator and process controller to incidents or process upsets. The CIMS uses chemical ionization mass spectrometry for gas analysis. This type of ionization produces ions without fragmenting the molecules into daughter ions, thus enabling easier identification of sample gas components. A sample is extracted from the gas stream, filtered, and delivered to the CIMS. The entire sampling system is heated to prevent condensation.

Validation tests of the CIMS were conducted by independently sampling the reformed gas stream (SS14) and comparing these results with the CIMS response, averaged over the sampling period. The results (Table 5-19) were fitted to a linear regression curve, and the correlation coefficient --R^2-- shows no correlation between the CIMS and reference method results for dichlorobenzene and trichlorobenzene. A moderately good correlation for chlorobenzene was seen; however, the correlation was far from one to one. As can be seen in Figure 5-8, the CIMS indicated absolute chlorobenzene concentrations over an

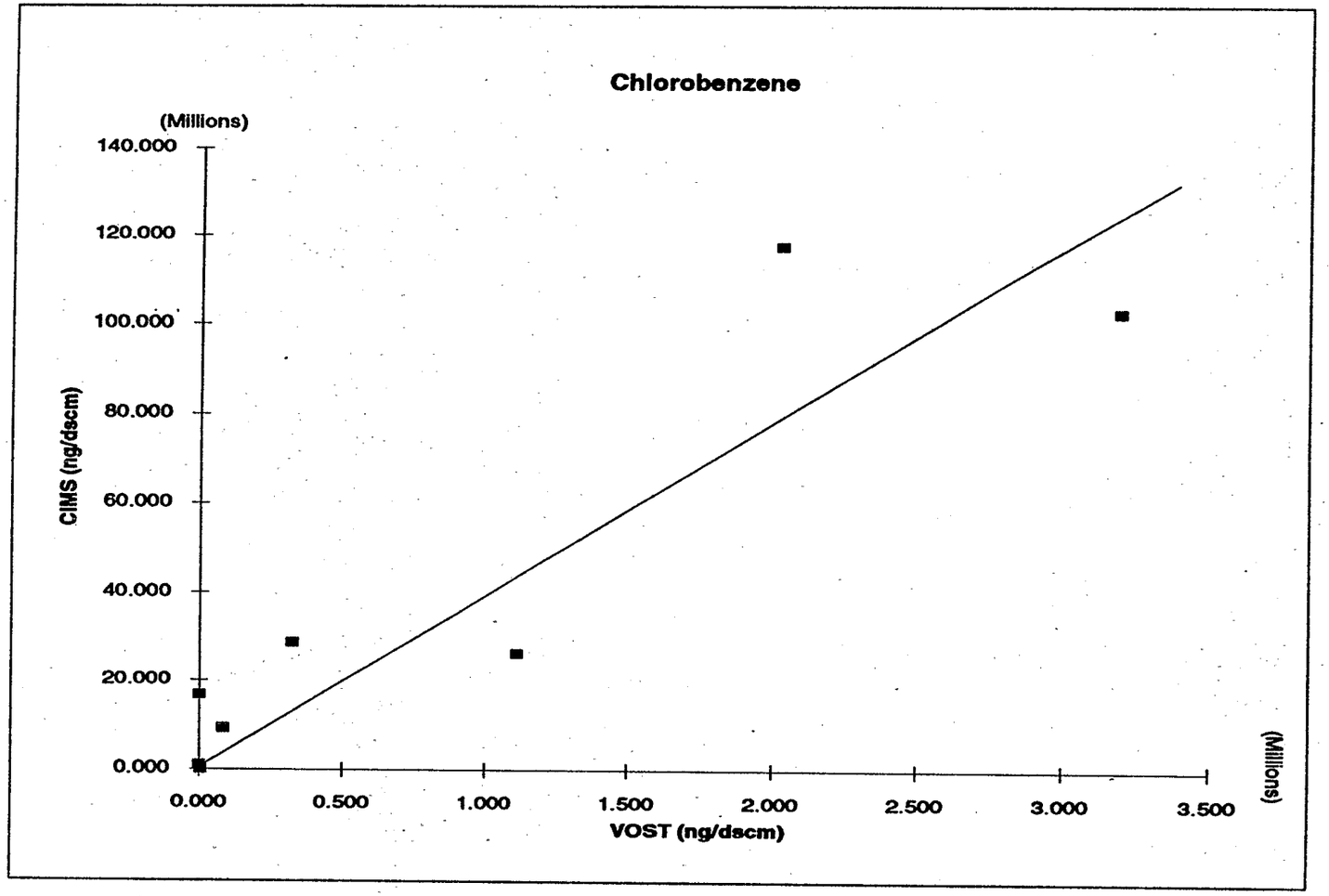


Figure 5-8. Comparison of CIMS response to VOST measurements for chlorobenzene.

order of magnitude higher than the reference method. Despite this discrepancy, CIMS appears useful as a qualitative trend indicator based on these extremely limited data.

TABLE 5-19. ELI CIMS VALIDATION

Test	Chlorobenzene ng/dscm		Dichlorobenzene ng/dscm		Trichlorobenzene µg/dscm	
Condition 1	CIMS	VOST	CIMS	VOST	CIMS	XAD-2
Run 1	1.68E+07	ND 1.94E+03	3.37E+07	ND 5.81E+03	2.79E+05	ND 1.13E+02
Run 2	9.26E+06	< 8.38E+04	7.45E+06	< 2.59E+04	6.64E+05	ND 1.42E+02
Run 3	2.88E+07	3.24E+05	3.85E+07	ND 6.13E+03	1.68E+06	ND 4.11E+01
Condition 2						
Run 1	1.45E+05	< 7.30E+03	7.35E+07	ND 6.28E+03	4.29E+06	ND 3.05E+01
Run 2	1.03E+06	ND 2.08E+03	7.80E+07	ND 6.23E+03	6.26E+05	ND 2.75E+01
Condition 3						
Run 1	1.03E+08	3.20E+06	5.09E+07	< 7.58E+04	4.19E+06	ND 1.14E+01
Run 2	1.18E+08	2.03E+06	3.92E+07	< 4.20E+04	2.36E+06	ND 2.15E+00
Run 3	2.63E+07	1.12E+06	2.95E+07	< 3.66E+04	1.36E+05	ND 9.62E+00
R^2	0.832		0.04		0.20	

System Reliability

For this program, system reliability was evaluated, based on three criteria:

- **Waste Feed Rate**—The actual waste feed rate compared to the test target waste feed rate;
- **Availability**—Availability of the system to process waste; and
- **Destruction Efficiency**—The reliability of the system to meet destruction efficiency objectives.

Waste Feed Rate—

The respective planned and demonstrated waste feed rates for each run are compared in Table 5–20. Actual feed rates during the Demonstration, based on process design and preliminary waste characteristics were substantially less than planned. For Condition 1, the waste water feed rate ranged from approximately 29 to 55 percent of the planned feed rate. Besides falling considerably below the target, the run-to-run variability was also much greater. This may be due in part to start-up problems, which were still being resolved during the Condition 1 tests, and due to lack of an on-line flow measurement of the waste water. The feed rate of soil during Condition 2 tests was also substantially below target levels, primarily due to deficiencies in TDU operation. Waste oil feed rate during Condition 3 tests was approximately 35 to 45 percent of the planned value, but the total amount of waste oil processed was close to the target value. It should be noted that these waste oil feed rates would not

be sustainable for more than a few hours without increasing the capacity of the reformed gas handling systems (i.e., compressed storage, auxiliary boiler). The actual PCB concentration was also substantially lower than expected, because the actual PCB concentration in the waste oil was only 25.4 percent, compared to the level of 39 percent measured before the Demonstration. As a result of the lower feed rates, the total amount of waste water and soil processed was substantially lower than planned. Thus, the reliability of the system to process the planned amount of waste within the planned period could not be demonstrated.

TABLE 5-20. WASTE FEED INPUTS

Waste Type	Test Number	Actual kg/min	Planned kg/min	% Achievement
Water and Oil	C1-R1	1.47	5.05	29.1
	C1-R2	2.78	5.05	55.0
	C1-R3	1.03	5.05	20.4
Soil	C2-R1	2.12	10	21.2
	C2-R2	0.40	10	4.0
Oil	C3-R1	0.355	1	35.5
	C3-R2	0.447	1	44.7
	C3-R3	0.353	1	35.3

Availability—

Availability of the process was calculated by comparing of the actual and planned amount of time needed to complete the tests. The availability was examined for four test phases:

Performance Test:	Days to perform performance test runs;
Reliability Test:	Days to perform 72-hour reliability test;
Test Prep/Recovery:	Days to recover samples, ship samples, and prepare sampling trains; and
Down Days:	Days where the unit was down for maintenance. These days were typically planned for Sundays in a weekly schedule.

As seen in Table 5-21, the unit very closely followed the planned schedule. One test during the TDU performance tests was canceled. The total number of down days was more than 4 times the planned number. However, most of these were due to TDU installation and resolution of feed hopper problems. Down days for maintenance were doubled due to three unscheduled maintenance days. At the completion of the performance tests, a continuous 72-hour reliability test was conducted. During this test, the unit did not experience any problems in maintaining operation. Overall, with the exception of the TDU segment of the Demonstration, the availability of the unit was considered good.

TABLE 5-21. UNIT AVAILABILITY

Test Phase	Planned Days	Actual Days
Performance tests	9	8
Reliability tests	3	3
Test Prep/recovery	9	8
Down days:		
Scheduled maintenance	3	3
Unscheduled maintenance	0	3
Compressor installation	0	1
TDU installation	7	31
TDU hopper problems	0	4
Total	10	42

Destruction Efficiency—

The system achieved most of the program objectives for DE and DRE, as discussed earlier in this report. The ELI process demonstrated 99.9999 percent DRE for PCB for almost all of the runs, and 99.99 percent DE of surrogate compounds for almost all of the runs in which surrogate spiking occurred. Thus, the reliability of the process destruction was excellent.

Key Cost Assumptions

The economic analysis of the ELI Gas-Phase Chemical Reduction Process encompasses 12 cost categories:

- Site preparation - including site design and layout, surveys, site investigations, legal searches, access rights and access roads, preparations for support facilities, decontamination facilities, utility connections, and auxiliary buildings;

- Permitting and regulatory requirements - including permits, system monitoring requirements, and development of monitoring and analytical protocols and procedures;

- Capital equipment - broken out by subsystems and major equipment items including process equipment, materials handling equipment, and residual streams handling equipment, including specifications;

- Startup and fixed costs - broken out by categories, such as mobilization, shakedown, testing, working capital, depreciation, taxes, and implementation of environmental monitoring programs;

- Labor - supervisory and administrative staff, professional staff, technical expert, maintenance personnel, and clerical support;

- Supplies and consumables - raw materials, fuel, chemicals, etc;

- Utilities - electric, water, steam, etc. (quantities consumed);

- Effluent treatment and disposal - both on-site and off-site facility costs including wastewater disposal and monitoring activities;

- Residual waste shipping, handling, and transport, (including the preparation of shipping and actual waste disposal charges);

- Analytical services - laboratory analyses for operations and environmental monitoring;

- Facility modification, repair, replacement - design adjustments, facility modifications, scheduled maintenance, and equipment replacement; and

- Site demobilization - shutdown, site cleanup, restoration, permanent storage costs, and site security.

The Demonstration generated data such as consumption of electricity, hydrogen, and other consumables which are key inputs to the economic analysis of the process. The economic analysis of the ELI process is presented in the Applications Analysis Report.

PERMIT CONDITIONS

TSCA Permit

In order to conduct the Demonstration with actual PCB-contaminated wastes, ELI obtained a permit under the Toxic Substances Control Act (TSCA) of 1976. Many of the conditions were based on the sampling and analysis results obtained during other demonstrations. Table 5-22 compares the TSCA permit conditions with those observed during the Demonstration. All of the TSCA permit conditions were achieved.

TABLE 5-22. RESPONSIVENESS TO TSCA PERMIT

Conditions of approval	Condition met
Feed stock restictions:	
Less then 30 tons of PCB-contaminated material (oil, water, and soil)	Yes
Less then 130 gal. DNAPL oil	Yes
Concentration of DNAPL oil, in the ground water, of less then 10,000 ppm	Yes
Treated materials:	
Limit PCBs in ground water to below 3 ppb/congener and/or total Aroclors	Yes
Limit PCBs in soil and DNAPL oil matrices to levels below 2 ppm/congener and/or total Aroclors	Yes
ELI shall dispose of all material at EPA-approved TSCA disposal facilities	Yes
Process Monitoring /Recording:	
Quantity and concentration of PCBs in process feed stocks	Yes
Quantity and concentration of PCBs in process wastes.	Yes
Concentrations of PCBs at the exhaust of the unit, and PCB exposure in the working area	Yes
Temperature of the reduction reaction, name of the operator and supervisor	Yes

Michigan Department of Natural Resources Permit

One of the program objectives was to document unit compliance with the Michigan Department of Natural Resources (MDNR) Air Permit conditions. Permit No. 1261-91 was issued to ELI Eco Logic International Inc. for the disposal of PCBs. The permit conditions included limits for both concentration (mg/dscm) and emission rate (lbs/hr). Some of these emissions limits were based on information provided by ELI to the MDNR from previous test programs, rather than by an MDNR policy or regulation.

Table 5-23 compares the MDNR permit conditions against demonstration results. The process was able to meet nearly all of the permit conditions. HCl, THC, CO, and PCB emissions easily met the requirements of the MDNR air permit. Stack concentrations of benzene and the 1,2,4-trichlorobenzene exceeded the limits in the permit, but emission rates were within the permit limits. It should be noted that the 1,2,4-trichlorobenzene results were below the analytical detection limit and therefore represent maximum possible emissions, and were only slightly above the permit limit for one test condition. In certain cases, the limitation for maximum system oxygen concentration (0.04 percent) was exceeded, although this is believed to be due to oxygen analyzer problems and not actual system conditions.

TABLE 5-23. MICHIGAN DEPARTMENT OF NATURAL RESOURCES AIR PERMIT CONDITIONS

		Units	Permit limit	Condition 1 (average)	Condition 2 Run 1	Condition 2 Run 2	Condition 3 (average)	Average (Note 3)
Air emissions	HCl (Notes 1, 2)	mg/dscm	5.2	ND 0.60	ND 0.80	ND 0.46	< 0.78	< 0.67
		lb/hr	0.027	ND 0.00024	ND 0.00037	ND 0.00030	< 0.00044	< 0.00034
	THC (Note 2)	ppmv	200	12.8	0.9	0.4	1.5	5.5
		lb/hr	0.19	0.0036	0.00027	0.00016	0.00055	0.0016
	CO (Note 2)	ppmv	100	20.6	8.0	11.5	2.2	11.0
		lb/hr	0.15	0.0097	0.0043	0.0088	0.0017	0.0059
	PCBs (tri- through deca-)	mg/dscm	0.090	< 0.00012	< 0.000076	< 0.0011	< 0.0011	< 0.00060
	including NDs (Notes 1, 2)	lb/hr	0.00048	< 4.9E-08	< 3.5E-08	< 7.2E-07	< 5.9E-07	< 3.3E-07
	Benzene (Notes 1, 2)	µg/dscm	20	< 61	< 1.9	< 5.4	> 109	> 65
		lb/hr	0.00009	< 0.000025	< 0.000001	< 0.000004	> 0.000063	> 0.000034
	1,2,4-trichlorobenzene	µg/dscm	1	ND 1.3	ND 0.90	ND 0.98	ND 0.41	ND 0.88
	(Notes 1, 2, 4)	lb/hr	2.00E-06	ND 5.2E-07	ND 4.1E-07	ND 6.4E-07	ND 2.7E-07	ND 4.3E-07
	Visible emissions (opacity)	%	0	0	N/A	N/A	0	0
Process permissives	Scrubber inlet water temperature (Note 5)	°C	> 35	46	45	37	42	42
	Scrubber solution	pH	> 8	8.8	8.4	8.4	9.3	8.9
	On-line mass spectrometer	yes/no	yes	yes	yes	yes	yes	yes
	Reactor temperature	°C	> 850	892	890	890	933	907
	Reactor pressure	in. WC	< 10	1.82	2.23	2.69	1.80	1.97
	System oxygen	%	< 0.04	0.05	0.02	0.01	0.06	0.045
	Gas booster dP	in. WC	< 16	11.60	10.23	8.09	7.81	9.57
	Recirculation flow rate	cfm	100	110	110	110	110	110
	Boiler flame on	yes/no	yes	yes	yes	yes	yes	yes
	Residence time	sec	>3.0	9.0	5.8	9.6	6.1	7.6
	Benzene (Note 2)	ppm	<1000	< 0.019	< 0.001	< 0.002	> 0.034	> 0.020
	Chlorobenzene (Note 2)	ppm	<100	ND 0.00019	ND 0.00019	ND 0.00019	ND 0.00020	ND 0.00019

Notes:
(1) Concentrations are corrected to 70°F and 29.92 in. Hg, as specified in permit, and are on a dry basis. Concentrations reported elsewhere in the report are corrected to 20°C (68°F) and 760 mm Hg (29.92 in. Hg), as specified in U.S. EPA test methods.
(2) Concentrations are reported on a dry, as measured (not corrected to constant dilution) basis.
(3) Average of all test runs.
(4) Permit limit specifies chlorobenzenes as 1,2,4-trichlorobenzene.
(5) Measured at the scrubber liquor tank (monitoring station 5, see Figure 3-4).

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SECTION 6
QUALITY ASSURANCE/QUALITY CONTROL

QA/QC DEFINITIONS

Quality assurance (QA) and quality control (QC) activities are distinguished in that the former are preventive in nature, while the latter are corrective. QA consists of those activities that are employed before and during a process, method, or measurement activity in order to ensure that the results of those activities are of a consistent quality. QC, on the other hand consists of those activities that validate and if necessary correct the results of the process, method, or measurement. For example, when a chemist makes three independent measurements of a sample, that is QA. When that chemist applies a statistical test for outliers on the set of measurements, and decides whether to retain or reject each measurement, that is QC.

The Category II Quality Assurance Project Plan (QAPP) for this project specified the QA objectives and QA/QC activities needed to ensure data quality is commensurate with the project objectives. In addition, external audits conducted in the field by the EPA and at the main analytical laboratories further assured data of acceptable quality. Overall, the QA/QC data indicated that the measured data are considered acceptable and defensible.

QUALITY ASSURANCE OBJECTIVES

QA objectives are either quantitative or qualitative statements that define the quality of data needed to support the program goals. These objectives are used to support decisions concerning test validity and adequacies with respect to project goals. Quantitative objectives are expressed in terms of accuracy, precision, and completeness, as defined below.

Accuracy — The degree of agreement of a measurement (or an average of measurements) of a parameter, X, with an accepted reference or true value, T. It is usually expressed as the difference between two values, X-T, or the difference as a percentage,

100(X–T)/T. It is also sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias or systematic distortion in a measurement.

Precision — A measure of mutual agreement among individual measurements of the same property, usually under similar prescribed conditions. Precision is usually expressed in terms of standard deviation, variance, or range and in either absolute or relative terms.

Completeness — A measure of the amount of valid data obtained from a measurement system, compared to the amount that was expected to be obtained under correct normal conditions.

Table 6-1 presents the project objectives for precision, accuracy, and completeness.

PRECISION, ACCURACY, AND COMPLETENESS RESULTS

Data Presentation

Due to the wide variety and scope of measurements made in this program, several methods were employed to determine precision and accuracy from the raw data. The basis for calculations, the approach, and the equations used for precision and accuracy are given in Table 6-2. Summary tables of the precision, accuracy, and completeness achieved for each of the sample locations are presented later in this section. These summary tables will show the result, the basis for the calculation, the number of samples or analyses used for the calculation, and the location of source data in Appendix 4.

Due to the very large amount of samples and results, a method of summarizing accuracy and precision was developed for this report. For example, the accuracy and precision of PCB measurements in the solid and liquid samples were based on matrix spikes (MS) and matrix spike duplicates (MSD). These MS and MSDs included 10 congeners of PCBs (mono- through deca-) performed once for sample locations SS1, SS2, SS3, SS24, twice for sample locations SS11, SS12, and three times for SS13, SS22. These results total (1MS + 1MSD per set) x (10 PCB congeners) x 14 sets = 280 data points. Noting that this is only the PCB data for these samples and not the CBs, CPs, PAHs, PCDDs/PCDFs, VOCs, metals, and other analyses, the amount of data that would be presented in the main body of the report would be overwhelming and of little use to the user.

TABLE 6-1. QUALITY ASSURANCE OBJECTIVES FOR ELI SITE DEMONSTRATION

Sample location	Compound	Analytes	Precision (%)	Accuracy (%)	Completeness (%)
SS1-waste water	VOC	Average	< 50	20 - 150	90
SS2-waste oil		PCE	< 50	20 - 150	90
SS3-contaminated soil	CP		< 50	20 - 150	90
SS10-treated soil	CB	Average	< 50	20 - 150	90
SS11-reactor grit		C6Cl6	< 50	20 - 150	90
SS12-scrubber sludge	PAH's		< 50	20 - 150	90
SS13-scrubber decant water	PCDD/PCDF		< 50	20 - 150	90
SS16-boiler flue gas	PCB's		< 50	20 - 150	90
	Total sulfur (as S)		< 10	80 - 120	90
	Metals	Average	< 20	80 - 120	90
		Ag	< 20	80 - 120	90
		As	< 20	80 - 120	90
		Ba	< 20	80 - 120	90
		Be	< 20	80 - 120	90
		Cd	< 20	80 - 120	90
		Cr	< 20	80 - 120	90
		Cu	< 20	80 - 120	90
		Hg	< 20	80 - 120	90
		Mn	< 20	80 - 120	90
		Ni	< 20	80 - 120	90
		P	< 20	80 - 120	90
		Pb	< 20	80 - 120	90
		Sb	< 20	80 - 120	90
		Se	< 20	80 - 120	90
		Sn	< 20	80 - 120	90
		Tl	< 20	80 - 120	90
		Zn	< 20	80 - 120	90
SS16-boiler flue gas	Flue gas only				
	Particulate		< 12	80 - 120	90
	HCl		< 10	90 - 110	95
	O2		< 10	90 - 110	95
	CO2		< 10	90 - 110	95
	CO		< 10	90 - 110	95
	NOx		< 20	85 - 115	95
	SO2		< 20	85 - 115	95
	THC		< 10	90 - 110	95
	Moisture		---	---	95
	Temperature		---	97 - 103	95
	Flowrate		---	---	95

TABLE 6-2. APPROACH FOR CALCULATION OF PRECISION AND ACCURACY

Objective	Basis of Calculation	Approach	Equation
Precision	Audit	The relative percent difference of the two audit results determines the precision. In cases where there is more than 1 target analyte in the sample, such as VOC's where there is 5 analytes, the RPD's for each analyte are averaged.	(result 1 - result 2)/((result 1 + result 2)/2)
Precision	LCS/LCSD	The relative percent difference between the LCS recovery and the LCSD recovery. In cases where there is more than 1 target analyte in the sample, such as organics, the RPD's for each analyte are averaged.	abs(100*(LS recovery - LSD recovery)/((LS recovery + LSD recovery)/2)
Precision	Dup	Duplicate analysis and the relative percent difference between the two results was used for precision. In cases where there is more than 1 target analyte in the sample, such as organics, the RPD's for each analyte are averaged.	(result 1 - result 2)/((result 1 + result 2)/2)
Precision	RSD of bias	Relative standard deviation of the bias check responses	Stdev(responses)/average(responces) * 100
Precision	RSD of trains	Relative standard deviation of the moisture result from three trains for each test run. These RSD's were then averaged for all 8 runs.	Average all test runs (stdev(moisture)/average(moisture) * 100)
Precision	MS/MSD	The relative percent difference between the MS recovery and the MSD recovery. In cases where there is more than 1 target analyte in the sample, such as organics, the RPD's for each analyte are averaged.	abs(100*(MS recovery - MSD recovery)/((MS recovery + MSD recovery)/2)
Precision	Field dup	Duplicate samples collected and the relative percent difference between the two results was used for precision. In cases where there is more than 1 target analyte in the sample, such as organics, the RPD's for each analyte are averaged.	(result 1 - result 2)/((result 1 + result 2)/2)
Accuracy	Audit	The percent difference between the known value and the result is the accuracy. In cases where there is more than 1 target analyte in the sample, such as organics, the differences for each analyte are averaged.	100 + 100*((result - true value)/true value)
Accuracy	LCS	The percent difference between the known value and the result is the accuracy. In cases where there is more than 1 target analyte in the sample, such as organics, the differences for each analyte are averaged.	101 + 100*((result - true value)/true value)

TABLE 6-2. (continued)

Objective	Basis of Calculation	Approach	Equation
Accuracy	MS	The percent difference between the known value and the result is the accuracy. In cases where there is more than 1 target analyte in the sample, such as organics, the differences for each analyte are averaged.	101 + 100*((result - true value)/true value)
Accuracy	LCS/LCSD	The percent difference for the LCS and the LCSD is averaged. In cases where there is more than 1 target analyte in the sample, such as organics, the differences for each analyte are averaged.	100 + 100*((result - true value)/true value)
Accuracy	FS	The percent difference between the known value and the result is the accuracy. When a frequency of more than 1 is shown, the percent differences were averaged.	100 + 100*((result - true value)/true value)
Accuracy	PEA	The measurement system is compared against a reference standard. The percent difference between the known value and the result is the accuracy.	100 + 100*((result - true value)/true value)
Accuracy	MS/MSD	The percent difference for the MS and the MSD is averaged. In cases where there is more than 1 target analyte in the sample, such as organics, the differences for each analyte are averaged.	100 + 100*((result - true value)/true value)
Accuracy	Surr	The average of all of the surrogate recoveries were used for accuracy determination.	Average (all surrogate recoveries)
Completeness	---	Always calculated as the percentage of valid data to expected data	Valid data/expected data *100

The presentation of QA/QC results in this report can be illustrated by using the example above for sample location SS13 to determine accuracy. The MS and MSD recoveries were averaged for each congener, and the average congener recoveries were then averaged to obtain an average total PCB recovery for each MS/MSD set. The average total PCB recoveries for each of the three MS/MSD sets were then averaged to obtain the average PCB accuracy for SS13 achieved in this project. In this case, this average result reflects the individual results achieved. In cases where the average result does not adequately reflect the data quality, supporting discussion is provided in the text. The user is referred to Appendix 4 for more specific QA/QC data.

Boiler Flue Gas Results

Table 6-3 presents the accuracy, precision, and completeness achieved for the boiler flue gas (SS16). Along with the result, the basis for the calculation , the number of samples that were used to calculate the accuracy and precision, and the location where the raw data can be located in Appendix 4 are given. In general, precision, accuracy, and completeness objectives were achieved for the boiler flue gas, except as noted below.

VOC—

VOC accuracy and precision results were within program objectives with the exception of vinyl chloride. The accuracy obtained from the audit sample was 230.7%. Vinyl chloride is not a critical analyte. The sampling and analysis for vinyl chloride is difficult due to its extremely low boiling point. The sampling method that was used has not been demonstrated for compounds with boiling points less than 30°C, although it is the most commonly used. This does not significantly affect the achievement of the project objectives. The results indicate that vinyl chloride results for the stack may be biased high.

Trace Metals—

A range is given in Table 6-3 for metals accuracy. These results were obtained from two audit filters supplied by the California Air Resources Board (CARB). Although the agency did not provide true values, they did inform EER of the range achieved. Accuracy for barium and mercury did not meet the QA objectives. This is not considered significant because CARB was still unsure of the stability of the mercury in their audit sample and mercury and barium quantification was not a primary objective of the program. A number of metals precision results were not determined because the analytes were not detected in both the original analysis and the duplicate analysis.

TABLE 6-3. SUMMARY OF PRECISION, ACCURACY, AND COMPLETENESS ACHIEVED FOR BOILER FLUE GAS SAMPLES

Substance	Precision			Accuracy			Completeness	Appendix 4 location
	Result (%)	Basis for calculation	Frequency	Result (%)	Basis for calculation	Frequency	(%)	
VOC	9.0	Audit	1	135.3	Audit	2	91.6	Table 4-14
PCE	9.2	Audit	1	84.2	Audit	2	91.6	Table 4-14
CP	33.7	LCS/LCSD	1	99.8	LCS/LCSD	1	100.0	Table 4-8
CB	32.9	LCS/LCSD	1	101.8	LCS/LCSD	1	100.0	Table 4-8
O6Cl6	15.6	LCS/LCSD	1	108.5	LCS/LCSD	1	100.0	Table 4-8
PAH	11.1	LCS/LCSD	2	84.3	LCS/LCSD	2	100.0	Table 4-8
PCDD/PCDF	10.0	Dup	1	99.0	LCS	1	100.0	Table 4-8,9
PCB	9.3	LCS/LCSD	1	73.4	LCS/LCSD	1	100.0	Table 4-8
Metals	8.3	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Ag	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
As	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Ba	2.3	Dup	1	~66 *	Audit	2	100.0	Table 4-17
Be	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Cd	26 *	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Cr	6.0	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Cu	2.6	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Hg	---	Dup	1	~33 *	Audit	2	100.0	Table 4-17
Mn	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Ni	8.6	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
P	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Pb	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Sb	7.4	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Se	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Sn	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Tl	---	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Zn	5.1	Dup	1	85 - 115	Audit	2	100.0	Table 4-17
Particulate	---	---	---	22 *	FS	1	66 *	---
HCl	---	---	---	90 - 110	Audit	2	100.0	---
O2	0.5	RSD of bias	3	99.7	Bias	3	100.0	Figure 4-5
CO2	0.3	RSD of bias	3	99.7	Bias	3	100.0	Figure 4-5
CO	2.9	RSD of bias	3	98.8	Bias	3	100.0	Figure 4-5
NOx	1.7	RSD of bias	3	102.1	Bias	3	100.0	Figure 4-5
SO2	2.7	RSD of bias	3	93.8	Bias	3	100.0	Figure 4-5
THC	2.6	RSD of bias	3	98.9	Bias	3	100.0	Figure 4-5
Moisture	10.1	RSD of trains	8	100.0	PEA	1	100.0	---
Temperature	---	---	---	100.0	PEA	1	100.0	---
Flow rate	---	---	---	---	---	---	100.0	---

*	Not achieved	Bias	Bias checks
---	Not determined	RSD	Relative standard deviation
Dup	Laboratory duplicate	FS	Field spike
LCS	Laboratory control spike	Audit	Audit sample
LCSD	Laboratory control spike duplicate	PEA	Performance evaluation audit

Particulate Matter—

The boiler flue gas particulate accuracy objective was not achieved. This was attributed to difficulties encountered with the field spike sample rather than a systematic problem in the test procedure. The completeness objective for particulate emissions measurements was not achieved due to ripped filters on the particulate train and an analytical procedure error (some of the filters were digested for metals analysis before being weighed). The primary use of the particulate results was to satisfy permit conditions. Enough data were gathered to show compliance with this permit.

Waste Water, Heat Exchanger Residue, Reactor Grit, and Scrubber Sludge Results

Table 6-4 presents the accuracy, precision, and completeness achieved for waste water (SS1), heat exchanger residue (SS18), reactor grit (SS11), and scrubber sludge (SS12). The matrices at locations SS1 and SS18 were very similar, therefore results were applied to both matrices. The QA objectives were achieved in all cases except as noted below.

Trace Metals—

The precision and accuracy of metals results were not determined for any of these matrices. For the reactor grit and scrubber sludge samples, there was a limited amount of sample collected. Sample size was so small that metal analysis was not performed on any of the sludge samples and only one grit sample was analyzed for metals. Due to the limited sample size, analysis for PCBs and the other critical analytes was given priority. This was probably responsible for several metals mass balance closures that were outside program objective limits. Metals precision for the waste water was determined from a field duplicate sample. Due to the low levels of metals (at or near the detection limit) present in the waste water, the precision data are not considered valid and could not be calculated for a number of metals. Metals accuracy was not determined for the waste water (SS1), but a MS was performed on the scrubber liquor (SS22). These results were applied to the waste water (SS1) and scrubber decant water (SS13) due to the similarity of these matrices.

Chlorophenols—

The objective for precision of chlorophenols in waste water (SS1) and heat exchanger residue (SS18) was not achieved. Chlorophenols showed low and variable recoveries for the MSs and MSDs that were conducted for these samples. In particular, pentachlorophenol was subject to low recoveries. Low recoveries for these acid organic compounds were observed in a number of samples. This is believed to be due to the high levels of other aromatic organics and/or harsh conditions during the extraction stage of analysis. Although this increases the uncertainty of this measurement, chlorophenols were not a critical

TABLE 6-4. SUMMARY OF PRECISION, ACCURACY, AND COMPLETENESS ACHIEVED FOR WASTE WATER, HEAT EXCHANGER RESIDUE, REACTOR GRIT, AND SCRUBBER SLUDGE

Compound	SS1 and SS18 - waste water							Appendix 4 location
	Precision			Accuracy			Completeness	
	Result (%)	Basis for calculation	Frequency	Result (%)	Basis for calculation	Frequency	(%)	
VOC	10.59	MS/MSD	1	103	MS/MSD	1	100	Table 4-40
PCE	8	MS/MSD	1	100	MS/MSD	1	100	Table 4-40
CP	114 *	MS/MSD	1	26.2	MS/MSD	1	100	Table 4-38
CB	3.6	MS/MSD	1	78.3	MS/MSD	1	100	Table 4-38
C6Cl6	0	MS/MSD	1	84	MS/MSD	1	100	Table 4-38
PAH's	4.63	MS/MSD	1	89	MS/MSD	1	100	Table 4-38
PCDD/PCDF	---	---	---	89.68	LCS	1	100	Table 4-41
PCB's	13.12	Field Dup	2	95.56	MS/MSD	1	100	Table 4-33,36
Total sulfur (as S)	---	---	---	80 - 120	Audit	1	100	---

Compound	SS11 - reactor grit							
	Precision			Accuracy			Completeness	
	Result (%)	Basis for calculation	Frequency	Result (%)	Basis for calculation	Frequency	(%)	Appendix 4 location
VOC	48.5	MS/MSD	2	124	MS/MSD	2	100	Table 4-40
PCE	40	MS/MSD	2	50	MS/MSD	2	100	Table 4-40
CP	17	MS/MSD	2	70.66	MS/MSD	2	100	Table 4-38
CB	17.9	MS/MSD	2	64.3	MS/MSD	2	100	Table 4-38
C6Cl6	17	MS/MSD	2	78	MS/MSD	2	100	Table 4-38
PAH's	4.3	MS/MSD	1	93	MS/MSD	1	100	Table 4-38
PCDD/PCDF	---	---	---	95	LCS	3	100	Table 4-41
PCB's	---	---	---	81	Surr	3	100	Table 4-37
Total sulfur (as S)	---	---	---	108.5	LCS	3	100	Table 4-46

Compound	SS12 - scrubber sludge							
	Precision			Accuracy			Completeness	
	Result (%)	Basis for calculation	Frequency	Result (%)	Basis for calculation	Frequency	(%)	Appendix 4 location
VOC	84	MS/MSD	2	662 *	MS/MSD	2	100	Table 4-40
PCE	50.7 *	MS/MSD	2	89	MS/MSD	2	100	Table 4-40
CP	47.8	MS/MSD	2	63.6	MS/MSD	2	100	Table 4-38
CB	4.28	MS/MSD	2	71	MS/MSD	2	100	Table 4-38
C6Cl6	0.75	MS/MSD	2	83.25	MS/MSD	2	100	Table 4-38
PAH's	7.17	MS/MSD	1	125.5	MS/MSD	1	100	Table 4-38
PCDD/PCDF	---	---	---	101.3	LCS	3	100	Table 4-41
PCB's	33	MS/MSD	2	73.5	MS/MSD	2	100	Table 4-36
Total sulfur (as S)	---	---	---	105	LCS	1	100	Table 4-46

*	Objective not achieved	LCS	Laboratory control spike
---	Not determined	Audit	Audit sample
MS	Matrix spike	Surr	Surrogates
MSD	Matrix spike duplicate	Field Dup	Field duplicate

analyte; therefore, this does not significantly impact conclusions related to the primary objectives of the project. The results may indicate a low bias for some of the chlorophenols and increased uncertainty of these measurements.

Sulfur—

An audit sample was submitted for sulfur analysis. As discussed above, the EPA provided the audit sample and informed EER of the range obtained. The audit sample results satisfied the QA objectives for sulfur measurements.

Perchloroethylene and VOCs—

The precision achieved for PCE in the scrubber sludge (SS12) was barely outside the program objectives. This result does not significantly impact the conclusions regarding PCE destruction since this stream was always insignificant in the data analysis. The accuracy for VOCs at the same location was significantly above the QA objective. This occurred due to the relatively high levels of benzene in the samples. The high level of benzene caused instrument saturation; hence, dilution of the samples was required to bring the benzene concentration within the range of the analytical instrument. This resulted in dilution of other VOC compounds to such low levels that spiked compounds could not be measured with confidence. This in turn, resulted in high recoveries for the other VOC compounds, some as high as 6,014 percent. Although this does impact the secondary project objective relative to residuals characterization to determine disposal requirements, the results indicate a probable high bias in the reported VOC concentrations, and hence could be considered conservative. Conclusions regarding the primary project objective for destruction efficiency of PCE are considered valid because PCE accuracy satisfied the QA objective. VOCs in reactor grit (SS11) samples were subject to similar problems due to the high levels of benzene.

PAH—

Samples of reactor grit (SS11) and scrubber sludge (SS12) contained levels of naphthalene that were much higher than expected. This required substantial dilution of the sample to quantify the naphthalene levels in the range of the analytical instrument. This resulted in low recoveries of PAH compound MSs because: (1) spiking levels were low compared to the level already in the samples; and (2) dilutions caused levels of MS compounds to be below the quantitation level. For these reasons, accuracy and precision were calculated using only the samples in which the MS recoveries could be quantified. Although these results indicate that the PAH data from these locations may be biased low, there is no impact on achievement of the primary project objectives.

PCBs—

Due to the high levels of PCBs present in the reactor grit (SS11) samples, PCB MS levels were insignificant compared to the levels already present. Therefore, MS/MSD data are not considered valid for this matrix. Surrogate recoveries were used instead to calculate accuracy. All surrogate recoveries satisfied the QA/QC criteria in the test methods. PCB MS/MSDs were used to calculate PCB accuracy and precision for the scrubber sludge (SS12) samples. The PCB MS/MSD results for Condition 3 resulted in low recoveries and those for condition 2 resulted in elevated recoveries. Although this does not affect the DRE PCB objective, it could affect the engineering objective for DE of PCB. Since (1) the MS/MSD results for some of the PCB congeners satisfied the QA objective, (2) all surrogate recoveries are within limits, and (3) levels of PCBs were detected in other output stream samples besides reactor grit, the reliability of the PCB DE results is considered adequate for engineering purposes.

Waste Oil, Contaminated Soil, and Treated Soil Results

Tables 6-5 and 6-6 show the precision, accuracy, and completeness achieved for waste oil (SS2), contaminated soil (SS3), and treated soil (SS10). Since samples from SS3 and SS10 were of similar matrices, precision and accuracy for both streams were determined from the one set of results. Precision objectives for the contaminated and treated soil generally were not met for two reasons: (1) variability of soil composition from drum to drum; and (2) metals concentrations were near the detection limits. Prior to testing, the soil was prepared by mixing drums of widely differing PCB content to minimize variations during testing. Grab samples of the mixed drums were collected at approximately 30 to 60 minute intervals during the tests as the soil was transferred from the drum to the feed conveyer. The individual grab samples for a test run were mixed together and a composite sample for analysis was obtained by "cone and quarter" methods. Despite these procedures, the soil was very heterogeneous in appearance and it was not possible to eliminate all variability. Additional comments on specific analytes are provided below.

PCBs—

Although the precision objective for PCBs in the soil was not achieved, the levels that were detected were sufficient to achieve the DRE objectives despite the increased uncertainty of the measurement.

VOCs-

The precision objective for VOCs in the soil also was not achieved; however, this does not impact achievement of the primary objectives. Since the treated soil was treated as a hazardous residue due to the PCB content, the added uncertainty of the VOC measurements has no impact on disposal of the treated soil. The VOC precision objective for the waste oil was not achieved due to the high levels

TABLE 6-5. SUMMARY OF PRECISION, ACCURACY, AND COMPLETENESS FOR WASTE OIL

Substance	SS2 - waste oil							Appendix 4 location
	Precision			Accuracy			Completeness	
	Result (%)	Basis for calculation	Frequency	Result (%)	Basis for calculation	Frequency	(%)	
VOC	46.22	MS/MSD	1	100	MS/MSD	1	100	Table 4-40
PCE	80 *	MS/MSD	1	100	MS/MSD	1	100	Table 4-40
CP	10.73	MS/MSD	1	66.7	MS/MSD	1	100	Table 4-38
CB	3.51	MS/MSD	1	85.5	MS/MSD	1	100	Table 4-38
C6Cl6	1.17	MS/MSD	1	85.5	MS/MSD	1	100	Table 4-38
PAH's	2.29	MS/MSD	1	85.5	MS/MSD	1	100	Table 4-38
PCDD/PCDF	---	---	---	109.16	LCS	1	100	Table 4-41
PCB's	7.91	Field dup	1	100.83	Surr	2	100	Table 4-34,37
Total sulfur (as S)	100.43 *	Field dup	1	112	LCS	1	100	Table 4-34,47
Metals	7.82	Field dup	1	---	---	---	100	Table 4-34
Ag	---	---	---	---	---	---	100	Table 4-34
As	---	---	---	---	---	---	100	Table 4-34
Ba	1.74	Field dup	1	---	---	---	100	Table 4-34
Be	---	---	---	---	---	---	100	Table 4-34
Cd	18.18	Field dup	1	---	---	---	100	Table 4-34
Cr	11.76	Field dup	1	---	---	---	100	Table 4-34
Cu	2.41	Field dup	1	---	---	---	100	Table 4-34
Hg	---	---	---	---	---	---	100	Table 4-34
Mn	---	---	---	---	---	---	100	Table 4-34
Ni	8.22	Field dup	1	---	---	---	100	Table 4-34
P	7.14	Field dup	1	---	---	---	100	Table 4-34
Pb	8.7	Field dup	1	---	---	---	100	Table 4-34
Sb	---	---	---	---	---	---	100	Table 4-34
Se	---	---	---	---	---	---	100	Table 4-34
Sn	---	---	---	---	---	---	100	Table 4-34
Tl	---	---	---	---	---	---	100	Table 4-34
Zn	4.44	Field dup	1	---	---	---	100	Table 4-34

* Not achieved
--- Not determined
Field dup Field duplicate
MS Matrix spike
MSD Matrix spike duplicate
Surr Surrogates
LCS Laboratory control spike

TABLE 6-6. SUMMARY OF PRECISION, ACCURACY, AND COMPLETENESS FOR CONTAMINATED AND TREATED SOIL

Substance	SS3 and SS10 - contaminated and treated soil							Appendix 4 location
	Precision			Accuracy			Completeness	
	Result (%)	Basis for calculation	Frequency	Result (%)	Basis for calculation	Frequency	(%)	
VOC	68 *	Field Dup	1	83.8	MS/MSD	1	100	Table 4-35,40
PCE	---	Field Dup	1	---	MS/MSD	1	100	Table 4-35,40
CP	4.5	MS/MSD	1	45.7	MS/MSD	1	100	Table 4-38
CB	12	MS/MSD	1	68	MS/MSD	1	100	Table 4-38
C6Cl6	6.6	MS/MSD	1	75.5	MS/MSD	1	100	Table 4-38
PAH's	41	MS/MSD	1	135.8	MS/MSD	1	100	Table 4-38
PCDD/PCDF	---	---	---	92.52	LCS	1	100	Table 4-41
PCB's	59 *	Field dup	1	73	Surr	1	100	Table 4-35,37
Total sulfur (as S)	---	---	---	105	LCS	1	100	Table 4-46
Metals	50 *	Field dup	1	---	---	---	100	Table 4-35
Ag	---	---	---	---	---	---	100	Table 4-35
As	51 *	Field dup	1	---	---	---	100	Table 4-35
Ba	9.5	Field dup	1	---	---	---	100	Table 4-35
Be	22 *	Field dup	1	---	---	---	100	Table 4-35
Cd	55 *	Field dup	1	---	---	---	100	Table 4-35
Cr	94 *	Field dup	1	---	---	---	100	Table 4-35
Cu	75 *	Field dup	1	---	---	---	100	Table 4-35
Hg	31 *	Field dup	1	---	---	---	100	Table 4-35
Mn	34 *	Field dup	1	---	---	---	100	Table 4-35
Ni	109 *	Field dup	1	---	---	---	100	Table 4-35
P	52 *	Field dup	1	---	---	---	100	Table 4-35
Pb	45 *	Field dup	1	---	---	---	100	Table 4-35
Sb	---	---	---	---	---	---	100	Table 4-35
Se	---	---	---	---	---	---	100	Table 4-35
Sn	71 *	Field dup	1	---	---	---	100	Table 4-35
Tl	---	---	---	---	---	---	100	Table 4-35
Zn	8.7	Field dup	1	---	---	---	100	Table 4-35

*	Not achieved	MSD	Matrix spike duplicate
---	Not determined	Surr	Surrogates
Field dup	Field duplicate	LCS	Laboratory control spike
MS	Matrix spike		

present, requiring a very high dilution ratio (1:1,000,000) to quantify the sample within the analytical instrument's calibrated range. For both the waste oil (SS2) and contaminated soil (SS3) locations, the VOC MSs were erratic and usually individual analytes did not fall within the QA/QC criteria. This was due to the high native levels of benzene and toluene present in the samples, resulting in MS levels that were insignificant compared to the native levels. This has no impact on achievement of the primary or secondary objectives of the project.

Sulfur—

The sulfur precision did not meet program objectives. This may have contributed to the poor mass balance closures for sulfur, but did not affect achievement of the primary project objectives.

Trace Metals—

The objective for precision of metals in contaminated soil (SS3), which was calculated based on analysis of field duplicates, was not achieved due to concentrations in the soil which were near the detection limit. This did not impact the primary project objectives but the uncertainty of these measurements is reflected in the poor mass balances for some trace metals in Condition 2.

Scrubber Decant Water Results

Table 6-7 shows the achieved precision, accuracy, and completeness for scrubber decant water (SS13). All objectives were achieved for all substances except metals and sulfur. Precision for several metals did not achieve the QA objectives due to the low concentration of metals in the samples (at or very near the detection limit). The precision for sulfur also was slightly above the QA objective. Both of these precision results are not significant to the primary project objectives but the uncertainty of metals and sulfur mass balances is increased.

FLUE GAS SAMPLING QUALITY ASSURANCE

In general, all flue gas sampling QA criteria were satisfied for this test program. All dry gas meters met the ±5 percent post-test calibration accuracy criterion. All isokinetic sample trains were operated within 90-110 percent of the isokinetic velocity ratio. All post-test leak rates were within specified limits except for the metals train during Condition 1 Run 2. The data from this train were corrected for the amount of air in-leakage that might have occurred according to EPA Method 5, estimated at 7.1 percent of the total sample volume.

TABLE 6-7. SUMMARY OF PRECISION, ACCURACY, AND COMPLETENESS FOR SCRUBBER DECANT WATER

Compound	SS13 - scrubber decant water							
	Precision			Accuracy			Completeness	Appendix 4 location
	Result (%)	Basis for calculation	Frequency	Result (%)	Basis for calculation	Frequency	(%)	
VOC	8.94	MS/MSD	3	149.2	MS/MSD	3	100	Table 4-40
PCE	7.11	MS/MSD	3	115.3	MS/MSD	3	100	Table 4-40
CP	16.64	MS/MSD	3	61.2	MS/MSD	3	100	Table 4-38
CB	13	MS/MSD	3	67.6	MS/MSD	3	100	Table 4-38
C6Cl6	12.4	MS/MSD	3	67.33	MS/MSD	3	100	Table 4-38
PAH's	20.9	MS/MSD	3	101.16	MS/MSD	3	100	Table 4-38
PCDD/PCDF	---	---	---	96.13	LCS	3	100	Table 4-41
PCB's	23.2	MS/MSD	3	40.16	MS/MSD	3	100	Table 4-36
Total sulfur (as S)	17.5 *	Field Dup	1	109.66	LCS	4	100	Table 4-35,46
Metals	38.8 *	Field dup	1	97	MS	1	100	Table 4-35,42
Ag	---	---	---	93	MS	1	100	Table 4-35,42
As	---	---	---	101	MS	1	100	Table 4-35,42
Ba	---	---	---	94	MS	1	100	Table 4-35,42
Be	---	---	---	105	MS	1	100	Table 4-35,42
Cd	---	---	---	98	MS	1	100	Table 4-35,42
Cr	17	Field dup	1	98	MS	1	100	Table 4-35,42
Cu	15.6	Field dup	1	94	MS	1	100	Table 4-35,42
Hg	17	Field dup	1	---	---	---	100	Table 4-35,42
Mn	87 *	Field dup	1	97	MS	1	100	Table 4-35,42
Ni	13	Field dup	1	100	MS	1	100	Table 4-35,42
P	---	---	---	101	MS	1	100	Table 4-35,42
Pb	81 *	Field dup	1	104	MS	1	100	Table 4-35,42
Sb	---	---	---	100	MS	1	100	Table 4-35,42
Se	---	---	---	97	MS	1	100	Table 4-35,42
Sn	40 *	Field dup	1	---	---	---	100	Table 4-35,42
Tl	---	---	---	80	MS	1	100	Table 4-35,42
Zn	40 *	Field dup	1	98	MS	1	100	Table 4-35,42

*	Not achieved
---	Not determined
Field dup	Field duplicate
MS	Matrix spike
MSD	Matrix spike duplicate
LCS	Laboratory control spike

All flue gas sample train glassware was subjected to a proof blank before testing began to ensure glassware cleanliness. Only a few native analytes were detected at levels very close to the detection limit. Field blanks were also produced for all of the sample trains. The metals field blank results, presented in Table 6-8, indicated contamination levels similar to those detected in the flue gas for antimony, barium, chromium, copper, lead, and zinc. Silver, phosphorus, and tin were detected in the field blank but not in any of the field samples. This was attributed to the background levels of metals in the filters and the low levels actually present in the flue gas. Since trace metal emissions from the flue gas were very low, this is not considered a significant problem. It does indicate a possible high bias in the reported trace metals emissions levels. All other field blanks did not result in significant levels of contamination.

The drift criteria for the NOX and SO2 analyzers used for boiler flue gas measurements were exceeded for Condition 1 Run 2 due to thermal drift. Data were corrected for drift for this run, with no significant change in the uncertainty of the measurements.

ANALYTICAL QUALITY ASSURANCE

A number of laboratory QA/QC samples were processed along with the field samples. The presence of benzene in the laboratory method blanks for VOST samples indicated carryover of benzene from sample to sample. This may have contributed to the high benzene levels observed in the boiler flue gas. Solid and liquid outlet stream samples had high levels of naphthalene and benzene, making quantitation of other analytes difficult. While problems with the VOC and the PAH analysis were encountered, the QA/QC results for PCBs and for samples which had an impact on achieving the primary project objectives generally support the conclusions that were developed.

ADDITIONAL QUALITY CONTROL CHECKS

In addition to the QC checks required by the sampling and analytical methods and those required to calculate precision and accuracy, a number of additional QC checks were implemented during the field test program. These additional QC checks and the results are summarized in Table 6-9.

AUDIT RESULTS

Internal technical systems audits (TSA) were conducted by the EER QA coordinator to ensure proper procedures and representative measurement systems were used. A technical systems audit involves observation and documentation of a procedure. A summary of the TSAs that were performed are shown

TABLE 6-8. FIELD BLANK RESULTS FOR MULTIPLE METALS TRAINS

Front Half	Field Blank	Condition 1 Run 1		Condition 1 Run 2		Condition 1 Run 3		Condition 3 Run 1		Condition 3 Run 2		Condition 3 Run 3		Condition 2 Run 1		Condition 2 Run 2	
	µg	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%
Antimony	14.0	15.0	93	ND	140	15.0	93	11.0	127	13.0	108	15.0	93	13.0	108	14.0	100
Barium	4.3	6.7	64	2.7	159	5.7	75	4.0	108	3.9	110	4.9	88	5.6	77	4.2	102
Chromium	1.7	2.2	77	1.8	94	2.6	65	1.8	94	4.9	35	2.4	71	2.5	68	5.1	33
Copper	2.6	4.1	63	1.5	173	3.6	72	3.4	76	5.0	52	5.1	51	6.6	39	3.8	68
Lead	9.7	24.0	40	7.9	123	16.0	61	11.0	88	12.0	81	15.0	65	16	61	20	49
Phosporus	10.0	ND	100	ND	100	14.0	71	13.0	77	17.0	59	17.0	59	ND	100	ND	100
Silver	1.5	ND	150	ND	150	ND	150	ND	150	ND	150	ND	150	ND	150	ND	150
Tin	74.0	ND	740	ND	740	ND	740	ND	740	ND	740	ND	740	13	569	ND	740
Zinc	11.0	81.0	14	26.0	42	30.0	37	52.0	21	25.0	44	210	5	32	63	20	100

Back Half	Field Blank	Condition 1 Run 1		Condition 1 Run 2		Condition 1 Run 3		Condition 3 Run 1		Condition 3 Run 2		Condition 3 Run 3	
	µg	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%
Zinc	9.0	14.0	64	8.2	110	4.5	200	4.8	188	12.0	75	14.0	64

FB% = field result expressed as a percentage of the field blank level
Front half & back half recovered together for Condition 2.
Front half field blank percentage for zinc is calculated from the sum of the front half and back half hits.
ND - Not detected

TABLE 6-9. SUMMARY OF QUALITY CONTROL CHECKS

Parameter	QC check description	Results
SS13 - scrubber decant flow rate	Comparison of decant tank level (volumetric) and gravimetric measurements.	Deviations between dipstick and gravimetric < 3%
Boiler flue gas background contamination	Field blank for all manual flue gas sampling trains	All trains clean except the metals train. Detectible concentrations of metals were seen in the front half portion. Contamination has been isolated to the filter.
Manual sampling train glassware proofs	All glassware cleaned and proofed to detect any contamination before beginning the program	All glassware clean.
Boiler flue gas dilution effects	Oxygen was measured at alternating points between the outlet of the boiler (reference) and at each sampling port location.	Approximately 18% greater O2 concentration at the organics and the HCl ports. All other ports matched the reference port.
Boiler flue gas cyclonic flow	Cyclonic flow check	Average 5 degrees, within QAPP guidelines
Boiler flue gas stratification	Traverse stratification using NOx and O2	Greatest point was 3.18% for O2 and 1.8% for NOx. Within general guidelines.
Continuous emission monitoring system response times	Time required for 95% of the gas concentration introduced at the probe to reach the analyzers.	For all analyzers < 1 minute except for the SO2 which took approximately 40 minutes
Waste water background contamination	Field blank using DI water. The bottle of water was treated just like SS1-waste water	Most trace compounds ND, some hits but very close to the detection limit.
Clean soil background contamination	Field blank using laboratory sand. The bottle of sand was treated just like SS10 - treated soil	Some hits of HCB and di-penta PCB's. All other trace elements ND.

in Table 6-10. As shown in the table, systems audits were conducted for the flue gas sampling trains and for the process sampling procedures. It should be noted that if any problems were recognized during the systems audit, corrective action was implemented immediately at that time. Most technical systems audits were performed before testing began to avoid any problems during testing. A follow up systems audit was performed if necessary to ensure any difficulties observed in the pre-test audit was corrected.

During the Demonstration tests, an external TSA of the field sampling activities was conducted by EPA. All sampling procedures were audited. The external field TSA concluded that sampling activities were performed adequately to ensure representative and quality sample collection and measurement. The external field audit report is included in an Appendix 5.

An external laboratory TSA was performed by EPA during the analytical phase. The TSA did not uncover any problems that would significantly impact the primary project objectives. Other issues were corrected to the extent possible. The external laboratory audit report is included in an Appendix 5.

A performance audit involves the performance of a measurement device compared to a reference. A number of performance evaluation audits (PEAs) were conducted during the test program. Table 6-11 lists the equipment, a description of the performance evaluation audit, and the result of the PEAs that were conducted during the course of the test program.

DEVIATIONS TO THE QAPP

Deviations to the QAPP dated December 18, 1992, include the following:

- Puffing in the boiler stack caused filters on the multiple metals train to rip. The problem was solved by securing the filter down on the frit with two pieces of Teflon tape in a cross pattern. The tape holds the filter down onto the frit but did not affect sample integrity. The tape was then recovered like a piece of glassware. This method was approved by EPA.

- The impinger setup for the HCl train was modified to prevent NaOH from back-washing into the H_2SO_4 impingers. The modifications are given in Table 6-12.

- In order to reduce the amount of HCB required to spike into the TDU to show four nines destruction efficiency, the treated soil HCB analysis was conducted using electron capture detection.

TABLE 6-10. SUMMARY OF TECHNICAL SYSTEM AUDITS

Date	Test Phase	Measurement system
30-Sep-92	Before testing	Pretest - HCl sampling train operation and recovery
30-Sep-92		SS12 sampling, flow rate recording, and compositing procedures
30-Sep-92		SS13 sampling, flow rate recording, and compositing procedures
30-Sep-92		SS22 sampling, flow rate recording, and compositing procedures
1-Oct-92		Pretest - trace metals sampling train procedure and recovery
1-Oct-92		Pretest - SVOC sampling train procedure and recovery
1-Oct-92		Pretest - process gas sampling system operation
1-Oct-92		Pretest - volatile organics sampling train operation and recovery
3-Oct-92		All equipment calibration documentation
3-Oct-92		SS1 sampling, flow rate recording, and compositing procedures
3-Oct-92		SS2 sampling, flow rate recording, and compositing procedure
3-Oct-92		SS4 sampling, flow rate recording, and compositing procedures
3-Oct-92		SS5 sampling, flow rate recording, and compositing procedures
3-Oct-92		SS11 sampling, flow rate recording, and compositing procedures
3-Oct-92		SS18 sampling, flow rate recording, and compositing procedures
5-Oct-92		Trace metals sampling train operation
5-Oct-92		Trace metals sampling train recovery
5-Oct-92		SS1 sampling, flow rate recording, and compositing procedures
12-Oct-92	During testing	Process gas sampling system operation
16-Oct-92		SVOC sampling train operation
16-Oct-92		SVOC sampling train recovery
17-Oct-92		CEM system performance
17-Oct-92		SS14 sample train operation and recovery
19-Oct-92		VOC sample train procedure
19-Oct-92		VOC sample train recovery
19-Oct-92		HCl sample train procedure
19-Oct-92		HCl sample train recovery
23-Oct-92		Sample storage, custody, and shipping
24-Oct-92		SVOC sample train procedure
24-Oct-92		SVOC sample train recovery

TABLE 6-11. SUMMARY OF PERFORMANCE EVALUATION AUDITS

Equipment	Description	Results
Dry gas meters	Critical orifice check for all dry gas meters	All but one dry gas meter passed within 5%. Although the post-test cal on the dry gas meter that failed did come wihin spec.
Analytical balances	Comparison against NBS traceable weight	Digital balance was within 0.02% and the triple beam balance was within 0.05%
Stack pitot tube	Verification of pitot tube dimensions	Met all method criteria
Stack TC	Comparison against mercury-in-glass thermometer	Identical temperatures were measured
CEM	Challenge all analyzers with EPA Protocol gases	All analyzers were within 1% of the true value

TABLE 6-12. MODIFICATIONS TO EPA METHOD 26 - HCl TRAIN

Impinger	Planned	Modified
Impinger 1	Empty	Empty
Impinger 2	0.1 N H_2SO_4	0.1 N H_2SO_4
Impinger 3	0.1 N H_2SO_4	0.1 N H_2SO_4
Impinger 4	0.1 N NaOH	Empty
Impinper 5	0.1 N HaOH	0.5 N NaOH
Impinger 6	Silica gel	Silica gel

- An engineering objective to the program was to show DE of PCBs to at least four nine's (99.99 percent) efficiency. For Condition 3, detection limits for the scrubber decant water (SS13) and scrubber liquor (SS22) were limiting the destruction efficiency result. These samples were re-analyzed using a modified procedure to obtain lower detection limits by eliminating matrix interferences. The modified extraction and cleanup procedure included methylene chloride extraction, silica gel cleanup followed by gel permeation column cleanup. The extract was then solvent exchanged to hexane followed by a florisil column cleanup. This procedure did provide substantially lower detection limits and allowed the PCB DE objective to be achieved.

QA ORGANIZATION

The QA/QC organization is shown in Figure 6-1. The test program was organized to provide both internal and external QA functions, which were independent of the program performance. The EER QA Coordinator was Mr. William Oberg. Mr. Oberg's responsibilities included internal QA audit activities, daily QA checks, daily documentation, daily reporting, and coordination of all project QA. The external QA team was overseen by the U.S. EPA Quality Assurance Coordinator, Ms. Ann Kern.

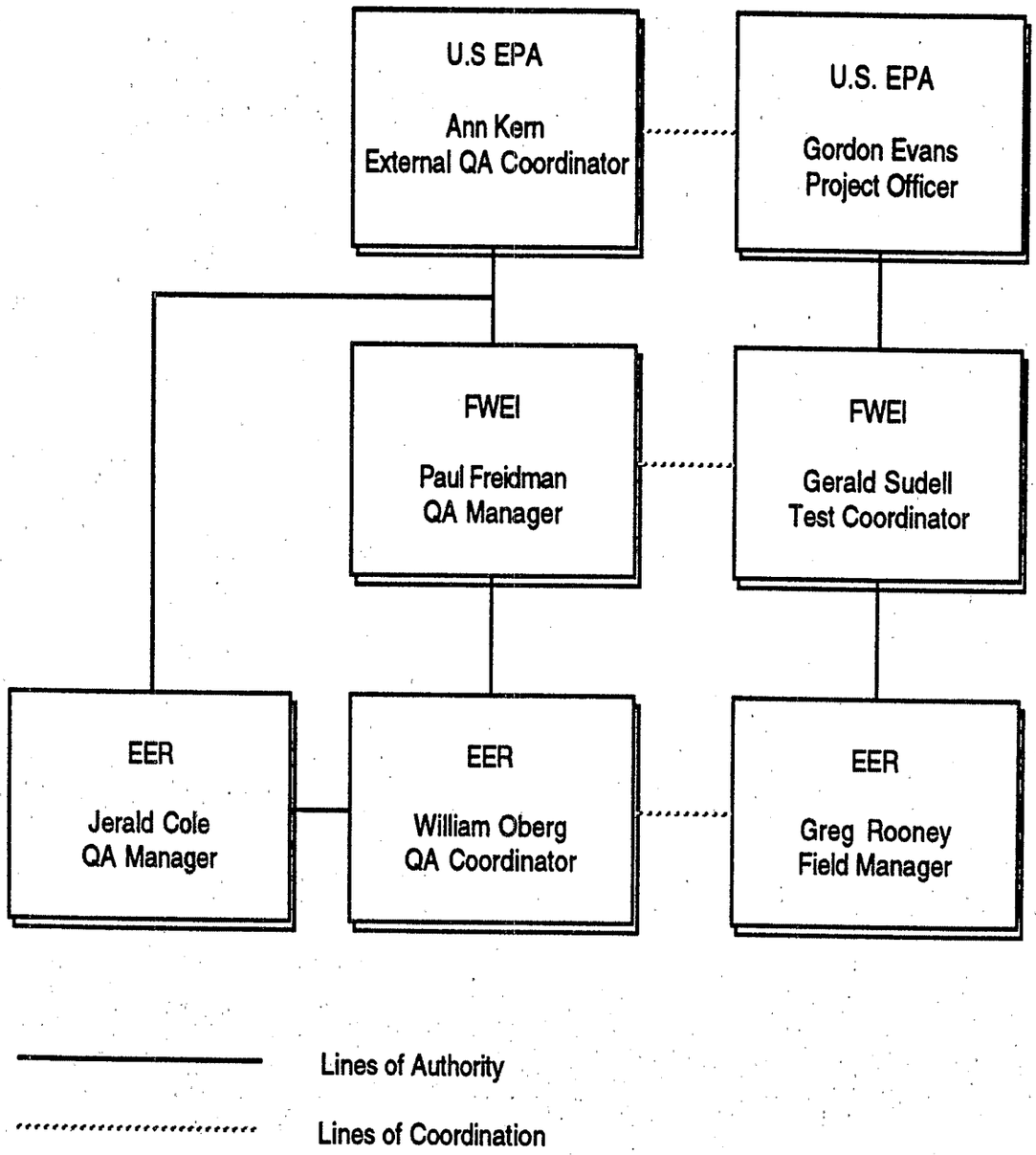

Figure 6-1. QA Organization

SITE PROGRAM DEMONSTRATION
ECO LOGIC INTERNATIONAL
GAS-PHASE CHEMICAL REDUCTION PROCESS
BAY CITY, MICHIGAN

TECHNOLOGY EVALUATION REPORT

Appendices

prepared for
Foster Wheeler Enviresponse, Inc.
Edison, New Jersey 08837

by
Energy and Environmental Research Corporation
Irvine, California 92718

Under Foster Wheeler Enviresponse Inc. Purchase Order Numbers
VN1-330-480000 and VN5-740-480000
EPA Contract No. 68-C9-0033

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July 15, 1994

NOTICE

The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under EPA Contract No. 68-C9-0033 to Foster Wheeler Enviresponse, Inc. It has been subjected to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

The Superfund Innovative Technology Evaluation (SITE) Program was authorized in the 1986 Superfund amendments. The program is a joint effort between EPA's Office of Research and Development and Office Solid Waste and Emergency Response. The purpose of the program is to assist the development of hazardous waste treatment technologies necessary to implement new cleanup standards which require greater reliance on permanent remedies. This is accomplished through technology demonstrations that are designed to provide engineering and cost data on selected technologies.

The SITE Program funded a field demonstration to evaluate the Eco Logic Gas-Phase Chemical Reduction Process developed by ELI Eco Logic International Inc. (ELI), Ontario, Canada. The Demonstration took place at the Middleground Landfill in Bay City, Michigan using landfill waste. The Demonstration effort assessed the technology's ability to treat hazardous wastes, based on performance and cost. Three reports contain the results of the Demonstration: this Technology Evaluation Report, which describes the field activities and presents the results including a performance evaluation; an Applications Analysis Report, which interprets the data and discusses the applicability of the technology to liquid feedstocks; and an independent Applications Analysis Report, which interprets the data and discusses the applicability of the thermal desorption unit (TDU) to soil feedstocks. Two independent demonstration bulletins, previously published by EPA, presented preliminary information on the reactor and TDU tests, respectively.

Additional copies of this report may be obtained at no charge from EPA's Center for Environmental Research Information, 26 West Martin Luther King Drive, Cincinnati, Ohio, 45268. Requests should include the EPA document number found on the report's front cover. When this supply is exhausted, additional copies can be purchased from the National Technical Information Service, Ravensworth Bldg., Springfield, VA, 22161, (702) 487-4600. Reference copies will be available at EPA libraries in their Hazardous Waste Collection. To inquire about the availability of other reports, call the SITE Clearinghouse Hotline at 1-800-424-9396 or (202) 382-3000 in Washington, DC.

E. Timothy Oppelt, Director
Risk Reduction Engineering Laboratory

ABSTRACT

The SITE Program demonstration of the ELI Eco Logic Gas-Phase Chemical Reduction Process was conducted to obtain reliable performance and cost data required to evaluate the applicability of the technology for remediating hazardous waste sites. The Demonstration took place at the Middleground Landfill in Bay City, Michigan.

The ELI process reacts complex high-molecular-weight organic contaminants, such as polychlorinated biphenyls (PCBs), with hydrogen-rich gas at high temperatures to produce simpler compounds such as methane, hydrogen chloride and water vapor. The SITE Demonstration of the ELI Process consisted of three test conditions. The process treated PCB-contaminated water, soil, and oil during test conditions 1, 2, and 3, respectively. A comprehensive sampling and analysis program was conducted during the Demonstration to characterize process air emissions, residuals and effluents; it also determined destruction efficiency and destruction and removal efficiency of the system.

This report presents the results of the Demonstration. It includes a process description, a performance evaluation, a summary of the sampling and analytical program and a quality assurance/quality control evaluation of the data.

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ABBREVIATIONS AND SYMBOLS

µg	microgram
%	percent
<	less than; average analytical results includes both detected and non-detected data
>	greater than; average analytical results includes data above linear range of analyzer
AAR	Applications Analysis Report
ACCUM	accumulative stream
acf	actual cubic feet
acm	actual cubic meters
Ag	silver
ALR	above linear range
As	arsenic
ASTM	American Society for Testing and Materials
B	lab method blank contamination
B.H.	back half (components of sampling train downstream of filter)
Ba	barium
Be	beryllium
BOR	beginning of run
BQL	below quantitation limit
Btu	British thermal unit
C	carbon
C_2Cl_4	perchloroethylene; also tetrachloroethylene or tetrachloroethene
C_2H_4	ethylene
C_6Cl_6	hexachlorobenzene
C_6H_6	benzene
$Ca(OH)_2$	calcium hydroxide (lime)
CAA	Clean Air Act
CARB	California Air Resources Board
CB	chlorobenzenes
cc	cubic centimeter
CCl_4	carbon tetrachloride
Cd	cadmium
CEL	Calscience Environmental Laboratory Inc.
CEM	continuous emissions monitoring
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cf	cubic foot
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CH_4	methane
CIMS	chemical ionization mass spectrometer
Cl	chlorine
cm	centimeter
cm^2	square centimeter

ABBREVIATIONS AND SYMBOLS (CONTINUED)

CO	carbon monoxide
CO_2	carbon dioxide
CP	chlorophenols
Cr	chromium
Cr(VI)	hexavalent chromium
Cu	copper
CV-AAS	cold vapor atomic absorption spectroscopy
CWA	Clean Water Act
DE	destruction efficiency
DI	deionized
DNAPL	dense nonaqueous-phase liquid
DOT	Department of Transportation
dP	differential pressure (e.g., velocity head)
DRE	destruction and removal efficiency
dscf	dry standard cubic feet at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
dscm	dry standard cubic meters at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
Dup	duplicate
E	estimated maximum possible concentration
EER	Energy and Environmental Research Corporation
ELI	ELI Eco Logic International, Incorporated
EMPC	estimated maximum possible concentration
EOR	end of run
EPA	U.S. Environmental Protection Agency
excl.	excluding
F	fluorine; or as flag meaning laboratory blank was 20 percent of measured value or greater (result not statistically significant)
F.H.	front half (filter and upstream components of sampling train)
FB	field blank
FID	flame ionization detector
FPD	flame photometric detector
FS	field spike
ft	feet
ft^2	square foot
ft^3	cubic foot
FWEI	Foster Wheeler Enviresponse Incorporated
g	gram
gal	gallon
GC	gas chromatography
GF-AAS	graphite furnace atomic absorption spectroscopy
gpm	gallons per minute
gr	grains
H	hydrogen (atomic)
H_2	hydrogen (molecular)
H_2SO_4	sulfuric acid
HCB	hexachlorobenzene
HCl	hydrogen chloride
Hg	mercury
HpCDD	heptachlorodibenzodioxin

ABBREVIATIONS AND SYMBOLS (CONTINUED)

HpCDF	heptachlorodibenzofuran
hr	hour
HRGC	high resolution gas chromatography
HRMS	high resolution mass spectrometry
HSL	hazardous substances list
HW	hazardous waste
HxCDD	hexachlorodibenzodioxin
HxCDF	hexachlorodibenzofuran
IC	ion chromatography
ICAP	inductively coupled argon plasma spectroscopy
IN	input stream
in. WC	inches of water column (pressure)in.inch
in^2	square inch
incl.	including
INT	interferences prevented quantification of substance
kg	kilogram
$KMnO_4$	potassium permanganate
KW	kilowatt
L	liter
lb	pound
lbm	pound mass
LC	laboratory control
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
m	meter
m^2	square meter
m^3	cubic meter
MBC	mass balance closure
MDNR	Michigan Department of Natural Resources
mg	milligram
MGD	million gallons per day
min	minute
Mn	manganese
MS	matrix spike (in context of QA)
MS	mass spectrometry (in context of analytical methods)
MS	monitoring station (in context of process monitoring)
MSD	matrix spike duplicate
MW	molecular weight
n	neglected
N	normality of solution
NA	not available or not analyzed
NAAQS	National Ambient Air Quality Standards
NaOH	sodium hydroxide (caustic soda)
NC	could not be calculated
ND	not detected
NDIR	non-dispersive infrared
NDUV	non-dispersive ultraviolet
ng	nanogram

ABBREVIATIONS AND SYMBOLS (CONTINUED)

Ni	nickel
nn	not needed for computations
NO_x	oxides of nitrogen ($NO + NO_2$)
NPDES	National Pollution Discharge Elimination System NPLNational Priorities List
NS	not spiked
O	oxygen (atomic)
O&M	operating and maintenance
O_2	oxygen (molecular)
OCDD	octachlorodibenzodioxin
OCDF	octachlorodibenzofuran
ORD	EPA Office of Research and Development
OSHA	Occupational Safety and Health Act
OSWER	EPA Office of Solid Waste and Emergency Response
OUT	output stream
P	phosphorus
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo[p]dioxins
PCDF	polychlorinated dibenzofurans
PCE	perchloroethylene; also tetrachloroethylene or tetrachloroethene
PEA	performance evaluation audit
PeCDD	pentachlorodibenzodioxin
PeCDF	pentachlorodibenzofuran
pH	negative log of hydrogen ion concentration in solution - a measure of acidity/alkalinity
PIC	product of incomplete combustion
PIR	product of incomplete reduction
POHC	principal organic hazardous constituent
POTW	publicity owned treatment works
ppb	parts per billion
PPE	personnel protection equipment
ppm	parts per million
ppmv	parts per million by volume
ppmw	parts per million by weight
PSD	prevention of significant deterioration
psi	pounds per square inch
psig	pounds per square inch, gage
QA	quality assurance
QAPP	quality assurance project plan QAPjP quality assurance project plan
QC	quality control
QS	quantified with secondary ion
R&D	research and development
RCRA	resource conservation and recovery act
RF	radio frequency
RPD	relative percent difference
RREL	Risk Reduction Engineering Laboratory
RSD	relative standard deviation
S	sulfur

ABBREVIATIONS AND SYMBOLS (CONTINUED)

SARA	Superfund Amendments and Reauthorization Act
SAT	data estimated based on saturated instrument response
Sb	antimony
scf	standard cubic foot at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
scfm	standard cubic feet per minute at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
scm	standard cubic meter at 20°C (68°F) and 760 mm Hg (29.92 in. Hg)
Se	selenium
sec	second
SI	International System of Units (Le Systeme International d Unites)
SITE	Superfund Innovative Technology Evaluation Program
sL	standard liter
Sn	tin
SO_2	sulfur dioxide
SPCC	system performance check compound
SS	sampling station
SSHO	site safety and health officer
stdev	standard deviation
Surr	surrogate
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzodioxin
TCDF	tetrachlorodibenzofuran
TCLP	Toxicity Characteristic Leachate Procedure
TCT	Twin City Testing Inc.
TDU	thermal desorption unit
TER	Technology Evaluation Report
THC	total hydrocarbons
Tl	thallium
TLI	Triangle Laboratiories, Inc.
TSA	technical systems audit
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSR	technical system review
U.S.	United States
VOC	volatile organic compounds
vol. %	percent, volume basis
VOST	volatile organic sampling train
wt. %	percent, weight basis
x	analyzed
yd	yard
Zn	zinc
°C	degrees centigrade
°F	degrees Fahrenheit

SI CONVERSION FACTORS

	Multiply	English (US)units	by	Factor	to get	Metric (SI) Units
Area:		1 ft^2		0.0929		m^2
		1 in^2		6.452		cm^2
Flow Rate:		1 gal/min		6.31×10^{-5}		m^3/s
		1 gal/min		0.0631		L/s
		1 MGD		43.81		L/s
Length:		1 ft		0.3048		m
		1 in		2.54		cm
Mass:		1 lb		453.59		g
		1 lb		0.45359		kg
Volume:		1 ft^3		28.316		L
		1 ft^3		0.028317		m^3
		1 gal		3.785		L
		1 gal		0.003785		m^3
Temperature:		°F - 32		0.55556		°C
Concentration:		1 gr/ft^3		2.2884		g/m^3
		1 gr/gal		0.0171		g/L
		1 lb/ft^3		16.03		g/L
Pressure:		1 lb/in^2		0.07031		kg/cm^2
		1 lb/in^2		6894.8		Newton/m^2
Heating value:		Btu/lb		2326		Joules/kg
		Btu/scf		37260		Joules/scm

ACKNOWLEDGEMENTS

Energy and Environmental Research Corporation (EER) performed the sampling and analysis activities and prepared this report for the U.S. EPA under subcontract to Foster Wheeler Enviresponse, Inc. (FWEI). The project was managed by FWEI under EPA Contract 68-C9-0033. The principal authors of the report were Greg Rooney, David Hansell, William Oberg, and Glenn England. The authors gratefully acknowledge the assistance and contributions of Gordon M. Evans, the EPA Program Manager, and Gerard W. Sudell, the FWEI Work Assignment Manager, throughout the entire project. The authors also would like to acknowledge the assistance of: ELI Eco Logic International Inc., especially Kelvin Campbell and Craig McEwen; Mr. Edward Golson, City of Bay City; Joel Pitman of Huntingdon Twin City Testing Inc. and Dr. Hani Karam of Triangle Laboratories Inc., who were responsible for sample analysis; and each of the EER test team members who participated in the demonstration.

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APPENDIX 1
PROCESS OPERATION

The average process operating conditions for each test run are presented in this appendix. Tables A1-1 through A1-8 present the average, maximum, and minimum values for key process parameters monitored during the Demonstration. The test values are compared to the target values and operational limits established in the Quality Assurance Project Plan. Table A1-9 summarizes the test periods and mass flow rate of each process stream for each test run. The data in Table A1-9 were used in all mass balance calculations. Flow rates for streams that are a net output from the process are distinguished from inputs by a minus sign. Note that some process streams such as heat exchanger residue and scrubber liquor are treated as batch rather than continuous streams. The flow rates of these streams are based on net mass gain or loss during the test divided by the test period. These streams are identified as "ACCUM" in Table A1-9.

During Condition 3, boiler tests were performed after waste oil processing was completed. Reformed gas was compressed and stored in a tank during waste processing. The time period for waste processing ranged from 55 minutes to 169 minutes. After waste processing was completed, reformed gas was fed from the tank to the boiler at a lower flow rate until the tank was empty. The time to empty the tank ranged from 431 minutes to 1417 minutes. The flow rate of reformed gas is calculated two ways: (1) rate of reformed gas production was determined by dividing the total quantity of reformed gas produced during waste processing by the waste processing period; and (2) the rate at which the reformed gas was fed to the boiler was determined by dividing the total quantity of reformed gas produced during waste processing by the total time required to empty the tank.

TABLE A1-1. CONDITION 1 RUN 1 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Waste water feed rate	–	kg/min	1.44	–	–	5	+/- 10%
Waste oil feed rate	–	kg/min	0.027	–	–	0.05	+/- 10%
PCE (spike) injection rate	–	g/min	6.49	–	–	6.51	–
Vaporizer pressure	12	psi	55.4	57.5	45.8	55	40-60
Vaporizer temperature	12	°C	150.0	152	145	–	–
Reactor temperature	2	°C	900.0	904	898	900	850-1000
Recirculation heater exit temperature	9	°C	487.0	499	475	500	450-550
Reactor pressure	1	in. WC	2.1	21.9	-0.99	0	-10 to +10
Gas booster differential pressure	7	in. WC	12.7	16.4	10.00	–	<16
Recirculation flowrate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	559	593	514	–	–
Scrubber exit temperature	6	°C	30	45	16	–	–
Scrubber liquor pH	5	---	9.2	8.50	10.00	9	9-10
System oxygen	10	%	0.067	0.224	0	0	<0.04
Oxygen - boiler stack	11	%	7.9	19.8	5.5	–	–
Residence time**	–	sec	8.2	–	–	–	>3
Reformed gas pressure	10	in. WC	8.7	12	0	–	–
Recirculation vacuum	7	in. WC	0 to -3	<0	-3	–	–
1-Chlorobenzene*	10	ppm	3.59	37.6	0	–	<100
2-Chlorobenzene*	10	ppm	5.51	11.8	0	–	–
3-Chlorobenzene*	10	ppb	37	129	0	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

TABLE A1-2. CONDITION 1 RUN 2 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Waste water feed rate	–	kg/min	2.75	–	–	5	+/- 10%
Waste oil feed rate	–	kg/min	0.026	–	–	0.05	+/- 10%
PCE - mass injection rate	–	g/min	6.50	–	–	6.51	–
Vaporizer pressure	12	psi	48.9	53.3	38.7	55	40-60
Vaporizer temperature	12	°C	147	150	141	–	–
Reactor temperature	2	°C	893	900	882	900	850-1000
Recirculation heater exit temperature	9	°C	482	492	469	500	450-550
Reactor pressure	1	in. WC	1.3	8.6	-3.88	0	-10 to +10
Gas booster differential pressure	7	in. WC	10.4	12.9	8.85	–	<16
Recirculation flowrate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	484	522	408	–	–
Scrubber exit temperature	6	°C	36	69	23	–	–
Scrubber liquor pH	5	–	7.92	8.95	6.85	9	9-10
System oxygen	10	%	0.053	0.626	-0.001	0	<0.04
Oxygen - boiler stack	11	%	6.6	8.9	3.7	–	–
Residence time**	–	sec	6.2	–	–	–	>3
Reformed gas pressure	10	in. WC	6.7	10	0	–	–
Recirculation vacuum	7	in. WC	<0	<0	<0	–	–
1-Chlorobenzene*	10	ppm	1.98	7.55	0	–	<100
2-Chlorobenzene*	10	ppm	1.22	2.8	0	–	–
3-Chlorobenzene*	10	ppb	88	25	0	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

TABLE A1-3. CONDITION 1 RUN 3 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Waste water feed rate	–	kg/min	1.01	–	–	5	+/- 10%
Waste oil feed rate	–	kg/min	0.020	–	–	0.05	+/- 10%
PCE (spike) injection rate	–	g/min	6.35	–	–	6.51	–
Vaporizer pressure	12	psi	51.2	53.2	47.8	55	40-60
Vaporizer temperature	12	°C	148	149	146	–	–
Reactor temperature	2	°C	884	892	872	900	850-1000
Recirculation heater exit temperature	9	°C	474	487	461	500	450-550
Reactor pressure	1	in. WC	2.0	14.4	-6.66	0	-10 to +10
Gas booster differential pressure	7	in. WC	11.6	17.5	9.49	–	<16
Recirculation flowrate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	595	626	555	–	–
Scrubber exit temperature	6	°C	32	35	29	–	–
Scrubber liquor pH	5	–	9.24	10.82	8.39	9	9-10
System oxygen	10	%	0.031	0.092	0.013	0	<0.04
Oxygen - boiler stack	11	%	6.2	7.5	4.9	–	–
Residence time**	–	sec	9.5	–	–	–	>3
Reformed gas pressure	10	in. WC	4	11	0	–	–
Recirculation vacuum	7	in. WC	<0 to 5	5	<0	–	–
1-Chlorobenzene*	10	ppm	6.15	15.9	1.55	–	<100
2-Chlorobenzene*	10	ppm	6.3	12.5	155	–	–
3-Chlorobenzene*	10	ppb	223	413	28	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

TABLE A1-4. CONDITION 2 RUN 1 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Contaminated soil feed rate	–	kg/min	2.12	–	–	10	+/- 10%
Clean steam	13	kg/min	1.89	–	–	1	+/- 10%
Hexachlorobenzene (spike) feed rate	–	g/min	16.8	–	–	41	–
TDU bath temperature	15	°C	616	645	592	–	–
TDU dome temperature	16	°C	614	656	589	–	–
TDU combustion gas temperature	17	°C	662	705	625	–	–
TDU exhaust gas temperature	18	°C	398	452	270	–	–
TDU pressure	16	in. WC	2.0	6.0	0.0	–	–
Reactor temperature	2	°C	890	893	881	900	850-1000
Recirculation heater exit temperature	9	°C	480	491	467	500	450-550
Reactor pressure	1	in. WC	2.23	6.24	-0.37	0	-10 to +10
Gas booster differential pressure	7	in. WC	10.2	12.6	8.3	–	<16
Recirculation flow rate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	506	523	477	–	–
Scrubber exit temperature	6	°C	32	29	30	–	–
Scrubber liquor pH	5	---	8.42	8.68	8.17	–	–
System oxygen	10	%	0.020	0.027	0.016	0	<0.04
Oxygen - boiler stack	11	%	6.10	7.60	5.40	–	–
Residence time**	–	sec	5.8	–	–	–	>3
Reformed gas pressure	10	in. WC	8	15	3	–	–
Recirculation vacuum	7	in. WC	3	4	2	–	–
1-Chlorobenzene*	10	ppm	0.03	0.62	0.00	–	<100
2-Chlorobenzene*	10	ppm	12.0	29.5	3.0	–	–
3-Chlorobenzene*	10	ppb	569	488	0	–	–
6-Chlorobenzene*	10	ppb	453	1330	9	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

TABLE A1-5. CONDITION 2 RUN 2 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Contaminated soil feed rate	–	kg/min	0.40	–	–	10	+/- 10%
Clean steam	13		1.38	–	–	1	+/- 10%
Hexachlorobenzene (spike) feed rate	–	g/min	9.87	–	–	41	–
TDU bath temperature	15	°C	632	673	603	–	–
TDU dome temperature	16	°C	610	676	557	–	–
TDU combustion gas temperature	17	°C	653	699	623	–	–
TDU exhaust gas temperature	18	°C	500	522	475	–	–
TDU pressure	16	in. WC	2.5	3.0	1.0	–	–
Reactor temperature	2	°C	890	891	888	900	850-1000
Recirculation heater exit temperature	9	°C	481	492	469	500	450-550
Reactor pressure	1	in. WC	2.69	3.78	1.12	0	-10 to +10
Gas booster differential pressure	7	in. WC	8.09	9.3	7.02	–	<16
Recirculation flow rate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	502	518	488	–	–
Scrubber exit temperature	6	°C	32	34	30	–	–
Scrubber liquor pH	5	---	8.42	8.61	8.20	–	–
System oxygen	10	%	0.010	0.015	0.008	0	<0.04
Oxygen - boiler stack	11	%	7.57	8.30	6.20	–	–
Residence time**	–	sec	9.6	–	–	–	>3
Reformed gas pressure	10	in. WC	2	4	2	–	–
Recirculation vacuum	7	in. WC	<0	<0	<0	–	–
1-Chlorobenzene*	10	ppm	0.22	0.87	0.00	–	<100
2-Chlorobenzene*	10	ppm	12.8	21.3	3.8	–	–
3-Chlorobenzene*	10	ppb	83	446	0	–	–
6-Chlorobenzene*	10	ppb	1	3	0	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

TABLE A1-6. CONDITION 3 RUN 1 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Waste water feed rate	–	kg/min	4.74	–	–	1	+/- 10%
Waste oil feed rate	–	kg/min	0.36	–	–	1	+/- 10%
PCE (spike) injection rate	–	g/min	13.0	–	–	13.02	–
Vaporizer pressure	12	PSI	53.1	53.3	52.9	55	40-60
Vaporizer temperature	12	°C	149.5	150	149	–	–
Reactor temperature	2	°C	901	904	899	900	850-1000
Recirculation heater exit temperature	9	°C	470	484	458	500	450-550
Reactor pressure	1	in. WC	2.10	3.9	0.7	0	-10 to +10
Gas booster differential pressure	7	in. WC	8.80	10.5	5.5	–	<16
Recirculation flow rate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	492	540	447	–	–
Scrubber exit temperature	6	°C	31	32	30	–	–
Scrubber liquor pH	5	---	9.45	11.40	7.89	9	9-10
System oxygen	10	%	0.058	0.11	0.008	0	<0.04
Oxygen - boiler stack	11	%	7.9	8	7.9	–	–
Residence time	–	sec	3.7	–	–	–	>3
Reformed gas pressure	10	in. WC	2	2	1	–	–
Recirculation vacuum	7	in. WC	0	***	***	–	–
1-Chlorobenzene*	10	ppm	22.0	90.4	4.51	–	<100
2-Chlorobenzene*	10	ppm	8.33	27.50	1.33	–	–
3-Chlorobenzene*	10	ppb	555	937	201	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

***No valid data obtained due to computer malfunction.

TABLE A1-7. CONDITION 3 RUN 2 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Waste water feed rate	–	kg/min	1.04	–	–	1	+/- 10%
Waste oil feed rate	–	kg/min	0.447	–	–	1	+/- 10%
PCE (spike) injection rate	–	g/min	13.1	–	–	13.02	–
Vaporizer pressure	12	PSI	50.0	53.00	48.00	55	40-60
Vaporizer temperature	12	°C	***	***	***	–	–
Reactor temperature	2	°C	903	910	894	900	850-1000
Recirculation heater exit temperature	9	°C	***	***	***	500	450-550
Reactor pressure	1	in. WC	1.5	2.0	1.1	0	-10 to +10
Gas booster differential pressure	7	in. WC	9.1	10.0	8.3	–	<16
Recirculation flow rate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	526	581	423	–	–
Scrubber exit temperature	6	°C	32	33	31	–	–
Scrubber liquor pH	5	---	8.80	10.30	6.40	9	9-10
System oxygen	10	%	***	***	***	0	<0.04
Oxygen - boiler stack	0	%	8.1	8.14	8.04	–	–
Residence time	–	sec	7.0	–	–	–	>3
Reformed gas pressure	10	in. WC	0	0	0	–	–
Recirculation vacuum	7	in. WC	***	***	***	–	–
1-Chlorobenzene*	10	ppm	25.1	52.50	0.045	–	<100
2-Chlorobenzene*	10	ppm	6.42	14.40	0.15	–	–
3-Chlorobenzene*	10	ppb	313	522	40	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

***No valid data obtained due to computer malfunction.

TABLE A1-8. CONDITION 3 RUN 3 PROCESS OPERATION SUMMARY

Parameter	Monitoring Station	Units	Average	Maximum	Minimum	Target condition	Operational limits
Waste water feed rate	–	kg/min	0.88	–	–	1	+/- 10%
Waste oil feed rate	–	kg/min	0.353	–	–	1	+/- 10%
PCE (spike) injection rate	–	g/min	13.2	–	–	13.02	–
Vaporizer pressure	12	PSI	51.0	55.00	46.00	55	40-60
Vaporizer temperature	12	°C	***	***	***	–	
Reactor temperature	2	°C	994	995	993	900	850-1000
Recirculation heater exit temperature	9	°C	***	***	***	500	450-550
Reactor pressure	1	in. WC	1.8	3.4	1.4	0	-10 to +10
Gas booster differential pressure	7	in. WC	5.5	7.0	3.0	–	<16
Recirculation flow rate **	–	cfm	110	–	–	100	80-120
Scrubber inlet temperature	3	°C	562	593	514	–	–
Scrubber exit temperature	6	°C	32	33	31	–	–
Scrubber liquor pH	5	–	9.70	10.20	8.90	9	9-10
System oxygen	10	%	***	***	***	0	<0.04
Oxygen - boiler stack	11	%	7.9	7.93	7.80	–	–
Residence time	–	sec	7.5	–	–	–	>3
Reformed gas pressure	10	in. WC	0.0	0	0	–	–
Recirculation vacuum	7	in. WC	***	***	***	–	–
1-Chlorobenzene*	10	ppm	5.63	21.30	0	–	<100
2-Chlorobenzene*	10	ppm	4.83	10.90	0.00	–	–
3-Chlorobenzene*	10	ppb	18	220	0	–	–

*Based on CIMS

**ELI estimate based on a manual valve setting.

***No valid data obtained due to computer malfunction.

TABLE A1-9. SUMMARY OF PROCESS FLOW RATES

Condition	Run	Location	Description	Stream direction	Test time - waste (min)	Test time - boiler (min)	Initial density (g/L)	Final density (g/L)	Average density (g/L)	Total mass (kg)	Mass rate - waste processing (kg/hr)	Mass rate - boiler (kg/hr)
1	1	SS1	Waste water	IN	389	389	-	-	980	558	86.1	-
1	1	SS11	Reactor grit	OUT	389	389	-	-	2204	-0.871	-0.134	-
1	1	SS12	Scrubber sludge	OUT	389	389	-	-	2200	-20.1	-3.10	-
1	1	SS13	Scrubber decant water	OUT	389	389	-	-	990	-630	-97.2	-
1	1	SS14	Reformed gas	OUT	389	389	-	-	0.753	-68.2	-10.5	-10.5
1	1	SS16	Boiler flue gas	OUT	389	389	-	-	1.19	-1630	-	-251
1	1	SS18	Heat exchanger residue	ACCUM	389	389	1000	1000	-	0.00	0.00	-
1	1	SS2	Waste oil	IN	389	389	-	-	1000	10.4	1.61	-
1	1	SS2 SPIKE	PCE spike	IN	389	389	-	-	-	2.25	0.348	-
1	1	SS22	Scrubber liquor	ACCUM	389	389	1021	981	-	146	22.5	-
1	1	SS4	Scrubber caustic	IN	389	389	-	-	1050	92.2	14.2	-
1	1	SS5	Scrubber make-up water	IN	389	389	-	-	980	0.00	0.00	-
1	1	SS6	Propane	IN	389	389	-	-	1.76	43.5	-	6.71
1	1	SS7	Hydrogen	IN	389	389	-	-	0.0833	1.38	0.213	-
1	1	SS9	Boiler combustion air	IN	389	389	-	-	1.20	1527	-	236
1	2	SS1	Waste water	IN	377	377	-	-	980	1037	165	-
1	2	SS11	Reactor grit	OUT	377	377	-	-	2204	-0.308	-0.0491	-
1	2	SS12	Scrubber sludge	OUT	377	377	-	-	2200	-20.1	-3.20	-
1	2	SS13	Scrubber decant water	OUT	377	377	-	-	990	-634	-101	-
1	2	SS14	Reformed gas	OUT	377	377	-	-	0.689	-51.9	-8.26	-8.26
1	2	SS16	Boiler flue gas	OUT	377	377	-	-	1.19	-1484	-	-236
1	2	SS18	Heat exchanger residue	ACCUM	377	377	1000	1000	-	0.00	0.00	-
1	2	SS2	Waste oil	IN	377	377	-	-	1000	9.75	1.55	-
1	2	SS2 SPIKE	PCE spike	IN	377	377	-	-	-	2.24	0.356	-
1	2	SS22	Scrubber liquor	ACCUM	377	377	990	971	-	31.6	5.03	-
1	2	SS4	Scrubber caustic	IN	377	377	-	-	1050	88.1	14.0	-
1	2	SS5	Scrubber make-up water	IN	377	377	-	-	980	0.00	0.00	-
1	2	SS6	Propane	IN	377	377	-	-	1.76	47.9	-	7.62
1	2	SS7	Hydrogen	IN	377	377	-	-	0.0833	0.712	0.113	-
1	2	SS9	Boiler combustion air	IN	377	377	-	-	1.20	1394	-	222
1	3	SS1	Waste water	IN	457	457	-	-	971	463	60.7	-
1	3	SS11	Reactor grit	OUT	457	457	-	-	2204	-0.104	-0.0137	-
1	3	SS12	Scrubber sludge	OUT	457	457	-	-	2200	-20.1	-2.64	-
1	3	SS13	Scrubber decant water	OUT	457	457	-	-	990	-746	-97.9	-
1	3	SS14	Reformed gas	OUT	457	457	-	-	0.801	-53.6	-7.03	-7.03
1	3	SS16	Boiler flue gas	OUT	457	457	-	-	1.19	-1773	-	-233
1	3	SS18	Heat exchanger residue	ACCUM	457	457	1000	1000	-	0.00	0.00	-
1	3	SS2	Waste oil	IN	457	457	-	-	1000	9.30	1.22	-
1	3	SS2 SPIKE	PCE spike	IN	457	457	-	-	-	2.23	0.292	-
1	3	SS22	Scrubber liquor	ACCUM	457	457	990	971	-	38.3	5.03	-
1	3	SS4	Scrubber caustic	IN	457	457	-	-	1050	188	24.7	-
1	3	SS5	Scrubber make-up water	IN	457	457	-	-	980	0.00	0.00	-
1	3	SS6	Propane	IN	457	457	-	-	1.76	65.0	-	8.53
1	3	SS7	Hydrogen	IN	457	457	-	-	0.0833	0.658	0.0864	-
1	3	SS9	Boiler combustion air	IN	457	457	-	-	1.20	1666	-	219

TABLE A1-9. SUMMARY OF PROCESS FLOW RATES (continued)

Condition	Run	Location	Description	Stream direction	Test time - waste (min)	Test time - boiler (min)	Initial density (g/L)	Final density (g/L)	Average density (g/L)	Total mass (kg)	Mass rate - waste processing (kg/hr)	Mass rate - boiler (kg/hr)
2	1	—	Clean steam	IN	362	362	-	-	-	685	114	-
2	1	SS10	Treated soil	OUT	362	362	-	-	-	-767	-127	-
2	1	SS11	Reactor grit	OUT	362	362	-	-	2200	-0.249	-0.0414	-
2	1	SS12	Scrubber sludge	OUT	362	362	-	-	2200	-2.81	-0.466	-
2	1	SS13	Scrubber decant water	OUT	362	362	-	-	990	-531	-88.0	-
2	1	SS14	Reformed gas	OUT	362	362	-	-	0.561	-44.9	-7.44	-7.44
2	1	SS16	Boiler flue gas	OUT	362	362	-	-	1.17	-1673	-	-277
2	1	SS20	TDU molten bath	ACCUM	362	362	5750	5750	-	0.00	0.00	-
2	1	SS22	Scrubber liquor	ACCUM	362	362	980	990	-	-34.9	-5.79	-
2	1	SS24	TDU quench water	ACCUM	362	362	1000	1000	-	-15.9	-2.63	-
2	1	SS3	Contaminated soil	IN	362	362	-	-	-	767	127	-
2	1	SS3 SPIKE	HCB spike	IN	362	362	-	-	-	9.53	1.58	-
2	1	SS4	Scrubber caustic	IN	362	362	-	-	1050	232	38.5	-
2	1	SS5	Scrubber make-up water	IN	362	362	-	-	1000	0.00	0.00	-
2	1	SS6	Propane	IN	362	362	-	-	1.76	57.5	-	9.53
2	1	SS7	Hydrogen	IN	362	362	-	-	0.0833	0.562	0.0932	-
2	1	SS9	Boiler combustion air	IN	362	362	-	-	1.20	1565	-	259
2	2	—	Clean steam	IN	496	496	-	-	-	685	82.9	-
2	2	SS10	Treated soil	OUT	496	496	-	-	-	-211	-25.5	-
2	2	SS11	Reactor grit	OUT	496	496	-	-	2200	-0.363	-0.0439	-
2	2	SS12	Scrubber sludge	OUT	496	496	-	-	2200	-3.61	-0.436	-
2	2	SS13	Scrubber decant water	OUT	496	496	-	-	990	-674	-81.5	-
2	2	SS14	Reformed gas	OUT	496	496	-	-	0.545	-27.7	-3.36	-3.36
2	2	SS16	Boiler flue gas	OUT	496	496	-	-	1.17	-3215	-	-389
2	2	SS20	TDU molten bath	ACCUM	496	496	5750	5750	-	0.00	0.00	-
2	2	SS22	Scrubber liquor	ACCUM	496	496	1000	980	-	72.1	8.72	-
2	2	SS24	TDU quench water	ACCUM	496	496	1000	1000	-	22.2	2.69	-
2	2	SS3	Contaminated soil	IN	496	496	-	-	-	196	23.7	-
2	2	SS3 SPIKE	HCB spike	IN	496	496	-	-	-	4.83	0.584	-
2	2	SS4	Scrubber caustic	IN	496	496	-	-	1050	196	23.8	-
2	2	SS5	Scrubber make-up water	IN	496	496	-	-	1000	0.00	0.00	-
2	2	SS6	Propane	IN	496	496	-	-	1.76	114	-	13.8
2	2	SS7	Hydrogen	IN	496	496	-	-	0.0833	0.703	0.0850	-
2	2	SS9	Boiler combustion air	IN	496	496	-	-	1.20	3070	-	371

TABLE A1-9. SUMMARY OF PROCESS FLOW RATES (continued)

Condition	Run	Location	Description	Stream direction	Test time - waste (min)	Test time - boiler (min)	Initial density (g/L)	Final density (g/L)	Average density (g/L)	Total mass (kg)	Mass rate - waste processing (kg/hr)	Mass rate - boiler (kg/hr)
3	1	SS1	Waste water	IN	55	431	-	-	971	261	284	-
3	1	SS11	Reactor grit	OUT	55	431	-	-	2204	-0.0907	-0.0990	-
3	1	SS12	Scrubber sludge	OUT	55	431	-	-	2200	-30.1	-32.9	-
3	1	SS13	Scrubber decant water	OUT	55	431	-	-	990	-216	-236	-
3	1	SS14	Reformed gas	OUT	55	431	-	-	0.545	-13.7	-14.9	-1.91
3	1	SS15	Tank condensate	OUT	55	431	-	-	1000	-0.186	-0.203	-
3	1	SS16	Boiler flue gas	OUT	55	431	-	-	1.19	-3233	-	-450
3	1	SS18	Heat exchanger residue	ACCUM	55	431	1000	1000	-	0.00	0.00	-
3	1	SS2	Waste oil	IN	55	431	-	-	1000	19.5	21.3	-
3	1	SS2 SPIKE	PCE spike	IN	55	431	-	-	-	0.649	0.708	-
3	1	SS22	Scrubber liquor	ACCUM	55	431	981	971	-	34.9	38.1	-
3	1	SS4	Scrubber caustic	IN	55	431	-	-	1050	76.1	83.0	-
3	1	SS5	Scrubber make-up water	IN	55	431	-	-	980	0.00	0.00	-
3	1	SS6	Propane	IN	55	431	-	-	1.76	124	-	17.3
3	1	SS7	Hydrogen	IN	55	431	-	-	0.0833	0.0680	0.0742	-
3	1	SS9	Boiler combustion air	IN	55	431	-	-	1.20	3102	-	432
3	2	SS1	Waste water	IN	169	767	-	-	981	175	62.2	-
3	2	SS11	Reactor grit	OUT	169	767	-	-	2204	-0.286	-0.101	-
3	2	SS12	Scrubber sludge	OUT	169	767	-	-	2200	-50.3	-17.8	-
3	2	SS13	Scrubber decant water	OUT	169	767	-	-	990	-1056	-375	-
3	2	SS14	Reformed gas	OUT	169	767	-	-	0.481	-42.9	-15.2	-3.36
3	2	SS15	Tank condensate	OUT	169	767	-	-	1000	-1.09	-0.386	-
3	2	SS16	Boiler flue gas	OUT	169	767	-	-	1.19	-3609	-	-282
3	2	SS18	Heat exchanger residue	ACCUM	169	767	1000	1000	-	0.00	0.00	-
3	2	SS2	Waste oil	IN	169	767	-	-	1000	75.5	26.8	-
3	2	SS2 SPIKE	PCE spike	IN	169	767	-	-	-	1.96	0.696	-
3	2	SS22	Scrubber liquor	ACCUM	169	767	981	990	-	-34.9	-12.4	-
3	2	SS4	Scrubber caustic	IN	169	767	-	-	1050	453	161	-
3	2	SS5	Scrubber make-up water	IN	169	767	-	-	980	598	212	-
3	2	SS6	Propane	IN	169	767	-	-	1.76	126	-	9.89
3	2	SS7	Hydrogen	IN	169	767	-	-	0.0833	0.154	0.0548	-
3	2	SS9	Boiler combustion air	IN	169	767	-	-	1.20	3448	-	270
3	3	SS1	Waste water	IN	156	1417	-	-	990	138	53.0	-
3	3	SS11	Reactor grit	OUT	156	1417	-	-	2204	-0.263	-0.101	-
3	3	SS12	Scrubber sludge	OUT	156	1417	-	-	2200	-40.2	-15.5	-
3	3	SS13	Scrubber decant water	OUT	156	1417	-	-	990	-1158	-445	-
3	3	SS14	Reformed gas	OUT	156	1417	-	-	0.465	-50.3	-19.4	-2.13
3	3	SS15	Tank condensate	OUT	156	1417	-	-	1000	-1.91	-0.733	-
3	3	SS16	Boiler flue gas	OUT	156	1417	-	-	1.19	-7257	-	-307
3	3	SS18	Heat exchanger residue	ACCUM	156	1417	1000	1000	-	0.00	0.00	-
3	3	SS2	Waste oil	IN	156	1417	-	-	1000	55.1	21.2	-
3	3	SS2 SPIKE	PCE spike	IN	156	1417	-	-	-	1.91	0.733	-
3	3	SS22	Scrubber liquor	ACCUM	156	1417	990	990	-	0.00	0.00	-
3	3	SS4	Scrubber caustic	IN	156	1417	-	-	1050	276	106	-
3	3	SS5	Scrubber make-up water	IN	156	1417	-	-	980	837	322	-
3	3	SS6	Propane	IN	156	1417	-	-	1.76	275	-	11.7
3	3	SS7	Hydrogen	IN	156	1417	-	-	0.0833	0.222	0.0855	-
3	3	SS9	Boiler combustion air	IN	156	1417	-	-	1.20	6941	-	294

"-" sign in front of mass and mass rate indicates net flow direction out of system

APPENDIX 2
SUMMARY OF RESULTS

Tables A2-1 through A2-20 summarize results of all measurements for individual samples of each stream. Each table is annotated with numbered flags indicating any notes regarding the data. A key to

Stream	Description	Table No.	Results
SS1	Waste water	2-1	Flow rate, moisture, PCBs, CBs, CPs, PAHs, PCDDs, PCDFs, VOCs, trace metals, C, S, hexavalent Cr, density, pH, chlorides
SS2	Waste oil	2-2	Flow rate, moisture, PCBs, CBs, CPs, PAHs, PCDDs, PCDFs, VOCs, trace metals, C, H, N, O, P, Cl, F, S, hexavalent Cr, ash, density, pH, chlorides
SS3	Contaminated soil	2-3	Flow rate, moisture, PCBs, CBs, CPs, PAHs, PCDDs, PCDFs, VOCs, trace metals, C, S, ash, hexavalent Cr, density, pH, chlorides, TCLP volatiles, TCLP trace metals
SS4	Scrubber caustic	2-4	Flow rate, trace metals, S, hexavalent Cr, density, pH, chlorides
SS5	Scrubber makeup water	2-5	Flow rate, moisture, trace metals, S, hexavalent Cr, density, pH, chlorides
SS6	Propane	2-6	Flow rate, PCBs, CBs, CPs, VOCs, C, H, N, O, P, Cl, F, S, hexavalent Cr, ash, density, pH, chlorides
SS7	Hydrogen	2-7	Flowrate, moisture, PCBs, CBs, CPs, VOCs
SS9	Combustion air	2-8	Flowrate, moisture, PCBs, CBs, CPs, VOCs, sulfur compounds, fixed gases
SS10	Treated soils	2-9	Flowrate, moisture, PCBs, CBs, CPs, PAHs, dioxins, furans, VOCs, trace metals, chlorides, C, S, ash, hexavalent Cr, TCLP volatiles, TCLP trace metals
SS11	Reactor grit	2-10	Flowrate, moisture, PCBs, CBs, CPs, PAHs, dioxins, furans, VOCs, trace metals, chlorides, C, S, ash hexavalent Cr, TCLP volatiles, TCLP trace metals
SS12	Scrubber sludge	2-11	Flowrate, moisture, CBs, CPs, PAHs, dioxins, furans, VOCs, trace metals, chlorides, S, hexavalent Cr, density, pH, TCLP volatiles, TCLP trace metals, PCBs
SS13	Scrubber decant water	2-12	Flowrate, moisture, PCBs, CBs, CPs, PAHs, dioxins, furans, trace metals, C, S, hexavalent Cr, density, pH, chlorides, C, H, N, Cl, F, P, O, VOCs
SS14	Reformed gas	2-13	Flowrate, moisture, PCBs, CBs, CPs, dioxins, furans, VOCs, sulfur compounds, fixed gases, hydrocarbons, heating value
SS15	Reformed gas storage tank condensate	2-14	Flowrate, moisture, PCBs, CBs, CPs, PAHs, dioxins, furans, VOCs, trace metals, C, S, hexavalent Cr, chlorides
SS16	Boiler stack gas	2-15	Flowrate, moisture, PCBs, CBs, CPs, PAHs, PCDDs, PCDFs, VOCs, trace metals, NOx, SO2, CO, CO2, O2, THC, particulate, HCl, opacity
SS18	Heat exchanger residual	2-16	PCBs, CBs, CPs, PAHs, dioxins, furans, trace metals, C, S, hexavalent Cr, chlorides, VOCs
SS19	TDU exit gas	2-17	PCBs, CBs, CPs, dioxins, furans, VOCs
SS20	Molten bath	2-18	Trace metals
SS22	Scrubber liquor	2-19	Moisture, PCBs, CBs, CPs, PAHs, PCDDs, PCDFs, VOCs, trace metals, C, S, hexavalent Cr, density, pH, chlorides, C, H, N, Cl, F, P
SS24	TDU quench water	2-20	PCBs, CBs, CPs, PAHs, PCDDs, PCDFs, VOCs, trace metals, S, hexavalent Cr, ash, C, chlorides

the flag numbers is provided at the end of this appendix. Flow rates are the net flow rate in or out of the system during actual test periods. Flow rates for reformed gas (SS18) during Condition 3 are rates during waste processing. Reformed gas flow rate during boiler testing was much lower. See appendix A1 for additional process flow rate information. Where shown, a "-" sign indicates net flow out of system for streams which accumulate (see Appendix 3 for additional information on accumulated streams). Please refer to the table of Abbreviations and Symbols at the front of the appendices for key to nomenclature used on tables.

TABLE A2-1. SS1 - WASTE WATER SUMMARY

Substance	Units	CONDITION 1 - WASTE WATER									
		Flag	Run 1		Flag	Run 2		Flag	Run 3		Average
Total stream flow rate	kg/hr			86.1			165			60.7	104.0
	lb/hr			190			364			134	229.3
	L/hr			87.9			168			62.6	106.3
Polychlorinated biphenyls (PCB)											
Monochlorobiphenyl (total)	µg/L		ND	0.3		BQL	0.08		ND	0.29	< 0.22
Dichlorobiphenyl (total)	µg/L		BQL	0.4			3.3			3	< 2.23
Trichlorobiphenyl (total)	µg/L		BQL	0.34			3.5			2.4	< 2.08
Tetrachlorobiphenyl (total)	µg/L		BQL	0.2		BQL	2.7		BQL	1.7	BQL 1.53
Pentachlorobiphenyl (total)	µg/L		BQL	0.01		BQL	0.62		BQL	0.51	BQL 0.38
Hexachlorobiphenyl (total)	µg/L		ND	8.5		BQL	0.06		BQL	0.02	< 2.86
Heptachlorobiphenyl (total)	µg/L		ND	7.3		ND	9.5		ND	7	ND 7.93
Octachlorobiphenyl (total)	µg/L		ND	3.6		ND	4.7		ND	3.6	ND 3.97
Nonachlorobiphenyl (total)	µg/L		ND	0.91		ND	1.2		ND	0.88	ND 1.00
Decachlorobiphenyl (total)	µg/L		ND	0.51		ND	0.66		ND	0.49	ND 0.55
Total PCBs (tri-deca) including NDs	µg/L		<	21.4		<	22.9		<	16.6	< 20.3
Total PCBs (mono-deca) including NDs	µg/L		<	22.1		<	26.3		<	19.9	< 22.8
Total PCBs (tri-deca) excluding NDs	µg/L		>	0.55		>	6.88		>	4.63	> 4.00
Total PCBs (mono-deca) excluding NDs	µg/L		>	0.95		>	10.26		>	7.63	> 6.28
Chlorobenzenes and chlorophenols											
1,2-Dichlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
1,3-Dichlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
1,4-Dichlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
Total dichlorobenzenes	µg/L	1,34	ND	3	34	ND	3.6	34	ND	2.97	ND 3.19
1,2,3-Trichlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
1,3,5-Trichlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
1,2,4-Trichlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
Total trichlorobenzenes	µg/L	1,34	ND	3	34	ND	3.6	34	ND	2.97	ND 3.19
1,2,3,4-Tetrachlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
1,2,3,5- and/or 1,2,4,5-Tetrachloro- benzene	µg/L	1,34	ND	2.1	34	ND	2.5	34	ND	2	ND 2.20
Total tetrachlorobenzenes	µg/L	1,34	ND	3.1	34	ND	3.7	34	ND	2.99	ND 3.26
Pentachlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
Hexachlorobenzene	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,3-Dichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,4-Dichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,5-Dichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,6-Dichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
3,4-Dichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
3,5-Dichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
Total dichlorophenols	µg/L	1,34	ND	6	34	ND	7.2	34	ND	5.94	ND 6.38
2,3,4-Trichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,3,5-Trichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,3,6-Trichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,4,5-Trichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
2,4,6-Trichlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
Total trichlorophenols	µg/L	1,34	ND	5	34	ND	6	34	ND	4.95	ND 5.32
2,3,4,5- and/or 2,3,4,6-Tetrachlorophenol	µg/L	1,34	ND	2.1	34	ND	2.5	34	ND	2	ND 2.20
2,3,5,6-Tetrachlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
Total tetrachlorophenols	µg/L	1,34	ND	3.1	34	ND	3.7	34	ND	2.99	ND 3.26
Pentachlorophenol	µg/L	1,34	ND	1	34	ND	1.2	34	ND	0.99	ND 1.06
Total CB including NDs	µg/L	1,34	ND	11.1	34	ND	13.3	34	ND	10.91	ND 11.77
Total CP including NDs	µg/L	1,34	ND	15.1	34	ND	18.1	34	ND	14.87	ND 16.02
Total CB excluding NDs	µg/L			all ND			all ND			all ND	all ND
Total CP excluding NDs	µg/L			all ND			all ND			all ND	all ND

TABLE A2-1. SS1 - WASTE WATER SUMMARY (continued)

Substance	Units	CONDITION 1 - WASTE WATER							
		Flag	Run 1	Flag	Run 2	Flag	Run 3		Average
Polycyclic aromatic hydrocarbons (PAH)									
Naphthalene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
2-Methylnaphthalene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
2-Cl-Naphthalene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Acenaphthylene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Acenapthene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Fluorene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Phenanthrene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Anthracene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Fluoranthene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Pyrene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Benzo (a) anthracene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Chrysene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Benzo (b) fluoranthene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Benzo (k) fluoranthene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Benzo (e) pyrene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Benzo (a) pyrene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Perylene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Indeno (1,2,3-cd) pyrene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Dibenz (a,h) anthracene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Benzo (g,h,i) perylene	µg/L	ND	1	ND	1.2	ND	0.99	ND	1.06
Total PAHs including NDs	µg/L	ND	20	ND	24	ND	19.8	ND	21.27
Total PAHs excluding NDs	µg/L	all	ND	all	ND	all	ND	all	ND
Dioxins and furans									
2378 TCDD	ng/L	ND	0.01	ND	0.005	ND	0.002	ND	0.005
12378 PeCDD	ng/L	ND	0.003	ND	0.003	ND	0.003	ND	0.003
123478 HxCDD	ng/L	ND	0.002	ND	0.003	ND	0.004	ND	0.003
123678 HxCDD	ng/L	ND	0.004		0.004		0.01	<	0.005
123789 HxCDD	ng/L	ND	0.002	ND	0.004		0.004	<	0.003
1234678 HpCDD	ng/L		0.02		0.06		0.07		0.050
OCDD	ng/L	F	0.12		0.52	F	0.35		0.330
2378 TCDF	ng/L		0.01		0.03		0.02		0.020
12378 PeCDF	ng/L	ND	0.01		0.02		0.01	<	0.011
23478 PeCDF	ng/L	ND	0.01		0.02		0.01	<	0.010
123478 HxCDF	ng/L		0.005		0.01		0.01		0.009
123678 HXCDF	ng/L	F	0.002	F	0.00	ND	0.004	<	0.003
234678 HxCDF	ng/L	ND	0.004		0.01	ND	0.004	<	0.006
123789 HxCDF	ng/L	ND	0.002	ND	0.00	ND	0.003	ND	0.003
1234678 HpCDF	ng/L		0.01		0.04		0.03		0.026
1234789 HpCDF	ng/L	ND	0.003	ND	0.004	ND	0.01	ND	0.005
OCDF	ng/L		0.02		0.09		0.03		0.046
TCDD (total)	ng/L		0.01		0.02		0.04		0.023
PeCDD (total)	ng/L	ND	0.05		0.01		0.04	<	0.030
HxCDD (total)	ng/L	F	0.01		0.02		0.10		0.042
HpCDD (total)	ng/L	F	0.02		0.12		0.14		0.092
TCDF (total)	ng/L		0.03		0.27		0.07		0.121
PeCDF (total)	ng/L	ND	0.23		0.09		0.04	<	0.120
HxCDF (total)	ng/L		0.01		0.05		0.03		0.030
HpCDF (total)	ng/L		0.03		0.09		0.04		0.054
Total dioxins (by isomer) including NDs	ng/L	<	0.16	<	0.60	<	0.44	<	0.401
Total furans (by isomer) including NDs	ng/L	<	0.07	<	0.22	<	0.12	<	0.139
Total dioxin/furans (by isomer) in NDs	ng/L	<	0.23	<	0.82	<	0.57	<	0.539
Total dioxins (by isomer) excluding NDs	ng/L	>	0.10	>	0.58	>	0.43	>	0.380
Total furans (by isomer) excluding NDs	ng/L	>	0.09	>	0.22	>	0.11	>	0.130
Total dioxin/furans (by isomer) ex NDs	ng/L	>	0.19	>	0.80	>	0.54	>	0.510

TABLE A2-1. SS1 - WASTE WATER SUMMARY (continued)

Substance	Units	CONDITION 1 - WASTE WATER							
		Flag	Run 1	Flag	Run 2	Flag	Run 3		Average
Volatile organic compounds									
Vinyl chloride	µg/L		ND 2		ND 2		ND 2	ND	2.0
Methyl chloride	µg/L		14		BQL 2		ND 2	<	6.0
Trans-1,2-dichloroethene	µg/L		ND 2		BQL 2		ND 2	<	2.0
Cis-1,2-dichloroethene	µg/L		ND 2		BQL 2		ND 2	<	2.0
Chloroform	µg/L		ND 2		ND 2		ND 2	ND	2.0
1,1,1 - Trichloroethane	µg/L		ND 2		BQL 2		ND 2	<	2.0
Carbon tetrachloride	µg/L		ND 2		BQL 2		ND 2	<	2.0
Benzene	µg/L		ND 2		BQL 5		BQL 4	<	3.7
1,2 - Dichloroethane	µg/L		ND 2		ND 2		ND 2	ND	2.0
Trichloroethene	µg/L		BQL 2		BQL 2		ND 2	<	2.0
Toluene	µg/L		ND 2		ND 2		ND 2	ND	2.0
1,1,2 - Trichloroethane	µg/L		ND 2		ND 2		ND 2	ND	2.0
Tetrachloroethene	µg/L		ND 2		BQL 2		ND 2	<	2.0
1,2 - Dibromoethane	µg/L		ND 2		ND 2		ND 2	ND	2.0
Chlorobenzene	µg/L		ND 2		ND 2		ND 2	ND	2.0
Ethylbenzene	µg/L		ND 2		ND 2		ND 2	ND	2.0
M-/P-Xylene	µg/L		ND 2		ND 2		ND 2	ND	2.0
O-Xylene	µg/L		ND 2		ND 2		ND 2	ND	2.0
1,3 - Dichlorobenzene	µg/L		ND 2		ND 2		ND 2	ND	2.0
1,4 - Dichlorobenzene	µg/L		ND 2		ND 2		ND 2	ND	2.0
1,2 - Dichlorobenzene	µg/L		ND 2		ND 2		ND 2	ND	2.0
Trace metals									
Antimony	µg/L		ND 100		ND 100		ND 100	ND	100.0
Arsenic	µg/L		ND 100		ND 100		ND 100	ND	100.0
Barium	µg/L		440		350		370		386.7
Beryllium	µg/L		ND 10		ND 10		ND 10	ND	10.0
Cadmium	µg/L		ND 10		ND 10		ND 10	ND	10.0
Chromium (total)	µg/L		ND 10		ND 10		13	<	11.0
Copper	µg/L		29		23		28		26.7
Lead	µg/L		54		ND 50		57		53.7
Manganese	µg/L		170		ND 10		200	<	127
Mercury	µg/L		ND 0.2		ND 0.2		ND 0.2	ND	0.20
Nickel	µg/L		ND 10		ND 10		ND 10	ND	10.0
Phosphorus	µg/L		150		210		250		203.3
Selenium	µg/L		ND 100		ND 100		ND 100	ND	100.0
Silver	µg/L		ND 10		ND 10		ND 10	ND	10.0
Thallium	µg/L		ND 100		ND 100		ND 100	ND	100.0
Tin	µg/L		ND 100		ND 100		ND 100	ND	100.0
Zinc	µg/L		160		270		440		290.0
Miscellaneous									
Total organic carbon	ppmw		21.9		10.8		8.9		13.9
Total sulfur (as S)	wt. %	31	0.002	31	0.002	31	0.003		0.002
Organic halogens (as chloride)	ppbw	30	103	30	1380	30	66.5		517
Inorganic halogens (as chloride)	ppmw		1600		1200		1400		1400
Hexavalent chromium	ppmw		0.01	ND	0.01	ND	0.01	<	0.010
Physical characteristics									
Density	g/cc		0.98		0.98		0.97		0.98
pH	-		10.0		7.8		7.7		8.5

TABLE A2-1. SS1 - WASTE WATER SUMMARY (continued)

Substance	Units	CONDITION 3 - WASTE OIL									
		Flag	Run 1	Flag	Run 2	Flag	Run 3		Average		
	kg/hr		284		62.2		53.0		133.2		
Total stream flow rate	lb/hr		627		137		117		293.6		
	L/hr		293		63.4		53.6		136.7		
Polychlorinated biphenyls (PCB)											
Monochlorobiphenyl (total)	µg/L	BQL	0.04	BQL	0.06	BQL	0.02	BQL	0.039		
Dichlorobiphenyl (total)	µg/L		6.4		1.55	BQL	0.62	<	2.855		
Trichlorobiphenyl (total)	µg/L		9.7	BQL	1.1	BQL	1	<	3.933		
Tetrachlorobiphenyl (total)	µg/L	BQL	9.4	BQL	0.61	BQL	1.25	BQL	3.753		
Pentachlorobiphenyl (total)	µg/L	BQL	3.8	BQL	0.14	BQL	0.53	BQL	1.487		
Hexachlorobiphenyl (total)	µg/L	BQL	0.47	ND	8.4	BQL	0.05	BQL	2.975		
Heptachlorobiphenyl (total)	µg/L	BQL	0.067	ND	7.2	ND	7.2	<	4.822		
Octachlorobiphenyl (total)	µg/L	ND	4.4	ND	3.6	ND	3.6	ND	3.867		
Nonachlorobiphenyl (total)	µg/L	ND	1.1	ND	0.9	ND	0.9	ND	0.967		
Decachlorobiphenyl (total)	µg/L	ND	0.62	ND	0.5	ND	0.5	ND	0.540		
Total PCBs (tri-deca) including NDs	µg/L	<	29.6	<	22.4	<	15.0	<	22.34		
Total PCBs (mono-deca) including NDs	µg/L	<	36.0	<	24.1	<	15.7	<	25.24		
Total PCBs (tri-deca) excluding NDs	µg/L	>	23.40	>	1.85	>	2.83	>	9.36		
Total PCBs (mono-deca) excluding NDs	µg/L	>	29.90	>	3.48	>	3.47	>	12.28		
Chlorobenzenes and chlorophenols											
1,2-Dichlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
1,3-Dichlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
1,4-Dichlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
Total dichlorobenzenes	µg/L	34 ND	2.94	34 ND	3	34 ND	2.88	ND	2.940		
1,2,3-Trichlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
1,3,5-Trichlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
1,2,4-Trichlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
Total trichlorobenzenes	µg/L	34 ND	2.94	34 ND	3	34 ND	2.88	ND	2.940		
1,2,3,4-Tetrachlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
1,2,3,5- and/or 1,2,4,5-Tetrachloro- benzene	µg/L	34 ND	2	34 ND	2	34 ND	1.90	ND	1.967		
Total tetrachlorobenzenes	µg/L	34 ND	2.98	34 ND	3	34 ND	2.86	ND	2.947		
Pentachlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
Hexachlorobenzene	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,3-Dichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,4-Dichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,5-Dichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,6-Dichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
3,4-Dichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
3,5-Dichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
Total dichlorophenols	µg/L	34 ND	5.88	34 ND	6	34 ND	5.76	ND	5.880		
2,3,4-Trichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,3,5-Trichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,3,6-Trichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,4,5-Trichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
2,4,6-Trichlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
Total trichlorophenols	µg/L	34 ND	4.9	34 ND	5	34 ND	4.80	ND	4.900		
2,3,4,5- and/or 2,3,4,6-Tetrachlorophenol	µg/L	34 ND	2	34 ND	2	34 ND	1.90	ND	1.967		
2,3,5,6-Tetrachlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
Total tetrachlorophenols	µg/L	34 ND	2.98	34 ND	3	34 ND	2.86	ND	2.947		
Pentachlorophenol	µg/L	34 ND	0.98	34 ND	1	34 ND	0.96	ND	0.980		
Total CB including NDs	µg/L	34 ND	10.82	34 ND	11	34 ND	10.5	ND	10.79		
Total CP including NDs	µg/L	34 ND	14.74	34 ND	15	34 ND	14.4	ND	14.71		
Total CB excluding NDs	µg/L	all	ND	all	ND	all	ND	all	ND		
Total CP excluding NDs	µg/L	all	ND	all	ND	all	ND	all	ND		

TABLE A2-1. SS1 - WASTE WATER SUMMARY (continued)

Substance	Units	CONDITION 3 - WASTE OIL							
		Flag	Run 1	Flag	Run 2	Flag	Run 3		Average
Polycyclic aromatic hydrocarbons (PAH)									
Naphthalene	µg/L		ND 0.98		BQL 4.7		BQL 4.70	<	3.460
2-Methylnaphthalene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
2-Cl-Naphthalene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Acenaphthylene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Acenapthene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Fluorene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Phenanthrene	µg/L		ND 0.98		BQL 5.2		ND 0.96	<	2.380
Anthracene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Fluoranthene	µg/L		BQL 2.5		BQL 1.6		BQL 1.10	<	1.733
Pyrene	µg/L		BQL 1.9		BQL 1.5		BQL 1.10	<	1.500
Benzo (a) anthracene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Chrysene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Benzo (b) fluoranthene	µg/L		BQL 1.1		ND 1		ND 0.96	<	1.020
Benzo (k) fluoranthene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Benzo (e) pyrene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Benzo (a) pyrene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Perylene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Indeno (1,2,3-cd) pyrene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Dibenz (a,h) anthracene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Benzo (g,h,i) perylene	µg/L		ND 0.98		ND 1		ND 0.96	ND	0.980
Total PAHs including NDs	µg/L		< 22.16		< 29.0		< 23.2	<	24.79
Total PAHs excluding NDs	µg/L		> 5.60		> 8.30		> 2.20	>	5.36
Dioxins and furans									
2378 TCDD	ng/L		0.003		ND 0.003		ND 0.04	<	0.014
12378 PeCDD	ng/L		ND 0.005		ND 0.001		ND 0.04	ND	0.016
123478 HxCDD	ng/L		0.004		ND 0.001		ND 0.01	<	0.005
123678 HxCDD	ng/L		0.02		ND 0.002		ND 0.02	<	0.013
123789 HxCDD	ng/L		ND 0.01		ND 0.002		ND 0.01	ND	0.007
1234678 HpCDD	ng/L		0.44		0.01		ND 0.02	<	0.156
OCDD	ng/L		2.80		F 0.06		0.14		1.000
2378 TCDF	ng/L		0.10		ND 0.004		ND 0.04	<	0.048
12378 PeCDF	ng/L		0.05		ND 0.001		ND 0.05	<	0.033
23478 PeCDF	ng/L		0.08		ND 0.001		ND 0.04	<	0.039
123478 HxCDF	ng/L		0.05		ND 0.002		ND 0.01	<	0.022
123678 HXCDF	ng/L		0.02		ND 0.005		ND 0.01	<	0.010
234678 HxCDF	ng/L		0.02		ND 0.006		ND 0.02	<	0.015
123789 HxCDF	ng/L		0.01		ND 0.002		ND 0.01	<	0.009
1234678 HpCDF	ng/L		0.15		ND 0.01		ND 0.01	<	0.056
1234789 HpCDF	ng/L		0.01		ND 0.004		ND 0.01	<	0.006
OCDF	ng/L		0.34		F 0.01		ND 0.02	<	0.122
TCDD (total)	ng/L		0.06		F 0.01		ND 0.77	<	0.279
PeCDD (total)	ng/L		0.08		0.004		ND 0.57	<	0.218
HxCDD (total)	ng/L		0.32		0.01		ND 0.12	<	0.148
HpCDD (total)	ng/L		0.84		0.02		ND 0.01	<	0.288
TCDF (total)	ng/L		0.53		0.01		0.03		0.187
PeCDF (total)	ng/L		0.34		ND 0.04		ND 1.16	<	0.513
HxCDF (total)	ng/L		0.22		ND 0.06		ND 0.20	<	0.161
HpCDF (total)	ng/L		0.37		ND 0.02		ND 0.04	<	0.143
Total dioxins (by isomer) including NDs	ng/L		3.28		< 0.08		< 0.27	<	1.211
Total furans (by isomer) including NDs	ng/L		0.83		< 0.04		< 0.21	<	0.361
Total dioxin/furans (by isomer) in NDs	ng/L		4.11		< 0.12		< 0.49	<	1.571
Total dioxins (by isomer) excluding NDs	ng/L		3.27		> 0.07		> 0.14	>	1.16
Total furans (by isomer) excluding NDs	ng/L		> 0.13		> 0.01		all ND	>	0.28
Total dioxin/furans (by isomer) ex NDs	ng/L		> 0.51		> 0.08		> 0.14	>	1.44

TABLE A2-1. SS1 - WASTE WATER SUMMARY (continued)

Substance	Units	CONDITION 3 - WASTE OIL							
		Flag	Run 1	Flag	Run 2	Flag	Run 3	Average	
Volatile organic compounds									
Vinyl chloride	µg/L	ND	2	ND	2	ND	2	ND	2.0
Methyl chloride	µg/L	BQL	3	ND	2	ND	2	<	2.3
Trans-1,2-dichloroethene	µg/L	ND	2	ND	2	ND	2	ND	2.0
Cis-1,2-dichloroethene	µg/L	ND	2	ND	2	ND	2	ND	2.0
Chloroform	µg/L	BQL	2	ND	2	ND	2	<	2.0
1,1,1 - Trichloroethane	µg/L	ND	2	ND	2	ND	2	ND	2.0
Carbon tetrachloride	µg/L	ND	2	ND	2	ND	2	ND	2.0
Benzene	µg/L	BQL	4		10		12	<	8.7
1,2 - Dichloroethane	µg/L	ND	2	ND	2	ND	2	ND	2.0
Trichloroethene	µg/L	ND	2	ND	2	ND	2	ND	2.0
Toluene	µg/L	ND	2	BQL	8	BQL	3	<	4.3
1,1,2 - Trichloroethane	µg/L	ND	2	ND	2	ND	2	ND	2.0
Tetrachloroethene	µg/L	BQL	9	ND	2	ND	2	<	4.3
1,2 - Dibromoethane	µg/L	ND	2	ND	2	ND	2	ND	2.0
Chlorobenzene	µg/L	ND	2	ND	2	ND	2	ND	2.0
Ethylbenzene	µg/L	ND	2	ND	2	ND	2	ND	2.0
M-/P-Xylene	µg/L	ND	2	ND	2	ND	2	ND	2.0
O-Xylene	µg/L	ND	2	ND	2	ND	2	ND	2.0
1,3 - Dichlorobenzene	µg/L	ND	2	ND	2	ND	2	ND	2.0
1,4 - Dichlorobenzene	µg/L	ND	2	ND	2	ND	2	ND	2.0
1,2 - Dichlorobenzene	µg/L	ND	2	ND	2	ND	2	ND	2.0
Trace metals									
Antimony	µg/L	ND	100	ND	100	ND	100	ND	100.0
Arsenic	µg/L		150	ND	100	ND	100	ND	116.7
Barium	µg/L		700		420		470		530.0
Beryllium	µg/L	ND	10	ND	10	ND	10	ND	10.0
Cadmium	µg/L	ND	10	ND	10	ND	10	ND	10.0
Chromium (total)	µg/L		80		10	ND	10	<	33.3
Copper	µg/L		260		15		40		105
Lead	µg/L		460	ND	50	ND	50		187
Manganese	µg/L		1700		86		110	<	632
Mercury	µg/L		0.49	ND	0.2	ND	0.2	ND	0.30
Nickel	µg/L		79	ND	10	ND	10	ND	33.0
Phosphorus	µg/L		1800		150		240		730.0
Selenium	µg/L	ND	100	ND	100	ND	100	ND	100.0
Silver	µg/L	ND	10	ND	10	ND	10	ND	10.0
Thallium	µg/L	ND	100	ND	100	ND	100	ND	100.0
Tin	µg/L	ND	100	ND	100	ND	100	ND	100.0
Zinc	µg/L		2800		210		310		1107
Miscellaneous									
Total organic carbon	ppmw		24.6		35.0		36.3		31.97
Total sulfur (as S)	wt. %	31	0.004	31	0.005	31	0.006		0.0051
Organic halogens (as chloride)	ppbw	30	136	30	37.8	30	53.6		75.80
Inorganic halogens (as chloride)	ppmw		1300		1900		1900		1700
Hexavalent chromium	ppmw	ND	0.01	ND	0.01	ND	0.01	ND	0.010
Physical characteristics									
Density	g/cc		0.97		0.98		0.99		0.98
pH	–		7.6		7.4		7.7		7.57

TABLE A2-2. SS2 - WASTE OIL SUMMARY

Substance	Units	CONDITION 1 WASTE WATER		CONDITION 3 WASTE OIL	
		Flag		Flag	
Total stream flow rate - Run 1	kg/hr		1.61		21.3
Total stream flow rate - Run 2	kg/hr		1.55		26.8
Total stream flow rate - Run 3	kg/hr		1.22		21.2
Average	kg/hr		1.460		23.10
Polychlorinated biphenyls (PCB)					
Monochlorobiphenyl (total)	µg/kg		265000		280000
Dichlorobiphenyl (total)	µg/kg		11500000		12500000
Trichlorobiphenyl (total)	µg/kg		68500000		70500000
Tetrachlorobiphenyl (total)	µg/kg		110000000		120000000
Pentachlorobiphenyl (total)	µg/kg	BQL	41500000	BQL	44500000
Hexachlorobiphenyl (total)	µg/kg	BQL	4950000	BQL	5300000
Heptachlorobiphenyl (total)	µg/kg		845000		825000
Octachlorobiphenyl (total)	µg/kg	BQL	225000	BQL	225000
Nonachlorobiphenyl (total)	µg/kg	BQL	44000	BQL	42500
Decachlorobiphenyl (total)	µg/kg	BQL	25700	BQL	1300
Total PCBs (tri-deca) including NDs	µg/kg		226000000		241000000
Total PCBs (mono-deca) including NDs	µg/kg		238000000		254000000
Total PCBs (tri-deca) excluding NDs	µg/kg	all	detected	all	detected
Total PCBs (mono-deca) excluding NDs	µg/kg	all	detected	all	detected
Chlorobenzenes and chlorophenols					
1,2-Dichlorobenzene	µg/kg	BQL	11000	ND	10000
1,3-Dichlorobenzene	µg/kg	ND	9300	ND	10000
1,4-Dichlorobenzene	µg/kg	BQL	57000	BQL	40000
Total dichlorobenzenes	µg/kg		77300		60000
1,2,3-Trichlorobenzene	µg/kg	BQL	20000	BQL	20000
1,3,5-Trichlorobenzene	µg/kg	ND	9300	ND	10000
1,2,4-Trichlorobenzene	µg/kg		100000	BQL	95000
Total trichlorobenzenes	µg/kg		129000		125000
1,2,3,4-Tetrachlorobenzene	µg/kg	ND	9300	ND	10000
1,2,3,5- and/or 1,2,4,5-Tetrachloro- benzene	µg/kg	ND	19000	ND	20000
Total tetrachlorobenzenes	µg/kg	ND	28300	ND	30000
Pentachlorobenzene	µg/kg	ND	9300	ND	10000
Hexachlorobenzene	µg/kg	ND	9300	ND	10000
2,3-Dichlorophenol	µg/kg	ND	9300	ND	10000
2,4-Dichlorophenol	µg/kg	ND	9300	ND	10000
2,5-Dichlorophenol	µg/kg	ND	9300	ND	10000
2,6-Dichlorophenol	µg/kg	ND	9300	ND	10000
3,4-Dichlorophenol	µg/kg	ND	9300	ND	10000
3,5-Dichlorophenol	µg/kg	ND	9300	ND	10000
Total dichlorophenols	µg/kg	ND	55800	ND	60000
2,3,4-Trichlorophenol	µg/kg	ND	9300	ND	10000
2,3,5-Trichlorophenol	µg/kg	ND	9300	ND	10000
2,3,6-Trichlorophenol	µg/kg	ND	9300	ND	10000
2,4,5-Trichlorophenol	µg/kg	ND	9300	ND	10000
2,4,6-Trichlorophenol	µg/kg	ND	9300	ND	10000
Total trichlorophenols	µg/kg	ND	46500	ND	50000
2,3,4,5- and/or 2,3,4,6-Tetrachlorophenol	µg/kg	ND	19000	ND	20000
2,3,5,6-Tetrachlorophenol	µg/kg	ND	9300	ND	10000
Total tetrachlorophenols	µg/kg	ND	28300	ND	30000
Pentachlorophenol	µg/kg	ND	9300	ND	10000
Total CB including NDs	µg/kg	ND	253500	ND	235000
Total CP including NDs	µg/kg	ND	140000	ND	150000
Total CB excluding NDs	µg/kg	>	188000	>	155000
Total CP excluding NDs	µg/kg	all	NDs	all	NDs

TABLE A2-2. SS2 - WASTE OIL SUMMARY (continued)

Substance	Units	CONDITION 1 WASTE WATER		CONDITION 3 WASTE OIL	
		Flag		Flag	
Polycyclic aromatic hydrocarbons (PAH)					
Naphthalene	µg/kg	BQL	58000	BQL	56000
2-Methylnaphthalene	µg/kg		95000	BQL	88000
2-Cl-Naphthalene	µg/kg	ND	9300	ND	10000
Acenaphthylene	µg/kg	ND	9300	ND	10000
Acenapthene	µg/kg	ND	9300	BQL	52000
Fluorene	µg/kg	ND	9300	ND	10000
Phenanthrene	µg/kg	ND	9300	ND	10000
Anthracene	µg/kg	ND	9300	ND	10000
Fluoranthene	µg/kg	ND	9300	ND	10000
Pyrene	µg/kg	ND	9300	ND	10000
Benzo (a) anthracene	µg/kg	ND	9300	ND	10000
Chrysene	µg/kg	ND	9300	ND	10000
Benzo (b) fluoranthene	µg/kg	ND	9300	ND	10000
Benzo (k) fluoranthene	µg/kg	ND	9300	ND	10000
Benzo (e) pyrene	µg/kg	ND	9300	ND	10000
Benzo (a) pyrene	µg/kg	ND	9300	ND	10000
Perylene	µg/kg	ND	9300	ND	10000
Indeno (1,2,3-cd) pyrene	µg/kg	ND	9300	ND	10000
Dibenz (a,h) anthracene	µg/kg	ND	9300	ND	10000
Benzo (g,h,i) perylene	µg/kg	ND	9300	ND	10000
Total PAHs including NDs	µg/kg	<	320000	<	366000
Total PAHs excluding NDs	µg/kg	>	153000	>	196000
Dioxins and furans					
2378 TCDD	ng/kg	ND	170	ND	98
12378 PeCDD	ng/kg	ND	1700	ND	68
123478 HxCDD	ng/kg	ND	290	ND	190
123678 HxCDD	ng/kg	ND	630		210
123789 HxCDD	ng/kg	ND	170	ND	100
1234678 HpCDD	ng/kg		2200		1900
OCDD	ng/kg		14000		13000
2378 TCDF	ng/kg		31000		33000
12378 PeCDF	ng/kg		16000		16000
23478 PeCDF	ng/kg		88000		150000
123478 HxCDF	ng/kg		58000		49000
123678 HXCDF	ng/kg		16000		15000
234678 HxCDF	ng/kg		6800		18000
123789 HxCDF	ng/kg		17000		21000
1234678 HpCDF	ng/kg		18000		18000
1234789 HpCDF	ng/kg		14000		13000
OCDF	ng/kg		43000		44000
TCDD (total)	ng/kg		190		160
PeCDD (total)	ng/kg	ND	23800	ND	952
HxCDD (total)	ng/kg	ND	3630		210
HpCDD (total)	ng/kg		3900		3600
TCDF (total)	ng/kg		910000		1100000
PeCDF (total)	ng/kg		570000		620000
HxCDF (total)	ng/kg		200000		200000
HpCDF (total)	ng/kg		57000		57000
Total dioxins (by isomer) including NDs	ng/kg	<	19000	<	16000
Total furans (by isomer) including NDs	ng/kg		308000		377000
Total dioxin/furans (by isomer) in NDs	ng/kg	<	327000	<	393000
Total dioxins (by isomer) excluding NDs	ng/kg	>	16200	>	15100
Total furans (by isomer) excluding NDs	ng/kg	all	detected	all	detected
Total dioxin/furans (by isomer) ex NDs	ng/kg	>	32400	>	392100

TABLE A2-2. SS2 - WASTE OIL SUMMARY (continued)

Substance	Units	CONDITION 1 WASTE WATER		CONDITION 3 WASTE OIL	
		Flag		Flag	
Volatile organic compounds					
Vinyl chloride	g/L	ND	2	ND	2
Methyl chloride	g/L		38		30
Trans-1,2-dichloroethene	g/L	ND	2	ND	2
Cis-1,2-dichloroethene	g/L	ND	20	ND	19
Chloroform	g/L	ND	2	ND	2
1,1,1 - Trichloroethane	g/L	ND	2	ND	2
Carbon tetrachloride	g/L	ND	2	ND	2
Benzene	g/L	BQL	3	ND	2
1,2 - Dichloroethane	g/L	ND	2	ND	2
Trichloroethene	g/L		180		200
Toluene	g/L		15	BQL	7
1,1,2 - Trichloroethane	g/L	ND	2	ND	2
Tetrachloroethene	g/L	ND	2	ND	2
1,2 - Dibromoethane	g/L	ND	2	ND	2
Chlorobenzene	g/L	ND	2	ND	2
Ethylbenzene	g/L	BQL	5	BQL	3
M-/P-Xylene	g/L		16		11
O-Xylene	g/L	BQL	5	BQL	3
1,3 - Dichlorobenzene	g/L	ND	2	ND	2
1,4 - Dichlorobenzene	g/L	ND	2	ND	2
1,2 - Dichlorobenzene	g/L	ND	2	ND	2
Trace metals					
Antimony	mg/kg	ND	10	ND	10
Arsenic	mg/kg	ND	10	ND	10
Barium	mg/kg		6		6
Beryllium	mg/kg	ND	1	ND	1
Cadmium	mg/kg	ND	1		1
Chromium (Total)	mg/kg		16		15
Copper	mg/kg		8		9
Lead	mg/kg		110		120
Manganese	mg/kg	ND	1	ND	1
Mercury	mg/kg	ND	0.10		0.26
Nickel	mg/kg		3.50		4.30
Phosphorus	mg/kg		270		280
Selenium	mg/kg	ND	10	ND	10
Silver	mg/kg	ND	1	ND	1
Thallium	mg/kg	ND	10	ND	10
Tin	mg/kg	ND	10		11
Zinc	mg/kg		88		100
Ultimate analysis					
Carbon	wt. %		62.1		2.0
Hydrogen	wt. %	32	7.78	32	7.89
Nitrogen	wt. %		0.04		0.05
Total sulfur (as S)	wt. %	31	0.58	31	0.67
Oxygen	wt. %		19.1		7.77
Miscellaneous					
Heating value	Btu/lb		13500		16700
Hexavalent chromium	ppmw		0.01	ND	0.01
Chlorine	wt. %		10.5		21.7
Fluorine	wt. %	<	0.01	<	0.01
Phosphate	wt. %	<	0.01	<	0.01
Ash	wt. %	ND	0.01		0.41
Total halogens (as chloride)	wt. %		10.5		21.7

TABLE A2-3. SS3 - CONTAMINATED SOIL SUMMARY

Substance	Units	CONDITION 2 - SOIL					
		Flag		Run 1	Flag		Run 2
Total stream flow rate	kg/hr			127			23.7
	lb/hr			280			52.3
Polychlorinated biphenyls (PCB)							
Monochlorobiphenyl (total)	µg/kg	50	BQL	520	50	BQL	755
Dichlorobiphenyl (total)	µg/kg	50		25000	50		33000
Trichlorobiphenyl (total)	µg/kg	50		140000	50		200000
Tetrachlorobiphenyl (total)	µg/kg	50		220000	50		315000
Pentachlorobiphenyl (total)	µg/kg	50		93000	50		141000
Hexachlorobiphenyl (total)	µg/kg	50	BQL	8900	50	BQL	13800
Heptachlorobiphenyl (total)	µg/kg	50	BQL	1100	50	BQL	2400
Octachlorobiphenyl (total)	µg/kg	50	ND	36000	50	BQL	640
Nonachlorobiphenyl (total)	µg/kg	50	ND	8900	50	BQL	4760
Decachlorobiphenyl (total)	µg/kg	50	ND	4900	50	ND	4850
Total PCBs (tri-deca) including NDs	µg/kg	50	<	513000	50	<	682000
Total PCBs (mono-deca) including NDs	µg/kg	50	<	538000	50	<	716000
Total PCBs (tri-deca) excluding NDs	µg/kg	50	>	463000	50	>	677000
Total PCBs (mono-deca) excluding NDs	µg/kg	50	>	488500	50	>	711000
Chlorobenzenes and chlorophenols							
1,2-Dichlorobenzene	µg/kg		ND	990		ND	890
1,3-Dichlorobenzene	µg/kg		ND	990		ND	890
1,4-Dichlorobenzene	µg/kg		ND	990		ND	890
Total dichlorobenzenes	µg/kg		ND	2970		ND	2670
1,2,3-Trichlorobenzene	µg/kg		ND	990		ND	890
1,3,5-Trichlorobenzene	µg/kg		ND	990		ND	890
1,2,4-Trichlorobenzene	µg/kg		ND	990		ND	890
Total trichlorobenzenes	µg/kg		ND	2970		ND	2670
1,2,3,4-Tetrachlorobenzene	µg/kg		ND	990		ND	890
1,2,3,5- and/or 1,2,4,5-Tetrachloro- benzene	µg/kg		ND	2000		ND	1800
Total tetrachlorobenzenes	µg/kg		ND	2990		ND	2690
Pentachlorobenzene	µg/kg		ND	990		ND	890
Hexachlorobenzene	µg/kg			6300			13000
2,3-Dichlorophenol	µg/kg		ND	990		ND	890
2,4-Dichlorophenol	µg/kg		ND	990		ND	890
2,5-Dichlorophenol	µg/kg		ND	990		ND	890
2,6-Dichlorophenol	µg/kg		ND	990		ND	890
3,4-Dichlorophenol	µg/kg		ND	990		ND	890
3,5-Dichlorophenol	µg/kg		ND	990		ND	890
Total dichlorophenols	µg/kg		ND	5940		ND	5340
2,3,4-Trichlorophenol	µg/kg		ND	990		ND	890
2,3,5-Trichlorophenol	µg/kg		ND	990		ND	890
2,3,6-Trichlorophenol	µg/kg		ND	990		ND	890
2,4,5-Trichlorophenol	µg/kg		ND	990		ND	890
2,4,6-Trichlorophenol	µg/kg		ND	990		ND	890
Total trichlorophenols	µg/kg		ND	4950		ND	4450
2,3,4,5- and/or 2,3,4,6-Tetrachlorophenol	µg/kg		ND	2000		ND	1800
2,3,5,6-Tetrachlorophenol	µg/kg		ND	990		ND	890
Total tetrachlorophenols	µg/kg		ND	2990		ND	2690
Pentachlorophenol	µg/kg		ND	990		ND	890
Total CB including NDs	µg/kg		<	16200		<	21900
Total CP including NDs	µg/kg		ND	14900		ND	13400
Total CB excluding NDs	µg/kg		>	6300		>	13000
Total CP excluding NDs	µg/kg		all	ND		all	ND

TABLE A2-3. SS3 - CONTAMINATED SOIL SUMMARY (continued)

Substance	Units	CONDITION 2 - SOIL					
		Flag	Run 1		Flag	Run 2	
Polycyclic aromatic hydrocarbons (PAH)							
Naphthalene	µg/kg	52	BQL	1800	47,52	ND	890
2-Methylnaphthalene	µg/kg	52	BQL	1000	47,52	ND	890
2-Cl-Naphthalene	µg/kg	52	ND	990	47,52	ND	890
Acenaphthylene	µg/kg	52	ND	990	47,52	ND	890
Acenapthene	µg/kg	52	ND	990	47,52	ND	890
Fluorene	µg/kg	52	ND	990	47,52	ND	890
Phenanthrene	µg/kg	52	BQL	2900	47,52	ND	890
Anthracene	µg/kg	52	ND	990	47,52	ND	890
Fluoranthene	µg/kg	52	BQL	2400	47,52	ND	890
Pyrene	µg/kg	52	BQL	1900	47,52	ND	890
Benzo (a) anthracene	µg/kg	52	ND	990	47,52	ND	890
Chrysene	µg/kg	52	ND	990	47,52	ND	890
Benzo (b) fluoranthene	µg/kg	52	ND	990	47,52	ND	890
Benzo (k) fluoranthene	µg/kg	52	ND	990	47,52	ND	890
Benzo (e) pyrene	µg/kg	52	ND	990	47,52	ND	890
Benzo (a) pyrene	µg/kg	52	ND	990	47,52	ND	890
Perylene	µg/kg	52	ND	990	47,52	ND	890
Indeno (1,2,3-cd) pyrene	µg/kg	52	ND	990	47,52	ND	890
Dibenz (a,h) anthracene	µg/kg	52	ND	990	47,52	ND	890
Benzo (g,h,i) perylene	µg/kg	52	ND	990	47,52	ND	890
Total PAHs including NDs	µg/kg	52	<	24900	47,52	ND	17800
Total PAHs excluding NDs	µg/kg	52	>	10000	47,52	all	ND
Dioxins and furans							
2378 TCDD	ng/kg		ND	8.40		ND	6.40
12378 PeCDD	ng/kg		ND	13.0		ND	62.0
123478 HxCDD	ng/kg		ND	13.0			4.5
123678 HxCDD	ng/kg			18.0			11.0
123789 HxCDD	ng/kg		ND	31.0			7.60
1234678 HpCDD	ng/kg			540			180
OCDD	ng/kg			6200			2000
2378 TCDF	ng/kg			350			240
12378 PeCDF	ng/kg			190			100
23478 PeCDF	ng/kg			840			380
123478 HxCDF	ng/kg			480			260
123678 HXCDF	ng/kg			160			81.0
234678 HxCDF	ng/kg			59.0			35.0
123789 HxCDF	ng/kg		ND	29.0		ND	54.0
1234678 HpCDF	ng/kg			280			130
1234789 HpCDF	ng/kg			110			66
OCDF	ng/kg			760			470
TCDD (total)	ng/kg			23			19
PeCDD (total)	ng/kg		ND	182		ND	868
HxCDD (total)	ng/kg			150			73
HpCDD (total)	ng/kg			1100			350
TCDF (total)	ng/kg			6000			6100
PeCDF (total)	ng/kg			4900			2800
HxCDF (total)	ng/kg			1700			890
HpCDF (total)	ng/kg			770			370
Total dioxins (by isomer) including NDs	ng/kg		<	6800		<	2270
Total furans (by isomer) including NDs	ng/kg		<	3260		<	1820
Total dioxin/furans (by isomer) in NDs	ng/kg		<	10100		<	4100
Total dioxins (by isomer) excluding NDs	ng/kg		>	6758		>	2203
Total furans (by isomer) excluding NDs	ng/kg		>	3229		>	1762
Total dioxin/furans (by isomer) ex NDs	ng/kg		>	9987		>	3965

TABLE A2-3. SS3 - CONTAMINATED SOIL SUMMARY (continued)

Substance	Units	CONDITION 2 - SOIL					
		Flag		Run 1	Flag		Run 2
Volatile organic compounds							
Vinyl chloride	µg/kg	51	ALR	4900	51	ALR	2700
Methyl chloride	µg/kg	51	ALR	18000	51	ALR	12000
Trans-1,2-dichloroethene	µg/kg	51	ND	30	51	BQL	27
Cis-1,2-dichloroethene	µg/kg	51	ALR	31000	51	ALR	18000
Chloroform	µg/kg	51	ND	30	51	ND	28
1,1,1 - Trichloroethane	µg/kg	51	ND	30	51	ND	28
Carbon tetrachloride	µg/kg	51	ND	30	51	ND	28
Benzene	µg/kg	51	BQL	42	51	ND	28
1,2 - Dichloroethane	µg/kg	51	ND	30	51	ND	28
Trichloroethene	µg/kg	51	ALR	98000	51	ALR	62000
Toluene	µg/kg	51	ALR	9100	51	ALR	5900
1,1,2 - Trichloroethane	µg/kg	51	ND	30	51	ND	28
Tetrachloroethene	µg/kg	51	ND	30	51	ND	28
1,2 - Dibromoethane	µg/kg	51	ND	30	51	ND	28
Chlorobenzene	µg/kg	51	BQL	46	51	ND	28
Ethylbenzene	µg/kg	51	ALR	5100	51		2400
M-/P-Xylene	µg/kg	51	ALR	6800	51	ALR	3900
O-Xylene	µg/kg	51	ALR	4500	51	ND	28
1,3 - Dichlorobenzene	µg/kg	51	ND	30	51	ND	28
1,4 - Dichlorobenzene	µg/kg	51	BQL	93	51	ND	28
1,2 - Dichlorobenzene	µg/kg	51	ND	30	51	ND	28
Trace metals							
Antimony	mg/kg		ND	7.40		ND	7.40
Arsenic	mg/kg			27.0			13.0
Barium	mg/kg			110			50.0
Beryllium	mg/kg			0.45			0.27
Cadmium	mg/kg			2.1		ND	0.74
Chromium (total)	mg/kg			75			15
Copper	mg/kg			99			30
Lead	mg/kg			270			72
Manganese	mg/kg			410			250
Mercury	mg/kg			0.26		ND	0.15
Nickel	mg/kg			65			20
Phosphorus	mg/kg			630			340
Selenium	mg/kg		ND	7.4		ND	7.4
Silver	mg/kg		ND	0.74		ND	0.74
Thallium	mg/kg			13		ND	7.4
Tin	mg/kg			95			34
Zinc	mg/kg			360			490
Miscellaneous							
Moisture	wt. %			33			27
Total organic carbon	ppmw			19500			18100
Total sulfur (as S)	wt. %		NA			<	0.01
Organic halogens (as chloride)	ppbw			392		NA	
Total halogens (as chloride)	wt. %	3,5,30		0.04	5,30		0.34
Ash	wt. %			62.4			55
Hexavalent chromium	ppmw		ND	0.01		ND	0.01

TABLE A2-3. SS3 - CONTAMINATED SOIL SUMMARY (continued)

Substance	Units	CONDITION 2 - SOIL				
		Flag		Run 1	Flag	Run 2
TCLP volatiles						
Vinyl chloride	µg/L	3		350	NA	
Methyl chloride	µg/L	3	ALR	2200	NA	
Trans-1,2-dichloroethene	µg/L	3	ND	10	NA	
Cis-1,2-dichloroethene	µg/L	3		770	NA	
Chloroform	µg/L	3	ND	10	NA	
1,1,1 - Trichloroethane	µg/L	3	BQL	12	NA	
Carbon tetrachloride	µg/L	3	ND	10	NA	
Benzene	µg/L	3	ND	10	NA	
1,2 - Dichloroethane	µg/L	3	ND	10	NA	
Trichloroethene	µg/L	3	ALR	2400	NA	
Toluene	µg/L	3		230	NA	
1,1,2 - Trichloroethane	µg/L	3	ND	10	NA	
Tetrachloroethene	µg/L	3	ND	10	NA	
1,2 - Dibromoethane	µg/L	3	ND	10	NA	
Chlorobenzene	µg/L	3	ND	10	NA	
Ethylbenzene	µg/L	3		100	NA	
M-/P-Xylene	µg/L	3		200	NA	
O-Xylene	µg/L	3		100	NA	
1,3 - Dichlorobenzene	µg/L	3	ND	10	NA	
1,4 - Dichlorobenzene	µg/L	3	ND	10	NA	
1,2 - Dichlorobenzene	µg/L	3	ND	10	NA	
TCLP trace metals						
Arsenic	µg/kg	3	ND	100	ND	100
Barium	µg/kg	3		1800		1500
Cadmium	µg/kg	3	ND	10	ND	10
Chromium	µg/kg	3	ND	10		11
Lead	µg/kg	3	ND	50	ND	50
Mercury	µg/kg	3	ND	0.4	ND	0.4
Selenium	µg/kg	3	ND	100	ND	100
Silver	µg/kg	3	ND	10	ND	10

TABLE A2-4. SS4 - SCRUBBER CAUSTIC SUMMARY

Substance	Units	Flag	Composite
Total stream flow rate			
Conditon 1- Run 1	kg/hr		14.2
Condition 1- Run 2	kg/hr		14.0
Condtion 1- Run 3	kg/hr		24.7
Average	kg/hr		17.6
Condition 2 - Run 1	kg/hr		38.5
Condition 2 - Run 2	kg/hr		23.8
Average	kg/hr		na
Condition 3 - Run 1	kg/hr		83.0
Condition 3 - Run 2	kg/hr		161
Condtion 3 - Run 3	kg/hr		106
Average	kg/hr		116.7
Trace metals			
Antimony	µg/L	ND	100
Arsenic	µg/L	ND	100
Barium	µg/L	ND	10
Beryllium	µg/L	ND	10
Cadmium	µg/L	ND	10
Chromium (total)	µg/L		13
Copper	µg/L		630
Lead	µg/L	ND	50
Manganese	µg/L		16
Mercury	µg/L	ND	0.2
Nickel	µg/L		43
Phosphorus	µg/L	ND	100
Selenium	µg/L	ND	100
Silver	µg/L	ND	10
Thallium	µg/L	ND	100
Tin	µg/L	ND	100
Zinc	µg/L		460
Miscellaneous			
Total sulfur (as S)	wt. %		0.002
Hexavalent chromium	ppmw	ND	0.01
Organic halogens (as chloride)	ppbw	3	959
Inorganic halogens (as chloride)	ppmw		1200
Physical characteristics			
Density	g/cc^3		1.05
pH	–		13.6

TABLE A2-5. SS5 - SCRUBBER MAKE-UP WATER SUMMARY

Substance	Units	Condition 1 Waste water		Condition 2 Soil		Condition 3 Waste oil	
		Flag	Run 1	Flag	Run 1	Flag	Run 1
Total stream flow rate							
Run 1	kg/hr		0		0		0
Run 2	kg/hr		0		0		212
Run 3	kg/hr		0		–		322
Average	kg/hr		0		–		178.1
Trace metals							
Antimony	µg/L	ND	100	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100	ND	100
Barium	µg/L		14	ND	10	ND	10
Beryllium	µg/L	ND	10	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10	ND	10
Chromium (total)	µg/L	ND	10	ND	10	ND	10
Copper	µg/L		74		21		65
Lead	µg/L		140	ND	50	ND	50
Manganese	µg/L		11	ND	10	ND	10
Mercury	µg/L	ND	0.2	ND	0.2	ND	0.2
Nickel	µg/L	ND	10	ND	10	ND	10
Phosphorus	µg/L	ND	100	ND	100	ND	100
Selenium	µg/L	ND	100	ND	100	ND	100
Silver	µg/L	ND	10	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100	ND	100
Tin	µg/L	ND	100	ND	100	ND	100
Zinc	µg/L		13		34		16
Miscellaneous.							
Total sulfur (as S)	wt. %		0.0008		0.0008		0.0008
Hexavalent chromium	ppmw	ND	0.01	ND	0.01	ND	0.01
Organic halogens (as chloride)	ppbw	3	102		44	3	102
Inorganic halogens (as chloride)	ppmw		47		33		47
Physical characteristics							
Density	g/cc		0.98		1.00		0.98
pH	–		8.7		8.7		8.8

TABLE A2-6. SS6 - PROPANE SUMMARY

Substance	Units	Flag	Composite
Total stream flow rate			
Conditon 1- Run 1	kg/hr		6.71
Condition 1- Run 2	kg/hr		7.62
Condtion 1- Run 3	kg/hr		8.53
Average	kg/hr		7.62
Condition 2 - Run 1	kg/hr		9.53
Condition 2 - Run 2	kg/hr		13.8
Condition 3 - Run 1	kg/hr		17.3
Condition 3 - Run 2	kg/hr		9.89
Condtion 3 - Run 3	kg/hr		11.7
Average	kg/hr		12.9
Polychlorinated biphenyls (PCB)			
Monochlorobiphenyl (total)	µg/dscm	ND	0.01
Dichlorobiphenyl (total)	µg/dscm		0.02
Trichlorobiphenyl (total)	µg/dscm		0.13
Tetrachlorobiphenyl (total)	µg/dscm		0.04
Pentachlorobiphenyl (total)	µg/dscm	ND	0.02
Hexachlorobiphenyl (total)	µg/dscm	ND	0.02
Heptachlorobiphenyl (total)	µg/dscm	ND	0.02
Octachlorobiphenyl (total)	µg/dscm	EMPC	1.12
Nonachlorobiphenyl (total)	µg/dscm	ND	0.02
Decachlorobiphenyl (total)	µg/dscm	ND	0.07
Total PCBs (Tri-Deca) including NDs	µg/dscm	<	1.44
Total PCBs (Mono-Deca) incl. NDs	µg/dscm	<	1.47
Total PCBs (Tri-Deca) excluding NDs	µg/dscm	>	0.19
Total PCBs (Mono-Deca) excl. NDs	µg/dscm	>	0.17
Chlorobenzenes and chlorophenols			
1,2 Dichlorobenzene	µg/dscm	ND	0.72
1,3 - Dichlorobenzene	µg/dscm	ND	0.68
1,4 - Dichlorobenzene	µg/dscm	ND	0.70
1,2,3 - Trichlorobenzene	µg/dscm	ND	0.74
1,2,4 - Trichlorobenzene	µg/dscm	ND	0.68
1,3,5 - Trichlorobenzene	µg/dscm	ND	0.70
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	0.69
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	0.47
1,2,3,5 - Tetrachlorobenzene	µg/dscm	ND	0.50
Pentachlorobenzene	µg/dscm	ND	0.53
Hexachlorobenzene	µg/dscm	ND	0.42
2 - Chlorophenol	µg/dscm	ND	0.72
3,4 - Chlorophenol	µg/dscm	ND	0.35
2,3 - Dichlorophenol	µg/dscm	ND	1.01
2,4 - Dichlorophenol	µg/dscm	ND	0.78
3,4 - Dichlorophenol	µg/dscm	ND	0.88
3,5 - Dichlorophenol	µg/dscm	ND	0.84
2,5 - Dichlorophenol	µg/dscm	ND	0.80
2,6 - Dichlorophenol	µg/dscm	ND	0.77
2,3,4 - Trichlorophenol	µg/dscm	ND	1.13
2,3,5 - Trichlorophenol	µg/dscm	ND	1.10
2,3,6 - Trichlorophenol	µg/dscm	ND	1.07
2,4,5 - Trichlorophenol	µg/dscm	ND	1.05
2,4,6 - Trichlorophenol	µg/dscm	ND	1.09
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	0.85
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	0.88
Pentachlorophenol	µg/dscm	ND	0.90
Total chlorobenzenes	µg/dscm	ND	6.82
Total cholorophenols	µg/dscm	ND	14.2
Volatile organic compounds			
Vinyl chloride	µg/L	ND	0.8
Methyl chloride	µg/L	ND	0.8
Trans-1,2-dichloroethene	µg/L	ND	0.8
Cis-1,2-dichloroethene	µg/L	ND	0.8

TABLE A2-6. SS6 - PROPANE SUMMARY (continued)

Substance	Units	Flag	Composite
Chloroform	µg/L	ND	0.8
1,1,1 - Trichloroethane	µg/L	ND	0.8
Carbon tetrachloride	µg/L	ND	0.8
Benzene	µg/L	ND	6.5
1,2 - Dichloroethane	µg/L	ND	0.8
Trichloroethene	µg/L	ND	0.8
Toluene	µg/L	ND	13
1,1,2 - Trichloroethane	µg/L	ND	0.8
Tetrachloroethene	µg/L	ND	0.8
1,2 - Dibromoethane	µg/L	ND	0.8
Chlorobenzene	µg/L	ND	0.8
Ethylbenzene	µg/L	BQL	2.1
M-/P-Xylene	µg/L		6.7
O-Xylene	µg/L	BQL	2.6
1,3 - Dichlorobenzene	µg/L	ND	0.8
1,4 - Dichlorobenzene	µg/L	ND	0.8
1,2 - Dichlorobenzene	µg/L	ND	0.8
Sulfur compounds			
Hydrogen sulfide	ppbv	ND	400
Carbonyl sulfide	ppbv		8280
Methyl mercaptan	ppbv		2760
Ethyl mercaptan	ppbv		4130
Dimethyl sulfide	ppbv	ND	400
Carbon sulfide	ppbv	ND	400
N-Propylmercaptan	ppbv	ND	400
Dimethyl disulfide	ppbv	ND	200
Miscellaneous			
Heating value	Btu/lb	25	-
Density (assumed)	g/L		1.76

A2-7. SS7 - HYDROGEN - SUMMARY TABLE

Substance	Units	PROGRAM COMPOSITE Flag	C1,C2,C3
Polychlorinated biphenyls (PCBs)			
Monochlorobiphenyl (total)	µg/dscm	ND	0.0002
Dichlorobiphenyl (total)	µg/dscm		0.01
Trichlorobiphenyl (total)	µg/dscm		0.03
Tetrachlorobiphenyl (total)	µg/dscm		0.01
Pentachlorobiphenyl (total)	µg/dscm	EMPC	0.02
Hexachlorobiphenyl (total)	µg/dscm	ND	0.01
Heptachlorobiphenyl (total)	µg/dscm	ND	0.01
Octachlorobiphenyl (total)	µg/dscm	ND	0.01
Nonachlorobiphenyl (total)	µg/dscm	ND	0.01
Decachlorobiphenyl (total)	µg/dscm	ND	0.02
Total PCBs (Tri-Deca)	µg/dscm	ND	0.10
Total PCBs (Mono-Deca)	µg/dscm	ND	0.11
Chlorobenzenes and chlorophenols			
1,2 Dichlorobenzene	µg/dscm	ND	4.03
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	3.01
1,2,3,5 - Tetrachlorobenzene	µg/dscm	ND	3.05
1,2,3 - Trichlorobenzene	µg/dscm	ND	4.51
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	2.85
1,2,4 - Trichlorobenzene	µg/dscm	ND	4.18
1,3 - Dichlorobenzene	µg/dscm	ND	3.83
1,3,5 - Trichlorobenzene	µg/dscm	ND	4.26
1,4 - Dichlorobenzene	µg/dscm	ND	3.92
2,3 - Dichlorophenol	µg/dscm	ND	6.18
2,3,4 - Trichlorophenol	µg/dscm	ND	4.92
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	3.70
2,3,5 - Trichlorophenol	µg/dscm	ND	4.80
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	3.83
2,3,6 - Trichlorophenol	µg/dscm	ND	4.66
2,4 - Dichlorophenol	µg/dscm	ND	4.79
2,4,5 - Trichlorophenol	µg/dscm	ND	4.57
2,4,6 - Trichlorophenol	µg/dscm	ND	4.76
2,5 - Dichlorophenol	µg/dscm	ND	4.90
2,6 - Dichlorophenol	µg/dscm	ND	4.73
2 - Chlorophenol	µg/dscm	ND	4.06
3,4 - Dichlorophenol	µg/dscm	ND	3.81
3,5 - Dichlorophenol	µg/dscm	ND	3.65
3,4 - Chlorophenol	µg/dscm	ND	1.97
Hexachlorobenzene	µg/dscm	ND	1.98
Pentachlorobenzene	µg/dscm	ND	2.29
Pentachlorophenol	µg/dscm	ND	4.25
Total chlorobenzes	µg/dscm	ND	37.9
Total chlorophenols	µg/dscm	ND	69.6

A2-7. SS7 - HYDROGEN - SUMMARY TABLE

Substance	Units	PROGRAM COMPOSITE Flag	C1,C2,C3
Volatile Organic Compounds			
Vinyl chloride	µg/L	ND	554
Methyl chloride	µg/L	<	1930
Trans-1,2-dichloroethene	µg/L	ND	554
Cis-1,2-dichloroethene	µg/L	ND	554
Chloroform	µg/L	ND	554
1,1,1 - Trichloroethane	µg/L	ND	554
Carbon tetrachloride	µg/L	ND	554
Benzene	µg/L	BQL	1040
1,2 - Dichloroethane	µg/L	ND	554
Trichloroethene	µg/L	ND	554
Toluene	µg/L		10700
1,1,2 - Trichloroethane	µg/L	ND	554
Tetrachloroethene	µg/L	ND	554
1,2 - Dibromoethane	µg/L	ND	554
Chlorobenzene	µg/L	ND	554
Ethylbenzene	µg/L	ND	554
M-/P-Xylene	µg/L	ND	1110
O-Xylene	µg/L	ND	554
1,3 - Dichlorobenzene	µg/L	ND	554
1,4 - Dichlorobenzene	µg/L	ND	554
1,2 - Dichlorobenzene	µg/L	ND	554

TABLE A2-8. SS9 - COMBUSTION AIR SUMMARY

Substance	Units	Condition 1 Waste water		Condition 2 Soil			
		Flag		Flag	Run 1	Flag	Run 2
Total stream flow rate							
Run 1	kg/hr		236		259		-
Run 2	kg/hr		222		-		371
Run 3	kg/hr		219		-		-
Average	kg/hr		225		-		-
Run 1	dscm/hr		196		216		-
Run 2	dscm/hr		185		-		309
Run 3	dscm/hr		182		-		-
Average	dscm/hr		188		-		-
Polychlorinated biphenyls (PCB)							
Monochlorobiphenyl (total)	µg/dscm	ND	0.001		NA		0.01
Dichlorobiphenyl (total)	µg/dscm	EMPC	0.03		NA		0.10
Trichlorobiphenyl (total)	µg/dscm	ND	0.001		NA		0.51
Tetrachlorobiphenyl (total)	µg/dscm	ND	0.001		NA		0.49
Pentachlorobiphenyl (total)	µg/dscm	B	0.01		NA		0.08
Hexachlorobiphenyl (total)	µg/dscm	ND	0.002		NA	ND	0.005
Heptachlorobiphenyl (total)	µg/dscm	ND	0.002		NA	ND	0.005
Octachlorobiphenyl (total)	µg/dscm	ND	0.002		NA	ND	0.005
Nonachlorobiphenyl (total)	µg/dscm	ND	0.002		NA	ND	0.003
Decachlorobiphenyl (total)	µg/dscm	ND	0.01		NA	ND	0.02
Total PCBs (Tri-Deca) including NDs	µg/dscm	ND	0.03		NA	<	1.11
Total PCBs (Mono-Deca) including NDs	µg/dscm	ND	0.06		NA	<	1.23
Total PCBs (Tri-Deca) excluding NDs	µg/dscm	all	ND		NA	>	1.08
Total PCBs (Mono-Deca) excluding NDs	µg/dscm	all	ND		NA	>	1.19
Chlorobenzenes and chlorophenols							
1,2 Dichlorobenzene	µg/dscm	ND	2.59		NA	ND	0.12
1,3 - Dichlorobenzene	µg/dscm	ND	2.35		NA	ND	0.12
1,4 - Dichlorobenzene	µg/dscm	ND	2.30		NA	ND	0.12
1,2,3 - Trichlorobenzene	µg/dscm	ND	2.23		NA	ND	0.15
1,2,4 - Trichlorobenzene	µg/dscm	ND	2.34		NA	ND	0.15
1,3,5 - Trichlorobenzene	µg/dscm	ND	2.30		NA	ND	0.14
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	1.58		NA	ND	0.14
1,2,3,5 - Tetrachlorobenzene	µg/dscm		N/A		NA	ND	0.12
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	1.81		NA	ND	0.16
Pentachlorobenzene	µg/dscm	ND	1.52		NA	EMPC	0.32
Hexachlorobenzene	µg/dscm	ND	2.14		NA	EMPC	0.66
2 - Chlorophenol	µg/dscm	ND	2.89		NA	ND	0.13
3,4 - Chlorophenol	µg/dscm	ND	2.17		NA	ND	0.06
2,3 - Dichlorophenol	µg/dscm	ND	2.92		NA	ND	0.18
2,4 - Dichlorophenol	µg/dscm	ND	2.85		NA	ND	0.14
3,4 - Dichlorophenol	µg/dscm	ND	2.17		NA	ND	0.13
3,5 - Dichlorophenol	µg/dscm	ND	1.87		NA	ND	0.13
2,5 - Dichlorophenol	µg/dscm	ND	3.01		NA	ND	0.15
2,6 - Dichlorophenol	µg/dscm	ND	2.51		NA	ND	0.14
2,3,4 - Trichlorophenol	µg/dscm	ND	2.55		NA	ND	0.22
2,3,6 - Trichlorophenol	µg/dscm	ND	2.58		NA	ND	0.21
2,4,5 - Trichlorophenol	µg/dscm	ND	2.48		NA	ND	0.19
2,4,6 - Trichlorophenol	µg/dscm	ND	2.67		NA	ND	0.20
2,3,5 - Trichlorophenol	µg/dscm	ND	2.74		NA	ND	0.26
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	2.67		NA	ND	0.17
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	2.89		NA	ND	0.18
Pentachlorophenol	µg/dscm	ND	4.12		NA	ND	0.29
Total chlorobenzenes incl. NDs	µg/dscm	ND	21.2		NA	<	2.19
Total chlorophenols incl. NDs	µg/dscm	ND	43.1		NA	<	2.78

TABLE A2-8. SS9 - COMBUSTION AIR SUMMARY (continued)

Substance	Units	Condition 1 Waste water			Condition 2 Soil				
		Flag			Flag	Run 1	Flag		Run 2
Volatile organic compounds									
Vinyl chloride	ng/dscm	9(4)	ND	452	ND	2170	42(2)	ND	603
Methyl chloride	ng/dscm	9(4)	<	979	<	4660	42(2)	<	3480
Trans-1,2-dichloroethene	ng/dscm	9(4)	ND	452	ND	2200	42(2)	ND	452
Cis-1,2-dichloroethene	ng/dscm	9(4)	ND	452	ND	2200	42(2)	<	532
Chloroform	ng/dscm	9(4)	ND	452	ND	2200	42(2)	<	475
1,1,1 - Trichloroethane	ng/dscm	9(4)	BQL	693	ND	4200	42(2)	<	1880
Carbon tetrachloride	ng/dscm	9(4)	BQL	557	ND	3310	42(2)	BQL	758
Benzene	ng/dscm	9(4)		9940		42500	42(2)	<	68300
1,2 - Dichloroethane	ng/dscm	9(4)	ND	452	ND	2200	42(2)	ND	452
Trichloroethene	ng/dscm	9(4)	ND	452	<	2200	42(2)	<	1090
Toluene	ng/dscm	9(4)	<	557		2670	42(2)	<	4230
1,1,2 - Trichloroethane	ng/dscm	9(4)	ND	452	ND	2200	42(2)	ND	452
Tetrachloroethene	ng/dscm	9(4)	BQL	964	<	4600	42(2)	<	69700
1,2 - Dibromoethane	ng/dscm	9(4)	ND	452	ND	2200	42(2)	ND	452
Chlorobenzene	ng/dscm	9(4)	ND	452		2200	42(2)	ND	452
Ethylbenzene	ng/dscm	9(4)	ND	452		2200	42(2)	ND	452
M-/P-Xylene	ng/dscm	9(4)	ND	903	<	4350	42(2)	ND	1210
O-Xylene	ng/dscm	9(4)	ND	452	ND	2200	42(2)	ND	452
1,3 - Dichlorobenzene	ng/dscm	9(4)	ND	452	<	2200	42(2)	ND	452
1,4 - Dichlorobenzene	ng/dscm	9(4)	ND	452	<	2200	42(2)	ND	452
1,2 - Dichlorobenzene	ng/dscm	9(4)	ND	452	<	2200	42(2)	ND	452
Sulfur compounds									
Hydrogen sulfide	ppbv		ND	4		NA		ND	4
Carbonyl sulfide	ppbv		ND	4		NA		ND	4
Methyl mercaptan	ppbv		ND	4		NA		ND	4
Ethyl mercaptan	ppbv		ND	4		NA		ND	4
Dimethyl sulfide	ppbv		ND	4		NA		ND	4
Carbon sulfide	ppbv		ND	4		NA		ND	4
N-Propylmercaptan	ppbv		ND	4		NA		ND	4
Dimethyl disulfide	ppbv		ND	2		NA		ND	2
Fixed gases									
Hydrogen	vol. %		ND	0.5		NA		ND	0.5
Oxygen	vol. %			20.2		NA			21
Nitrogen	vol. %			77		NA			78
Methane	vol. %		ND	0.1		NA		ND	0.1
Carbon monoxide	vol. %		ND	0.1		NA		ND	0.1
Carbon dioxide	vol. %	33	ND	0.1		NA	33	ND	0.1

TABLE A2-8. SS9 - COMBUSTION AIR SUMMARY (continued)

Substance	Units	Condition 3 Waste oil	
		Flag	
Total stream flow rate			
Run 1	kg/hr		432
Run 2	kg/hr		270
Run 3	kg/hr		294
Average	kg/hr		332
Run 1	dscm/hr		360
Run 2	dscm/hr		225
Run 3	dscm/hr		245
Average	dscm/hr		276
Polychlorinated biphenyls (PCB)			
Monochlorobiphenyl (total)	µg/dscm	ND	0.002
Dichlorobiphenyl (total)	µg/dscm	EMPC	0.08
Trichlorobiphenyl (total)	µg/dscm	ND	0.003
Tetrachlorobiphenyl (total)	µg/dscm	ND	0.01
Pentachlorobiphenyl (total)	µg/dscm	ND	0.01
Hexachlorobiphenyl (total)	µg/dscm	ND	0.01
Heptachlorobiphenyl (total)	µg/dscm	ND	0.01
Octachlorobiphenyl (total)	µg/dscm	ND	0.01
Nonachlorobiphenyl (total)	µg/dscm	ND	0.01
Decachlorobiphenyl (total)	µg/dscm	ND	0.02
Total PCBs (Tri-Deca) including NDs	µg/dscm	ND	0.06
Total PCBs (Mono-Deca) including NDs	µg/dscm	ND	0.15
Total PCBs (Tri-Deca) excluding NDs	µg/dscm	all	ND
Total PCBs (Mono-Deca) excluding NDs	µg/dscm	all	ND
Chlorobenzenes and chlorophenols			
1,2 Dichlorobenzene	µg/dscm	ND	0.71
1,3 - Dichlorobenzene	µg/dscm	ND	0.68
1,4 - Dichlorobenzene	µg/dscm	ND	0.69
1,2,3 - Trichlorobenzene	µg/dscm	ND	0.61
1,2,4 - Trichlorobenzene	µg/dscm	ND	0.56
1,3,5 - Trichlorobenzene	µg/dscm	ND	0.56
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	0.64
1,2,3,5 - Tetrachlorobenzene	µg/dscm		NA
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	0.27
Pentachlorobenzene	µg/dscm	ND	0.65
Hexachlorobenzene	µg/dscm	ND	0.83
2 - Chlorophenol	µg/dscm	ND	0.75
3,4 - Chlorophenol	µg/dscm	ND	0.14
2,3 - Dichlorophenol	µg/dscm	ND	0.67
2,4 - Dichlorophenol	µg/dscm	ND	0.56
3,4 - Dichlorophenol	µg/dscm	ND	0.71
3,5 - Dichlorophenol	µg/dscm	ND	0.30
2,5 - Dichlorophenol	µg/dscm	ND	0.71
2,6 - Dichlorophenol	µg/dscm	ND	0.25
2,3,4 - Trichlorophenol	µg/dscm	ND	0.92
2,3,6 - Trichlorophenol	µg/dscm	ND	0.90
2,4,5 - Trichlorophenol	µg/dscm	ND	0.81
2,4,6 - Trichlorophenol	µg/dscm	ND	0.90
2,3,5 - Trichlorophenol	µg/dscm	ND	1.01
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	0.71
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	1.15
Pentachlorophenol	µg/dscm	ND	1.88
Total chlorobenzenes incl. NDs	µg/dscm	ND	6.20
Total chlorophenols incl. NDs	µg/dscm	ND	12.38

TABLE A2-8. SS9 - COMBUSTION AIR SUMMARY (continued)

Substance	Units	Condition 3 Waste oil	
		Flag	
Volatile organic compounds			
Vinyl chloride	ng/dscm	ND	672
Methyl chloride	ng/dscm	<	1731
Trans-1,2-dichloroethene	ng/dscm	ND	504
Cis-1,2-dichloroethene	ng/dscm	ND	504
Chloroform	ng/dscm	ND	504
1,1,1 - Trichloroethane	ng/dscm	<	768
Carbon tetrachloride	ng/dscm	<	605
Benzene	ng/dscm	ALR	115880
1,2 - Dichloroethane	ng/dscm	ND	504
Trichloroethene	ng/dscm	ND	504
Toluene	ng/dscm		4030
1,1,2 - Trichloroethane	ng/dscm	ND	504
Tetrachloroethene	ng/dscm	BQL	1091
1,2 - Dibromoethane	ng/dscm	ND	504
Chlorobenzene	ng/dscm	ND	504
Ethylbenzene	ng/dscm	ND	504
M-/P-Xylene	ng/dscm	ND	672
O-Xylene	ng/dscm	ND	504
1,3 - Dichlorobenzene	ng/dscm	ND	504
1,4 - Dichlorobenzene	ng/dscm	BQL	819
1,2 - Dichlorobenzene	ng/dscm	ND	504
Sulfur compounds			
Hydrogen sulfide	ppbv	ND	4
Carbonyl sulfide	ppbv	ND	4
Methyl mercaptan	ppbv	ND	4
Ethyl mercaptan	ppbv	ND	4
Dimethyl sulfide	ppbv	ND	4
Carbon sulfide	ppbv	ND	4
N-Propylmercaptan	ppbv	ND	4
Dimethyl disulfide	ppbv	ND	2
Fixed gases			
Hydrogen	vol. %		0.7
Oxygen	vol. %		20.9
Nitrogen	vol. %		78
Methane	vol. %	ND	0.1
Carbon monoxide	vol. %	ND	0.1
Carbon dioxide	vol. %	33 ND	0.1

TABLE A2-9. SS10 - TREATED SOIL SUMMARY

Substance	Units	Condition 2 - Soil				
		Flag		Run 1	Flag	Run 2
Total stream flow rate						
	kg/hr			127		25.5
	lb/hr			280		56.3
Polychlorinated biphenyls (PCB)						
Monochlorobiphenyl (total)	µg/kg	48		260	BQL	7.1
Dichlorobiphenyl (total)	µg/kg	48		1500		270
Trichlorobiphenyl (total)	µg/kg	48		7700		1600
Tetrachlorobiphenyl (total)	µg/kg	48		11000	BQL	3000
Pentachlorobiphenyl (total)	µg/kg	48	BQL	4600		2900
Hexachlorobiphenyl (total)	µg/kg	48		3600	BQL	350
Heptachlorobiphenyl (total)	µg/kg	48	BQL	650	BQL	79
Octachlorobiphenyl (total)	µg/kg	48	BQL	140	BQL	21
Nonachlorobiphenyl (total)	µg/kg	48	BQL	40	BQL	5
Decachlorobiphenyl (total)	µg/kg	48		310	BQL	27
Total PCBs (Tri-Deca)	µg/kg	48		28000		7980
Total PCBs (Mono-Deca)	µg/kg	48		29800		8260
Chlorobenzenes and chlorophenols						
1,2-Dichlorobenzene	µg/kg		ND	9000	ND	56
1,3-Dichlorobenzene	µg/kg		ND	9000	ND	56
1,4-Dichlorobenzene	µg/kg		ND	9000	ND	56
Total dichlorobenzenes	µg/kg		ND	27000	ND	168
1,2,3-Trichlorobenzene	µg/kg		ND	9000	ND	56
1,3,5-Trichlorobenzene	µg/kg		ND	9000	ND	56
1,2,4-Trichlorobenzene	µg/kg		ND	9000	ND	56
Total trichlorobenzenes	µg/kg		ND	27000	ND	168
1,2,3,4-Tetrachlorobenzene	µg/kg		ND	9000	ND	56
1,2,3,5- and/or 1,2,4,5-Tetrachloro-benzene	µg/kg		ND	18000	ND	70
Total tetrachlorobenzenes	µg/kg		ND	27000	ND	126
Pentachlorobenzene	µg/kg		BQL	19000		580
Hexachlorobenzene	µg/kg			4800000	ND	56
2,3-Dichlorophenol	µg/kg		ND	9000	ND	56
2,4-Dichlorophenol	µg/kg		ND	9000	ND	56
2,5-Dichlorophenol	µg/kg		ND	9000	ND	56
2,6-Dichlorophenol	µg/kg		ND	9000	ND	56
3,4-Dichlorophenol	µg/kg		ND	9000	ND	56
3,5-Dichlorophenol	µg/kg		ND	9000	ND	56
Total dichlorophenols	µg/kg		ND	54000	ND	336
2,3,4-Trichlorophenol	µg/kg		ND	9000	ND	56
2,3,5-Trichlorophenol	µg/kg		ND	9000	ND	56
2,3,6-Trichlorophenol	µg/kg		ND	9000	ND	56
2,4,5-Trichlorophenol	µg/kg		ND	9000	ND	56
2,4,6-Trichlorophenol	µg/kg		ND	9000	ND	56
Total trichlorophenols	µg/kg		ND	45000	ND	280
2,3,4,5,- and/or 2,3,4,6-Tetrachloro- phenol	µg/kg		ND	18000	ND	110
2,3,5,6-Tetrachlorophenol	µg/kg		ND	9000	ND	56
Total tetrachlorophenols	µg/kg		ND	27000	ND	166
Pentachlorophenol	µg/kg		ND	9000	BQL	59
Total CB including NDs	µg/kg		<	4900000	<	1100
Total CP including NDs	µg/kg		ND	135000	<	841
Total CB excluding NDs	µg/kg		>	4819000	>	580
Total CP excluding NDs	µg/kg		all	ND	>	59

TABLE A2-9. SS10 - TREATED SOIL SUMMARY (continued)

Substance	Units	Condition 2 - Soil Flag	Run 1	Flag	Run 2
Polycyclic aromatic hydrocarbons (PAH)					
Naphthalene	µg/kg	ND	9000		1100
2-Methylnaphthalene	µg/kg	ND	9000	ND	56
2-Cl-Naphthalene	µg/kg	ND	9000	ND	56
Acenaphthylene	µg/kg	ND	9000	BQL	120
Acenapthene	µg/kg	ND	9000	ND	56
Fluorene	µg/kg	ND	9000	ND	56
Phenanthrene	µg/kg	ND	9000	BQL	180
Anthracene	µg/kg	ND	9000	ND	56
Fluoranthene	µg/kg	ND	9000	BQL	76
Pyrene	µg/kg	ND	9000	BQL	79
Benzo (a) anthracene	µg/kg	ND	9000	ND	56
Chrysene	µg/kg	ND	9000	ND	56
Benzo (b) fluoranthene	µg/kg	ND	9000	ND	56
Benzo (k) fluoranthene	µg/kg	ND	9000	ND	56
Benzo (e) pyrene	µg/kg	ND	9000	ND	56
Benzo (a) pyrene	µg/kg	ND	9000	ND	56
Perylene	µg/kg	ND	9000	ND	56
Indeno (1,2,3-cd) pyrene	µg/kg	ND	9000	ND	56
Dibenz (a,h) anthracene	µg/kg	ND	9000	ND	56
Benzo (g,h,i) perylene	µg/kg	ND	9000	ND	56
Total PAHs including NDs	µg/kg	ND	180000	<	2400
Total PAHs excluding NDs	µg/kg	all	ND	>	1431
Dioxins and furans					
2378 TCDD	ng/kg		27	ND	5.4
12378 PeCDD	ng/kg		780	ND	26
123478 HxCDD	ng/kg		1700		14
123678 HxCDD	ng/kg		1600		18
123789 HxCDD	ng/kg		2500		23
1234678 HpCDD	ng/kg		36000		290
OCDD	ng/kg		450000		3300
2378 TCDF	ng/kg		130	ND	3.6
12378 PeCDF	ng/kg		270	ND	12
23478 PeCDF	ng/kg		230	ND	15
123478 HxCDF	ng/kg	ND	1300		15
123678 HXCDF	ng/kg		1300		27
234678 HxCDF	ng/kg		110	ND	0.53
123789 HxCDF	ng/kg		420		5.4
1234678 HpCDF	ng/kg		13000		1300
1234789 HpCDF	ng/kg		4300		36
OCDF	ng/kg		120000		950
TCDD (total)	ng/kg		1100		24
PeCDD (total)	ng/kg		8900		364
HxCDD (total)	ng/kg		34000		260
HpCDD (total)	ng/kg		93000		660
TCDF (total)	ng/kg		2600		71
PeCDF (total)	ng/kg		3300		35
HxCDF (total)	ng/kg		11000		110
HpCDF (total)	ng/kg		27000		1400
Total dioxins (by isomer) incl. NDs	ng/kg		493000	<	3680
Total furans (by isomer) incl. NDs	ng/kg	<	141000	<	2360
Total dioxin/furans (by isomer) incl. NDs	ng/kg	<	634000	<	6040
Total dioxins (by isomer) excl. NDs	ng/kg	all	detected	>	3645
Total furans (by isomer) excl. Nds	ng/kg	>	140000	>	2333
Total dioxin/furans (by isomer) excl. NDs	ng/kg	>	632000	>	5978

TABLE A2-9. SS10 - TREATED SOIL SUMMARY (continued)

Substance	Units	Condition 2 - Soil					
		Flag		Run 1	Flag		Run 2
Volatile organic compounds							
Vinyl chloride	µg/kg	3	BQL	81	3	ND	34
Methyl chloride	µg/kg	3		140	3		520
Trans-1,2-dichloroethene	µg/kg	3	ND	28	3	ND	34
Cis-1,2-dichloroethene	µg/kg	3	BQL	66	3	BQL	120
Chloroform	µg/kg	3	ND	28	3	BQL	41
1,1,1 - Trichloroethane	µg/kg	3	ND	28	3	ND	34
Carbon tetrachloride	µg/kg	3	ND	28	3	ND	34
Benzene	µg/kg	3	ND	28	3	ALR	5100
1,2 - Dichloroethane	µg/kg	3	ND	28	3	ND	34
Trichloroethene	µg/kg	3		220	3		190
Toluene	µg/kg	3	BQL	36			190
1,1,2 - Trichloroethane	µg/kg	3	ND	28	3	ND	34
Tetrachloroethene	µg/kg	3	ND	28	3	ND	34
1,2 - Dibromoethane	µg/kg	3	ND	28	3	BQL	41
Chlorobenzene	µg/kg	3	ND	28	3	BQL	87
Ethylbenzene	µg/kg	3	ND	28	3	BQL	76
M-/P-Xylene	µg/kg	3	BQL	34	3	BQL	88
O-Xylene	µg/kg	3	BQL	32	3	BQL	68
1,3 - Dichlorobenzene	µg/kg	3	ND	28	3		200
1,4 - Dichlorobenzene	µg/kg	3	ND	28	3	ND	34
1,2 - Dichlorobenzene	µg/kg	3	ND	28	3		220
Trace metals							
Antimony	mg/kg			9.6			16
Arsenic	mg/kg			19		ND	7.4
Barium	mg/kg			88			110
Beryllium	mg/kg			0.31			0.31
Cadmium	mg/kg			1			9.4
Chromium (Total)	mg/kg			26			440
Copper	mg/kg			60			70
Lead	mg/kg			170			110
Manganese	mg/kg			280			200
Mercury	mg/kg			0.24		ND	0.15
Nickel	mg/kg			28			27
Phosphorus	mg/kg			1800			130
Selenium	mg/kg		ND	7.4		ND	7.4
Silver	mg/kg		ND	0.74		ND	0.74
Thallium	mg/kg			8.5		ND	7.4
Tin	mg/kg			6400		ND	14000
Zinc	mg/kg			400			700
Miscellaneous							
Total organic carbon	ppmw			8270			4920
Total sulfur (as S)	wt. %		<	0.01		<	0.01
Ash	wt. %			62			44
Moisture	wt. %			28			41
Organic halogens (as chloride)	ppbw			NA			NA
Inorganic halogens (as chloride)	ppmw			NA			NA
Total halogens (as chloride)	ppmw	5		0.1	5		0.3
Hexavalent chromium	ppmw		ND	0.01		ND	0.01

TABLE A2-9. SS10 - TREATED SOIL SUMMARY (continued)

Substance	Units	Condition 2 - Soil				
		Flag		Run 1	Flag	Run 2
TCLP volatile organics						
Vinyl chloride	µg/L	3		80		NA
Methyl chloride	µg/L	3	ALR	1200		NA
Trans-1,2-dichloroethene	µg/L	3	ND	10		NA
Cis-1,2-dichloroethene	µg/L	3		64		NA
Chloroform	µg/L	3	ND	10		NA
1,1,1 - Trichloroethane	µg/L	3	ND	10		NA
Carbon tetrachloride	µg/L	3	ND	10		NA
Benzene	µg/L	3	BQL	16		NA
1,2 - Dichloroethane	µg/L	3	ND	10		NA
Trichloroethene	µg/L	3		83		NA
Toluene	µg/L	3	BQL	18		NA
1,1,2 - Trichloroethane	µg/L	3	ND	10		NA
Tetrachloroethene	µg/L	3	ND	10		NA
1,2 - Dibromoethane	µg/L	3	ND	10		NA
Chlorobenzene	µg/L	3	ND	10		NA
Ethylbenzene	µg/L	3	ND	10		NA
M-/P-Xylene	µg/L	3	ND	10		NA
O-Xylene	µg/L	3	BQL	10		NA
1,3 - Dichlorobenzene	µg/L	3	ND	10		NA
1,4 - Dichlorobenzene	µg/L	3	ND	10		NA
1,2 - Dichlorobenzene	µg/L	3	ND	10		NA
TCLP trace metals						
Arsenic	µg/L		ND	100	ND	100
Barium	µg/L			1700		1500
Cadmium	µg/L			11	ND	10
Chromium	µg/L		ND	10	ND	10
Lead	µg/L		ND	50	ND	50
mercury	µg/L		ND	0.4	ND	0.4
Selenium	µg/L		ND	100	ND	100
Silver	µg/L		ND	10	ND	10

TABLE A2-10. SS11 - REACTOR GRIT SUMMARY

Substance	Units	Condition 1 Waste water		Condition 2 Soil		Condition 3 Waste oil	
		Flag	Composite	Flag	Composite	Flag	Composite
Total stream flow rate							
Run 1	kg/hr		0.134		0.041		0.099
Run 2	kg/hr		0.049		0.044		0.101
Run 3	kg/hr		0.014		–		0.101
Average	kg/hr		0.0656		–		0.1003
Polychlorinated biphenyls (PCB)							
Monochlorobiphenyl (total)	µg/kg		6400		410		900
Dichlorobiphenyl (total)	µg/kg		60000	BQL	360		740
Trichlorobiphenyl (total)	µg/kg		560000	BQL	460		520
Tetrachlorobiphenyl (total)	µg/kg	BQL	1000000	BQL	660		570
Pentachlorobiphenyl (total)	µg/kg	BQL	460000	BQL	270	BQL	210
Hexachlorobiphenyl (total)	µg/kg	BQL	58000	BQL	19	BQL	28
Heptachlorobiphenyl (total)	µg/kg		14000	BQL	2.5	BQL	4.7
Octachlorobiphenyl (total)	µg/kg		4500	ND	1600	ND	240
Nonachlorobiphenyl (total)	µg/kg		840	ND	400	ND	60
Decachlorobiphenyl (total)	µg/kg	BQL	38	ND	220	ND	33
Total PCBs (Tri-Deca) including NDs	µg/kg		2100000	<	3630	<	1670
Total PCBs (Mono-Deca) including NDs	µg/kg		2160000	<	4400	<	3310
Total PCBs (Tri-Deca) excluding NDs	µg/kg	all	detected	>	1410	>	1237
Total PCBs (Mono-Deca) excluding NDs	µg/kg	all	detected	>	2180	>	2977
Chlorobenzenes and chlorophenols							
1,2-Dichlorobenzene	µg/kg	3 ND	430	ND	1900	ND	13000
1,3-Dichlorobenzene	µg/kg	3 ND	430	ND	1900	ND	13000
1,4-Dichlorobenzene	µg/kg	3 ND	430	BQL	1600	ND	13000
Total Dichlorobenzenes	µg/kg	3 ND	1290		5400	ND	39000
1,2,3-Trichlorobenzene	µg/kg	3 ND	430	ND	1900	ND	13000
1,3,5-Trichlorobenzene	µg/kg	3 ND	430	ND	1900	ND	13000
1,2,4-Trichlorobenzene	µg/kg	3 ND	430	BQL	1700	ND	13000
Total Trichlorobenzenes	µg/kg	3 ND	1290		5500	ND	39000
1,2,3,4-Tetrachlorobenzene	µg/kg	3 ND	430	ND	1900	ND	13000
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/kg	3 ND	870	ND	3900	ND	27000
Total Tetrachlorobenzenes	µg/kg	3 ND	1300	ND	5800	ND	40000
Pentachlorobenzene	µg/kg	3 ND	430	ND	1900	ND	13000
Hexachlorobenzene	µg/kg	3 ND	430	BQL	3100	ND	13000
2,3-Dichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
2,4-Dichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
2,5-Dichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
2,6-Dichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
3,4-Dichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
3,5-Dichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
Total Dichlorophenols	µg/kg	3 ND	2580	ND	11400	ND	78000
2,3,4-Trichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
2,3,5-Trichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
2,3,6-Trichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
2,4,5-Trichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
2,4,6-Trichlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
Total Trichlorophenols	µg/kg	3 ND	2150	ND	9500	ND	65000
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/kg	3 ND	870	ND	3900	ND	27000
2,3,5,6-Tetrachlorophenol	µg/kg	3 ND	430	ND	1900	ND	13000
Total Tetrachlorophenols	µg/kg	3 ND	1300	ND	5800	ND	40000
Pentalchlorophenol	µg/kg	3 ND	430	BQL	1800	ND	13000
Total CB including NDs	µg/kg	3 ND	4740	<	21700	ND	144000
Total CP including NDs	µg/kg	3 ND	6460	<	28500	ND	196000
Total CB excluding NDs	µg/kg	3 all	ND	>	6400	all	ND
Total CP excluding NDs	µg/kg	3 all	ND	>	1800	all	ND

TABLE A2-10. SS11 - REACTOR GRIT SUMMARY (continued)

Substance	Units	Condition 1 Waste water			Condition 2 Soil			Condition 3 Waste oil		
		Flag		Composite	Flag		Composite	Flag		Composite
Polycyclic aromatic hydrocarbons (PAH)										
Naphthalene	µg/kg	3		160000	35	BQL	17000	35	BQL	85000
2-Methylnaphthalene	µg/kg	3	ND	8700	35	ND	1900	35	ND	13000
2-Cl-Naphthalene	µg/kg	3	ND	8700	35	ND	1900	35	ND	13000
Acenaphthylene	µg/kg	3	BQL	58000	35	ND	1900	35	ND	13000
Acenapthene	µg/kg	3	ND	8700	35	BQL	2100	35	ND	13000
Fluorene	µg/kg	3	BQL	12000	35	BQL	2100	35	ND	13000
Phenanthrene	µg/kg	3		93000	35		120000	35		220000
Anthracene	µg/kg	3	BQL	12000	35	BQL	4600	35	ND	13000
Fluoranthene	µg/kg	3	BQL	69000	35		120000	35		170000
Pyrene	µg/kg	3	BQL	83000	35		38000	35	BQL	93000
Benzo (a) anthracene	µg/kg	3	BQL	12000	35	BQL	4900	35	ND	13000
Chrysene	µg/kg	3	BQL	20000	35	BQL	17000	35	BQL	22000
Benzo (b) fluoranthene	µg/kg	3	BQL	17000	35	BQL	7400	35	BQL	35000
Benzo (k) fluoranthene	µg/kg	3	ND	8700	35	ND	1900	35	ND	13000
Benzo (e) pyrene	µg/kg	3	BQL	15000	35	BQL	3600	35	BQL	27000
Benzo (a) pyrene	µg/kg	3	BQL	20000	35	ND	1900	35	ND	13000
Perylene	µg/kg	3	ND	8700	35	ND	1900	35	ND	13000
Indeno (1,2,3-cd) pyrene	µg/kg	3	BQL	11000	35	ND	1900	35	BQL	19000
Dibenz (a,h) anthracene	µg/kg	3	ND	8700	35	ND	1900	35	ND	13000
Benzo (g,h,i) perylene	µg/kg	3	BQL	21000	35	ND	1900	35	BQL	32000
Total PAHs including NDs	µg/kg	3	<	655000	35	<	354000	35	<	846000
Total PAHs excluding NDs	µg/kg	3	>	603000	35	>	336700	35	>	703000
Dioxins and furans										
2378 TCDD	ng/kg		ND	0.64		ND	13		ND	11
12378 PeCDD	ng/kg		ND	2.1			18		ND	17
123478 HxCDD	ng/kg		ND	0.38			13		ND	2.6
123678 HxCDD	ng/kg		ND	0.69			5.9		ND	3.6
123789 HxCDD	ng/kg		ND	0.65			2.3		ND	3
1234678 HpCDD	ng/kg			1.8			42			9.5
OCDD	ng/kg			12			43			20
2378 TCDF	ng/kg			11			14		ND	14
12378 PeCDF	ng/kg			8			16		ND	20
23478 PeCDF	ng/kg			64		ND	38		ND	24
123478 HxCDF	ng/kg			20			41		ND	6
123678 HXCDF	ng/kg			6.7			46		ND	4.3
234678 HxCDF	ng/kg			8			35		ND	4.2
123789 HxCDF	ng/kg			6			13		ND	5.6
1234678 HpCDF	ng/kg			8.3			110		ND	4.8
1234789 HpCDF	ng/kg			6.5			14		ND	4.4
OCDF	ng/kg			22			42			8
TCDD (total)	ng/kg		ND	14.1			286		ND	242
PeCDD (total)	ng/kg		ND	29.4			16		ND	238
HxCDD (total)	ng/kg		ND	5.73			160		ND	30.7
HpCDD (total)	ng/kg		F	3.4			80			21
TCDF (total)	ng/kg			380			530		ND	532
PeCDF (total)	ng/kg			220			330		ND	616
HxCDF (total)	ng/kg			68			380		ND	80.4
HpCDF (total)	ng/kg			25			160		ND	18.4
Total dioxins (by isomer) incl. NDs	ng/kg		<	18.3		<	135.2		<	66.7
Total furans (by isomer) incl. NDs	ng/kg			161		<	369		<	95.3
Total dioxin/furans (by isomer) incl. NDs	ng/kg		<	179		<	504		<	162
Total dioxins (by isomer) excl. NDs	ng/kg		>	13.8		>	122.2		>	29.5
Total furans (by isomer) excl. Nds	ng/kg		all	detected		>	331		>	8
Total dioxin/furans (by isomer) excl. NDs	ng/kg		>	175		>	453		>	37.5

TABLE A2-10. SS11 - REACTOR GRIT SUMMARY (continued)

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 2 Soil Flag	Condition 2 Soil Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Volatile organic compounds							
Vinyl chloride	µg/kg	ND	14	45	10	2,38 ND	20
Methyl chloride	µg/kg	ND	14	45	79	2,38	210
Trans-1,2-dichloroethene	µg/kg	ND	14	45 ND	2	2,38 ND	20
Cis-1,2-dichloroethene	µg/kg	ND	14	45 BQL	6	2,38 ND	20
Chloroform	µg/kg	ND	14	45 BQL	3	2,38 ND	20
1,1,1 - Trichloroethane	µg/kg	ND	14	45 BQL	5	2,38 ND	20
Carbon tetrachloride	µg/kg	ND	14	45 ND	2	2,38 ND	20
Benzene	µg/kg		430	45	190	2,38 ALR	17000
1,2 - Dichloroethane	µg/kg	ND	14	45 ND	2	2,38 ND	20
Trichloroethene	µg/kg	ND	14	45	90	2,38 ND	20
Toluene	µg/kg	BQL	16	45	33	2,38 ND	20
1,1,2 - Trichloroethane	µg/kg	ND	14	45 BQL	4	2,38 ND	20
Tetrachloroethene	µg/kg	ND	14	45	23	2,38 ND	20
1,2 - Dibromoethane	µg/kg	ND	14	45 ND	2	2,38 ND	20
Chlorobenzene	µg/kg	ND	14	45 ND	2	2,38 ND	20
Ethylbenzene	µg/kg	ND	14	45 BQL	4	2,38 ND	20
M-/P-Xylene	µg/kg	ND	14	45 BQL	7	2,38 ND	20
O-Xylene	µg/kg	ND	14	45 BQL	5	2,38 ND	20
1,3 - Dichlorobenzene	µg/kg	ND	14	45 ND	2	2,38 ND	20
1,4 - Dichlorobenzene	µg/kg	ND	14	45 ND	2	2,38 ND	20
1,2 - Dichlorobenzene	µg/kg	ND	14	45 ND	2	2,38 ND	20
Trace metals							
Antimony	mg/kg	4	NA	ND	5	ND	5
Arsenic	mg/kg	4	NA		46		23
Barium	mg/kg	4	NA		63		30
Beryllium	mg/kg	4	NA	ND	0.05	ND	0.5
Cadmium	mg/kg	4	NA		2.2	ND	0.5
Chromium (total)	mg/kg	4	NA		71		27
Copper	mg/kg	4	NA		51		10
Lead	mg/kg	4	NA		23		6.7
Manganese	mg/kg	4	NA		600		330
Mercury	mg/kg	4	NA	ND	0.1	ND	0.1
Nickel	mg/kg	4	NA		120		100
Phosphorus	mg/kg	4	NA		590		300
Selenium	mg/kg	4	NA	ND	5	ND	5
Silver	mg/kg	4	NA	ND	0.5	ND	0.5
Thallium	mg/kg	4	NA		22		8
Tin	mg/kg	4	NA		NA		21
Zinc	mg/kg	4	NA		64		25
Miscellaneous							
Total organic carbon	ppmw	4	NA		17300	3	60900
Total sulfur (as S)	wt. %	4	NA	<	0.01	<	0.01
Ash	wt. %	4	NA		82		88.5
Organic halogens (as chloride)	ppbw	4	NA		2230	3	205
Inorganic halogens (as chloride)	ppmw	4	NA		NA	5	NA
Total halogens (as chloride)	ppmw	4	NA		NA		0.73
Hexavalent chromium	ppmw	4	NA	ND	0.02		NA

TABLE A2-10. SS11 - REACTOR GRIT SUMMARY (continued)

Substance	Units	Condition 1 Waste water		Condition 2 Soil		Condition 3 Waste oil	
		Flag	Composite	Flag	Composite	Flag	Composite
TCLP volatile organics							
Vinyl chloride	µg/L	4	NA	ND	10	4	NA
Methyl chloride	µg/L	4	NA	BQL	12	4	NA
Trans-1,2-dichloroethene	µg/L	4	NA	ND	10	4	NA
Cis-1,2-dichloroethene	µg/L	4	NA	ND	10	4	NA
Chloroform	µg/L	4	NA	ND	10	4	NA
1,1,1 - Trichloroethane	µg/L	4	NA	ND	10	4	NA
Carbon tetrachloride	µg/L	4	NA	ND	10	4	NA
Benzene	µg/L	4	NA	ND	10	4	NA
1,2 - Dichloroethane	µg/L	4	NA	ND	10	4	NA
Trichloroethene	µg/L	4	NA	ND	10	4	NA
Toluene	µg/L	4	NA	BQL	11	4	NA
1,1,2 - Trichloroethane	µg/L	4	NA	ND	10	4	NA
Tetrachloroethene	µg/L	4	NA	ND	10	4	NA
1,2 - Dibromoethane	µg/L	4	NA	ND	10	4	NA
Chlorobenzene	µg/L	4	NA	ND	10	4	NA
Ethylbenzene	µg/L	4	NA	ND	10	4	NA
M-/P-Xylene	µg/L	4	NA	ND	10	4	NA
O-Xylene	µg/L	4	NA	ND	10	4	NA
1,3 - Dichlorobenzene	µg/L	4	NA	ND	10	4	NA
1,4 - Dichlorobenzene	µg/L	4	NA	ND	10	4	NA
1,2 - Dichlorobenzene	µg/L	4	NA	ND	10	4	NA
TCLP trace metals							
Arsenic	µg/L	4	NA		410	4	NA
Barium	µg/L	4	NA		3200	4	NA
Cadmium	µg/L	4	NA	ND	10	4	NA
Chromium	µg/L	4	NA		12	4	NA
Lead	µg/L	4	NA		50	4	NA
Mercury	µg/L	4	NA	ND	0.4	4	NA
Selenium	µg/L	4	NA	ND	100	4	NA
Silver	µg/L	4	NA	ND	10	4	NA

TABLE A2-11. SS12 - SCRUBBER SLUDGE SUMMARY

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 2 Soil Flag	Condition 2 Soil Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Total stream flow rate							
Run 1	kg/hr		3.10		0.47		32.9
Run 2	kg/hr		3.20		0.44		17.8
Run 3	kg/hr		2.64		–		15.5
Average	kg/hr		2.979		–		22.06
Polychlorinated biphenyls (PCB)			**Run 1**		**Composite**		**Run 1**
Monochlorobiphenyl (total)	µg/kg	ND	230	BQL	68	28 BQL	77
Dichlorobiphenyl (total)	µg/kg	ND	910	BQL	230	28 BQL	220
Trichlorobiphenyl (total)	µg/kg	BQL	27	BQL	1300	28 BQL	720
Tetrachlorobiphenyl (total)	µg/kg	ND	6300	BQL	1200	28 BQL	720
Pentachlorobiphenyl (total)	µg/kg	ND	6900	BQL	470	28 BQL	44
Hexachlorobiphenyl (total)	µg/kg	ND	6300	BQL	61	28 ND	13000
Heptachlorobiphenyl (total)	µg/kg	ND	5400	ND	7700	28 ND	11000
Octachlorobiphenyl (total)	µg/kg	ND	2700	ND	3900	28 ND	5600
Nonachlorobiphenyl (total)	µg/kg	ND	680	ND	960	28 ND	1400
Decachlorobiphenyl (total)	µg/kg	ND	380	ND	530	28 BQL	130
Total PCBs (Tri-Deca) in NDs	µg/kg	<	28700	<	16100	28 <	32600
Total PCBs (Mono-Deca) in NDs	µg/kg	<	29800	<	16400	28 <	32900
Total PCBs (Tri-Deca) ex NDs	µg/kg	>	27	>	3031	28 >	1614
Total PCBs (Mono-Deca) ex NDs	µg/kg	>	27	>	3321	28 >	2208
Polychlorinated biphenyls (PCB)			**Run 2**				**Run 2**
Monochlorobiphenyl (total)	µg/kg	ND	120	–		28 BQL	53
Dichlorobiphenyl (total)	µg/kg	BQL	100	–		28 BQL	42
Trichlorobiphenyl (total)	µg/kg	BQL	320	–		28 BQL	130
Tetrachlorobiphenyl (total)	µg/kg	BQL	350	–		28 BQL	240
Pentachlorobiphenyl (total)	µg/kg	BQL	42	–		28 BQL	72
Hexachlorobiphenyl (total)	µg/kg	ND	3400	–		28 BQL	3.8
Heptachlorobiphenyl (total)	µg/kg	ND	2900	–		28 ND	1100
Octachlorobiphenyl (total)	µg/kg	ND	1500	–		28 ND	570
Nonachlorobiphenyl (total)	µg/kg	ND	370	–		28 ND	140
Decachlorobiphenyl (total)	µg/kg	ND	200	–		28 ND	79
Total PCBs (Tri-Deca) in NDs	µg/kg	<	9080	–		28 <	2340
Total PCBs (Mono-Deca) in NDs	µg/kg	<	9300	–		28 <	2430
Total PCBs (Tri-Deca) ex NDs	µg/kg	>	712	–		28 >	446
Total PCBs (Mono-Deca) ex NDs	µg/kg	>	920	–		28 >	540
Polychlorinated biphenyls (PCB)			**Run 3**				
Monochlorobiphenyl (total)	µg/kg		530	–			–
Dichlorobiphenyl (total)	µg/kg		500	–			–
Trichlorobiphenyl (total)	µg/kg		870	–			–
Tetrachlorobiphenyl (total)	µg/kg	BQL	610	–			–
Pentachlorobiphenyl (total)	µg/kg	BQL	97	–			–
Hexachlorobiphenyl (total)	µg/kg	ND	1900	–			–
Heptachlorobiphenyl (total)	µg/kg	ND	1700	–			–
Octachlorobiphenyl (total)	µg/kg	ND	830	–			–
Nonachlorobiphenyl (total)	µg/kg	ND	210	–			–
Decachlorobiphenyl (total)	µg/kg	ND	120	–			–
Total PCBs (Tri-Deca) in NDs	µg/kg	<	6340	–			–
Total PCBs (Mono-Deca) in NDs	µg/kg	<	7370	–			–
Total PCBs (Tri-Deca) ex NDs	µg/kg	>	1577	–			–
Total PCBs (Mono-Deca) ex NDs	µg/kg	>	2600	–			–

TABLE A2-11. SS12 - SCRUBBER SLUDGE SUMMARY (continued)

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 2 Soil Flag	Condition 2 Soil Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Chlorobenzenes and chlorophenols							
1,2-Dichlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
1,3-Dichlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
1,4-Dichlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
Total dichlorobenzenes	µg/kg	ND	39000	ND	39000	ND	480000
1,2,3-Trichlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
1,3,5-Trichlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
1,2,4-Trichlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
Total trichlorobenzenes	µg/kg	ND	39000	ND	39000	ND	480000
1,2,3,4-Tetrachlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/kg	ND	27000	ND	25000	ND	320000
Total tetrachlorobenzenes	µg/kg	ND	40000	ND	38000	ND	480000
Pentachlorobenzene	µg/kg	ND	13000	ND	13000	ND	160000
Hexachlorobenzene	µg/kg	ND	13000	BQL	18000	ND	160000
2,3-Dichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
2,4-Dichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
2,5-Dichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
2,6-Dichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
3,4-Dichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
3,5-Dichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
Total dichlorophenols	µg/kg	ND	78000	ND	78000	ND	960000
2,3,4-Trichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
2,3,5-Trichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
2,3,6-Trichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
2,4,5-Trichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
2,4,6-Trichlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
Total trichlorophenols	µg/kg	ND	65000	ND	65000	ND	800000
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/kg	ND	27000	ND	25000	ND	320000
2,3,5,6-Tetrachlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
Total tetrachlorophenols	µg/kg	ND	40000	ND	38000	ND	480000
Pentachlorophenol	µg/kg	ND	13000	ND	13000	ND	160000
Total CB including NDs	µg/kg	ND	144000	<	147000	ND	1760000
Total CP including NDs	µg/kg	ND	196000	ND	194000	ND	2400000
Total CB excluding NDs	µg/kg	all	ND	>	18000	all	ND
Total CP excluding NDs	µg/kg	all	ND	all	ND	all	ND
Trace metals							
Antimony	µg/kg	4	NA	4	NA	4	NA
Arsenic	µg/kg	4	NA	4	NA	4	NA
Barium	µg/kg	4	NA	4	NA	4	NA
Beryllium	µg/kg	4	NA	4	NA	4	NA
Cadmium	µg/kg	4	NA	4	NA	4	NA
Chromium (total)	µg/kg	4	NA	4	NA	4	NA
Copper	µg/kg	4	NA	4	NA	4	NA
Lead	µg/kg	4	NA	4	NA	4	NA
Manganese	µg/kg	4	NA	4	NA	4	NA
Mercury	µg/kg	4	NA	4	NA	4	NA
Nickel	µg/kg	4	NA	4	NA	4	NA
Phosphorus	µg/kg	4	NA	4	NA	4	NA
Selenium	µg/kg	4	NA	4	NA	4	NA
Silver	µg/kg	4	NA	4	NA	4	NA
Thallium	µg/kg	4	NA	4	NA	4	NA
Tin	µg/kg	4	NA	4	NA	4	NA
Zinc	µg/kg	4	NA	4	NA	4	NA

TABLE A2-11. SS12 - SCRUBBER SLUDGE SUMMARY (continued)

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 2 Soil Flag	Condition 2 Soil Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Polycyclic aromatic hydrocarbons (PAH)							
Naphthalene	µg/kg		660000	35 BQL	59000	36 QS	11000000
2-Methylnaphthalene	µg/kg	BQL	14000	35 ND	13000	36 ND	160000
2-Cl-Naphthalene	µg/kg	ND	13000	35 ND	13000	36 ND	160000
Acenaphthylene	µg/kg		960000	35	170000	36	5000000
Acenapthene	µg/kg	BQL	17000	35 ND	13000	36 ND	160000
Fluorene	µg/kg		140000	35 BQL	57000	36 BQL	340000
Phenanthrene	µg/kg	BQL	2600000	35	6900000	36	5200000
Anthracene	µg/kg		340000	35	550000	36 BQL	540000
Fluoranthene	µg/kg	BQL	2400000	35	11000000	36	4400000
Pyrene	µg/kg		2900000	35	12000000	36	6300000
Chrysene	µg/kg		370000	35	580000	36 BQL	600000
Benzo (b) fluoranthene	µg/kg		310000	35	970000	36 BQL	670000
Benzo (k) fluoranthene	µg/kg	BQL	100000	35 BQL	91000	36 BQL	200000
Benzo (e) pyrene	µg/kg		320000	35	660000	36 BQL	770000
Benzo (a) pyrene	µg/kg		540000	35	840000	36 BQL	1200000
Perylene	µg/kg		180000	35	450000	36 BQL	380000
Indeno (1,2,3-cd) pyrene	µg/kg		240000	35	660000	36 BQL	920000
Dibenz (a,h) anthracene	µg/kg	ND	13000	35 BQL	38000	36 ND	160000
Benzo (g,h,i) perylene	µg/kg		490000	35	880000	36	2300000
Total PAHs including NDs	µg/kg	<	12800000	35 <	36300000	36 <	40700000
Total PAHs excluding NDs	µg/kg	>	12774000	35 <	36261000	36 >	40080000
Dioxins and furans							
2378 TCDD	ng/kg	ND	17	ND	2200	ND	40
12378 PeCDD	ng/kg	ND	37	ND	5000	ND	73
123478 HxCDD	ng/kg	ND	16	ND	1500	ND	26
123678 HxCDD	ng/kg	ND	28	ND	1500	ND	25
123789 HxCDD	ng/kg	ND	20	ND	1600	ND	18
1234678 HpCDD	ng/kg		250		14000		100
OCDD	ng/kg		3300		190000		310
2378 TCDF	ng/kg	ND	140		7200	ND	170
12378 PeCDF	ng/kg	ND	27		4200	ND	120
23478 PeCDF	ng/kg	ND	74	ND	8400	ND	180
123478 HxCDF	ng/kg	ND	15		5600	ND	47
123678 HXCDF	ng/kg	ND	15		7000	ND	56
234678 HxCDF	ng/kg	ND	15		5800		92
123789 HxCDF	ng/kg	ND	7.3		1600		36
1234678 HpCDF	ng/kg		24		16000		210
1234789 HpCDF	ng/kg	ND	2.8		2900		65
OCDF	ng/kg		46		56000		350
TCDD (total)	ng/kg	ND	374		8700	ND	880
PeCDD (total)	ng/kg	ND	518		37000		79
HxCDD (total)	ng/kg	ND	42.7		31000		2400
HpCDD (total)	ng/kg		440		27000		200
TCDF (total)	ng/kg		370		230000		1200
PeCDF (total)	ng/kg		200		90000		550
HxCDF (total)	ng/kg	ND	209		66000		490
HpCDF (total)	ng/kg		42		28000		410
Total dioxins (by isomer) including NDs	ng/kg	<	3670	<	216000	<	592
Total furans (by isomer) including NDs	ng/kg	<	366	<	115000	<	1330
Total dioxins/furans (by isomer) inc NDs	ng/kg	<	4030	<	331000	<	1920
Total dioxins (by isomer) excluding NDs	ng/kg	>	3550	>	204000	>	410
Total furans (by isomer) excluding NDs	ng/kg	>	80	>	106000	>	753
Total dioxins/furans (by isomer) ex. NDs	ng/kg	>	3630	>	310000	>	1163

TABLE A2-11. SS12 - SCRUBBER SLUDGE SUMMARY (continued)

Substance	Units	Condition 1 Waste water		Condition 2 Soil		Condition 3 Waste oil	
		Flag	Composite	Flag	Composite	Flag	Composite
Volatile organic compounds							
Vinyl chloride	µg/kg	ND	22	45 ND	44	39 ND	18
Methyl chloride	µg/kg	BQL	73	45 ND	44	39 ND	18
Trans-1,2-dichloroethene	µg/kg	ND	22	45 ND	44	39 ND	18
Cis-1,2-dichloroethene	µg/kg	ND	22	45 ND	44	39 ND	18
Chloroform	µg/kg	ND	22	45 ND	44	39 ND	18
1,1,1 - Trichloroethane	µg/kg	ND	22	45 BQL	90	39 ND	18
Carbon tetrachloride	µg/kg	ND	22	45 ND	44	39 ND	18
Benzene	µg/kg	ALR	15000	45	2400	39 ND	18
1,2 - Dichloroethane	µg/kg	ND	22	45 ND	44	39 ND	18
Trichloroethene	µg/kg	ND	22	45 ND	44	39 ND	18
Toluene	µg/kg		1100	45 ND	44	39 ND	18
1,1,2 - Trichloroethane	µg/kg	ND	22	45 ND	44	39 ND	18
Tetrachloroethene	µg/kg	ND	22	45 ND	44	39 ND	18
1,2 - Dibromoethane	µg/kg	ND	22	45 ND	44	39 ND	18
Chlorobenzene	µg/kg	ND	22	45 ND	44	39 BQL	62
Ethylbenzene	µg/kg	ND	22	45 ND	44	39 BQL	51
M-/P-Xylene	µg/kg	ND	22	45 ND	44	39 ND	18
O-Xylene	µg/kg	ND	22	45 ND	44	39 ND	18
1,3 - Dichlorobenzene	µg/kg	ND	22	45 ND	44	39 ND	18
1,4 - Dichlorobenzene	µg/kg	ND	22	45 ND	44	39 ND	18
1,2 - Dichlorobenzene	µg/kg	ND	22	45 ND	44	39 ND	18
Miscellaneous							
Total sulfur (as S)	wt. %	4	NA	4	NA	4	NA
Organic halogens (as chloride)	ppbw	4	NA	4	NA	4	NA
Inorganic halogens (as chloride)	ppmw	4	NA	4	NA	4	NA
Hexavalent chromium	ppmw	4	NA	4	NA	4	NA
Physical characteristics							
Density	g/cc	4	NA	4	NA	4	NA
pH		4	NA	4	NA	4	NA
TCLP volatile organics							
Vinyl chloride	µg/kg	4	NA	4	NA	4	NA
Methyl chloride	µg/kg	4	NA	4	NA	4	NA
Trans-1,2-dichloroethene	µg/kg	4	NA	4	NA	4	NA
Cis-1,2-dichloroethene	µg/kg	4	NA	4	NA	4	NA
Chloroform	µg/kg	4	NA	4	NA	4	NA
1,1,1 - Trichloroethane	µg/kg	4	NA	4	NA	4	NA
Carbon tetrachloride	µg/kg	4	NA	4	NA	4	NA
Benzene	µg/kg	4	NA	4	NA	4	NA
1,2 - Dichloroethane	µg/kg	4	NA	4	NA	4	NA
Trichloroethene	µg/kg	4	NA	4	NA	4	NA
Toluene	µg/kg	4	NA	4	NA	4	NA
1,1,2 - Trichloroethane	µg/kg	4	NA	4	NA	4	NA
Tetrachloroethene	µg/kg	4	NA	4	NA	4	NA
1,2 - Dibromoethane	µg/kg	4	NA	4	NA	4	NA
Chlorobenzene	µg/kg	4	NA	4	NA	4	NA
Ethylbenzene	µg/kg	4	NA	4	NA	4	NA
M-/P-Xylene	µg/kg	4	NA	4	NA	4	NA
O-Xylene	µg/kg	4	NA	4	NA	4	NA
1,3 - Dichlorobenzene	µg/kg	4	NA	4	NA	4	NA
1,4 - Dichlorobenzene	µg/kg	4	NA	4	NA	4	NA
1,2 - Dichlorobenzene	µg/kg	4	NA	4	NA	4	NA
TCLP trace metals							
Arsenic	µg/kg	4	NA	4	NA	4	NA
Barium	µg/kg	4	NA	4	NA	4	NA
Cadmium	µg/kg	4	NA	4	NA	4	NA
Chromium	µg/kg	4	NA	4	NA	4	NA
Lead	µg/kg	4	NA	4	NA	4	NA
Mercury	µg/kg	4	NA	4	NA	4	NA
Selenium	µg/kg	4	NA	4	NA	4	NA
Silver	µg/kg	4	NA	4	NA	4	NA

TABLE A2-12. SS13 - SCRUBBER DECANT WATER

Substance	Units	Condition 1 Waste water		Condition 2 Soil		Condition 3 Waste oil	
		Flag	Composite	Flag	Composite	Flag	Composite
Total stream flow rate							
Run 1	kg/hr		97.2		88.0		236
Run 2	kg/hr		101		81.5		375
Run 3	kg/hr		97.9		–		445
Avarage	kg/hr		98.60		–		352.0
Polychlorinated biphenyls (PCB)							
Monochlorobiphenyl (total)	µg/L	ND	1.5	49 ND	0.45	BQL	0.005
Dichlorobiphenyl (total)	µg/L	ND	6.2	49 BQL	0.02	ND	1.2
Trichlorobiphenyl (total)	µg/L	BQL	0.03	49 BQL	0.1	BQL	1.21
Tetrachlorobiphenyl (total)	µg/L	ND	43	49 BQL	0.06	ND	8.4
Pentachlorobiphenyl (total)	µg/L	ND	47	49 ND	14	ND	9.2
Hexachlorobiphenyl (total)	µg/L	ND	43	49 ND	13	ND	8.4
Heptachlorobiphenyl (total)	µg/L	ND	37	49 ND	11	ND	7.2
Octachlorobiphenyl (total)	µg/L	ND	18	49 ND	5.4	ND	3.6
Nonachlorobiphenyl (total)	µg/L	ND	4.6	49 ND	1.3	ND	0.9
Decachlorobiphenyl (total)	µg/L	ND	2.6	49 ND	0.75	ND	0.5
Total PCBs (Tri-Deca) in NDs	µg/L	<	195	49 <	45.6	<	39.4
Total PCBs (Mono-Deca) in NDs	µg/L	<	203	49 <	46.1	<	40.6
Total PCBs (Tri-Deca) ex NDs	µg/L	>	0.03	49 >	0.16	>	1.21
Total PCBs (Mono-Deca) ex NDs	µg/L	>	0.03	49 >	0.18	>	1.22
Chlorobenzenes and chlorophenols							
1,2-Dichlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
1,3-Dichlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
1,4-Dichlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
Total dichlorobenzenes	µg/L	ND	15.3	ND	60	1 ND	3.3
1,2,3-Trichlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
1,3,5-Trichlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
1,2,4-Trichlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
Total trichlorobenzenes	µg/L	ND	15.3	ND	60	1 ND	3.3
1,2,3,4-Tetrachlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	ND	10	ND	40	1 ND	2.3
Total tetrachlorobenzenes	µg/L	ND	15.1	ND	60	1 ND	3.4
Pentachlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
Hexachlorobenzene	µg/L	ND	5.1	ND	20	1 ND	1.1
2,3-Dichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
2,4-Dichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
2,5-Dichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
2,6-Dichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
3,4-Dichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
3,5-Dichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
Total dichlorophenols	µg/L	ND	25.5	ND	120	1 ND	5.5
2,3,4-Trichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
2,3,5-Trichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
2,3,6-Trichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
2,4,5-Trichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
2,4,6-Trichlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
Total trichlorophenols	µg/L	ND	25.5	ND	100	1 ND	5.5
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	ND	10	ND	40	1 ND	2.3
2,3,5,6-Tetrachlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
Total tetrachlorophenols	µg/L	ND	15.1	ND	60	1 ND	3.4
Pentachlorophenol	µg/L	ND	5.1	ND	20	1 ND	1.1
Total CB including NDs	µg/L	ND	55.9	ND	220	1 ND	12.2
Total CP including NDs	µg/L	ND	71.2	ND	300	1 ND	15.5
Total CB excluding NDs	µg/L	all	ND	all	ND	1 all	ND
Total CP excluding NDs	µg/L	all	ND	all	ND	1 all	ND

TABLE A2-12. SS13 - SCRUBBER DECANT WATER (continued)

Substance	Units	Condition 1 Waste water		Condition 2 Soil		Condition 3 Waste oil	
		Flag	Composite	Flag	Composite	Flag	Composite
Polycyclic aromatic hydrocarbons (PAH)							
Naphthalene	µg/L		3900	35	1000		13000
2-Methylnaphthalene	µg/L	BQL	20	35 ND	20	QI	31
2-Cl-Naphthalene	µg/L	ND	5.1	35 ND	20	ND	1.1
Acenaphthylene	µg/L		1400	35	430	BQL	1800
Acenapthene	µg/L	BQL	12	35 ND	20		24
Fluorene	µg/L		65	35 BQL	25		45
Phenanthrene	µg/L	BQL	540	35	650	ALR	150
Anthracene	µg/L		51	35	610	BQL	9.8
Fluoranthene	µg/L		210	35	550		59
Pyrene	µg/L		260	35	590		64
Benzo (a) anthracene	µg/L	BQL	13	35 ND	20	ND	1.1
Chrysene	µg/L	BQL	25	35 BQL	62	BQL	2.4
Benzo (b) fluoranthene	µg/L	BQL	22	35 BQL	83	BQL	2.8
Benzo (k) fluoranthene	µg/L	BQL	7.8	35 ND	20	ND	1.1
Benzo (e) pyrene	µg/L	BQL	22	35 BQL	68	BQL	3
Benzo (a) pyrene	µg/L	BQL	36	35 BQL	78	BQL	2.5
Perylene	µg/L	BQL	12	35 BQL	47	ND	1.1
Indeno (1,2,3-cd) pyrene	µg/L	BQL	11	35 BQL	58	BQL	2.5
Dibenz (a,h) anthracene	µg/L	ND	5.1	35 ND	20	ND	1.1
Benzo (g,h,i) perylene	µg/L	BQL	21	35 BQL	86	BQL	4.9
Total PAHs including NDs	µg/L	<	6640	35 <	4460		15200
Total PAHs excluding NDs	µg/L	>	6630	35 >	4340		15200
Dioxins and furans							
2378 TCDD	ng/L	ND	0.02	ND	0.07	ND	0.01
12378 PeCDD	ng/L	ND	0.03	ND	0.05	ND	0.01
123478 HxCDD	ng/L	ND	0.04	ND	0.01	ND	0.003
123678 HxCDD	ng/L	ND	0.03	ND	0.02	ND	0.001
123789 HxCDD	ng/L	ND	0.04	ND	0.03	ND	0.002
1234678 HpCDD	ng/L	ND	0.04	ND	0.03	ND	0.01
OCDD	ng/L	F	0.06		0.19	F	0.04
2378 TCDF	ng/L	ND	0.02	ND	0.05	ND	0.01
12378 PeCDF	ng/L	ND	0.01	ND	0.07	ND	0.01
23478 PeCDF	ng/L	ND	0.02	ND	0.05	ND	0.01
123478 HxCDF	ng/L	ND	0.04	ND	0.04	ND	0.003
123678 HXCDF	ng/L	ND	0.04	ND	0.05	ND	0.002
234678 HxCDF	ng/L	ND	0.03	ND	0.05	ND	0.01
123789 HxCDF	ng/L	ND	0.04	ND	0.02	ND	0.002
1234678 HpCDF	ng/L	ND	0.10		0.05	ND	0.004
1234789 HpCDF	ng/L	ND	0.04	ND	0.02	ND	0.001
OCDF	ng/L	ND	0.06		0.05	ND	0.01
TCDD (total)	ng/L	ND	0.35	ND	1.61		0.03
PeCDD (total)	ng/L	ND	0.45	ND	0.71	ND	0.08
HxCDD (total)	ng/L	ND	0.33	ND	0.20	ND	0.02
HpCDD (total)	ng/L	ND	0.08		0.03		0.004
TCDF (total)	ng/L		0.01		0.05	ND	0.26
PeCDF (total)	ng/L	ND	0.39	ND	1.55	ND	0.29
HxCDF (total)	ng/L	ND	0.61	ND	0.63	ND	0.05
HpCDF (total)	ng/L	ND	0.27		0.05	ND	0.01
Total dioxins (by isomer) including NDs	ng/L	<	0.24	<	0.40	<	0.07
Total furans (by isomer) including NDs	ng/L	ND	0.39	<	0.43	ND	0.06
Total dioxins/furans (by isomer) inc NDs	ng/L	<	0.63	<	0.83	<	0.13
Total dioxins (by isomer) excluding NDs	ng/L	>	0.06	>	0.19	>	0.04
Total furans (by isomer) excluding NDs	ng/L	all	ND	>	0.10	all	ND
Total dioxins/furans (by isomer) ex. NDs	ng/L	>	0.06	>	0.29	>	0.04

TABLE A2-12. SS13 - SCRUBBER DECANT WATER (continued)

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 2 Soil Flag	Condition 2 Soil Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Trace metals							
Antimony	µg/L	ND	100	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100	ND	100
Barium	µg/L		11	ND	10		15
Beryllium	µg/L	ND	10	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10	ND	10
Chromium (Total)	µg/L		22		19	ND	10
Copper	µg/L		33		550		20
Lead	µg/L		120		130	ND	50
Manganese	µg/L		23		100		16
Mercury	µg/L	ND	0.2		0.31	ND	0.2
Nickel	µg/L		39		140		190
Phosphorus	µg/L	ND	100	ND	100	ND	100
Selenium	µg/L	ND	100	ND	100	ND	100
Silver	µg/L	ND	10	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100	ND	100
Tin	µg/L	ND	100		1200	ND	100
Zinc	µg/L		260		740		120
Volatile organic compounds			**Run 1**		**Composite**		**Composite**
Vinyl chloride	µg/L	ND	100	ND	200	39 ND	2
Methyl chloride	µg/L	ND	100	ND	200	39. ND	2
Trans-1,2-dichloroethene	µg/L	ND	100	ND	200	39 ND	2
Cis-1,2-dichloroethene	µg/L	ND	100	ND	200	39 ND	2
Chloroform	µg/L	ND	100	ND	200	39 ND	2
1,1,1 - Trichloroethane	µg/L	ND	100	ND	200	39 ND	2
Carbon tetrachloride	µg/L	ND	100	ND	200	39 ND	2
Benzene	µg/L		2800		4900	39 ALR	7700
1,2 - Dichloroethane	µg/L	ND	100	ND	200	39 ND	2
Trichloroethene	µg/L	ND	100	ND	200	39 ND	2
Toluene	µg/L	ND	100	ND	200	39	220
1,1,2 - Trichloroethane	µg/L	ND	100	ND	200	39 ND	2
Tetrachloroethene	µg/L	ND	100	ND	200	39 BQL	4
1,2 - Dibromoethane	µg/L	ND	100	ND	200	39 ND	2
Chlorobenzene	µg/L	ND	100	ND	200	39 BQL	6
Ethylbenzene	µg/L	ND	100	ND	200	39 BQL	2
M-/P-Xylene	µg/L	ND	100	ND	200	39 ND	2
O-Xylene	µg/L	ND	100	ND	200	39 ND	2
1,3 - Dichlorobenzene	µg/L	ND	100	ND	200	39 ND	2
1,4 - Dichlorobenzene	µg/L	ND	100	ND	200	39 ND	2
1,2 - Dichlorobenzene	µg/L	ND	100	ND	200	39 ND	2
Volatile organic compounds			**Run 2**				
Vinyl chloride	µg/L	3 ND	40				
Methyl chloride	µg/L	3 ND	40				
Trans-1,2-dichloroethene	µg/L	3 ND	40				
Cis-1,2-dichloroethene	µg/L	3 ND	40				
Chloroform	µg/L	3 ND	40				
1,1,1 - Trichloroethane	µg/L	3 ND	40				
Carbon tetrachloride	µg/L	3 ND	40				
Benzene	µg/L	3	680				
1,2 - Dichloroethane	µg/L	3 ND	40				
Trichloroethene	µg/L	3 ND	40				
Toluene	µg/L	3 ND	40				
1,1,2 - Trichloroethane	µg/L	3 ND	40				
Tetrachloroethene	µg/L	3 ND	40				
1,2 - Dibromoethane	µg/L	3 ND	40				
Chlorobenzene	µg/L	3 ND	40				
Ethylbenzene	µg/L	3 ND	40				
M-/P-Xylene	µg/L	3 ND	40				
O-Xylene	µg/L	3 ND	40				
1,3 - Dichlorobenzene	µg/L	3 ND	40				
1,4 - Dichlorobenzene	µg/L	3 ND	40				
1,2 - Dichlorobenzene	µg/L	3 ND	40				

TABLE A2-12. SS13 - SCRUBBER DECANT WATER (continued)

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 2 Soil Flag	Condition 2 Soil Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Volatile organic compounds			Run 3				
Vinyl chloride	µg/L	3 ND	200				
Methyl chloride	µg/L	3 ND	200				
Trans-1,2-dichloroethene	µg/L	3 ND	200				
Cis-1,2-dichloroethene	µg/L	3 ND	200				
Chloroform	µg/L	3 ND	200				
1,1,1 - Trichloroethane	µg/L	3 ND	200				
Carbon tetrachloride	µg/L	3 ND	200				
Benzene	µg/L	3	18000				
1,2 - Dichloroethane	µg/L	3 BQL	390				
Trichloroethene	µg/L	3 ND	200				
Toluene	µg/L	3 ND	200				
1,1,2 - Trichloroethane	µg/L	3 ND	200				
Tetrachloroethene	µg/L	3 ND	200				
1,2 - Dibromoethane	µg/L	3 ND	200				
Chlorobenzene	µg/L	3 ND	200				
Ethylbenzene	µg/L	3 ND	200				
M-/P-Xylene	µg/L	3 ND	200				
O-Xylene	µg/L	3 ND	200				
1,3 - Dichlorobenzene	µg/L	3 ND	200				
1,4 - Dichlorobenzene	µg/L	3 ND	200				
1,2 - Dichlorobenzene	µg/L	3 ND	200				
Miscellaneous							
Total organic carbon	ppmw		32.8		50.6		19.7
Organic halogens (as chloride)	ppbw	3	18.4		55.2	3	149
Inorganic halogens (as chloride)	ppmw		1400		580		3000
Chrlorine	wt. %		0.06		NA		NA
Fluorine	wt. %	<	0.01		NA		NA
Phosphate	wt. %	<	0.01		NA		NA
Hexavalent chromium	ppmw	ND	0.01	ND	0.01	ND	0.01
Physical characteristics							
Density	g/cc		0.99		0.98		0.99
pH	–		9.8		9.9		10.1
Ultimate analysis							
Carbon	wt. %		0.53		NA		NA
Hydrogen	wt. %		23.5		NA		NA
Nitrogen	wt. %	<	0.01		NA		NA
Total sulfur (as S)	wt. %		0.003		0.003		0.001
Oxygen	wt. %		75.9		NA		NA

TABLE A2-13. SS14 - REFORMED GAS SUMMARY

Substance	Units	Condition 1 - Waste water					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Total stream flow rate							
	lb/hr		23.2		18.2		15.5
	kg/hr		10.5		8.26		7.03
	dscm/hr		14.0		12.0		8.78
Polychlorinated biphenyls (PCB)							
Monochlorobiphenyl (total)	µg/dscm	ND	0.02		0.87	ND	0.003
Dichlorobiphenyl (total)	µg/dscm	ND	0.02		2.61	EMPC	0.08
Trichlorobiphenyl (total)	µg/dscm	ND	0.04		1.99	ND	0.01
Tetrachlorobiphenyl (total)	µg/dscm	ND	0.05	27	0.34	EMPC	0.04
Pentachlorobiphenyl (total)	µg/dscm	ND	0.07	27 EMPC	1.34	EMPC	0.25
Hexachlorobiphenyl (total)	µg/dscm	ND	0.05	ND	0.03	ND	0.01
Heptachlorobiphenyl (total)	µg/dscm	ND	0.05	ND	0.03	ND	0.01
Octachlorobiphenyl (total)	µg/dscm	ND	0.04	ND	0.03	EMPC	0.04
Nonachlorobiphenyl (total)	µg/dscm	ND	0.05	ND	0.04	EMPC	0.05
Decachlorobiphenyl (total)	µg/dscm	ND	0.23	ND	0.14	ND	0.03
Total PCBs (Tri-Deca) in NDs	µg/dscm	<	0.56	<	3.95	<	0.42
Total PCBs (Mono-Deca) in NDs	µg/dscm	<	0.60	<	7.42	<	0.50
Total PCBs (Tri-Deca) ex NDs	µg/dscm	all ND		>	3.67	>	0.38
Total PCBs (Mono-Deca) ex NDs	µg/dscm	all ND		>	7.15	>	0.46
Chlorobenzenes and chlorophenols							
1,2 Dichlorobenzene	µg/dscm	ND	49.4	ND	43.3	ND	14.4
1,3 - Dichlorobenzene	µg/dscm	ND	51.8	ND	45.3	ND	14.9
1,4 - Dichlorobenzene	µg/dscm	ND	47.7	ND	41.8	ND	13.9
2,3 - Dichlorophenol	µg/dscm	ND	58.0	ND	61.7	ND	24.2
1,2,3 - Trichlorobenzene	µg/dscm	ND	45.2	ND	48.1	ND	17.8
1,2,4 - Trichlorobenzene	µg/dscm	ND	46.1	ND	49.0	ND	17.1
1,3,5 - Trichlorobenzene	µg/dscm	ND	47.3	ND	50.4	ND	17.1
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	25.2	ND	27.9	ND	15.7
1,2,3,5-Tetrachlorobenzene	µg/dscm	NA		NA		NA	
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	19.9	ND	42.4	ND	6.75
Pentachlorobenzene	µg/dscm	ND	23.9	ND	28.2	ND	8.35
Hexachlorobenzene	µg/dscm	ND	30.6	ND	37.9	ND	8.81
2 - Chlorophenol	µg/dscm	ND	64.2	ND	56.2	ND	18.3
3,4 - Chlorophenol	µg/dscm	ND	24.3	ND	42.6	ND	7.17
2,4 - Dichlorophenol	µg/dscm	ND	65.6	ND	69.8	ND	22.7
2,5 - Dichlorophenol	µg/dscm	ND	58.5	ND	59.0	ND	20.9
2,6 - Dichlorophenol	µg/dscm	ND	54.1	ND	57.5	ND	20.8
3,4 - Dichlorophenol	µg/dscm	ND	35.9	ND	39.8	ND	11.2
3,5 - Dichlorophenol	µg/dscm	ND	32.8	ND	36.3	ND	15.1
2,3,4 - Trichlorophenol	µg/dscm	ND	42.6	ND	47.1	ND	16.7
2,3,5 - Trichlorophenol	µg/dscm	ND	49.2	ND	54.4	ND	14.6
2,3,6 - Trichlorophenol	µg/dscm	ND	40.5	ND	44.8	ND	11.7
2,4,5 - Trichlorophenol	µg/dscm	ND	41.2	ND	48.8	ND	14.5
2,4,6 - Trichlorophenol	µg/dscm	ND	43.7	ND	51.7	ND	15.1
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	39.3	ND	43.5	ND	14.9
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	46.8	ND	51.8	ND	16.5
Pentachlorophenol	µg/dscm	ND	54.1	ND	66.9	ND	18.5
Total chlorobenzenes	µg/dscm	ND	387	ND	414	ND	135
Total chlorophenols	µg/dscm	ND	751	ND	832	ND	283

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 1 - Waste water						
		Flag		Run 1	Flag	Run 2	Flag	Run 3
Dioxins and furans								
2378 TCDD	ng/dscm		ND	0.004	ND	0.003	ND	0.001
12378 PeCDD	ng/dscm		ND	0.006	ND	0.003	EMPC	0.003
123478 HxCDD	ng/dscm		ND	0.01	ND	0.01		0.01
123678 HxCDD	ng/dscm		ND	0.01		0.01		0.01
123789 HxCDD	ng/dscm		ND	0.01		0.03		0.01
1234678 HpCDD	ng/dscm		B	0.03	B	0.07		0.05
OCDD	ng/dscm	26	B	0.31	26 B	0.32	26	0.19
2378 TCDF	ng/dscm		B	0.01		0.06		0.06
12378 PeCDF	ng/dscm		ND	0.004	ND	0.01		0.04
23478 PeCDF	ng/dscm		ND	0.004	ND	0.01		0.09
123478 HxCDF	ng/dscm		ND	0.03	ND	0.11		0.28
123678 HXCDF	ng/dscm		ND	0.02	ND	0.07		0.06
234678 HxCDF	ng/dscm			0.06	B	0.18		0.29
123789 HxCDF	ng/dscm		ND	0.04	ND	0.14		2.35
1234678 HpCDF	ng/dscm		ND	0.02	ND	0.07		0.12
1234789 HpCDF	ng/dscm		ND	0.02	ND	0.14		0.07
OCDF	ng/dscm		ND	0.01		0.01		0.03
TCDD (total)	ng/dscm		ND	0.004		0.003	EMPC	0.002
PeCDD (total)	ng/dscm		ND	0.006	ND	0.003		0.01
HxCDD (total)	ng/dscm		ND	0.01		0.17		0.09
HpCDD (total)	ng/dscm			0.05	Q	0.13		0.08
TCDF (total)	ng/dscm			0.01		0.25	Q	0.20
PeCDF (total)	ng/dscm		ND	0.004		0.05	Q	0.53
HxCDF (total)	ng/dscm			0.06		0.18		0.85
HpCDF (total)	ng/dscm		<	0.37	<	0.44	<	0.28
Total dioxins (by isomer) including NDs	ng/dscm		<	0.37	<	0.44	<	0.28
Total furans (by isomer) including NDs	ng/dscm		<	0.21	<	0.80	<	3.40
Total dioxins/furans (by isomer) inc NDs	ng/dscm		<	0.59	<	1.24	<	3.68
Total dioxins (by isomer) excluding NDs	ng/dscm		>	0.34	>	0.43	>	0.27
Total furans (by isomer) excluding NDs	ng/dscm		>	0.07	>	0.25		–
Total dioxins/furans (by isomer) ex. NDs	ng/dscm		>	0.41	>	0.68	>	0.27
Volatile organic compounds								
Vinyl chloride	µg/dscm	8(1,2,3)	ND	1.94	<	8.47	**1 ND	2.04
Methyl chloride	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
Trans-1,2-dichloroethene	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
Cis-1,2-dichloroethene	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
Chloroform	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
1,1,1 - Trichloroethane	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
Carbon tetrachloride	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
Benzene	µg/dscm	8(1,2,3)	ALR	2330	SAT	12400	**1	1550000
1,2 - Dichloroethane	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
Trichloroethene	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 <	76.8
Toluene	µg/dscm	8(1,2,3)	ND	1.94	<	3070	**1	32800
1,1,2 - Trichloroethane	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 <	5.73
Tetrachloroethene	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 <	15.8
1,2 - Dibromoethane	µg/dscm	8(1,2,3)	ND	1.94	ND	8.93	**1 ND	2.04
Chlorobenzene	µg/dscm	8(1,2,3)	ND	1.94	<	83.8	**1	324
Ethylbenzene	µg/dscm	8(1,2,3)	ND	1.94	<	71.6	**1	473
M-/P-Xylene	µg/dscm	8(1,2,3)	ND	3.88	<	51.9	**1	278
O-Xylene	µg/dscm	8(1,2,3)	ND	1.94	<	44.5	**1 ND	2.04
1,3 - Dichlorobenzene	µg/dscm	8(1,2,3)	ND	1.94	<	8.39	**1 ND	2.04
1,4 - Dichlorobenzene	µg/dscm	8(1,2,3)	ND	1.94	<	9.06	**1 ND	2.04
1,2 - Dichlorobenzene	µg/dscm	8(1,2,3)	ND	1.94	<	8.39	**1 ND	2.04

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 1 - Waste water					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Sulfur compounds							
Hydrogen sulfide	ppbv		45800		7690	ND	4.8
Carbonyl sulfide	ppbv	ND	92.0		537		61.8
Methyl mercaptan	ppbv	ND	92.0	ND	43.0	ND	4.8
Ethyl mercaptan	ppbv	ND	92.0	ND	43.0	ND	4.8
Dimethyl sulfide	ppbv	ND	92.0	ND	43.0	ND	4.8
Carbon sulfide	ppbv		92.8		50.6		8.07
N-Propylmercaptan	ppbv	ND	92.0	ND	43.0		10.2
Dimethyl disulfide	ppbv	ND	46.0	ND	21.5	ND	3.61
Fixed gases							
Hydrogen	vol. %		42.1		46.6		34.6
Oxygen	vol. %		0.07		0.05		0.03
Nitrogen	vol. %		28.9		28.7		43.5
Methane	vol. %		11.7		10.8		14.0
Carbon monoxide	vol. %		6.45		4.51		4.46
Carbon dioxide	vol. %	33	8.98	33	8.49	33	2.53
Hydrocarbons							
C1 Hydrocarbons	ppmv		134483		122581		159036
C2 Hydrocarbons	ppmv		3931		4086		3880
C3 Hydrocarbons	ppmv		398		6		365
C4 Hydrocarbons	ppmv		6		5		6
C5 Hydrocarbons	ppmv		6		6		17108
C6 Hydrocarbons	ppmv		4		4		37
Miscellaneous							
Heating value	Btu/lb		6320		6640		5840
Moisture	vol. %		–		17.0		1.60

Note: **1 refers to flags 8(4),12(2,3),13(1,2,4),14(2,3) **2 refers to flags 15(1,2,3,4),16(1,2,3,4),17(4) **3 refers to flags 15(1,2,3,4),44(1,2,3,4) **4 refers to flags 8(2),10(2),15(2),16(2),18(1) **5 refers to flags 8(2,4),11(1,3),10(2,4),13(2),14(4),15(2,4) **6 refers to flags 10(1,2,3),8(1,2,3),16(2),141,2,3)

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 2 - Soil			
		Flag	Run 1	Flag	Run 2
Total stream flow rate					
	lb/hr		16.4		7.40
	kg/hr		7.44		3.36
	dscm/hr		13.3		6.16
Polychlorinated biphenyls (PCB)					
Monochlorobiphenyl (total)	µg/dscm		0.08		0.13
Dichlorobiphenyl (total)	µg/dscm		0.10		0.16
Trichlorobiphenyl (total)	µg/dscm		0.26		0.48
Tetrachlorobiphenyl (total)	µg/dscm		0.31		0.80
Pentachlorobiphenyl (total)	µg/dscm	EMPC	0.14	ND	0.05
Hexachlorobiphenyl (total)	µg/dscm	ND	0.06	ND	0.02
Heptachlorobiphenyl (total)	µg/dscm	ND	0.06	ND	0.02
Octachlorobiphenyl (total)	µg/dscm	ND	0.06	ND	0.02
Nonachlorobiphenyl (total)	µg/dscm	ND	0.03	ND	0.02
Decachlorobiphenyl (total)	µg/dscm	ND	0.17	ND	0.09
Total PCBs (Tri-Deca) in NDs	µg/dscm	<	1.08	<	1.49
Total PCBs (Mono-Deca) in NDs	µg/dscm	<	1.26	<	1.78
Total PCBs (Tri-Deca) ex NDs	µg/dscm	>	0.71	>	1.28
Total PCBs (Mono-Deca) ex NDs	µg/dscm	>	0.89	>	1.67
Chlorobenzenes and chlorophenols					
1,2 Dichlorobenzene	µg/dscm	ND	7.39	ND	13.7
1,3 - Dichlorobenzene	µg/dscm	ND	7.04	ND	13.6
1,4 - Dichlorobenzene	µg/dscm	ND	7.19	ND	13.9
2,3 - Dichlorophenol	µg/dscm	ND	14.6	ND	12.8
1,2,3 - Trichlorobenzene	µg/dscm	ND	10.6	ND	9.73
1,2,4 - Trichlorobenzene	µg/dscm	ND	9.86	ND	9.01
1,3,5 - Trichlorobenzene	µg/dscm	ND	10.0	ND	8.76
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	6.52	ND	12.0
1,2,3,5-Tetrachlorobenzene	µg/dscm	ND	7.19	ND	7.02
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	6.73	ND	5.93
Pentachlorobenzene	µg/dscm	ND	4.96	ND	10.40
Hexachlorobenzene	µg/dscm	ND	4.05	ND	7.75
2 - Chlorophenol	µg/dscm	ND	7.44	ND	13.8
3,4 - Chlorophenol	µg/dscm	ND	3.61	ND	6.60
2,4 - Dichlorophenol	µg/dscm	ND	11.3	ND	10.9
2,5 - Dichlorophenol	µg/dscm	ND	11.5	ND	9.84
2,6 - Dichlorophenol	µg/dscm	ND	11.1	ND	10.3
3,4 - Dichlorophenol	µg/dscm	ND	8.25	ND	13.8
3,5 - Dichlorophenol	µg/dscm	ND	7.91	ND	14.1
2,3,4 - Trichlorophenol	µg/dscm	ND	10.6	ND	19.4
2,3,5 - Trichlorophenol	µg/dscm	ND	10.4	ND	18.0
2,3,6 - Trichlorophenol	µg/dscm	ND	10.1	ND	19.6
2,4,5 - Trichlorophenol	µg/dscm	ND	9.88	ND	16.3
2,4,6 - Trichlorophenol	µg/dscm	ND	10.3	ND	19.1
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	8.00	ND	14.5
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	8.29	ND	16.2
Pentachlorophenol	µg/dscm	ND	8.68	ND	17.10
Total chlorobenzenes	µg/dscm	ND	74.19	ND	98.10
Total chlorophenols	µg/dscm	ND	152.02	ND	234.3

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 2 - Soil				
		Flag	Run 1		Flag	Run 2
Dioxins and furans						
2378 TCDD	ng/dscm		ND	0.003		ND	0.004
12378 PeCDD	ng/dscm		ND	0.01		ND	0.01
123478 HxCDD	ng/dscm		ND	0.01		ND	0.02
123678 HxCDD	ng/dscm		ND	0.01		ND	0.01
123789 HxCDD	ng/dscm		ND	0.01		ND	0.02
1234678 HpCDD	ng/dscm			0.04			0.02
OCDD	ng/dscm	26 B		0.39	26,29	B	0.12
2378 TCDF	ng/dscm		ND	0.002			0.03
12378 PeCDF	ng/dscm		ND	0.003		EMPC/PR	0.01
23478 PeCDF	ng/dscm		ND	0.003			0.02
123478 HxCDF	ng/dscm		ND	0.02		EMPC	0.15
123678 HXCDF	ng/dscm		ND	0.02		ND/U	0.07
234678 HxCDF	ng/dscm		ND	0.02			0.27
123789 HxCDF	ng/dscm		ND	0.03		ND/U	0.12
1234678 HpCDF	ng/dscm		ND	0.03		EMPC	0.04
1234789 HpCDF	ng/dscm		ND	0.06			0.08
OCDF	ng/dscm			0.08			0.01
TCDD (total)	ng/dscm		ND	0.003		ND	0.004
PeCDD (total)	ng/dscm		ND	0.01		EMPC	0.05
HxCDD (total)	ng/dscm			0.03			0.02
HpCDD (total)	ng/dscm			0.08			0.02
TCDF (total)	ng/dscm		ND	0.002			0.04
PeCDF (total)	ng/dscm		ND	0.003			0.04
HxCDF (total)	ng/dscm		ND	0.02		Q	0.32
HpCDF (total)	ng/dscm		ND	0.03		Q	0.06
Total dioxins (by isomer) including NDs	ng/dscm		<	0.470		<	0.20
Total furans (by isomer) including NDs	ng/dscm		<	0.261		<	0.81
Total dioxins/furans (by isomer) inc NDs	ng/dscm		<	0.731		<	1.01
Total dioxins (by isomer) excluding NDs	ng/dscm		>	0.340		>	0.14
Total furans (by isomer) excluding NDs	ng/dscm		>	0.060		>	0.80
Total dioxins/furans (by isomer) ex. NDs	ng/dscm		>	0.400		>	0.94
Volatile organic compounds							
Vinyl chloride	µg/dscm	**2	INT		**3	<	333
Methyl chloride	µg/dscm	**2	INT		**3	<	266
Trans-1,2-dichloroethene	µg/dscm	**2	INT		**3	ND	2.08
Cis-1,2-dichloroethene	µg/dscm	**2	INT		**3	ND	2.08
Chloroform	µg/dscm	**2	INT		**3	ND	2.08
1,1,1 - Trichloroethane	µg/dscm	**2	INT		**3	INT	
Carbon tetrachloride	µg/dscm	**2	INT		**3	INT	
Benzene	µg/dscm	**2	SAT		**3	SAT	
1,2 - Dichloroethane	µg/dscm	**2	INT		**3	INT	
Trichloroethene	µg/dscm	**2	INT		**3	ND	2.08
Toluene	µg/dscm	**2	<	15900	**3		159000
1,1,2 - Trichloroethane	µg/dscm	**2	ND	2.09	**3	ND	2.08
Tetrachloroethene	µg/dscm	**2	<	199	**3		59.7
1,2 - Dibromoethane	µg/dscm	**2	ND	2.09	**3	ND	2.08
Chlorobenzene	µg/dscm	**2	<	7.30	**3	ND	2.08
Ethylbenzene	µg/dscm	**2	<	12.6	**3		69.2
M-/P-Xylene	µg/dscm	**2	ND	4.19	**3	<	23.2
O-Xylene	µg/dscm	**2	ND	2.09	**3	<	13.2
1,3 - Dichlorobenzene	µg/dscm	**2	ND	2.09	**3	ND	2.08
1,4 - Dichlorobenzene	µg/dscm	**2	ND	2.09	**3	ND	2.08
1,2 - Dichlorobenzene	µg/dscm	**2	ND	2.09	**3	ND	2.08

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 2 - Soil			
		Flag	Run 1	Flag	Run 2
Sulfur compounds					
Hydrogen sulfide	ppbv	ND	4.9	ND	4.49
Carbonyl sulfide	ppbv		119.3		37.9
Methyl mercaptan	ppbv	ND	4.90	ND	4.49
Ethyl mercaptan	ppbv	ND	4.90	ND	4.49
Dimethyl sulfide	ppbv	ND	4.90	ND	4.49
Carbon sulfide	ppbv		23	ND	4.49
N-Propylmercaptan	ppbv	ND	4.90	ND	4.49
Dimethyl disulfide	ppbv	ND	2.50	ND	2.25
Fixed gases					
Hydrogen	vol. %		67.4		62.3
Oxygen	vol. %		0.02		0.01
Nitrogen	vol. %		18.3		25.0
Methane	vol. %		7.37		6.89
Carbon monoxide	vol. %		2.95		3.73
Carbon dioxide	vol. %	33	3.32	33	1.81
Hydrocarbons					
C1 Hydrocarbons	ppmv		84321		67416
C2 Hydrocarbons	ppmv		1096		392
C3 Hydrocarbons	ppmv		74		17
C4 Hydrocarbons	ppmv		4		1
C5 Hydrocarbons	ppmv		46		42
C6 Hydrocarbons	ppmv		3		21
Miscellaneous					
Heating value	Btu/lb		11520		9600
Moisture	vol. %		2.11		1.81

Note: **1 refers to flags 8(4),12(2,3),13(1,2,4),14(2,3) **2 refers to flags 15(1,2,3,4),16(1,2,3,4),17(4) **3 refers to flags 15(1,2,3,4),44(1,2,3,4) **4 refers to flags 8(2),10(2),15(2),16(2),18(1) **5 refers to flags 8(2,4),11(1,3),10(2,4),13(2),14(4),15(2,4) **6 refers to flags 10(1,2,3),8(1,2,3),16(2),141,2,3)

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 3 - Waste oil					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Total stream flow rate							
	lb/hr		32.9		33.6		42.7
	kg/hr		14.9		15.2		19.4
	dscm/hr		27.4		31.7		41.7
Polychlorinated biphenyls (PCB)							
Monochlorobiphenyl (total)	µg/dscm		0.22		1.48	ND	0.01
Dichlorobiphenyl (total)	µg/dscm		2.67		11.1	ND	0.02
Trichlorobiphenyl (total)	µg/dscm		0.36		40.6	EMPC	0.04
Tetrachlorobiphenyl (total)	µg/dscm	EMPC	1.44		29.2	ND	0.04
Pentachlorobiphenyl (total)	µg/dscm	ND	0.14		7.70	EMPC	0.91
Hexachlorobiphenyl (total)	µg/dscm	ND	0.07		0.38	ND	0.03
Heptachlorobiphenyl (total)	µg/dscm	ND	0.07	ND	0.07	ND	0.03
Octachlorobiphenyl (total)	µg/dscm	ND	0.07	ND	0.07	EMPC	0.14
Nonachlorobiphenyl (total)	µg/dscm	ND	0.06	ND	0.07	EMPC	0.21
Decachlorobiphenyl (total)	µg/dscm	ND	0.29	ND	0.31	ND	0.14
Total PCBs (Tri-Deca) in NDs	µg/dscm	<	2.51	<	78.3	<	1.54
Total PCBs (Mono-Deca) in NDs	µg/dscm	<	5.40	<	90.9	<	1.57
Total PCBs (Tri-Deca) ex NDs	µg/dscm	>	1.80	>	77.9	>	1.30
Total PCBs (Mono-Deca) ex NDs	µg/dscm	>	4.69	>	90.5	>	1.30
Chlorobenzenes and chlorophenols							
1,2 Dichlorobenzene	µg/dscm	ND	3.25	ND	1.70	ND	0.44
1,3 - Dichlorobenzene	µg/dscm	ND	3.11	ND	1.63	ND	0.41
1,4 - Dichlorobenzene	µg/dscm	ND	3.15	ND	1.65	ND	0.42
2,3 - Dichlorophenol	µg/dscm	ND	2.02	ND	1.04	ND	0.39
1,2,3 - Trichlorobenzene	µg/dscm	ND	1.83	ND	0.95	ND	0.36
1,2,4 - Trichlorobenzene	µg/dscm	ND	1.69	ND	0.87	ND	0.33
1,3,5 - Trichlorobenzene	µg/dscm	ND	1.68	ND	0.87	ND	0.32
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	2.77	ND	1.54	ND	0.41
1,2,3,5-Tetrachlorobenzene	µg/dscm		NA		NA		NA
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	0.80	ND	0.41	ND	0.31
Pentachlorobenzene	µg/dscm	ND	2.82	ND	1.57	ND	0.42
Hexachlorobenzene	µg/dscm	ND	3.16	ND	17.02	ND	0.57
2 - Chlorophenol	µg/dscm	ND	3.42	ND	1.79	ND	0.46
3,4 - Chlorophenol	µg/dscm	ND	0.40	ND	0.21	ND	0.08
2,4 - Dichlorophenol	µg/dscm	ND	1.68	ND	0.87	ND	0.33
2,5 - Dichlorophenol	µg/dscm	ND	2.12	ND	1.09	ND	0.41
2,6 - Dichlorophenol	µg/dscm	ND	0.76	ND	0.39	ND	0.15
3,4 - Dichlorophenol	µg/dscm	ND	3.06	ND	1.70	ND	0.46
3,5 - Dichlorophenol	µg/dscm	ND	1.29	ND	0.72	ND	0.19
2,3,4 - Trichlorophenol	µg/dscm	ND	4.00	ND	2.23	ND	0.60
2,3,5 - Trichlorophenol	µg/dscm	ND	4.37	ND	2.43	ND	0.65
2,3,6 - Trichlorophenol	µg/dscm	ND	3.89	ND	2.16	ND	0.58
2,4,5 - Trichlorophenol	µg/dscm	ND	3.51	ND	1.95	ND	0.52
2,4,6 - Trichlorophenol	µg/dscm	ND	3.93	ND	2.18	ND	0.58
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	3.11	ND	1.73	ND	0.46
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	5.01	ND	2.78	ND	0.74
Pentachlorophenol	µg/dscm	ND	7.20	ND	3.88	ND	1.30
Total chlorobenzenes	µg/dscm	ND	24.3	ND	28.2	ND	4.00
Total chlorophenols	µg/dscm	ND	49.8	ND	27.2	ND	7.89

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 3 - Waste oil								
		Flag		Run 1	Flag		Run 2	Flag		Run 3
Dioxins and furans										
2378 TCDD	ng/dscm		ND	0.004		ND	0.001		ND	0.002
12378 PeCDD	ng/dscm		ND	0.01		ND	0.002		ND	0.002
123478 HxCDD	ng/dscm		ND	0.01		ND	0.003		ND	0.004
123678 HxCDD	ng/dscm		ND	0.01		ND	0.002		EMPC	0.003
123789 HxCDD	ng/dscm		ND	0.01		ND	0.003		PR	0.004
1234678 HpCDD	ng/dscm		EMPC/B	0.03		EMPC/B	0.02			0.04
OCDD	ng/dscm	26	B	0.30	26	B	0.02	26	B	0.27
2378 TCDF	ng/dscm			0.03			0.002			0.01
12378 PeCDF	ng/dscm			0.01		EMPC	0.001			0.002
23478 PeCDF	ng/dscm			0.02		EMPC	0.002			0.003
123478 HxCDF	ng/dscm		EMPC	0.06		ND	0.007			0.01
123678 HXCDF	ng/dscm		EMPC	0.02		ND	0.003		EMPC	0.004
234678 HxCDF	ng/dscm		B	0.05			0.01			0.02
123789 HxCDF	ng/dscm		ND	0.01		ND	0.01		ND	0.01
1234678 HpCDF	ng/dscm			0.04		ND	0.00			0.01
1234789 HpCDF	ng/dscm		ND	0.01		ND	0.01		ND	0.01
OCDF	ng/dscm		ND	0.01		ND	0.003		EMPC	0.01
TCDD (total)	ng/dscm		ND	0.004		ND	0.001		Q	0.005
PeCDD (total)	ng/dscm		ND	0.01		ND	0.002		Q	0.004
HxCDD (total)	ng/dscm		ND	0.01		ND	0.003			0.01
HpCDD (total)	ng/dscm		EMPC	0.06		EMPC	0.034			0.06
TCDF (total)	ng/dscm			0.07			0.002		Q	0.03
PeCDF (total)	ng/dscm			0.12		EMPC	0.003		Q	0.01
HxCDF (total)	ng/dscm			0.06			0.01			0.04
HpCDF (total)	ng/dscm			0.07		ND	0.003			0.02
Total dioxins (by isomer) including NDs	ng/dscm		<	0.36		<	0.05		<	0.32
Total furans (by isomer) including NDs	ng/dscm		<	0.27		<	0.05		<	0.11
Total dioxins/furans (by isomer) inc NDs	ng/dscm		<	0.64		<	0.10		<	0.43
Total dioxins (by isomer) excluding NDs	ng/dscm		>	0.33		>	0.04		>	0.32
Total furans (by isomer) excluding NDs	ng/dscm		>	0.23		>	0.01		>	0.07
Total dioxins/furans (by isomer) ex. NDs	ng/dscm		>	0.56		>	0.05		>	0.39
Volatile organic compounds										
Vinyl chloride	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6		101000
Methyl chloride	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6	<	343
Trans-1,2-dichloroethene	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6	ND	2.17
Cis-1,2-dichloroethene	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6	ND	2.17
Chloroform	µg/dscm	**4	ND	4.21	**5	<	8.34	**6	<	35.4
1,1,1 - Trichloroethane	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6	ND	2.17
Carbon tetrachloride	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6	ND	2.17
Benzene	µg/dscm	**4		1760000	**5		2860000	**6		724000
1,2 - Dichloroethane	µg/dscm	**4	ND	4.21	**5	<	5.11	**6	ND	2.17
Trichloroethene	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6		54.5
Toluene	µg/dscm	**4		58900	**5		113000	**6		38000
1,1,2 - Trichloroethane	µg/dscm	**4		46.3	**5	ND	2.08	**6	ND	2.17
Tetrachloroethene	µg/dscm	**4		3030	**5	ND	2.08	**6		4410
1,2 - Dibromoethane	µg/dscm	**4	ND	4.21	**5	ND	2.08	**6	ND	2.17
Chlorobenzene	µg/dscm	**4		3200	**5		2030	**6		1120
Ethylbenzene	µg/dscm	**4		5470	**5		2170	**6		1210
M-/P-Xylene	µg/dscm	**4		505	**5		296	**6		283
O-Xylene	µg/dscm	**4	ND	4.21	**5	<	44.8	**6	ND	2.17
1,3 - Dichlorobenzene	µg/dscm	**4		32.0	**5	<	5.52	**6	<	11.9
1,4 - Dichlorobenzene	µg/dscm	**4	ND	4.21	**5	<	20.8	**6	<	14.5
1,2 - Dichlorobenzene	µg/dscm	**4		39.6	**5	<	15.6	**6	<	10.2

TABLE A2-13. SS14 - REFORMED GAS SUMMARY (continued)

Substance	Units	Condition 3 - Waste oil					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Sulfur compounds							
Hydrogen sulfide	ppbv		51400		41900		11900
Carbonyl sulfide	ppbv		1650		1890		2540
Methyl mercaptan	ppbv		74.7		114	ND	41.2
Ethyl mercaptan	ppbv		20.6	ND	82.5	ND	41.2
Dimethyl sulfide	ppbv	ND	4.21	ND	82.5	ND	41.2
Carbon sulfide	ppbv		1280		1007		489
N-Propylmercaptan	ppbv	ND	4.21	ND	82.5	ND	41.2
Dimethyl disulfide	ppbv		7.89	ND	41.2	ND	41.2
Fixed gases							
Hydrogen	vol. %		50.4		54.6		61.9
Oxygen	vol. %		0.06		0.06		0.06
Nitrogen	vol. %		20.5		12.5		8.12
Methane	vol. %		18.1		22.0		10.7
Carbon monoxide	vol. %		5.68		5.65		12.69
Carbon dioxide	vol. %	33	2.63	33	3.29	33	4.02
Hydrocarbons							
C1 Hydrocarbons	ppmv		206316		252577		121649
C2 Hydrocarbons	ppmv		7495		9814		3711
C3 Hydrocarbons	ppmv		700		752		265
C4 Hydrocarbons	ppmv		57		30		5
C5 Hydrocarbons	ppmv		2621		56		9
C6 Hydrocarbons	ppmv		1		94	ND	1
Miscellaneous							
Heating value	Btu/lb		11180		14250		12570
Moisture	vol. %		2.69		2.49		2.07

Note: **1 refers to flags 8(4),12(2,3),13(1,2,4),14(2,3) **2 refers to flags 15(1,2,3,4),16(1,2,3,4),17(4) **3 refers to flags 15(1,2,3,4),44(1,2,3,4) **4 refers to flags 8(2),10(2),15(2),16(2),18(1) **5 refers to flags 8(2,4),11(1,3),10(2,4),13(2),14(4),15(2,4) **6 refers to flags 10(1,2,3),8(1,2,3),16(2),141,2,3)

TABLE A2-14. SS15 - REFORMED GAS STORAGE TANK CONDENSATE

Substance	Units	Condition 3 - Waste oil							
		Flag		Run 1	Flag		Run 2	Flag		Run 3		Average
Total stream flow rate												
	kg/hr			0.203			0.386			0.733		0.441
Polychlorinated biphenyls (PCB)												
Monochlorobiphenyl (total)	µg/L	6	ND	97.5					BQL	8.81	<	97.50
Dichlorobiphenyl (total)	µg/L	6	BQL	2.17					BQL	2.96	BQL	2.17
Trichlorobiphenyl (total)	µg/L	6	BQL	21.7					BQL	2.02	BQL	21.70
Tetrachlorobiphenyl (total)	µg/L	6	ND	2680					ND	4700	ND	2680
Pentachlorobiphenyl (total)	µg/L	6	ND	2930					ND	5100	ND	2930
Hexachlorobiphenyl (total)	µg/L	6	ND	2680					ND	4700	ND	2680
Heptachlorobiphenyl (total)	µg/L	6	ND	2290					ND	4000	ND	2290
Octachlorobiphenyl (total)	µg/L	6	ND	1150					ND	2000	ND	1150
Nonachlorobiphenyl (total)	µg/L	6	ND	287					ND	500	ND	286.5
Decachlorobiphenyl (total)	µg/L	6	ND	159					ND	280	ND	159.2
Total PCBs (Tri-Deca) including NDs	µg/L	6	<	12200					<	21300	<	12200
Total PCBs (Mono-Deca) including NDs	µg/L	6	<	12300					<	21300	<	12300
Total PCBs (Tri-Deca) excluding NDs	µg/L	6	>	22					>	2.02	>	12
Total PCBs (Mono-Deca) excluding NDs	µg/L	6	>	24					>	13.8	>	19
Chlorobenzenes and chlorophenols												
1,2-Dichlorobenzene	µg/L	4		NA					ND	960		
1,3-Dichlorobenzene	µg/L	4		NA					ND	960		
1,4-Dichlorobenzene	µg/L	4		NA					ND	960		
Total dichlorobenzenes	µg/L	4		NA					ND	2880		
1,2,3-Trichlorobenzene	µg/L	4		NA					ND	960		
1,3,5-Trichlorobenzene	µg/L	4		NA					ND	960		
1,2,4-Trichlorobenzene	µg/L	4		NA					ND	960		
Total trichlorobenzenes	µg/L	4		NA					ND	2880		
1,2,3,4-Tetrachlorobenzene	µg/L	4		NA					ND	960		
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	4		NA					ND	1900		
Total tetrachlorobenzenes	µg/L	4		NA					ND	2860		
Pentachlorobenzene	µg/L	4		NA					ND	960		
Hexachlorobenzene	µg/L	4		NA					ND	960		
2,3-Dichlorophenol	µg/L	4		NA					ND	960		
2,4-Dichlorophenol	µg/L	4		NA					ND	960		
2,5-Dichlorophenol	µg/L	4		NA					ND	960		
2,6-Dichlorophenol	µg/L	4		NA					ND	960		
3,4-Dichlorophenol	µg/L	4		NA					ND	960		
3,5-Dichlorophenol	µg/L	4		NA					ND	960		
Total dichlorophenols	µg/L	4		NA					ND	5760		
2,3,4-Trichlorophenol	µg/L	4		NA					ND	960		
2,3,5-Trichlorophenol	µg/L	4		NA					ND	960		
2,3,6-Trichlorophenol	µg/L	4		NA					ND	960		
2,4,5-Trichlorophenol	µg/L	4		NA					ND	960		
2,4,6-Trichlorophenol	µg/L	4		NA					ND	960		
Total trichlorophenols	µg/L	4		NA					ND	4800		
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	4		NA					ND	1900		
2,3,5,6-Tetrachlorophenol	µg/L	4		NA					ND	960		
Total tetrachlorophenols	µg/L	4		NA					ND	2860		
Pentachlorophenol	µg/L	4		NA					ND	960		
Total CB	µg/L	4		NA					ND	10540		
Total CP	µg/L	4		NA					ND	14380		

TABLE A2-14. SS15 - REFORMED GAS STORAGE TANK CONDENSATE (continued)

Substance	Units	Condition 3 - Waste oil								
		Flag	Run 1		Flag	Run 2	Flag	Run 3	Average	
Polycyclic aromatic hydrocarbons (PAH)										
Naphthalene	µg/L	4	NA					6100000		
2-Methylnaphthalene	µg/L	4	NA					61000		
2-Cl-Naphthalene	µg/L	4	NA				ND	960		
Acenaphthylene	µg/L	4	NA					210000		
Acenapthene	µg/L	4	NA				BQL	3600		
Fluorene	µg/L	4	NA				BQL	5100		
Phenanthrene	µg/L	4	NA					17000		
Anthracene	µg/L	4	NA				BQL	1700		
Fluoranthene	µg/L	4	NA				BQL	5700		
Pyrene	µg/L	4	NA				BQL	5800		
Benzo (a) anthracene	µg/L	4	NA				ND	960		
Chrysene	µg/L	4	NA				ND	960		
Benzo (b) fluoranthene	µg/L	4	NA				ND	960		
Benzo (k) fluoranthene	µg/L	4	NA				ND	960		
Benzo (e) pyrene	µg/L	4	NA				ND	960		
Benzo (a) pyrene	µg/L	4	NA				BQL	1100		
Perylene	µg/L	4	NA				ND	960		
Indeno (1,2,3-cd) pyrene	µg/L	4	NA				ND	960		
Dibenz (a,h) anthracene	µg/L	4	NA				ND	960		
Benzo (g,h,i) perylene	µg/L	4	NA				BQL	1300		
Total PAHs including NDs	µg/L	4	NA				<	6420000		
Total PAHs excluding NDs	µg/L	4	NA				>	641000		
Miscellaneous										
Total organic carbon	ppmw	4	NA					313		
Total sulfur (as S)	wt. %	4	NA					0.0003		
Organic halogens (as chloride)	ppbw	4	NA				3	1920		
Inorganic halogens (as chloride)	ppmw	4	NA					17		
Hexavalent chromium	ppmw	4	NA					NA		
Volatile organic compounds										
Vinyl chloride	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Methyl chloride	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Trans-1,2-dichloroethene	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Cis-1,2-dichloroethene	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Chloroform	mg/L	6,24	ND	2.50			ND	5	ND	2.50
1,1,1 - Trichloroethane	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Carbon tetrachloride	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Benzene	mg/L	6,24	ALR	738			ALR	900	ALR	738.1
1,2 - Dichloroethane	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Trichloroethene	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Toluene	mg/L	6,24		45.0			ND	5	BQL	45.00
1,1,2 - Trichloroethane	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Tetrachloroethene	mg/L	6,24	BQL	7.51			BQL	8	BQL	7.51
1,2 - Dibromoethane	mg/L	6,24	ND	2.50			ND	5	ND	2.50
Chlorobenzene	mg/L	6,24	ND	2.50			BQL	5	BQL	2.50
Ethylbenzene	mg/L	6,24	ND	2.50			BQL	6	BQL	2.50
M-/P-Xylene	mg/L	6,24	ND	2.50			ND	5	ND	2.50
O-Xylene	mg/L	6,24	ND	2.50			ND	5	ND	2.50
1,3 - Dichlorobenzene	mg/L	6,24	ND	2.50			ND	5	ND	2.50
1,4 - Dichlorobenzene	mg/L	6,24	ND	2.50			ND	5	ND	2.50
1,2 - Dichlorobenzene	mg/L	6,24	ND	2.50			ND	5	ND	2.50

TABLE A2-14. SS15 - REFORMED GAS STORAGE TANK CONDENSATE (continued)

Substance	Units	Condition 3 - Waste oil						
		Flag	Run 1	Flag	Run 2	Flag	Run 3	Average
Dioxins and furans								
2378 TCDD	ng/L	4	NA			ND	0.22	
12378 PeCDD	ng/L	4	NA			ND	0.6	
123478 HxCDD	ng/L	4	NA			ND	0.13	
123678 HxCDD	ng/L	4	NA			ND	0.16	
123789 HxCDD	ng/L	4	NA			ND	0.2	
1234678 HpCDD	ng/L	4	NA			ND	0.29	
OCDD	ng/L	4	NA				0.72	
2378 TCDF	ng/L	4	NA			ND	0.17	
12378 PeCDF	ng/L	4	NA			ND	0.095	
23478 PeCDF	ng/L	4	NA			ND	0.27	
123478 HxCDF	ng/L	4	NA			INT		
123678 HXCDF	ng/L	4	NA			INT		
234678 HxCDF	ng/L	4	NA			INT		
123789 HxCDF	ng/L	4	NA			INT		
1234678 HpCDF	ng/L	4	NA			ND	0.13	
1234789 HpCDF	ng/L	4	NA			ND	0.22	
OCDF	ng/L	4	NA			ND	0.19	
TCDD (total)	ng/L	4	NA			ND	4.84	
PeCDD (total)	ng/L	4	NA			ND	8.4	
HxCDD (total)	ng/L	4	NA			ND	1.63	
HpCDD (total)	ng/L	4	NA			ND	0.58	
TCDF (total)	ng/L	4	NA			ND	6.46	
PeCDF (total)	ng/L	4	NA			ND	5.11	
HxCDF (total)	ng/L	4	NA			INT		
HpCDF (total)	ng/L	4	NA			STE	0.7	
Total dioxins (by isomer) including NDs	ng/L	4	NA			<	2.32	
Total furans (by isomer) including NDs	ng/L	4	NA			ND	1.08	
Total dioxins/furans (by isomer) inc NDs	ng/L	4	NA			<	3.40	
Total dioxins (by isomer) excluding NDs	ng/L	4	NA			>	0.72	
Total furans (by isomer) excluding NDs	ng/L	4	NA			all	ND	
Total dioxins/furans (by isomer) excluding NDs	ng/L	4	NA			>	0.72	
Trace metals								
Antimony	µg/L	4	NA			ND	100	
Arsenic	µg/L	4	NA			ND	100	
Barium	µg/L	4	NA				43	
Beryllium	µg/L	4	NA			ND	10	
Cadmium	µg/L	4	NA				12	
Chromium (total)	µg/L	4	NA				16	
Copper	µg/L	4	NA				5300	
Lead	µg/L	4	NA				4600	
Manganese	µg/L	4	NA				170	
Mercury	µg/L	4	NA				7.4	
Nickel	µg/L	4	NA				23	
Phosphorus	µg/L	4	NA				520	
Selenium	µg/L	4	NA			ND	100	
Silver	µg/L	4	NA			ND	10	
Thallium	µg/L	4	NA			ND	100	
Tin	µg/L	4	NA			ND	100	
Zinc	µg/L	4	NA				8200	

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 1 - WASTE WATER					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Total stream flow rate							
	dscm/hr		192		178		177
	kg/hr		251		236		233
Polychlorinated biphenyls (PCBs)							
Monochlorobiphenyl (total)	µg/dscm	ND	0.004	ND	0.001	ND	0.001
Dichlorobiphenyl (total)	µg/dscm	EMPC/B	0.14		0.003	EMPC/B	0.08
Trichlorobiphenyl (total)	µg/dscm	EMPC/B	0.08	EMPC	0.02	EMPC/B	0.06
Tetrachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.002	ND	0.002
Pentachlorobiphenyl (total)	µg/dscm	ND	0.02	EMPC	0.004	ND	0.003
Hexachlorobiphenyl (total)	µg/dscm	ND	0.02	ND	0.003	ND	0.002
Heptachlorobiphenyl (total)	µg/dscm		0.03	EMPC	0.007	ND	0.002
Octachlorobiphenyl (total)	µg/dscm	ND	0.02	ND	0.003	ND	0.002
Nonachlorobiphenyl (total)	µg/dscm	ND	0.02	ND	0.003	ND	0.002
Decachlorobiphenyl (total)	µg/dscm	ND	0.09	ND	0.01	ND	0.01
Total PCBs (Tri-Deca) including NDs	µg/dscm	<	0.28	<	0.05	<	0.08
Total PCBs (Mono-Deca) including NDs	µg/dscm	<	0.42	<	0.06	<	0.16
Total PCBs (Tri-Deca) excluding NDs	µg/dscm	>	0.11	>	0.03	>	0.06
Total PCBs (Mono-Deca) excluding NDs	µg/dscm	>	0.25	>	0.04	>	0.14
Chlorobenzenes and chlorophenols							
1,2 Dichlorobenzene	µg/dscm	ND	0.71	ND	3.53	ND	0.38
1,3 - Dichlorobenzene	µg/dscm	ND	0.74	ND	3.21	ND	0.37
1,4 - Dichlorobenzene	µg/dscm	ND	0.69	ND	3.13	ND	0.37
1,2,3 - Trichlorobenzene	µg/dscm	ND	0.71	ND	3.02	ND	0.35
1,2,4 - Trichlorobenzene	µg/dscm	ND	0.68	ND	3.16	ND	0.40
1,3,5 - Trichlorobenzene	µg/dscm	ND	0.68	ND	3.12	ND	0.39
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	0.55	ND	2.07	ND	0.48
1,2,3,5-Tetrachlorobenzene	µg/dscm		NA		NA		NA
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	0.54	ND	2.44	ND	0.15
Pentachlorobenzene	µg/dscm	ND	0.52	ND	1.99	ND	0.30
Hexachlorobenzene	µg/dscm	ND	0.54	ND	2.32	ND	0.35
2 - Chlorophenol	µg/dscm	ND	0.91	ND	3.94	ND	0.48
3,4 - Chlorophenol	µg/dscm	ND	0.71	ND	2.96	ND	0.21
2,3 - Dichlorophenol	µg/dscm	ND	0.96	ND	3.96	ND	0.51
2,4 - Dichlorophenol	µg/dscm	ND	0.90	ND	3.85	ND	0.48
2,5 - Dichlorophenol	µg/dscm	ND	0.83	ND	4.07	ND	0.53
2,6 - Dichlorophenol	µg/dscm	ND	0.83	ND	3.39	ND	0.45
3,4 - Dichlorophenol	µg/dscm	ND	0.73	ND	2.85	ND	0.43
3,5 - Dichlorophenol	µg/dscm	ND	0.70	ND	2.45	ND	0.53
2,3,4 - Trichlorophenol	µg/dscm	ND	0.92	ND	3.33	ND	0.53
2,3,5 - Trichlorophenol	µg/dscm	ND	1.03	ND	3.59	ND	0.52
2,3,6 - Trichlorophenol	µg/dscm	ND	0.91	ND	3.38	ND	0.43
2,4,5 - Trichlorophenol	µg/dscm	ND	0.90	ND	3.26	ND	0.53
2,4,6 - Trichlorophenol	µg/dscm	ND	0.94	ND	3.50	ND	0.53
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	0.97	ND	3.50	ND	0.53
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	1.03	ND	3.78	ND	0.54
Pentachlorophenol	µg/dscm	ND	1.14	ND	4.48	ND	0.79
Total CB	µg/dscm	ND	6.37	ND	27.98	ND	3.54
Total CP	µg/dscm	ND	14.4	ND	56.3	ND	8.0

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 1 - WASTE WATER							
		Flag		Run 1	Flag		Run 2	Flag		Run 3
Polycyclic aromatic hydrocarbons (PAH)										
Naphthalene	µg/dscm	41		12.7	41	E	30.4	41		17.9
2-Methylnaphthalene	µg/dscm	41	ND	0.34	41	ND	1.86	41	ND	0.25
2-Cl-Naphthalene	µg/dscm	41	ND	0.30	41	ND	1.16	41	ND	0.21
Acenaphthylene	µg/dscm	41	ND	0.19	41	ND	0.95	41	ND	0.16
Acenapthene	µg/dscm	41	ND	0.31	41	ND	1.47	41	ND	0.21
Fluorene	µg/dscm	41	ND	0.27	41	ND	1.24	41	ND	0.20
Phenanthrene	µg/dscm	41	E	0.34	41	ND	0.76	41	ND	0.13
Anthracene	µg/dscm	41	ND	0.13	41	ND	0.82	41	ND	0.15
Fluoranthene	µg/dscm	41	ND	0.10	41	ND	0.82	41	E	0.75
Pyrene	µg/dscm	41	E	0.14	41	ND	0.61	41	E	0.51
Benzo (a) anthracene	µg/dscm	41	ND	0.08	41	ND	0.74	41	ND	0.20
Chrysene	µg/dscm	41	ND	0.09	41	ND	0.79	41	ND	0.21
Benzo (b) fluoranthene	µg/dscm	41	ND	0.08	41	ND	0.69	41	ND	0.18
Benzo (k) fluoranthene	µg/dscm	41	ND	0.08	41	ND	0.74	41	ND	0.17
Benzo (e) pyrene	µg/dscm	41	ND	0.08	41	ND	0.76	41	ND	0.19
Benzo (a) pyrene	µg/dscm	41	ND	0.09	41	ND	0.73	41	ND	0.19
Perylene	µg/dscm	41	ND	0.09	41	ND	0.75	41	ND	0.20
Indeno (1,2,3-cd) pyrene	µg/dscm	41	ND	0.06	41	ND	0.88	41	ND	0.20
Dibenz (a,h) anthracene	µg/dscm	41	ND	0.07	41	ND	0.90	41	ND	0.22
Benzo (g,h,i) perylene	µg/dscm	41	ND	0.07	41	ND	0.84	41	ND	0.19
Total PAHs including NDs	µg/dscm	41	<	15.6	41	<	47.9	41	<	22.4
Total PAHs excluding NDs	µg/dscm	41	>	13.1	41	>	30.4	41	>	18.3
Dioxins and furans										
2378 TCDD	ng/dscm		ND	0.003		ND	0.007		ND	0.001
12378 PeCDD	ng/dscm		ND	0.01		ND	0.01		ND	0.001
123478 HxCDD	ng/dscm			0.01		ND	0.01		ND	0.001
123678 HxCDD	ng/dscm			0.02		ND	0.01		ND	0.001
123789 HxCDD	ng/dscm		EMPC	0.02		ND	0.01		ND	0.001
1234678 HpCDD	ng/dscm		B	0.20			0.01		EMPC/B	0.01
OCDD	ng/dscm	26	B	0.55	26		0.17	26	B	0.12
2378 TCDF	ng/dscm		B	0.02			0.01		ND	0.000
12378 PeCDF	ng/dscm			0.02		ND	0.01		ND	0.001
23478 PeCDF	ng/dscm		EMPC	0.02		ND	0.01		ND	0.001
123478 HxCDF	ng/dscm			0.07		ND	0.01		ND	0.001
123678 HXCDF	ng/dscm			0.03		ND	0.004		ND	0.001
234678 HxCDF	ng/dscm			0.04		EMPC	0.003		EMPC	0.002
123789 HxCDF	ng/dscm		EMPC	0.01		ND	0.01		ND	0.001
1234678 HpCDF	ng/dscm			0.10			0.01		ND	0.001
1234789 HpCDF	ng/dscm			0.05			0.01		ND	0.001
OCDF	ng/dscm			0.64			0.03		ND	0.001
TCDD (total)	ng/dscm			0.02			0.01		ND	0.001
PeCDD (total)	ng/dscm			0.03		ND	0.01		ND	0.001
HxCDD (total)	ng/dscm			0.19		ND	0.01		ND	0.001
HpCDD (total)	ng/dscm			0.35			0.01			0.006
TCDF (total)	ng/dscm			0.05			0.01		ND	0.000
PeCDF (total)	ng/dscm			0.11		EMPC	0.01		ND	0.001
HxCDF (total)	ng/dscm			0.23		EMPC	0.003		EMPC	0.002
HpCDF (total)	ng/dscm			0.25			0.03		ND	0.001
Total dioxins (by isomer) incl. NDs	ng/dscm		<	0.816		<	0.230		<	0.136
Total furans (by isomer) incl. NDs	ng/dscm		<	0.995		<	0.100		<	0.010
Total dioxins and furans (by isomer) incl. NDs	ng/dscm		<	1.811		<	0.330		<	0.146
Total dioxins (by isomer) excl. NDs	ng/dscm		>	0.800		>	0.180		>	0.130
Total furans (by isomer) excl. NDs	ng/dscm		>	0.995		>	0.063		>	0.002
Total dioxins and furans (by isomer) excl. NDs	ng/dscm		>	1.795		>	0.243		>	0.132

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 1 - WASTE WATER Flag	Run 1	Flag	Run 2	Flag	Run 3
Volatile organic compounds							
Vinyl chloride	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Methyl chloride	µg/dscm	<	104		52		45
Trans-1,2-dichloroethene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Cis-1,2-dichloroethene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Chloroform	µg/dscm	ND	1.18	ND	1.00	ND	0.95
1,1,1 - Trichloroethane	µg/dscm	<	1.26	ND	1.00	<	1.04
Carbon tetrachloride	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Benzene	µg/dscm	<	181		30		8
1,2 - Dichloroethane	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Trichloroethene	µg/dscm	<	1.53	ND	1.00	ND	0.95
Toluene	µg/dscm		15.7	<	4.2	<	5.7
1,1,2 - Trichloroethane	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Tetrachloroethene	µg/dscm		5.96	BQL	2.03	<	3.55
1,2 - Dibromoethane	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Chlorobenzene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Ethylbenzene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
M-/P-Xylene	µg/dscm	<	2.00	ND	1.00	ND	0.95
O-Xylene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
1,3 - Dichlorobenzene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
1,4 - Dichlorobenzene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
1,2 - Dichlorobenzene	µg/dscm	ND	1.18	ND	1.00	ND	0.95
Trace metals							
Antimony	µg/dscm	40 <	10.8	20,40 ND	7.2	40 ND	8.0
Arsenic	µg/dscm	40 ND	8.62	20,40 ND	7.16	40 ND	6.43
Barium	µg/dscm	40 <	3.32	20,40 <	1.32	40 <	2.15
Beryllium	µg/dscm	40 ND	0.09	20,40 ND	0.07	40 ND	0.35
Cadmium	µg/dscm	40 ND	0.86	20,40 <	3.47	40 <	0.74
Chromium (total)	µg/dscm	40	1.47	20,40	1.04	40 <	1.16
Copper	µg/dscm	40	2.72	20,40	1.58	40	1.48
Lead	µg/dscm	40 <	12.5	20,40 <	4.6	40 <	6.8
Manganese	µg/dscm	40	64.0	20,40	13.1	40	77.8
Mercury	µg/dscm	40 <	0.11	20,40 ND	0.06	40,22 ND	0.08
Nickel	µg/dscm	40 <	1.03	20,40 <	0.82	40 <	1.54
Phosphorus	µg/dscm	40 <	11.2	20,40	9.7	40 <	7.7
Selenium	µg/dscm	40 ND	8.62	20,40 ND	7.16	40 ND	6.43
Silver	µg/dscm	40 ND	0.86	20,40 ND	0.72	40 ND	0.64
Thallium	µg/dscm	40 ND	8.62	20,40 ND	7.16	40 ND	6.43
Tin	µg/dscm	40 ND	8.62	20,40 ND	7.16	40 ND	6.43
Zinc	µg/dscm	40	40.9	20,40	12.4	40	11.1
Major gas species (dry, 7% O2)							
Oxygen (O2)	vol. %		9.64		7.79		7.17
Carbon dioxide (CO2)	vol. %		8.87		8.91		8.89
Moisture	vol. %		8.8		10.3		10.1
Minor gas species (dry, 7% O2)							
Total hydrocarbons (methane equivalent)	ppmv		41.4		3.5		1.6
Hydrogen chloride (HCl)	mg/dscm	ND	0.75	ND	0.55	ND	0.68
Carbon monoxide (CO)	ppmv		34		32		4
Nitrogen oxides (NOx)	ppmv		60.8	23	60		61.5
Sulfur dioxide (SO2)	ppmv		5.1		1.1		0.3
Particulate and visible emissions							
Particulate (7% O2)	mg/dscm	19	0.43	20 ND	0.04		0.03
Opacity	%		0		0		0

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 2 - SOIL Flag	Run 1	Flag	Run 2
Total stream flow rate					
	dscm/hr		208		297
	kg/hr		277		389
Polychlorinated biphenyls (PCBs)					
Monochlorobiphenyl (total)	µg/dscm	ND	0.002	ND	0.008
Dichlorobiphenyl (total)	µg/dscm	ND	0.002		0.13
Trichlorobiphenyl (total)	µg/dscm	ND	0.003		0.53
Tetrachlorobiphenyl (total)	µg/dscm	ND	0.01		0.48
Pentachlorobiphenyl (total)	µg/dscm	EMPC	0.02		0.03
Hexachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.03
Heptachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.03
Octachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.03
Nonachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.01
Decachlorobiphenyl (total)	µg/dscm	ND	0.02	ND	0.10
Total PCBs (Tri-Deca) including NDs	µg/dscm	<	0.08	<	1.24
Total PCBs (Mono-Deca) including NDs	µg/dscm	<	0.08	<	1.37
Total PCBs (Tri-Deca) excluding NDs	µg/dscm	>	0.02	>	1.04
Total PCBs (Mono-Deca) excluding NDs	µg/dscm	>	0.02	>	1.17
Chlorobenzenes and chlorophenols					
1,2 Dichlorobenzene	µg/dscm	ND	0.91	ND	1.07
1,3 - Dichlorobenzene	µg/dscm	ND	0.89	ND	1.06
1,4 - Dichlorobenzene	µg/dscm	ND	0.89	ND	1.09
1,2,3 - Trichlorobenzene	µg/dscm	ND	1.00	ND	1.20
1,2,4 - Trichlorobenzene	µg/dscm	ND	0.93	ND	1.11
1,3,5 - Trichlorobenzene	µg/dscm	ND	0.92	ND	1.08
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	0.81	ND	0.88
1,2,3,5-Tetrachlorobenzene	µg/dscm	ND	0.62	ND	0.86
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	0.71	ND	0.73
Pentachlorobenzene	µg/dscm	ND	0.63	ND	0.76
Hexachlorobenzene	µg/dscm	E	0.63	ND	0.64
2 - Chlorophenol	µg/dscm	ND	0.97	ND	1.08
3,4 - Chlorophenol	µg/dscm	ND	0.49	ND	0.52
2,3 - Dichlorophenol	µg/dscm	ND	1.42	ND	1.57
2,4 - Dichlorophenol	µg/dscm	ND	1.11	ND	1.34
2,5 - Dichlorophenol	µg/dscm	ND	1.19	ND	1.21
2,6 - Dichlorophenol	µg/dscm	ND	1.09	ND	1.27
3,4 - Dichlorophenol	µg/dscm	ND	1.34	ND	1.01
3,5 - Dichlorophenol	µg/dscm	ND	1.22	ND	1.03
2,3,4 - Trichlorophenol	µg/dscm	ND	1.40	ND	1.41
2,3,5 - Trichlorophenol	µg/dscm	ND	1.37	ND	1.32
2,3,6 - Trichlorophenol	µg/dscm	ND	1.33	ND	1.44
2,4,5 - Trichlorophenol	µg/dscm	ND	1.42	ND	1.34
2,4,6 - Trichlorophenol	µg/dscm	ND	1.38	ND	1.39
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	1.13	ND	1.06
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	1.12	ND	1.18
Pentachlorophenol	µg/dscm	ND	1.34	ND	1.41
Total CB	µg/dscm	ND	8.05	ND	9.41
Total CP	µg/dscm	ND	19.3	ND	19.6

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 2 - SOIL					
		Flag		Run 1	Flag		Run 2
Polycyclic aromatic hydrocarbons (PAH)							
Naphthalene	µg/dscm	41	E	2.5	41	E	1.5
2-Methylnaphthalene	µg/dscm	41	ND	0.21	41	ND	0.10
2-Cl-Naphthalene	µg/dscm	41	ND	0.25	41	ND	0.12
Acenaphthylene	µg/dscm	41	ND	0.16	41	ND	0.07
Acenapthene	µg/dscm	41	ND	0.25	41	ND	0.12
Fluorene	µg/dscm	41	ND	0.21	41	ND	0.10
Phenanthrene	µg/dscm	41	ND	0.12	41	ND	0.05
Anthracene	µg/dscm	41	ND	0.11	41	ND	0.05
Fluoranthene	µg/dscm	41	ND	0.08	41	ND	0.04
Pyrene	µg/dscm	41	ND	0.05	41	ND	0.02
Benzo (a) anthracene	µg/dscm	41	ND	0.05	41	ND	0.02
Chrysene	µg/dscm	41	ND	0.05	41	ND	0.02
Benzo (b) fluoranthene	µg/dscm	41	ND	0.04	41	ND	0.02
Benzo (k) fluoranthene	µg/dscm	41	ND	0.04	41	ND	0.02
Benzo (e) pyrene	µg/dscm	41	ND	0.04	41	ND	0.02
Benzo (a) pyrene	µg/dscm	41	ND	0.04	41	ND	0.02
Perylene	µg/dscm	41	ND	0.06	41	ND	0.03
Indeno (1,2,3-cd) pyrene	µg/dscm	41	ND	0.04	41	ND	0.02
Dibenz (a,h) anthracene	µg/dscm	41	ND	0.05	41	ND	0.02
Benzo (g,h,i) perylene	µg/dscm	41	ND	0.04	41	ND	0.02
Total PAHs including NDs	µg/dscm	41	ND	4.4	41	ND	2.3
Total PAHs excluding NDs	µg/dscm	41	>	2.5	41	>	1.5
Dioxins and furans							
2378 TCDD	ng/dscm		ND	0.002		ND	0.003
12378 PeCDD	ng/dscm			0.003		ND	0.004
123478 HxCDD	ng/dscm		ND	0.003		ND	0.005
123678 HxCDD	ng/dscm		ND	0.002		ND	0.004
123789 HxCDD	ng/dscm		ND	0.003		ND	0.004
1234678 HpCDD	ng/dscm		ND	0.02		EMPC	0.01
OCDD	ng/dscm	26	B	0.20	26	B	0.08
2378 TCDF	ng/dscm			0.003			0.001
12378 PeCDF	ng/dscm		ND	0.002		ND	0.003
23478 PeCDF	ng/dscm		ND	0.002		ND	0.003
123478 HxCDF	ng/dscm		ND	0.002		EMPC	0.003
123678 HXCDF	ng/dscm			0.003		ND	0.003
234678 HxCDF	ng/dscm			0.009		ND	0.003
123789 HxCDF	ng/dscm		ND	0.003		ND	0.004
1234678 HpCDF	ng/dscm			0.033		EMPC	0.004
1234789 HpCDF	ng/dscm			0.009		ND	0.005
OCDF	ng/dscm			0.063		ND	0.010
TCDD (total)	ng/dscm		ND	0.002		EMPC	0.003
PeCDD (total)	ng/dscm		ND	0.003		ND	0.004
HxCDD (total)	ng/dscm			0.003		EMPC	0.007
HpCDD (total)	ng/dscm			0.042		EMPC	0.019
TCDF (total)	ng/dscm			0.003			0.001
PeCDF (total)	ng/dscm			0.01		EMPC	0.001
HxCDF (total)	ng/dscm			0.03		EMPC	0.005
HpCDF (total)	ng/dscm			0.06		EMPC	0.005
Total dioxins (by isomer) incl. NDs	ng/dscm		<	0.233		<	0.107
Total furans (by isomer) incl. NDs	ng/dscm		<	0.131		<	0.038
Total dioxins and furans (by isomer) incl. NDs	ng/dscm		<	0.364		<	0.145
Total dioxins (by isomer) excl. NDs	ng/dscm		>	0.203		>	0.900
Total furans (by isomer) excl. NDs	ng/dscm		>	0.120		>	0.008
Total dioxins and furans (by isomer) excl. NDs	ng/dscm		>	0.323		>	0.908

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 2 - SOIL Flag		Run 1	Flag		Run 2
Volatile organic compounds							
Vinyl chloride	µg/dscm	**1	ND	0.98	**1	ND	1.05
Methyl chloride	µg/dscm	**1	<	3	**1	<	2
Trans-1,2-dichloroethene	µg/dscm	**1	ND	0.98	**1	ND	1.05
Cis-1,2-dichloroethene	µg/dscm	**1	ND	0.98	**1	ND	1.05
Chloroform	µg/dscm	**1	ND	0.98	**1	ND	1.05
1,1,1 - Trichloroethane	µg/dscm	**1	<	2.66	**1	<	1.05
Carbon tetrachloride	µg/dscm	**1	ND	0.98	**1	ND	1.05
Benzene	µg/dscm	**1	BQL	2	**1	<	6
1,2 - Dichloroethane	µg/dscm	**1	ND	0.98	**1	ND	1.05
Trichloroethene	µg/dscm	**1	ND	0.98	**1	ND	1.05
Toluene	µg/dscm	**1	<	1.8	**1	<	4.7
1,1,2 - Trichloroethane	µg/dscm	**1	ND	0.98	**1	ND	1.05
Tetrachloroethene	µg/dscm	**1	<	1.00	**1	ND	1.05
1,2 - Dibromoethane	µg/dscm	**1	ND	0.98	**1	ND	1.05
Chlorobenzene	µg/dscm	**1	ND	0.98	**1	ND	1.05
Ethylbenzene	µg/dscm	**1	ND	0.98	**1	ND	1.05
M-/P-Xylene	µg/dscm	**1	ND	1.96	**1	ND	2.11
O-Xylene	µg/dscm	**1	ND	0.98	**1	ND	1.05
1,3 - Dichlorobenzene	µg/dscm	**1	ND	0.98	**1	ND	1.05
1,4 - Dichlorobenzene	µg/dscm	**1	ND	0.98	**1.	<	1.14
1,2 - Dichlorobenzene	µg/dscm	**1	<	1.10	**1	<	1.28
Trace metals							
Antimony	µg/dscm	40		3.7	40		1.9
Arsenic	µg/dscm	40	ND	2.88	40	ND	1.35
Barium	µg/dscm	40		1.61	40		0.57
Beryllium	µg/dscm	40	ND	0.29	40	ND	0.13
Cadmium	µg/dscm	40	ND	0.29	40		0.35
Chromium (total)	µg/dscm	40		0.72	40		0.69
Copper	µg/dscm	40		1.90	40		0.51
Lead	µg/dscm	40		4.6	40		2.7
Manganese	µg/dscm	40		3.5	40		0.3
Mercury	µg/dscm	40	ND	0.06	40	ND	6.00
Nickel	µg/dscm	40		0.55	40		0.32
Phosphorus	µg/dscm	40	ND	2.9	40	ND	1.3
Selenium	µg/dscm	40	ND	2.88	40	ND	1.35
Silver	µg/dscm	40	ND	2.88	40	ND	1.35
Thallium	µg/dscm	40	ND	2.88	40	ND	1.35
Tin	µg/dscm	40	ND	2.88	40		1.75
Zinc	µg/dscm	40		9.2	40		2.7
Major gas species (dry, 7% O2)							
Oxygen (O2)	vol. %			7.38			8.57
Carbon dioxide (CO2)	vol. %			8.71			9.11
Moisture	vol. %			11.8			9.7
Minor gas species (dry, 7% O2)							
Total hydrocarbons (methane equivalent)	ppmv			0.9			0.4
Hydrogen chloride (HCl)	mg/dscm	3	ND	0.83		ND	0.53
Carbon monoxide (CO)	ppmv			8.2			13
Nitrogen oxides (NOx)	ppmv			62.9			69.7
Sulfur dioxide (SO2)	ppmv			1.7			2.2
Particulate and visible emissions							
Particulate (7% O2)	mg/dscm	19		0.43		ND	0.13
Opacity	%			NA			NA

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 3 - WASTE OIL					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Total stream flow rate							
	dscm/hr		344		214		232
	kg/hr		450		282		307
Polychlorinated biphenyls (PCBs)							
Monochlorobiphenyl (total)	µg/dscm	ND	0.003	ND	0.005	ND	0.001
Dichlorobiphenyl (total)	µg/dscm	EMPC	0.20	ND	0.005	EMPC/B	0.05
Trichlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.01	EMPC/B	0.03
Tetrachlorobiphenyl (total)	µg/dscm	EMPC	0.60	EMPC	2.54	ND	0.005
Pentachlorobiphenyl (total)	µg/dscm	EMPC	0.07	ND	0.01	ND	0.005
Hexachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.01	ND	0.005
Heptachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.01	ND	0.005
Octachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.01	ND	0.005
Nonachlorobiphenyl (total)	µg/dscm	ND	0.01	ND	0.01	ND	0.01
Decachlorobiphenyl (total)	µg/dscm	ND	0.02	ND	0.02	ND	0.02
Total PCBs (Tri-Deca) including NDs	µg/dscm	<	0.72	<	2.62	<	0.09
Total PCBs (Mono-Deca) including NDs	µg/dscm	<	0.92	<	2.63	<	0.14
Total PCBs (Tri-Deca) excluding NDs	µg/dscm	>	0.67	>	2.54	>	0.03
Total PCBs (Mono-Deca) excluding NDs	µg/dscm	>	0.87	>	2.54	>	0.08
Chlorobenzenes and chlorophenols							
1,2 Dichlorobenzene	µg/dscm	ND	0.69	ND	0.52	ND	0.16
1,3 - Dichlorobenzene	µg/dscm	ND	0.66	ND	0.50	ND	0.15
1,4 - Dichlorobenzene	µg/dscm	ND	0.67	ND	0.51	ND	0.15
1,2,3 - Trichlorobenzene	µg/dscm	ND	0.81	ND	0.46	ND	0.15
1,2,4 - Trichlorobenzene	µg/dscm	ND	0.75	ND	0.42	ND	0.14
1,3,5 - Trichlorobenzene	µg/dscm	ND	0.73	ND	0.42	ND	0.14
1,2,3,4-Tetrachlorobenzene	µg/dscm	ND	0.73	ND	0.47	ND	0.13
1,2,3,5-Tetrachlorobenzene	µg/dscm		NA		NA		NA
1,2,4,5 - Tetrachlorobenzene	µg/dscm	ND	0.38	ND	0.20	ND	0.13
Pentachlorobenzene	µg/dscm	ND	0.86	ND	0.48	ND	0.14
Hexachlorobenzene	µg/dscm	ND	1.12	ND	0.62	ND	0.17
2 - Chlorophenol	µg/dscm	ND	0.70	ND	0.55	ND	0.17
3,4 - Chlorophenol	µg/dscm	ND	0.16	ND	0.10	ND	0.03
2,3 - Dichlorophenol	µg/dscm	ND	0.79	ND	0.50	ND	0.16
2,4 - Dichlorophenol	µg/dscm	ND	0.64	ND	0.42	ND	0.14
2,5 - Dichlorophenol	µg/dscm	ND	0.70	ND	0.53	ND	0.17
2,6 - Dichlorophenol	µg/dscm	ND	0.24	ND	0.19	ND	0.06
3,4 - Dichlorophenol	µg/dscm	ND	0.61	ND	0.52	ND	0.15
3,5 - Dichlorophenol	µg/dscm	ND	0.23	ND	0.22	ND	0.06
2,3,4 - Trichlorophenol	µg/dscm	ND	0.87	ND	0.68	ND	0.19
2,3,5 - Trichlorophenol	µg/dscm	ND	1.12	ND	0.75	ND	0.21
2,3,6 - Trichlorophenol	µg/dscm	ND	0.89	ND	0.66	ND	0.19
2,4,5 - Trichlorophenol	µg/dscm	ND	0.96	ND	0.60	ND	0.17
2,4,6 - Trichlorophenol	µg/dscm	ND	1.05	ND	0.67	ND	0.19
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	0.77	ND	0.53	ND	0.15
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	1.19	ND	0.85	ND	0.24
Pentachlorophenol	µg/dscm	ND	2.00	ND	1.42	ND	0.38
Total CB	µg/dscm	ND	7.40	ND	4.60	ND	1.45
Total CP	µg/dscm	ND	12.9	ND	9.2	ND	2.7

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 3 - WASTE OIL								
		Flag		Run 1	Flag		Run 2	Flag		Run 3
Polycyclic aromatic hydrocarbons (PAH)										
Naphthalene	µg/dscm	41	ND	1.1	41	ND	1.5	41	E	4.4
2-Methylnaphthalene	µg/dscm	41	ND	1.41	41	ND	1.91	41	ND	0.29
2-Cl-Naphthalene	µg/dscm	41	ND	1.53	41	ND	2.12	41	ND	0.24
Acenaphthylene	µg/dscm	41	ND	1.02	41	ND	1.41	41	ND	0.16
Acenapthene	µg/dscm	41	ND	1.54	41	ND	2.13	41	ND	0.27
Fluorene	µg/dscm	41	ND	1.36	41	ND	1.87	41	ND	0.21
Phenanthrene	µg/dscm	41	ND	0.94	41	ND	1.23	41	ND	0.12
Anthracene	µg/dscm	41	ND	0.91	41	ND	1.18	41	ND	0.12
Fluoranthene	µg/dscm	41	ND	0.88	41	ND	1.14	41	ND	0.13
Pyrene	µg/dscm	41	ND	0.88	41	ND	1.20	41	ND	0.21
Benzo (a) anthracene	µg/dscm	41	ND	1.23	41	ND	1.67	41	ND	0.27
Chrysene	µg/dscm	41	ND	1.40	41	ND	1.90	41	ND	0.29
Benzo (b) fluoranthene	µg/dscm	41	ND	1.50	41	ND	2.07	41	ND	0.45
Benzo (k) fluoranthene	µg/dscm	41	ND	1.48	41	ND	2.04	41	ND	0.47
Benzo (e) pyrene	µg/dscm	41	ND	1.46	41	ND	2.01	41	ND	0.46
Benzo (a) pyrene	µg/dscm	41	ND	1.49	41	ND	2.05	41	ND	0.49
Perylene	µg/dscm	41	ND	1.58	41	ND	2.17	41	ND	0.73
Indeno (1,2,3-cd) pyrene	µg/dscm	41	ND	1.24	41	ND	1.70	41	ND	0.66
Dibenz (a,h) anthracene	µg/dscm	41	ND	1.40	41	ND	1.92	41	ND	0.67
Benzo (g,h,i) perylene	µg/dscm	41	ND	1.36	41	ND	1.86	41	ND	0.62
Total PAHs including NDs	µg/dscm	41	ND	25.7	41	ND	35.1	41	<	11.3
Total PAHs excluding NDs	µg/dscm	41	all	ND	41	all	ND	41	>	4.4
Dioxins and furans										
2378 TCDD	ng/dscm		ND	0.001		ND	0.002		ND	0.002
12378 PeCDD	ng/dscm		ND	0.001		ND	0.002		ND	0.002
123478 HxCDD	ng/dscm		ND	0.001		ND	0.002		ND	0.002
123678 HxCDD	ng/dscm		EMPC	0.001		ND	0.001		ND	0.002
123789 HxCDD	ng/dscm			0.001		ND	0.002		ND	0.002
1234678 HpCDD	ng/dscm		B	0.01		B	0.010		EMPC	0.002
OCDD	ng/dscm	26	B	0.09	26	B	0.12	26	B	0.07
2378 TCDF	ng/dscm			0.003			0.002		EMPC	0.001
12378 PeCDF	ng/dscm			0.003		ND	0.002		ND	0.002
23478 PeCDF	ng/dscm		EMPC	0.002		ND	0.002		ND	0.002
123478 HxCDF	ng/dscm			0.005		EMPC	0.002		EMPC	0.001
123678 HXCDF	ng/dscm			0.002			0.002		ND	0.001
234678 HxCDF	ng/dscm		B	0.003		B	0.005			0.001
123789 HxCDF	ng/dscm		ND	0.001		ND	0.002		ND	0.002
1234678 HpCDF	ng/dscm			0.008			0.017		EMPC	0.001
1234789 HpCDF	ng/dscm		EMPC	0.002			0.007		ND	0.005
OCDF	ng/dscm			0.008			0.221		ND	0.007
TCDD (total)	ng/dscm			0.001		ND	0.002		ND	0.002
PeCDD (total)	ng/dscm			0.002		ND	0.002		EMPC	0.002
HxCDD (total)	ng/dscm			0.003		EMPC	0.002		EMPC	0.024
HpCDD (total)	ng/dscm			0.017			0.022		Q	0.005
TCDF (total)	ng/dscm			0.012			0.002		EMPC	0.001
PeCDF (total)	ng/dscm			0.015			0.005		EMPC	0.002
HxCDF (total)	ng/dscm			0.015			0.007		Q	0.002
HpCDF (total)	ng/dscm			0.013			0.040		EMPC	0.002
Total dioxins (by isomer) incl. NDs	ng/dscm		<	0.101		<	0.139		<	0.080
Total furans (by isomer) incl. NDs	ng/dscm		<	0.038		<	0.263		<	0.025
Total dioxins and furans (by isomer) incl. NDs	ng/dscm		<	0.138		<	0.403		<	0.105
Total dioxins (by isomer) excl. NDs	ng/dscm		>	0.102		>	0.130		>	0.072
Total furans (by isomer) excl. NDs	ng/dscm		>	0.036		>	0.256		>	0.004
Total dioxins and furans (by isomer) excl. NDs	ng/dscm		>	0.138		>	0.386		>	0.076

TABLE A2-15. SS16 - BOILER FLUE GAS SUMMARY (continued)

Substance (Concentrations corrected to 7% O2)	Units	CONDITION 3 - WASTE OIL								
		Flag		Run 1	Flag		Run 2	Flag		Run 3
Volatile organic compounds										
Vinyl chloride	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.00
Methyl chloride	µg/dscm	**2	<	79		<	106		<	115
Trans-1,2-dichloroethene	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.00
Cis-1,2-dichloroethene	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.00
Chloroform	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.33
1,1,1 - Trichloroethane	µg/dscm	**2	ND	1.01		<	1.47		<	2.68
Carbon tetrachloride	µg/dscm	**2	ND	1.01		ND	1.00		<	1.20
Benzene	µg/dscm	**2	<	128	**3	ALR	203	**4		8
1,2 - Dichloroethane	µg/dscm	**2	<	1.01		ND	1.00		<	1.10
Trichloroethene	µg/dscm	**2	ND	1.01		<	1.00		<	2.55
Toluene	µg/dscm	**2	BQL	6.3		<	26.6		<	11.3
1,1,2 - Trichloroethane	µg/dscm	**2	ND	1.01		ND	1.00		<	1.54
Tetrachloroethene	µg/dscm	**2	<	2.24		<	4.82		<	6.47
1,2 - Dibromoethane	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.00
Chlorobenzene	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.00
Ethylbenzene	µg/dscm	**2	ND	1.01		ND	1.00		<	2.40
M-/P-Xylene	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.00
O-Xylene	µg/dscm	**2	ND	1.01		ND	1.00		ND	1.00
1,3 - Dichlorobenzene	µg/dscm	**2	ND	1.01	**3	ND	1.00	**4	ND	1.00
1,4 - Dichlorobenzene	µg/dscm	**2	ND	1.01	**3	ND	1.00	**4	ND	1.00
1,2 - Dichlorobenzene	µg/dscm	**2	ND	1.01	**3	ND	1.00	**4	ND	1.00
Trace metals										
Antimony	µg/dscm	40	<	3.6	40	<	5.8	40	<	6.1
Arsenic	µg/dscm	40	ND	3.40	40	ND	5.00	40	ND	4.86
Barium	µg/dscm	40	<	0.85	40	,<	1.23	40	<	1.43
Beryllium	µg/dscm	40	ND	0.03	40	ND	0.05	40	ND	0.05
Cadmium	µg/dscm	40	ND	0.34	40	ND	0.50	40	<	2.14
Chromium (total)	µg/dscm	40	<	0.48	40	<	1.48	40		0.85
Copper	µg/dscm	40	<	0.75	40		1.78	40		2.04
Lead	µg/dscm	40	<	2.7	40	<	4.3	40	<	4.9
Manganese	µg/dscm	40		5.0	40		0.7	40	<	0.6
Mercury	µg/dscm	40,22	<	0.04	40	ND	0.08	40	<	0.08
Nickel	µg/dscm	40	<	0.61	40	<	0.88	40	<	0.78
Phosphorus	µg/dscm	40	<	3.9	40	<	6.8	40		8.3
Selenium	µg/dscm	40	ND	3.40	40	ND	5.00	40	ND	4.86
Silver	µg/dscm	40	ND	0.34	40	ND	0.50	40	ND	0.49
Thallium	µg/dscm	40	ND	3.40	40	ND	5.00	40	ND	4.86
Tin	µg/dscm	40	ND	3.40	40	<	5.00	40	ND	4.86
Zinc	µg/dscm	40		9.7	40		9.3	40		54.4
Major gas species (dry, 7% O2)										
Oxygen (O2)	vol. %			7.75			7.29			7.43
Carbon dioxide (CO2)	vol. %			8.97			8.89			8.94
Moisture	vol. %			10.2			10.8			10.9
Minor gas species (dry, 7% O2)										
Total hydrocarbons (methane equivalent)	ppmv			1.1			1.1			2.4
Hydrogen chloride (HCl)	mg/dscm		ND	0.59		ND	0.67			1.16
Carbon monoxide (CO)	ppmv			4			1			2
Nitrogen oxides (NOx)	ppmv			62.8			63.9			63.9
Sulfur dioxide (SO2)	ppmv			2.3			1.5			0.5
Particulate and visible emissions										
Particulate (7% O2)	mg/dscm			0.02	21		0.03	21		2.92
Opacity	%			0			0			0

**1 refers to flags 42(3,4),43; **2 refers to flags 8(3), 15(3), 18(2);
**3 refers to flags 10(1,2,4), 11(3); **4 refers to flag 10(1,2,3,4);
**Condition 3 Run 2 value excluded from average because ALR.

TABLE A2-16. SS18 - HEAT EXCHANGER RESIDUE SUMMARY

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Total stream flow rate					
Run 1	kg/hr		0		0
Run 2	kg/hr		0		0
Run 3	kg/hr		0		0
Average	kg/hr		0		0
Polychlorinated biphenyls (PCB)					
Monochlorobiphenyl (total)	µg/L	BQL	0.035	ND	0.33
Dichlorobiphenyl (total)	µg/L		1.1	BQL	0.64
Trichlorobiphenyl (total)	µg/L		2.3	BQL	1.6
Tetrachlorobiphenyl (total)	µg/L		2.6	BQL	2
Pentachlorobiphenyl (total)	µg/L	BQL	1.1	BQL	0.5
Hexachlorobiphenyl (total)	µg/L	BQL	0.16	BQL	0.15
Heptachlorobiphenyl (total)	µg/L	BQL	0.03	BQL	0.01
Octachlorobiphenyl (total)	µg/L	ND	0.97	ND	4
Nonachlorobiphenyl (total)	µg/L	ND	0.24	ND	1
Decachlorobiphenyl (total)	µg/L	ND	0.14	ND	0.56
Total PCBs (Tri-Deca) including NDs	µg/L	<	7.54	<	9.82
Total PCBs (Mono-Deca) including NDs	µg/L	<	8.67	<	10.79
Total PCBs (Tri-Deca) excluding NDs	µg/L	>	6.19	>	4.26
Total PCBs (Mono-Deca) excluding NDs	µg/L	>	7.32	>	4.90
Chlorobenzenes and chlorophenols					
1,2-Dichlorobenzene	µg/L	ND	0.25	ND	1.2
1,3-Dichlorobenzene	µg/L	ND	0.25	ND	1.2
1,4-Dichlorobenzene	µg/L	ND	0.25	ND	1.2
Total dichlorobenzenes	µg/L	ND	0.75	ND	3.6
1,2,3-Trichlorobenzene	µg/L	ND	0.25	ND	1.2
1,3,5-Trichlorobenzene	µg/L	ND	0.25	ND	1.2
1,2,4-Trichlorobenzene	µg/L	ND	0.25	ND	1.2
Total trichlorobenzenes	µg/L	ND	0.75	ND	3.6
1,2,3,4-Tetrachlorobenzene	µg/L	ND	0.25	ND	1.2
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	ND	0.51	ND	2.3
Total tetrachlorobenzenes	µg/L	ND	0.76	ND	3.5
Pentachlorobenzene	µg/L	ND	0.25	ND	1.2
Hexachlorobenzene	µg/L	ND	0.25	ND	1.2
2,3-Dichlorophenol	µg/L	ND	0.25	ND	1.2
2,4-Dichlorophenol	µg/L	ND	0.25	ND	1.2
2,5-Dichlorophenol	µg/L	ND	0.25	ND	1.2
2,6-Dichlorophenol	µg/L	ND	0.25	ND	1.2
3,4-Dichlorophenol	µg/L	ND	0.25	ND	1.2
3,5-Dichlorophenol	µg/L	ND	0.25	ND	1.2
Total dichlorophenols	µg/L	ND	1.5	ND	7.2
2,3,4-Trichlorophenol	µg/L	ND	0.25	ND	1.2
2,3,5-Trichlorophenol	µg/L	ND	0.25	ND	1.2
2,3,6-Trichlorophenol	µg/L	ND	0.25	ND	1.2
2,4,5-Trichlorophenol	µg/L	ND	0.25	ND	1.2
2,4,6-Trichlorophenol	µg/L	ND	0.25	ND	1.2
Total trichlorophenols	µg/L	ND	1.25	ND	6
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	ND	0.51	ND	2.3
2,3,5,6-Tetrachlorophenol	µg/L	ND	0.25	ND	1.2
Total tetrachlorophenols	µg/L	ND	0.76	ND	3.5
Pentachlorophenol	µg/L	ND	0.25	ND	1.2
Total CB	µg/L	ND	2.76	ND	13.1
Total CP	µg/L	ND	3.76	ND	17.9

TABLE A2-16. SS18 - HEAT EXCHANGER RESIDUE SUMMARY (continued)

Substance	Units	Condition 1 Waste water Flag	Condition 1 Waste water Composite	Condition 3 Waste oil Flag	Condition 3 Waste oil Composite
Polycyclic aromatic hydrocarbons (PAH)					
Naphthalene	µg/L	ND	0.25		21
2-Methylnaphthalene	µg/L	ND	0.25	ND	1.2
2-Cl-Naphthalene	µg/L	ND	0.25	ND	1.2
Acenaphthylene	µg/L	ND	0.25	ND	1.2
Acenapthene	µg/L	ND	0.25	ND	1.2
Fluorene	µg/L	ND	0.25	ND	1.2
Phenanthrene	µg/L	ND	0.25	ND	1.2
Anthracene	µg/L	ND	0.25	ND	1.2
Fluoranthene	µg/L	BQL	0.4	ND	1.2
Pyrene	µg/L	BQL	0.3	ND	1.2
Benzo (a) anthracene	µg/L	ND	0.25	ND	1.2
Chrysene	µg/L	ND	0.25	ND	1.2
Benzo (b) fluoranthene	µg/L	BQL	0.3	ND	1.2
Benzo (k) fluoranthene	µg/L	ND	0.25	ND	1.2
Benzo (e) pyrene	µg/L	ND	0.25	ND	1.2
Benzo (a) pyrene	µg/L	ND	0.25	ND	1.2
Perylene	µg/L	ND	0.25	ND	1.2
Indeno (1,2,3-cd) pyrene	µg/L	ND	0.25	ND	1.2
Dibenz (a,h) anthracene	µg/L	ND	0.25	ND	1.2
Benzo (g,h,i) perylene	µg/L	ND	0.25	ND	1.2
Total PAHs including NDs	µg/L	<	5.25	<	43.8
Total PAHs excluding NDs	µg/L	>	1.00	>	21.0
Dioxins and furans					
2378 TCDD	ng/L	ND	0.001	ND	0.03
12378 PeCDD	ng/L	ND	0.001	ND	0.01
123478 HxCDD	ng/L	ND	0.001	ND	0.004
123678 HxCDD	ng/L		0.002	ND	0.02
123789 HxCDD	ng/L		0.001	ND	0.01
1234678 HpCDD	ng/L		0.03		0.07
OCDD	ng/L		0.17		0.39
2378 TCDF	ng/L		0.01	ND	0.03
12378 PeCDF	ng/L		0.003	ND	0.04
23478 PeCDF	ng/L		0.005	ND	0.02
123478 HxCDF	ng/L		0.003		0.004
123678 HXCDF	ng/L	F	0.001	ND	0.003
234678 HxCDF	ng/L		0.001		0.006
123789 HxCDF	ng/L		0.001	ND	0.010
1234678 HpCDF	ng/L		0.008	ND	0.015
1234789 HpCDF	ng/L	ND	0.001	ND	0.003
OCDF	ng/L		0.01		0.02
TCDD (total)	ng/L		0.003	ND	0.03
PeCDD (total)	ng/L	ND	0.001	ND	0.18
HxCDD (total)	ng/L		0.02	ND	0.09
HpCDD (total)	ng/L		0.06		0.07
TCDF (total)	ng/L		0.04	ND	1.10
PeCDF (total)	ng/L		0.02	ND	0.90
HxCDF (total)	ng/L		0.01		0.02
HpCDF (total)	ng/L		0.02		0.01
Total dioxins (by isomer) including NDs	ng/L	<	0.21	<	0.53
Total furans (by isomer) including NDs	ng/L	<	0.04	<	0.15
Total dioxins/furans (by isomer) inc NDs	ng/L	<	0.25	<	0.68
Total dioxins (by isomer) excluding NDs	ng/L	>	0.20	>	0.46
Total furans (by isomer) excluding NDs	ng/L	>	0.04	>	0.03
Total dioxins/furans (by isomer) excluding NDs	ng/L	>	0.25	>	0.49

TABLE A2-16. SS18 - HEAT EXCHANGER RESIDUE SUMMARY (continued)

Substance	Units	Condition 1 Waste water		Condition 3 Waste oil	
		Flag	Composite	Flag	Composite
Trace metals					
Antimony	µg/L	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100
Barium	µg/L		750		640
Beryllium	µg/L	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10
Chromium (total)	µg/L		23		18
Copper	µg/L	ND	10		61
Lead	µg/L		80		51
Manganese	µg/L		260		300
Mercury	µg/L		1		0.37
Nickel	µg/L		10		32
Phosphorus	µg/L		260		640
Selenium	µg/L	ND	100	ND	100
Silver	µg/L	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100
Tin	µg/L	ND	100	ND	100
Zinc	µg/L		900		2200
Miscellaneous					
Total organic carbon	ppmw		22.8	3	53.3
Total sulfur (as S)	wt. %	31	0.01	31	0.01
Organic halogens (as chloride)	ppbw	3,30	628	3,30	30500
Inorganic halogens (as chloride)	ppmw		2400		2300
Hexavalent chromium	ppmw	ND	0.01	ND	0.01

TABLE A2-17. SS19 - TDU OFF-GAS SUMMARY

Substance	Units	Condition 2 - Soil			
		Flag	Run 1	Flag	Run 2
Polychlorinated biphenyls (PCB)					
Monochlorobiphenyl (total)	µg/dscm		490		118
Dichlorobiphenyl (total)	µg/dscm		1900		615
Trichlorobiphenyl (total)	µg/dscm		5220		2120
Tetrachlorobiphenyl (total)	µg/dscm		4620		2010
Pentachlorobiphenyl (total)	µg/dscm		2180		710
Hexachlorobiphenyl (total)	µg/dscm		247		87.8
Heptachlorobiphenyl (total)	µg/dscm		38.6		14.1
Octachlorobiphenyl (total)	µg/dscm		4.38		1.39
Nonachlorobiphenyl (total)	µg/dscm		4.78		2.06
Decachlorobiphenyl (total)	µg/dscm		30.3		5.75
Total PCBs (Tri-Deca)	µg/dscm		12300		4960
Total PCBs (Mono-Deca)	µg/dscm		14700		5690
Chlorobenzenes and chlorophenols					
1,2 Dichlorobenzene	µg/dscm		17200		8960
1,3 - Dichlorobenzene	µg/dscm		13500		8010
1,4 - Dichlorobenzene	µg/dscm		11500		6100
2,3 - Dichlorophenol	µg/dscm	ND	589	ND	255
1,2,3 - Trichlorobenzene	µg/dscm		14500	E	1900
1,2,4 - Trichlorobenzene	µg/dscm		34500		5370
1,3,5 - Trichlorobenzene	µg/dscm		4930	E	1030
1,2,3,4-Tetrachlorobenzene	µg/dscm		37300		3410
1,2,3,5 - Tetrachlorobenzene	µg/dscm		43000		3940
1,2,4,5 - Tetrachlorobenzene	µg/dscm		30900		3860
Pentachlorobenzene	µg/dscm	E	112000		25000
Hexachlorobenzene	µg/dscm	E	74369		9792
2 - Chlorophenol	µg/dscm	E	953	ND	168
3,4 - Chlorophenol	µg/dscm	ND	193	ND	78
2,4 - Dichlorophenol	µg/dscm		451	ND	195
2,5 - Dichlorophenol	µg/dscm		507	ND	219
2,6 - Dichlorophenol	µg/dscm		465	ND	201
3,4 - Dichlorophenol	µg/dscm		4000	ND	173
3,5 - Dichlorophenol	µg/dscm	E	1370	ND	166
2,3,4 - Trichlorophenol	µg/dscm	ND	752	ND	291
2,3,5 - Trichlorophenol	µg/dscm	ND	873	ND	337
2,3,6 - Trichlorophenol	µg/dscm	ND	709	ND	274
2,4,5 - Trichlorophenol	µg/dscm	ND	654	ND	253
2,4,6 - Trichlorophenol	µg/dscm	ND	686	ND	265
2,3,4,5 - Tetrachlorophenol	µg/dscm	ND	564	ND	218
2,3,5,6 - Tetrachlorophenol	µg/dscm	ND	623	ND	241
Pentachlorophenol	µg/dscm	E	2453	ND	322
Total CBs including NDs	µg/dscm	<	394000	<	77400
Total CPs including NDs	µg/dscm	<	15800	ND	3660
Total CBs excluding NDs	µg/dscm	>	394000	>	77400
Total CPs excluding NDs	µg/dscm	>	10200	all	ND

TABLE A2-17. SS19 - TDU OFF-GAS SUMMARY (continued)

Substance	Units	Condition 2 - Soil					
		Flag		Run 1	Flag		Run 2
Dioxins and furans							
2378 TCDD	ng/dscm	53	ND/U	0.28	53	ND/U	0.15
12378 PeCDD	ng/dscm	53	PR	114	53		51.5
123478 HxCDD	ng/dscm	53	Q	349	53	PR	109
123678 HxCDD	ng/dscm	53		278	53	PR	44.0
123789 HxCDD	ng/dscm	53	Q	797	53	PR	196
1234678 HpCDD	ng/dscm	53		3741	53		517
OCDD	ng/dscm	26,53		6175	26,53	B	464
2378 TCDF	ng/dscm	53		386	53		108
12378 PeCDF	ng/dscm	53	PR	74.1	53	PR	42.7
23478 PeCDF	ng/dscm	53		108	53	Q	45.8
123478 HxCDF	ng/dscm	53	Q	295	53		117
123678 HXCDF	ng/dscm	53		156	53		62.8
234678 HxCDF	ng/dscm	53	Q	169	53		78.3
123789 HxCDF	ng/dscm	53	EMPC/Q	140	53	EMPC/PR	54.6
1234678 HpCDF	ng/dscm	53	PR	1160	53	ND	0
1234789 HpCDF	ng/dscm	53	PR,Q	510	53	ND	0
OCDF	ng/dscm	53		2220	53	PR	170
TCDD (Total)	ng/dscm	53		450	53	S	5000
PeCDD (Total)	ng/dscm	53	S,Q	546	53	S,Q	145
HxCDD (Total)	ng/dscm	53	Q	4620	53		977
HpCDD (Total)	ng/dscm	53		7450	53		988
TCDF (Total)	ng/dscm	53		4460	53	Q	1080
PeCDF (Total)	ng/dscm	53	Q	873	53	Q	533
HxCDF (Total)	ng/dscm	53	Q	1550	53		694
HpCDF (Total)	ng/dscm	53	Q	3080	53	EMPC	9
Total dioxins (by isomer)	ng/dscm	53	<	11500	53	<	1380
Total furans (by isomer)	ng/dscm	53	<	5220	53	<	680
Total dioxins/furans (by isomer)	ng/dscm	53	<	16700	53	<	2060
Volatile organic compounds							
Vinyl chloride	µg/dscm	**1	INT		**2	ND	23.8
Methyl chloride	µg/dscm	**1	INT		**2	<	11200
Trans-1,2-dichloroethene	µg/dscm	**1	INT		**2	<	24800
Cis-1,2-dichloroethene	µg/dscm	**1	INT		**2	<	19600
Chloroform	µg/dscm	**1	INT		**2	ND	23.8
1,1,1 - Trichloroethane	µg/dscm	**1	INT		**2	ND	23.8
Carbon tetrachloride	µg/dscm	**1	INT		**2	ND	23.8
Benzene	µg/dscm	**1	SAT		**2	SAT	10400000
1,2 - Dichloroethane	µg/dscm	**1	INT		**2	ND	23.8
Trichloroethene	µg/dscm	**1	INT (1,2) SAT(3,4)		**2	<	147000
Toluene	µg/dscm	**1	SAT	7780000	**2	<	262000
1,1,2 - Trichloroethane	µg/dscm	**1	ND	20.0	**2	ND	23.8
Tetrachloroethene	µg/dscm	**1	<	1880	**2	<	50.5
1,2 - Dibromoethane	µg/dscm	**1	ND	20.0	**2	<	23.8
Chlorobenzene	µg/dscm	**1	<	50400	**2	<	9880
Ethylbenzene	µg/dscm	**1	<	210000	**2	<	12100
M-/P-Xylene	µg/dscm	**1	<	132000	**2	<	12400
O-Xylene	µg/dscm	**1	<	3680	**2	<	4340
1,3 - Dichlorobenzene	µg/dscm	**1	ND	2350	**2	<	597
1,4 - Dichlorobenzene	µg/dscm	**1	ND	1950	**2	<	525
1,2 - Dichlorobenzene	µg/dscm	**1	ND	2610	**2	ND	23.8

Note: **1 refers to flags 8(1,2,3,4),15(1,2,3,4),16(1,2,3,4),17(3) **2 refers to flags 15(1,2,3,4),17(4),44(1,2,3,4)

TABLE A2-18. SS20 - MOLTEN BATH SUMMARY

Substance	Units	Condition 2 - Soil			
		Run 1		Run 2	
Trace metals					
Antimony	ppm	ND	30	ND	30
Arsenic	ppm	ND	20	ND	30
Barium	ppm	ND	1	ND	1
Beryllium	ppm	ND	0.02	ND	0.02
Cadmium	ppm	ND	1	ND	1
Chromium (total)	ppm	ND	2		150
Copper	ppm		98		99
Lead	ppm		160	ND	10
Manganese	ppm	ND	1		2
Mercury	ppm	ND	0.4	ND	0.4
Nickel	ppm	ND	2		110
Phosphorus	ppm		380		370
Selenium	ppm	ND	20	ND	20
Silver	ppm	ND	1	ND	1
Thallium	ppm	ND	30	ND	30
Iron	ppm		40		930
Zinc	ppm		12		6

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY

Substance	Units	Condition 1 - waste water							
		Flag		Run 1	Flag		Run 2	Flag	Run 3
Total stream flow rate									
	kg/hr		IN	22.50		IN	5.03	IN	5.03
Polychlorinated biphenyls (PCB) - BOR									
Monochlorobiphenyl (total)	µg/L		ND	0.3		BQL	0.01		
Dichlorobiphenyl (total)	µg/L		ND	1.2		BQL	0.03		
Trichlorobiphenyl (total)	µg/L		ND	2.4		BQL	0.09		
Tetrachlorobiphenyl (total)	µg/L		ND	8.4		BQL	0.13		
Pentachlorobiphenyl (total)	µg/L		ND	9.2		BQL	0.01		
Hexachlorobiphenyl (total)	µg/L		ND	8.4		ND	8.4		
Heptachlorobiphenyl (total)	µg/L		ND	7.2		ND	7.2		
Octachlorobiphenyl (total)	µg/L		ND	3.6		ND	3.6		
Nonachlorobiphenyl (total)	µg/L		ND	0.9		ND	0.9		
Decachlorobiphenyl (total)	µg/L		ND	0.5		ND	0.5		
Total PCBs (Tri-Deca) including NDs	µg/L		ND	40.6		<	20.8		
Total PCBs (Mono-Deca) including NDs	µg/L		ND	42.1		<	20.9		
Total PCBs (Tri-Deca) excluding NDs	µg/L		all	ND		>	0.23		
Total PCBs (Mono-Deca) excluding NDs	µg/L		all	ND		>	0.27		
Polychlorinated biphenyls (PCB) - EOR	µg/L								
Monochlorobiphenyl (total)	µg/L		ND	0.3				BQL	0.28
Dichlorobiphenyl (total)	µg/L		ND	1.2				BQL	0.2
Trichlorobiphenyl (total)	µg/L		ND	2.4				ND	2.4
Tetrachlorobiphenyl (total)	µg/L		ND	8.4				BQL	0.24
Pentachlorobiphenyl (total)	µg/L		ND	9.2				BQL	0.02
Hexachlorobiphenyl (total)	µg/L		ND	8.4				ND	8.4
Heptachlorobiphenyl (total)	µg/L		ND	7.2				ND	7.2
Octachlorobiphenyl (total)	µg/L		ND	3.6				ND	3.6
Nonachlorobiphenyl (total)	µg/L		ND	0.9				ND	0.9
Decachlorobiphenyl (total)	µg/L		ND	0.5				ND	0.5
Total PCBs (Tri-Deca) including NDs	µg/L		ND	40.6				<	23.3
Total PCBs (Mono-Deca) including NDs	µg/L		ND	42.1				<	23.7
Total PCBs (Tri-Deca) excluding NDs	µg/L		all	ND				>	0.26
Total PCBs (Mono-Deca) excluding NDs	µg/L		all	ND				>	0.54
Polycyclic aromatic hydrocarbons (PAH) - BOR									
Acenaphthene	µg/L	37	ND	0.26	37	BQL	13		
Fluorene	µg/L	37	BQL	1.6	37		69		
Phenanthrene	µg/L	37		69	37		950		
Anthracene	µg/L	37		5.1	37		94		
Fluoranthene	µg/L	37		44	37	BQL	670		
Pyrene	µg/L	37		21	37	BQL	840		
Benz (a) anthracene	µg/L	37	BQL	0.6	37		51		
Chrysene	µg/L	37	BQL	1.1	37		110		
Benzo (b) fluoranthene	µg/L	37	BQL	1.1	37		100		
Benzo (k) fluoranthene	µg/L	37	BQL	0.3	37	BQL	31		
Benzo (e) pyrene	µg/L	37	BQL	0.7	37		100		
Benzo (a) pyrene	µg/L	37	BQL	0.3	37		170		
Perylene	µg/L	37	ND	0.26	37		63		
Indeno (1,2,3-cd) pyrene	µg/L	37	BQL	0.4	37		82		
Dibenz (a,h) anthracene	µg/L	37	ND	0.26	37	ND	4.8		
Benzo (g,h,i) perylene	µg/L	37	BQL	0.7	37		170		
Naphthalene	µg/L	37		2.6	37	BQL	710		
2-Methylnaphthalene	µg/L	37	ND	0.26	37	ND	4.8		
2-Chloronaphthalene	µg/L	37	ND	0.26	37	ND	4.8		
Acenaphthlene	µg/L	37		4	37		1000		
Total PAHs	µg/L	37	<	154	37	<	5240		

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 1 - waste water								
		Flag		Run 1	Flag		Run 2	Flag		Run 3
Polycyclic aromatic hydrocarbons (PAH) - EOR										
Acenaphthene	µg/L	37	ND	1				37		250
Fluorene	µg/L	37	BQL	1.6				37	BQL	1800
Phenanthrene	µg/L	37		67				37		18000
Anthracene	µg/L	37	BQL	5.5				37	BQL	2900
Fluoranthene	µg/L	37		43				37		13000
Pyrene	µg/L	37		27				37		16000
Benz (a) anthracene	µg/L	37	ND	1				37		1200
Chrysene	µg/L	37	BQL	1.3				37	BQL	2300
Benzo (b) fluoranthene	µg/L	37	BQL	1.1				37	BQL	1600
Benzo (k) fluoranthene	µg/L	37	ND	1				37		640
Benzo (e) pyrene	µg/L	37	ND	1				37	BQL	1700
Benzo (a) pyrene	µg/L	37	ND	1				37	BQL	3000
Perylene	µg/L	37	ND	1				37		1000
Indeno (1,2,3-cd) pyrene	µg/L	37	ND	1				37		660
Dibenz (a,h) anthracene	µg/L	37	ND	1				37	ND	20
Benzo (g,h,i) perylene	µg/L	37	ND	1				37		1000
Naphthalene	µg/L	37	BQL	3.2				37		29000
2-Methylnaphthalene	µg/L	37	ND	1				37		330
2-Chloronaphthalene	µg/L	37	ND	1				37	ND	20
Acenaphthlene	µg/L	37	BQL	4.4				37		17000
Total PAHs including NDs	µg/L	37	<	165.1				37	<	111000
Total PAHs excluding NDs	µg/L	37	>	155				37	>	111000
Chlorobenzenes and chlorophenols -BOR										
1,2-Dichlorobenzene	µg/L	1	ND	0.26		ND	4.8			
1,3-Dichlorobenzene	µg/L	1	ND	0.26		ND	4.8			
1,4-Dichlorobenzene	µg/L	1	ND	0.26		ND	4.8			
Total dichlorobenzenes	µg/L	1	ND	0.78		ND	14.4			
1,2,3-Trichlorobenzene	µg/L	1	ND	0.26		ND	4.8			
1,3,5-Trichlorobenzene	µg/L	1	ND	0.26		ND	4.8			
1,2,4-Trichlorobenzene	µg/L	1	ND	0.26		ND	4.8			
Total trichlorobenzenes	µg/L	1	ND	0.78		ND	14.4			
1,2,3,4-Tetrachlorobenzene	µg/L	1	ND	0.26		ND	4.8			
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	1	ND	0.53		ND	9.5			
Total tetrachlorobenzenes	µg/L	1	ND	0.79		ND	14.3			
Pentachlorobenzene	µg/L	1	ND	0.26		ND	4.8			
Hexachlorobenzene	µg/L	1	ND	0.26		ND	4.8			
2,3-Dichlorophenol	µg/L	1	ND	0.26		ND	4.8			
2,4-Dichlorophenol	µg/L	1	ND	0.26		ND	4.8			
2,5-Dichlorophenol	µg/L	1	ND	0.26		ND	4.8			
2,6-Dichlorophenol	µg/L	1	ND	0.26		ND	4.8			
3,4-Dichlorophenol	µg/L	1	ND	0.26		ND	4.8			
3,5-Dichlorophenol	µg/L	1	ND	0.26		ND	4.8			
Total dichlorophenols	µg/L	1	ND	1.56		ND	28.8			
2,3,4-Trichlorophenol	µg/L	1	ND	0.26		ND	4.8			
2,3,5-Trichlorophenol	µg/L	1	ND	0.26		ND	4.8			
2,3,6-Trichlorophenol	µg/L	1	ND	0.26		ND	4.8			
2,4,5-Trichlorophenol	µg/L	1	ND	0.26		ND	4.8			
2,4,6-Trichlorophenol	µg/L	1	ND	0.26		ND	4.8			
Total trichlorophenols	µg/L	1	ND	1.3		ND	24			
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	1	ND	0.53		ND	4.8			
2,3,5,6-Tetrachlorophenol	µg/L	1	ND	0.26		ND	4.8			
Total tetrachlorophenols	µg/L	1	ND	0.79		ND	9.6			
Pentachlorophenol	µg/L	1	ND	0.26		ND	4.8			
Total CB	µg/L	1	ND	2.87		ND	52.7			
Total CP	µg/L	1	ND	3.91		ND	67.2			

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 1 - waste water					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Chlorobenzenes and chlorophenols -EOR							
1,2-Dichlorobenzene	µg/L		ND 1				ND 20
1,3-Dichlorobenzene	µg/L		ND 1				ND 20
1,4-Dichlorobenzene	µg/L		ND 1				ND 20
Total dichlorobenzenes	µg/L		ND 3				ND 60
1,2,3-Trichlorobenzene	µg/L		ND 1				ND 20
1,3,5-Trichlorobenzene	µg/L		ND 1				ND 20
1,2,4-Trichlorobenzene	µg/L		ND 1				ND 20
Total trichlorobenzenes	µg/L		ND 3				ND 60
1,2,3,4-Tetrachlorobenzene	µg/L		ND 1				ND 20
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L		ND 2				ND 40
Total tetrachlorobenzenes	µg/L		ND 3				ND 60
Pentachlorobenzene	µg/L		ND 1				ND 20
Hexachlorobenzene	µg/L		ND 1				ND 20
2,3-Dichlorophenol	µg/L		ND 1				ND 20
2,4-Dichlorophenol	µg/L		ND 1				ND 20
2,5-Dichlorophenol	µg/L		ND 1				ND 20
2,6-Dichlorophenol	µg/L		ND 1				ND 20
3,4-Dichlorophenol	µg/L		ND 1				ND 20
3,5-Dichlorophenol	µg/L		ND 1				ND 20
Total dichlorophenols	µg/L		ND 6				ND 120
2,3,4-Trichlorophenol	µg/L		ND 1				ND 20
2,3,5-Trichlorophenol	µg/L		ND 1				ND 20
2,3,6-Trichlorophenol	µg/L		ND 1				ND 20
2,4,5-Trichlorophenol	µg/L		ND 1				ND 20
2,4,6-Trichlorophenol	µg/L		ND 1				ND 20
Total trichlorophenols	µg/L		ND 5				ND 100
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L		ND 2				ND 40
2,3,5,6-Tetrachlorophenol	µg/L		ND 1				ND 20
Total tetrachlorophenols	µg/L		ND 3				ND 60
Pentachlorophenol	µg/L		ND 1				ND 20
Total CB	µg/L		ND 11				ND 220
Total CP	µg/L		ND 15				ND 300
Volatile organic compounds - BOR							
Vinyl chloride	µg/L	3,39	ND 2	3	ND 2		
Methyl chloride	µg/L	3,39	BQL 8	3	ND 2		
Trans-1,2-dichloroethene	µg/L	3,39	ND 2	3	ND 2		
Cis-1,2-dichloroethene	µg/L	3,39	ND 2	3	ND 2		
Chloroform	µg/L	3,39	ND 2	3	ND 2		
1,1,1 - Trichloroethane	µg/L	3,39	ND 2	3	ND 2		
Carbon tetrachloride	µg/L	3,39	ND 2	3	ND 2		
Benzene	µg/L	3,39	ND 2	3	35		
1,2 - Dichloroethane	µg/L	3,39	ND 2	3	ND 2		
Trichloroethene	µg/L	3,39	ND 2	3	ND 2		
Toluene	µg/L	3,39	ND 2	3	ND 2		
1,1,2 - Trichloroethane	µg/L	3,39	ND 2	3	ND 2		
Tetrachloroethene	µg/L	3,39	ND 2	3	ND 2		
1,2 - Dibromoethane	µg/L	3,39	ND 2	3	ND 2		
Chlorobenzene	µg/L	3,39	ND 2	3	ND 2		
Ethylbenzene	µg/L	3,39	ND 2	3	ND 2		
M-/P-Xylene	µg/L	3,39	ND 2	3	ND 2		
O-Xylene	µg/L	3,39	ND 2	3	ND 2		
1,3 - Dichlorobenzene	µg/L	3,39	ND 2	3	ND 2		
1,4 - Dichlorobenzene	µg/L	3,39	ND 2	3	ND 2		
1,2 - Dichlorobenzene	µg/L	3,39	ND 2	3	ND 2		

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 1 - waste water					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Volatile organic compounds - EOR							
Vinyl chloride	µg/L	39	ND 2				ND 100
Methyl chloride	µg/L	39	BQL 6				ND 100
Trans-1,2-dichloroethene	µg/L	39	ND 2				ND 100
Cis-1,2-dichloroethene	µg/L	39	ND 2				ND 100
Chloroform	µg/L	39	ND 2				ND 100
1,1,1 - Trichloroethane	µg/L	39	ND 2				ND 100
Carbon tetrachloride	µg/L	39	ND 2				ND 100
Benzene	µg/L	39	BQL 4				6900
1,2 - Dichloroethane	µg/L	39	ND 2				ND 100
Trichloroethene	µg/L	39	ND 2				ND 100
Toluene	µg/L	39	ND 2				ND 100
1,1,2 - Trichloroethane	µg/L	39	ND 2				ND 100
Tetrachloroethene	µg/L	39	ND 2				ND 100
1,2 - Dibromoethane	µg/L	39	ND 2				ND 100
Chlorobenzene	µg/L	39	ND 2				ND 100
Ethylbenzene	µg/L	39	ND 2				ND 100
M-/P-Xylene	µg/L	39	ND 2				ND 100
O-Xylene	µg/L	39	ND 2				ND 100
1,3 - Dichlorobenzene	µg/L	39	ND 2				ND 100
1,4 - Dichlorobenzene	µg/L	39	ND 2				ND 100
1,2 - Dichlorobenzene	µg/L	39	ND 2				ND 100
Dioxins and furans - BOR							
2378-TCDD	ng/L		ND 0.0004		ND 0.02		
12378-PeCDD	ng/L		ND 0.001		ND 0.01		
123478-HxCDD	ng/L		ND 0.001		ND 0.02		
123678-HxCDD	ng/L		ND 0.001		ND 0.02		
123789-HxCDD	ng/L		ND 0.001		ND 0.01		
1234678-HpCDD	ng/L		0.002		0.06		
OCDD	ng/L		F 0.02		0.32		
2378-TCDF	ng/L		ND 0.001		ND 0.03		
12378-PeCDF	ng/L		ND 0.002		ND 0.01		
23478-PeCDF	ng/L		ND 0.001		ND 0.01		
123478-HxCDF	ng/L		ND 0.001		ND 0.02		
123678-HxCDF	ng/L		ND 0.0004		ND 0.15		
123789-HxCDF	ng/L		ND 0.001		ND 0.02		
234678-HxCDF	ng/L		ND 0.001		ND 0.03		
1234678-HpCDF	ng/L		ND 0.001		ND 0.06		
1234789-HpCDF	ng/L		ND 0.001		0.01		
OCDF	ng/L		0.002		0.05		
Total TCDD	ng/L		0.004		ND 0.48		
Total PeCDD	ng/L		ND 0.007		ND 0.18		
Total HxCDD	ng/L		F 0.001		ND 0.15		
Total HpCDD	ng/L		F 0.004		0.06		
Total TCDF	ng/L		ND 0.04		0.35		
Total PeCDF	ng/L		ND 0.04		ND 0.27		
Total HxCDF	ng/L		ND 0.01		ND 0.88		
Total HpCDF	ng/L		ND 0.004		0.01		
Total PCDD (by isomer)	ng/L		< 0.02		< 0.46		
Total PCDF (by isomer)	ng/L		< 0.01		< 0.39		
Total PCDD/PCDF (by isomer)	ng/L		< 0.04		< 0.85		

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 1 - waste water					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Dioxins and furans - EOR							
2378-TCDD	ng/L	ND	0.004			ND	0.03
12378-PeCDD	ng/L	ND	0.003			ND	0.02
123478-HxCDD	ng/L	ND	0.001			ND	0.02
123678-HxCDD	ng/L	ND	0.003			ND	0.003
123789-HxCDD	ng/L	ND	0.003			ND	0.01
1234678-HpCDD	ng/L		0.02			ND	0.02
OCDD	ng/L		0.14			F	0.16
2378-TCDF	ng/L	ND	0.002			ND	0.02
12378-PeCDF	ng/L	ND	0.003			ND	0.01
23478-PeCDF	ng/L	ND	0.001			ND	0.02
123478-HxCDF	ng/L	ND	0.002			ND	0.02
123678-HxCDF	ng/L	ND	0.002			ND	0.03
123789-HxCDF	ng/L	ND	0.01			ND	0.07
234678-HxCDF	ng/L	ND	0.01			ND	0.03
1234678-HpCDF	ng/L		0.01			ND	0.11
1234789-HpCDF	ng/L	ND	0.003			ND	0.02
OCDF	ng/L		0.01			ND	0.04
Total TCDD	ng/L	F	0.02			ND	0.75
Total PeCDD	ng/L		0.07			ND	0.24
Total HxCDD	ng/L	ND	0.02			ND	0.09
Total HpCDD	ng/L		0.02			ND	0.04
Total TCDF	ng/L		0.01			ND	0.72
Total PeCDF	ng/L		0.01			ND	0.42
Total HxCDF	ng/L		0.005			ND	0.58
Total HpCDF	ng/L		0.01			ND	0.27
Total dioxins (by isomer) including NDs	ng/L	<	0.17			<	0.26
Total furans (by isomer) including NDs	ng/L	<	0.05			<	0.36
Total dioxins/furans (by isomer) inc NDs	ng/L	<	0.22			<	0.62
Total dioxins (by isomer) excluding NDs	ng/L	>	0.16			>	0.16
Total furans (by isomer) excluding NDs	ng/L	>	0.02			all	ND
Total dioxins/furans (by isomer) excluding NDs	ng/L	>	0.18			>	0.16
Trace metals - EOR							
Antimony	µg/L	ND	100	ND	100		
Arsenic	µg/L	ND	100	ND	100		
Barium	µg/L		48		98		
Beryllium	µg/L	ND	10	ND	10		
Cadmium	µg/L	ND	10	ND	10		
Chromium (total)	µg/L	ND	10		200		
Copper	µg/L		110		450		
Lead	µg/L		370		1200		
Manganese	µg/L		88		440		
Mercury	µg/L		0.6		1.1		
Nickel	µg/L	ND	10		71		
Phosphorus	µg/L	ND	100		190		
Selenium	µg/L	ND	100	ND	100		
Silver	µg/L	ND	10	ND	10		
Thallium	µg/L	ND	100	ND	100		
Tin	µg/L	ND	100	ND	100		
Zinc	µg/L		1300		4300		

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 1 - waste water					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Trace metals - EOR							
Antimony	µg/L	ND	100			ND	100
Arsenic	µg/L	ND	100			ND	100
Barium	µg/L		21				61
Beryllium	µg/L	ND	10			ND	10
Cadmium	µg/L	ND	10			ND	10
Chromium (total)	µg/L	ND	10				470
Copper	µg/L		23				380
Lead	µg/L		68				1500
Manganese	µg/L		13				380
Mercury	µg/L	ND	0.2				1.1
Nickel	µg/L	ND	10				190
Phosphorus	µg/L	ND	100				500
Selenium	µg/L	ND	100			ND	100
Silver	µg/L	ND	10			ND	10
Thallium	µg/L	ND	100			ND	100
Tin	µg/L	ND	100			ND	100
Zinc	µg/L		280				7400
Miscellaneous - BOR							
Total organic carbon	ppmw	NA		3 ND	1		
Chlorine	wt. %		0.103				
Fluorine	wt. %	<	0.01				
Phosphate	wt. %	<	0.01				
Organic halogens (as chloride)	ppbw	3	32.7	3	30.4		
Inorganic halogens (as chloride)	ppmw		150		140		
Hexavalent chromium	ppmw	ND	0.01	ND	0.01		
Miscellaneous - EOR							
Total organic carbon	ppmw		14.2			3	18.3
Chlorine	wt. %						0.19
Fluorine	wt. %					<	0.01
Phosphate	wt. %					<	0.01
Organic halogens (as chloride)	ppbw		62.6				62.2
Inorganic halogens (as chloride)	ppmw		150				2000
Hexavalent chromium	ppmw	ND	0.01			ND	0.01
Physical characteristics - BOR							
Density	g/cc		1.02		0.99		
pH	–		7.9		11.4		
Physical characteristics - EOR							
Density	g/cc		0.98				0.97
pH	–		9.9				9.4
Ultimate analysis - BOR							
Carbon	wt. %		5.03				
Hydrogen	wt. %		12.59				
Nitrogen	wt. %		0.01				
Total sulfur (as S)	wt. %		0.004		0.001		
Oxygen	wt. %		82.3				
Ultimate analysis - EOR							
Carbon	wt. %						0.71
Hydrogen	wt. %						26.2
Nitrogen	wt. %					<	0.01
Total sulfur (as S)	wt. %		0.004				0.003
Oxygen	wt. %						73.0

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 2 - soil					
		Flag		Run 1	Flag		Run 2
Total stream flow rate							
	kg/hr		OUT	5.79		IN	8.72
Polychlorinated biphenyls (PCB) - BOR							
Monochlorobiphenyl (total)	µg/L		BQL	0.04		BQL	0.01
Dichlorobiphenyl (total)	µg/L		BQL	0.07		BQL	0.01
Trichlorobiphenyl (total)	µg/L		BQL	0.15		BQL	0.10
Tetrachlorobiphenyl (total)	µg/L		BQL	0.14		BQL	0.08
Pentachlorobiphenyl (total)	µg/L		BQL	4.71		ND	9.5
Hexachlorobiphenyl (total)	µg/L		ND	8.6		ND	8.7
Heptachlorobiphenyl (total)	µg/L		ND	7.4		ND	7.4
Octachlorobiphenyl (total)	µg/L		ND	3.7		BQL	0.01
Nonachlorobiphenyl (total)	µg/L		ND	0.92		ND	0.93
Decachlorobiphenyl (total)	µg/L		ND	0.51		BQL	0.03
Total PCBs (Tri-Deca) including NDs	µg/L		<	26.1		<	26.7
Total PCBs (Mono-Deca) including NDs	µg/L		<	26.2		<	26.8
Total PCBs (Tri-Deca) excluding NDs	µg/L		>	5.00		>	0.22
Total PCBs (Mono-Deca) excluding NDs	µg/L		>	5.11		>	0.24
Polychlorinated biphenyls (PCB) - EOR	µg/L						
Monochlorobiphenyl (total)	µg/L		BQL	0.01		BQL	0.01
Dichlorobiphenyl (total)	µg/L		BQL	0.01		BQL	0.02
Trichlorobiphenyl (total)	µg/L		BQL	0.10		BQL	0.13
Tetrachlorobiphenyl (total)	µg/L		BQL	0.08		BQL	0.06
Pentachlorobiphenyl (total)	µg/L		ND	9.50		BQL	0.01
Hexachlorobiphenyl (total)	µg/L		ND	8.7		ND	8.1
Heptachlorobiphenyl (total)	µg/L		ND	7.4		ND	6.9
Octachlorobiphenyl (total)	µg/L		BQL	0.01		ND	3.5
Nonachlorobiphenyl (total)	µg/L		ND	0.93		ND	0.87
Decachlorobiphenyl (total)	µg/L		BQL	0.03		ND	0.48
Total PCBs (Tri-Deca) including NDs	µg/L		<	26.7		<	20.1
Total PCBs (Mono-Deca) including NDs	µg/L		<	26.8		<	20.1
Total PCBs (Tri-Deca) excluding NDs	µg/L		>	0.20		>	0.20
Total PCBs (Mono-Deca) excluding NDs	µg/L		>	0.22		>	0.23
Polycyclic aromatic hydrocarbons (PAH) - BOR							
Acenaphthene	µg/L	35	ND	20	35	ND	19
Fluorene	µg/L	35	ND	20	35	ND	19
Phenanthrene	µg/L	35		900	35		730
Anthracene	µg/L	35	BQL	69	35	BQL	72
Fluoranthene	µg/L	35		630	35		630
Pyrene	µg/L	35		780	35		790
Benz (a) anthracene	µg/L	35	BQL	48	35	BQL	44
Chrysene	µg/L	35	BQL	88	35	BQL	85
Benzo (b) fluoranthene	µg/L	35	BQL	120	35	BQL	130
Benzo (k) fluoranthene	µg/L	35	BQL	25	35	ND	19
Benzo (e) pyrene	µg/L	35	BQL	130	35	BQL	100
Benzo (a) pyrene	µg/L	35	BQL	150	35	BQL	110
Perylene	µg/L	35	BQL	63	35	BQL	65
Indeno (1,2,3-cd) pyrene	µg/L	35	BQL	110	35	BQL	93
Dibenz (a,h) anthracene	µg/L	35	ND	20	35	ND	19
Benzo (g,h,i) perylene	µg/L	35		260	35	BQL	150
Naphthalene	µg/L	35		410	35		390
2-Methylnaphthalene	µg/L	35	ND	20	35	ND	19
2-Chloronaphthalene	µg/L	35	ND	20	35	ND	19
Acenaphthlene	µg/L	35		240	35		200
Total PAHs	µg/L	35	<	4120	35	<	3700

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 2 - soil			
		Flag	Run 1	Flag	Run 2
Polycyclic aromatic hydrocarbons (PAH) - EOR					
Acenaphthene	µg/L			35 BQL	33
Fluorene	µg/L			35 BQL	89
Phenanthrene	µg/L			35 BQL	2300
Anthracene	µg/L			35	240
Fluoranthene	µg/L			35 BQL	2300
Pyrene	µg/L			35 BQL	2200
Benz (a) anthracene	µg/L			35 ND	19
Chrysene	µg/L			35	260
Benzo (b) fluoranthene	µg/L			35	300
Benzo (k) fluoranthene	µg/L			35 BQL	51
Benzo (e) pyrene	µg/L			35	220
Benzo (a) pyrene	µg/L			35	270
Perylene	µg/L			35 BQL	160
Indeno (1,2,3-cd) pyrene	µg/L			35	210
Dibenz (a,h) anthracene	µg/L			35 ND	19
Benzo (g,h,i) perylene	µg/L			35	290
Naphthalene	µg/L			35	3900
2-Methylnaphthalene	µg/L			35 ND	19
2-Chloronaphthalene	µg/L			35 ND	19
Acenaphthlene	µg/L			35	1200
Total PAHs including NDs	µg/L			35 <	14100
Total PAHs excluding NDs	µg/L			35 >	14000
Chlorobenzenes and chlorophenols -BOR					
1,2-Dichlorobenzene	µg/L	ND	20	ND	19
1,3-Dichlorobenzene	µg/L	ND	20	ND	19
1,4-Dichlorobenzene	µg/L	ND	20	ND	19
Total dichlorobenzenes	µg/L	ND	60	ND	57
1,2,3-Trichlorobenzene	µg/L	ND	20	ND	19
1,3,5-Trichlorobenzene	µg/L	ND	20	ND	19
1,2,4-Trichlorobenzene	µg/L	ND	20	ND	19
Total trichlorobenzenes	µg/L	ND	60	ND	57
1,2,3,4-Tetrachlorobenzene	µg/L	ND	20	ND	19
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	ND	40	ND	39
Total tetrachlorobenzenes	µg/L	ND	60	ND	58
Pentachlorobenzene	µg/L	ND	20	ND	19
Hexachlorobenzene	µg/L	ND	20	ND	19
2,3-Dichlorophenol	µg/L	ND	20	ND	19
2,4-Dichlorophenol	µg/L	ND	20	ND	19
2,5-Dichlorophenol	µg/L	ND	20	ND	19
2,6-Dichlorophenol	µg/L	ND	20	ND	19
3,4-Dichlorophenol	µg/L	ND	20	ND	19
3,5-Dichlorophenol	µg/L	ND	20	ND	19
Total dichlorophenols	µg/L	ND	120	ND	114
2,3,4-Trichlorophenol	µg/L	ND	20	ND	19
2,3,5-Trichlorophenol	µg/L	ND	20	ND	19
2,3,6-Trichlorophenol	µg/L	ND	20	ND	19
2,4,5-Trichlorophenol	µg/L	ND	20	ND	19
2,4,6-Trichlorophenol	µg/L	ND	20	ND	19
Total trichlorophenols	µg/L	ND	100	ND	95
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	ND	40	ND	39
2,3,5,6-Tetrachlorophenol	µg/L	ND	20	ND	19
Total tetrachlorophenols	µg/L	ND	60	ND	58
Pentachlorophenol	µg/L	ND	20	ND	19
Total CB	µg/L	ND	220	ND	210
Total CP	µg/L	ND	300	ND	286

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 2 - soil				
		Flag	Run 1		Flag	Run 2
Chlorobenzenes and chlorophenols -EOR						
1,2-Dichlorobenzene	µg/L				ND	19
1,3-Dichlorobenzene	µg/L				ND	19
1,4-Dichlorobenzene	µg/L				ND	19
Total dichlorobenzenes	µg/L				ND	57
1,2,3-Trichlorobenzene	µg/L				ND	19
1,3,5-Trichlorobenzene	µg/L				ND	19
1,2,4-Trichlorobenzene	µg/L				ND	19
Total trichlorobenzenes	µg/L				ND	57
1,2,3,4-Tetrachlorobenzene	µg/L				ND	19
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L				ND	39
Total tetrachlorobenzenes	µg/L				ND	58
Pentachlorobenzene	µg/L				ND	19
Hexachlorobenzene	µg/L				ND	19
2,3-Dichlorophenol	µg/L				ND	19
2,4-Dichlorophenol	µg/L				ND	19
2,5-Dichlorophenol	µg/L				ND	19
2,6-Dichlorophenol	µg/L				ND	19
3,4-Dichlorophenol	µg/L				ND	19
3,5-Dichlorophenol	µg/L				ND	19
Total dichlorophenols	µg/L				ND	114
2,3,4-Trichlorophenol	µg/L				ND	19
2,3,5-Trichlorophenol	µg/L				ND	19
2,3,6-Trichlorophenol	µg/L				ND	19
2,4,5-Trichlorophenol	µg/L				ND	19
2,4,6-Trichlorophenol	µg/L				ND	19
Total trichlorophenols	µg/L				ND	95
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L				ND	39
2,3,5,6-Tetrachlorophenol	µg/L				ND	19
Total tetrachlorophenols	µg/L				ND	58
Pentachlorophenol	µg/L				ND	19
Total CB	µg/L				ND	210
Total CP	µg/L				ND	286
Volatile organic compounds - BOR						
Vinyl chloride	µg/L	3	ND	10	ND	2
Methyl chloride	µg/L	3	ND	10	ND	2
Trans-1,2-dichloroethene	µg/L	3	ND	10	ND	2
Cis-1,2-dichloroethene	µg/L	3	ND	10	ND	2
Chloroform	µg/L	3	ND	10	ND	2
1,1,1 - Trichloroethane	µg/L	3	ND	10	ND	2
Carbon tetrachloride	µg/L	3	ND	10	ND	2
Benzene	µg/L	3		340	ALR	210
1,2 - Dichloroethane	µg/L	3	ND	10	ND	2
Trichloroethene	µg/L	3	ND	10	ND	2
Toluene	µg/L	3	ND	10	ND	2
1,1,2 - Trichloroethane	µg/L	3	ND	10	ND	2
Tetrachloroethene	µg/L	3	ND	10	ND	2
1,2 - Dibromoethane	µg/L	3	ND	10	ND	2
Chlorobenzene	µg/L	3	ND	10	ND	2
Ethylbenzene	µg/L	3	ND	10	ND	2
M-/P-Xylene	µg/L	3	ND	10	ND	2
O-Xylene	µg/L	3	ND	10	ND	2
1,3 - Dichlorobenzene	µg/L	3	ND	10	ND	2
1,4 - Dichlorobenzene	µg/L	3	ND	10	ND	2
1,2 - Dichlorobenzene	µg/L	3	ND	10	ND	2

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 2 - soil			
		Flag	Run 1	Flag	Run 2
Volatile organic compounds - EOR					
Vinyl chloride	µg/L	ND	10	ND	500
Methyl chloride	µg/L	ND	10	ND	500
Trans-1,2-dichloroethene	µg/L	ND	10	ND	500
Cis-1,2-dichloroethene	µg/L	ND	10	ND	500
Chloroform	µg/L	ND	10	ND	500
1,1,1 - Trichloroethane	µg/L	ND	10	ND	500
Carbon tetrachloride	µg/L	ND	10	ND	500
Benzene	µg/L		220		25000
1,2 - Dichloroethane	µg/L	ND	10	ND	500
Trichloroethene	µg/L	ND	10	ND	500
Toluene	µg/L	ND	10	ND	500
1,1,2 - Trichloroethane	µg/L	ND	10	ND	500
Tetrachloroethene	µg/L	ND	10	ND	500
1,2 - Dibromoethane	µg/L	ND	10	ND	500
Chlorobenzene	µg/L	ND	10	ND	500
Ethylbenzene	µg/L	ND	10	ND	500
M-/P-Xylene	µg/L	ND	10	ND	500
O-Xylene	µg/L	ND	10	ND	500
1,3 - Dichlorobenzene	µg/L	ND	10	ND	500
1,4 - Dichlorobenzene	µg/L	ND	10	ND	500
1,2 - Dichlorobenzene	µg/L	ND	10	ND	500
Dioxins and furans - BOR					
2378-TCDD	ng/L	ND	0.01	ND	0.04
12378-PeCDD	ng/L		0.02	ND	0.09
123478-HxCDD	ng/L		0.01	ND	0.02
123678-HxCDD	ng/L		0.02	ND	0.07
123789-HxCDD	ng/L		0.02	ND	0.01
1234678-HpCDD	ng/L		0.06		0.03
OCDD	ng/L		0.17		0.19
2378-TCDF	ng/L		0.05	ND	0.38
12378-PeCDF	ng/L		0.05	ND	0.05
23478-PeCDF	ng/L		0.10	ND	0.09
123478-HxCDF	ng/L		0.08	ND	0.02
123678-HxCDF	ng/L		0.08		0.02
123789-HxCDF	ng/L		0.08	ND	0.02
234678-HxCDF	ng/L		0.03	ND	0.01
1234678-HpCDF	ng/L		0.15		0.03
1234789-HpCDF	ng/L	ND	0.21	ND	0.03
OCDF	ng/L		0.05		0.05
Total TCDD	ng/L		0.09		0.02
Total PeCDD	ng/L		0.12	ND	1.30
Total HxCDD	ng/L		0.21	ND	0.33
Total HpCDD	ng/L		0.12		0.06
Total TCDF	ng/L		1.20		0.63
Total PeCDF	ng/L		1.00		0.07
Total HxCDF	ng/L		0.74		0.10
Total HpCDF	ng/L		0.20		0.03
Total PCDD (by isomer)	ng/L	<	0.30	<	0.45
Total PCDF (by isomer)	ng/L	<	0.88	<	0.69
Total PCDD/PCDF (by isomer)	ng/L	<	1.18	<	1.14

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 2 - soil			
		Flag	Run 1	Flag	Run 2
Dioxins and furans - EOR					
2378-TCDD	ng/L			ND	0.04
12378-PeCDD	ng/L			ND	0.03
123478-HxCDD	ng/L			ND	0.01
123678-HxCDD	ng/L			ND	0.02
123789-HxCDD	ng/L			ND	0.01
1234678-HpCDD	ng/L			ND	0.03
OCDD	ng/L				0.25
2378-TCDF	ng/L				0.02
12378-PeCDF	ng/L			ND	0.05
23478-PeCDF	ng/L			ND	0.03
123478-HxCDF	ng/L			ND	0.01
123678-HxCDF	ng/L				0.01
123789-HxCDF	ng/L			ND	0.01
234678-HxCDF	ng/L			ND	0.01
1234678-HpCDF	ng/L				0.03
1234789-HpCDF	ng/L			ND	0.01
OCDF	ng/L				0.08
Total TCDD	ng/L			ND	0.97
Total PeCDD	ng/L			ND	0.46
Total HxCDD	ng/L			ND	0.14
Total HpCDD	ng/L			ND	0.05
Total TCDF	ng/L				0.44
Total PeCDF	ng/L				0.07
Total HxCDF	ng/L				0.06
Total HpCDF	ng/L				0.03
Total dioxins (by isomer) including NDs	ng/L			<	0.40
Total furans (by isomer) including NDs	ng/L			<	0.26
Total dioxins/furans (by isomer) inc NDs	ng/L			<	0.65
Total dioxins (by isomer) excluding NDs	ng/L			>	0.25
Total furans (by isomer) excluding NDs	ng/L			>	0.12
Total dioxins/furans (by isomer) excluding NDs	ng/L			>	0.37
Trace metals - BOR					
Antimony	µg/L	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100
Barium	µg/L		15	ND	10
Beryllium	µg/L	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10
Chromium (total)	µg/L		37		18
Copper	µg/L		340		370
Lead	µg/L		130		160
Manganese	µg/L		190		59
Mercury	µg/L		1.4		0.28
Nickel	µg/L		92		180
Phosphorus	µg/L	ND	100	ND	100
Selenium	µg/L	ND	100	ND	100
Silver	µg/L	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100
Tin	µg/L		250		1100
Zinc	µg/L		1300		690

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 2 - soil			
		Flag	Run 1	Flag	Run 2
Trace metals - EOR					
Antimony	µg/L	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100
Barium	µg/L		19		19
Beryllium	µg/L	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10
Chromium (total)	µg/L		76		17
Copper	µg/L		360		590
Lead	µg/L		210		200
Manganese	µg/L		300		78
Mercury	µg/L		0.28		0.65
Nickel	µg/L		110		160
Phosphorus	µg/L	ND	100		110
Selenium	µg/L	ND	100	ND	100
Silver	µg/L	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100
Tin	µg/L		320		4200
Zinc	µg/L		2100		670
Miscellaneous - BOR					
Total organic carbon	ppmw		17.9		57.7
Chlorine	wt. %				
Fluorine	wt. %				
Phosphate	wt. %				
Organic halogens (as chloride)	ppbw	3	470	3	92.8
Inorganic halogens (as chloride)	ppmw		190		680
Hexavalent chromium	ppmw	ND	0.01	ND	0.01
Miscellaneous - EOR					
Total organic carbon	ppmw				44.7
Chlorine	wt. %				
Fluorine	wt. %				
Phosphate	wt. %				
Organic halogens (as chloride)	ppbw			3	184
Inorganic halogens (as chloride)	ppmw		200		970
Hexavalent chromium	ppmw			ND	0.01
Physical characteristics - BOR					
Density	g/cc		0.98		1.00
pH	–		9.8		10
Physical characteristics - EOR					
Density	g/cc		0.99		0.98
pH	–		9.8		9.9
Ultimate analysis - BOR					
Carbon	wt. %				
Hydrogen	wt. %				
Nitrogen	wt. %				
Total sulfur (as S)	wt. %		0.002		0.003
Oxygen	wt. %				
Ultimate analysis - EOR					
Carbon	wt. %				
Hydrogen	wt. %				
Nitrogen	wt. %				
Total sulfur (as S)	wt. %		0.002		0.003
Oxygen	wt. %				

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 3 - waste oil								
		Flag		Run 1	Flag		Run 2	Flag		Run 3
Total stream flow rate										
	kg/hr		IN	38.10		OUT	12.40			0.00
Polychlorinated biphenyls (PCB) - BOR										
Monochlorobiphenyl (total)	µg/L	29	ND	0.30	29	BQL	0.08	29	BQL	0.29
Dichlorobiphenyl (total)	µg/L	29	BQL	0.05	29	BQL	0.32	29	BQL	0.44
Trichlorobiphenyl (total)	µg/L	29	BQL	0.2	29	BQL	1.2	29	BQL	1.2
Tetrachlorobiphenyl (total)	µg/L	29	BQL	0.26	29	BQL	2.5	29	BQL	2.2
Pentachlorobiphenyl (total)	µg/L	29	BQL	0.02	29	BQL	1.1	29	BQL	0.67
Hexachlorobiphenyl (total)	µg/L	29	ND	8.4	29	ND	42	29	BQL	0.06
Heptachlorobiphenyl (total)	µg/L	29	ND	7.2	29	ND	36	29	ND	7.2
Octachlorobiphenyl (total)	µg/L	29	ND	3.6	29	ND	18	29	ND	3.6
Nonachlorobiphenyl (total)	µg/L	29	ND	0.9	29	ND	4.5	29	ND	0.9
Decachlorobiphenyl (total)	µg/L	29	ND	0.5	29	ND	2.5	29	ND	0.5
Total PCBs (Tri-Deca) including NDs	µg/L	29	<	21.1	29	<	108	29	<	16.3
Total PCBs (Mono-Deca) including NDs	µg/L	29	<	21.4	29	<	108	29	<	17.1
Total PCBs (Tri-Deca) excluding NDs	µg/L	29	>	0.30	29	>	4.80	29	>	4.13
Total PCBs (Mono-Deca) excluding NDs	µg/L	29	>	0.35	29	>	5.18	29	>	4.86
Polychlorinated biphenyls (PCB) - EOR	µg/L									
Monochlorobiphenyl (total)	µg/L	29		0.44	29	BQL	0.18	29		0.76
Dichlorobiphenyl (total)	µg/L	29	BQL	0.45	29	BQL	0.31	29	BQL	0.89
Trichlorobiphenyl (total)	µg/L	29	BQL	0.54	29	BQL	0.25	29	BQL	0.47
Tetrachlorobiphenyl (total)	µg/L	29	BQL	0.53	29	BQL	0.35	29	BQL	1.2
Pentachlorobiphenyl (total)	µg/L	29	BQL	0.05	29	ND	51	29	BQL	0.48
Hexachlorobiphenyl (total)	µg/L	29	ND	8.4	29	ND	47	29	BQL	0.02
Heptachlorobiphenyl (total)	µg/L	29	ND	7.2	29	ND	40	29	ND	7.2
Octachlorobiphenyl (total)	µg/L	29	ND	3.6	29	ND	20	29	ND	3.6
Nonachlorobiphenyl (total)	µg/L	29	ND	0.9	29	ND	5	29	ND	0.9
Decachlorobiphenyl (total)	µg/L	29	ND	0.5	29	ND	2.8	29	ND	0.5
Total PCBs (Tri-Deca) including NDs	µg/L	29	<	21.7	29	<	166.4	29	<	14.4
Total PCBs (Mono-Deca) including NDs	µg/L	29	<	22.6	29	<	166.9	29	<	16.0
Total PCBs (Tri-Deca) excluding NDs	µg/L	29	>	1.13	29	>	0.60	29	>	2.17
Total PCBs (Mono-Deca) excluding NDs	µg/L	29	>	2.02	29	>	1.09	29	>	3.82
Polycyclic aromatic hydrocarbons (PAH) - BOR										
Acenaphthene	µg/L		ND	25		ND	20		BQL	130
Fluorene	µg/L		BQL	85		BQL	86			460
Phenanthrene	µg/L			1300			1300			7300
Anthracene	µg/L		BQL	160		BQL	140			760
Fluoranthene	µg/L			830			800			5600
Pyrene	µg/L			1000			990			6100
Benz (a) anthracene	µg/L		BQL	69		BQL	64			430
Chrysene	µg/L		BQL	120		BQL	130			860
Benzo (b) fluoranthene	µg/L		BQL	110		BQL	140			1100
Benzo (k) fluoranthene	µg/L		BQL	41		BQL	46			300
Benzo (e) pyrene	µg/L		BQL	120		BQL	130			980
Benzo (a) pyrene	µg/L		BQL	180			210			1400
Perylene	µg/L		BQL	66		BQL	75			520
Indeno (1,2,3-cd) pyrene	µg/L		BQL	92		BQL	110			630
Dibenz (a,h) anthracene	µg/L		ND	25		ND	20		ND	19
Benzo (g,h,i) perylene	µg/L		BQL	190		BQL	190			940
Naphthalene	µg/L			870			2600			12000
2-Methylnaphthalene	µg/L		ND	25		ND	20		BQL	94
2-Chloronaphthalene	µg/L		ND	25		ND	20		ND	19
Acenaphthlene	µg/L			910			1500			6500
Total PAHs	µg/L		<	6240		<	8590		<	46140

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 3 - waste oil					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Polycyclic aromatic hydrocarbons (PAH) - EOR							
Acenaphthene	µg/L	BQL	130	BQL	120	BQL	540
Fluorene	µg/L		490		390	BQL	1400
Phenanthrene	µg/L		7900		5600		19000
Anthracene	µg/L		1000		600	BQL	1900
Fluoranthene	µg/L		5600		4000		18000
Pyrene	µg/L		6600		4900		26000
Benz (a) anthracene	µg/L		470		330	BQL	800
Chrysene	µg/L		960		690	BQL	1700
Benzo (b) fluoranthene	µg/L		1100		810	BQL	2100
Benzo (k) fluoranthene	µg/L		350		240	BQL	640
Benzo (e) pyrene	µg/L		980		750	BQL	3200
Benzo (a) pyrene	µg/L	BQL	1500		1200		4500
Perylene	µg/L		490		380	BQL	1400
Indeno (1,2,3-cd) pyrene	µg/L		500		460	BQL	3600
Dibenz (a,h) anthracene	µg/L	ND	20	ND	20	ND	380
Benzo (g,h,i) perylene	µg/L		750		680		10000
Naphthalene	µg/L		14000		26000	QS	30000
2-Methylnaphthalene	µg/L	BQL	120	BQL	150	ND	380
2-Chloronaphthalene	µg/L	ND	20	ND	20	ND	380
Acenaphthlene	µg/L		6000		6800		20000
Total PAHs including NDs	µg/L	<	49000	<	54100	<	146000
Total PAHs excluding NDs	µg/L	>	49000	>	54000	>	145000
Chlorobenzenes and chlorophenols -BOR							
1,2-Dichlorobenzene	µg/L	ND	25	ND	20	ND	19
1,3-Dichlorobenzene	µg/L	ND	25	ND	20	ND	19
1,4-Dichlorobenzene	µg/L	ND	25	ND	20	ND	19
Total dichlorobenzenes	µg/L	ND	75	ND	60	ND	57
1,2,3-Trichlorobenzene	µg/L	ND	25	ND	20	ND	19
1,3,5-Trichlorobenzene	µg/L	ND	25	ND	20	ND	19
1,2,4-Trichlorobenzene	µg/L	ND	25	ND	20	ND	19
Total trichlorobenzenes	µg/L	ND	75	ND	60	ND	57
1,2,3,4-Tetrachlorobenzene	µg/L	ND	25	ND	20	ND	19
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	ND	50	ND	40	ND	38
Total tetrachlorobenzenes	µg/L	ND	75	ND	60	ND	57
Pentachlorobenzene	µg/L	ND	25	ND	20	ND	19
Hexachlorobenzene	µg/L	ND	25	ND	20	ND	19
2,3-Dichlorophenol	µg/L	ND	25	ND	20	ND	19
2,4-Dichlorophenol	µg/L	ND	25	ND	20	ND	19
2,5-Dichlorophenol	µg/L	ND	25	ND	20	ND	19
2,6-Dichlorophenol	µg/L	ND	25	ND	20	ND	19
3,4-Dichlorophenol	µg/L	ND	25	ND	20	ND	19
3,5-Dichlorophenol	µg/L	ND	150	ND	120	ND	114
Total dichlorophenols	µg/L	ND	200	ND	160	ND	152
2,3,4-Trichlorophenol	µg/L	ND	25	ND	20	ND	19
2,3,5-Trichlorophenol	µg/L	ND	25	ND	20	ND	19
2,3,6-Trichlorophenol	µg/L	ND	25	ND	20	ND	19
2,4,5-Trichlorophenol	µg/L	ND	25	ND	20	ND	19
2,4,6-Trichlorophenol	µg/L	ND	25	ND	20	ND	19
Total trichlorophenols	µg/L	ND	125	ND	100	ND	95
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	ND	50	ND	40	ND	38
2,3,5,6-Tetrachlorophenol	µg/L	ND	25	ND	20	ND	19
Total tetrachlorophenols	µg/L	ND	75	ND	60	ND	57
Pentachlorophenol	µg/L	ND	25	ND	20	ND	19
Total CB	µg/L	ND	275	ND	220	ND	209
Total CP	µg/L	ND	425	ND	340	ND	323

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 3 - waste oil					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Chlorobenzenes and chlorophenols -EOR							
1,2-Dichlorobenzene	µg/L		ND 20		ND 20		ND 380
1,3-Dichlorobenzene	µg/L		ND 20		ND 20		ND 380
1,4-Dichlorobenzene	µg/L		ND 20		ND 20		ND 380
Total dichlorobenzenes	µg/L		ND 60		ND 60		ND 1140
1,2,3-Trichlorobenzene	µg/L		ND 20		ND 20		ND 380
1,3,5-Trichlorobenzene	µg/L		ND 20		ND 20		ND 380
1,2,4-Trichlorobenzene	µg/L		ND 20		ND 20		ND 380
Total trichlorobenzenes	µg/L		ND 60		ND 60		ND 1140
1,2,3,4-Tetrachlorobenzene	µg/L		ND 20		ND 20		ND 380
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L		ND 40		ND 40		ND 760
Total tetrachlorobenzenes	µg/L		ND 60		ND 60		ND 1140
Pentachlorobenzene	µg/L		ND 20		ND 20		ND 380
Hexachlorobenzene	µg/L		ND 20		ND 20		ND 380
2,3-Dichlorophenol	µg/L		ND 20		ND 20		ND 380
2,4-Dichlorophenol	µg/L		ND 20		ND 20		ND 380
2,5-Dichlorophenol	µg/L		ND 20		ND 20		ND 380
2,6-Dichlorophenol	µg/L		ND 20		ND 20		ND 380
3,4-Dichlorophenol	µg/L		ND 20		ND 20		ND 380
3,5-Dichlorophenol	µg/L		ND 120		ND 120		ND 2280
Total dichlorophenols	µg/L		ND 160		ND 160		ND 3040
2,3,4-Trichlorophenol	µg/L		ND 20		ND 20		ND 380
2,3,5-Trichlorophenol	µg/L		ND 20		ND 20		ND 380
2,3,6-Trichlorophenol	µg/L		ND 20		ND 20		ND 380
2,4,5-Trichlorophenol	µg/L		ND 20		ND 20		ND 380
2,4,6-Trichlorophenol	µg/L		ND 20		ND 20		ND 380
Total trichlorophenols	µg/L		ND 100		ND 100		ND 1900
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L		ND 40		ND 40		ND 760
2,3,5,6-Tetrachlorophenol	µg/L		ND 20		ND 20		ND 380
Total tetrachlorophenols	µg/L		ND 60		ND 60		ND 1140
Pentachlorophenol	µg/L		ND 20		ND 20		ND 380
Total CB	µg/L		ND 220		ND 220		ND 4180
Total CP	µg/L		ND 340		ND 340		ND 6460
Volatile organic compounds - BOR							
Vinyl chloride	µg/L		ND 2	24	ND 2		ND 10
Methyl chloride	µg/L		BQL 2	24	ND 2		ND 10
Trans-1,2-dichloroethene	µg/L		ND 2	24	ND 2		ND 10
Cis-1,2-dichloroethene	µg/L		ND 2	24	ND 2		ND 10
Chloroform	µg/L		BQL 2	24	ND 2		ND 10
1,1,1 - Trichloroethane	µg/L		ND 2	24	ND 2		ND 10
Carbon tetrachloride	µg/L		ND 2	24	ND 2		ND 10
Benzene	µg/L		ALR 520	24	130		390
1,2 - Dichloroethane	µg/L		ND 2	24	ND 2		ND 10
Trichloroethene	µg/L		ND 2	24	ND 2		ND 10
Toluene	µg/L		BQL 4	24	63		ND 10
1,1,2 - Trichloroethane	µg/L		ND 2	24	ND 2		ND 10
Tetrachloroethene	µg/L		ND 2	24	ND 2		BQL 17
1,2 - Dibromoethane	µg/L		ND 2	24	ND 2		ND 10
Chlorobenzene.	µg/L		ND 2	24	ND 2		ND 10
Ethylbenzene	µg/L		ND 2	24	ND 2		ND 10
M-/P-Xylene	µg/L		ND 2	24	ND 2		ND 10
O-Xylene	µg/L		ND 2	24	ND 2		ND 10
1,3 - Dichlorobenzene	µg/L		ND 2	24	ND 2		ND 10
1,4 - Dichlorobenzene	µg/L		ND 2	24	ND 2		ND 10
1,2 - Dichlorobenzene	µg/L		ND 2	24	ND 2		ND 10

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 3 - waste oil					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Volatile organic compounds - EOR							
Vinyl chloride	µg/L	ND	2	ND	2	ND	2
Methyl chloride	µg/L	ND	2	ND	2	ND	2
Trans-1,2-dichloroethene	µg/L	ND	2	ND	2	ND	2
Cis-1,2-dichloroethene	µg/L	ND	2	ND	2	ND	2
Chloroform	µg/L	ND	2	ND	2	ND	2
1,1,1 - Trichloroethane	µg/L	ND	2	ND	2	ND	2
Carbon tetrachloride	µg/L	ND	2	ND	2	ND	2
Benzene	µg/L		91		3200		480
1,2 - Dichloroethane	µg/L	ND	2	ND	2	ND	2
Trichloroethene	µg/L	ND	2	ND	2	ND	2
Toluene	µg/L	BQL	3		19	BQL	5
1,1,2 - Trichloroethane	µg/L	ND	2	ND	10	ND	2
Tetrachloroethene	µg/L	ND	2	ND	2	BQL	4
1,2 - Dibromoethane	µg/L	ND	2	ND	2	ND	2
Chlorobenzene	µg/L	ND	2	ND	2	ND	2
Ethylbenzene	µg/L	ND	2	ND	2	ND	2
M-/P-Xylene	µg/L	ND	2	ND	2	ND	2
O-Xylene	µg/L	ND	2	ND	2	ND	2
1,3 - Dichlorobenzene	µg/L	ND	2	ND	2	ND	2
1,4 - Dichlorobenzene	µg/L	ND	2	ND	2	ND	2
1,2 - Dichlorobenzene	µg/L	ND	2	ND	2	ND	2
Dioxins and furans - BOR							
2378-TCDD	ng/L	ND	0.01	ND	0.02	ND	0.20
12378-PeCDD	ng/L	ND	0.02	ND	0.01	ND	0.15
123478-HxCDD	ng/L	ND	0.004	ND	0.01	ND	0.05
123678-HxCDD	ng/L	ND	0.008	ND	0.01	ND	0.01
123789-HxCDD	ng/L	ND	0.004	ND	0.01	ND	0.01
1234678-HpCDD	ng/L		0.04	ND	0.03	ND	0.14
OCDD	ng/L		0.19	ND	0.12		0.26
2378-TCDF	ng/L		0.09		0.10		0.24
12378-PeCDF	ng/L	ND	0.04		0.03	ND	0.14
23478-PeCDF	ng/L		0.04		0.03	ND	0.26
123478-HxCDF	ng/L		0.04		0.17		0.07
123678-HxCDF	ng/L		0.03		0.02		0.08
123789-HxCDF	ng/L		0.03	ND	0.02		0.07
234678-HxCDF	ng/L		0.03	ND	0.01		0.04
1234678-HpCDF	ng/L		0.12		0.06		0.13
1234789-HpCDF	ng/L		0.07		0.01		0.03
OCDF	ng/L		0.25		0.07		0.17
Total TCDD	ng/L		0.01	ND	0.40		0.88
Total PeCDD	ng/L		0.02		0.01		1.50
Total HxCDD	ng/L		0.03		0.02		2.50
Total HpCDD	ng/L		0.07	ND	0.06		0.17
Total TCDF	ng/L		1.80		2.10		6.70
Total PeCDF	ng/L		0.33		0.28		2.00
Total HxCDF	ng/L		0.30		0.11		0.82
Total HpCDF	ng/L		0.28		0.12		0.23
Total PCDD (by isomer)	ng/L	<	0.27	<	0.20	<	0.81
Total PCDF (by isomer)	ng/L		0.74	<	0.52		1.23
Total PCDD/PCDF (by isomer)	ng/L	<	1.01	<	0.72	<	2.04

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 3 - waste oil					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Dioxins and furans - EOR							
2378-TCDD	ng/L	ND	0.11	ND	0.03	ND	0.40
12378-PeCDD	ng/L	ND	0.06	ND	0.03	ND	0.17
123478-HxCDD	ng/L	ND	0.02	ND	0.01	ND	0.15
123678-HxCDD	ng/L	ND	0.02	ND	0.01	ND	0.10
123789-HxCDD	ng/L	ND	0.01	ND	0.01	ND	0.26
1234678-HpCDD	ng/L	ND	0.17	ND	0.01	ND	0.35
OCDD	ng/L		0.28	F	0.12		0.30
2378-TCDF	ng/L		0.11		0.03	ND	0.28
12378-PeCDF	ng/L	ND	0.09	ND	0.02	ND	0.37
23478-PeCDF	ng/L	ND	0.09	ND	0.02	ND	0.39
123478-HxCDF	ng/L	ND	0.04	ND	0.01	ND	0.08
123678-HxCDF	ng/L	ND	0.04	ND	0.01	ND	0.08
123789-HxCDF	ng/L	ND	0.09	ND	0.01	ND	0.08
234678-HxCDF	ng/L	ND	0.06	ND	0.02	ND	0.08
1234678-HpCDF	ng/L	ND	0.35	ND	0.03		0.13
1234789-HpCDF	ng/L	ND	0.23	ND	0.01	ND	0.12
OCDF	ng/L		0.39	ND	0.03	ND	0.28
Total TCDD	ng/L	ND	2.42	ND	0.57		0.29
Total PeCDD	ng/L	ND	0.88	ND	0.38		0.35
Total HxCDD	ng/L	ND	0.14	ND	0.09		0.76
Total HpCDD	ng/L	ND	0.34	ND	0.03	ND	0.70
Total TCDF	ng/L		2.00		0.05		5.50
Total PeCDF	ng/L	ND	2.44	ND	0.53		0.55
Total HxCDF	ng/L	ND	0.91		0.02		0.16
Total HpCDF	ng/L	ND	1.16	ND	0.07		0.13
Total dioxins (by isomer) including NDs	ng/L	<	0.67	<	0.21	<	1.73
Total furans (by isomer) including NDs	ng/L	<	1.48	<	0.19	<	1.89
Total dioxins/furans (by isomer) inc NDs	ng/L	<	2.15	<	0.40	<	3.62
Total dioxins (by isomer) excluding NDs	ng/L	>	0.28	>	0.12	>	0.30
Total furans (by isomer) excluding NDs	ng/L	>	0.50	>	0.03	>	0.13
Total dioxins/furans (by isomer) excluding NDs	ng/L	>	0.78	>	0.15	>	0.43
Trace metals - BOR							
Antimony	µg/L	ND	100	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100		130
Barium	µg/L		24		35		42
Beryllium	µg/L	ND	10	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10	ND	10
Chromium (total)	µg/L		39		50		300
Copper	µg/L		120		150		370
Lead	µg/L		120		170		1200
Manganese	µg/L		99		370		730
Mercury	µg/L	ND	0.2		0.37		1
Nickel	µg/L		11		17		86
Phosphorus	µg/L	ND	100		66		430
Selenium	µg/L	ND	100	ND	100	ND	100
Silver	µg/L	ND	10	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100	ND	100
Tin	µg/L	ND	100	ND	100		210
Zinc	µg/L		820		1000		7200

TABLE A2-19. SS22 - SCRUBBER LIQUOR SUMMARY (continued)

Substance	Units	Condition 3 - waste oil					
		Flag	Run 1	Flag	Run 2	Flag	Run 3
Trace metals - EOR							
Antimony	µg/L	ND	100	ND	100	ND	100
Arsenic	µg/L		140		350		200
Barium	µg/L		57		72		46
Beryllium	µg/L	ND	10	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10	ND	10
Chromium (total)	µg/L		250		660		820
Copper	µg/L		380		620		710
Lead	µg/L		830		2300		2000
Manganese	µg/L		940		1800		1100
Mercury	µg/L		1.1		2.3		2.3
Nickel	µg/L		250		340		420
Phosphorus	µg/L		200		650		810
Selenium	µg/L	ND	100	ND	100	ND	100
Silver	µg/L	ND	10	ND	10	ND	10
Thallium	µg/L		160		140		110
Tin	µg/L	ND	100		450		390
Zinc	µg/L		4200		15000		14000
Miscellaneous - BOR							
Total organic carbon	ppmw		63.3		15.9		15.7
Chlorine	wt. %						
Fluorine	wt. %						
Phosphate	wt. %						
Organic halogens (as chloride)	ppbw	3	56.6	3	43300	11	119000
Inorganic halogens (as chloride)	ppmw		1700		100		280
Hexavalent chromium	ppmw	ND	0.01	ND	0.01	ND	0.01
Miscellaneous - EOR							
Total organic carbon	ppmw		19		41.6		30.3
Chlorine	wt. %						
Fluorine	wt. %						
Phosphate	wt. %						
Organic halogens (as chloride)	ppbw	3	216	3	78900	11	1410
Inorganic halogens (as chloride)	ppmw		1700		5100		4100
Hexavalent chromium	ppmw	ND	0.01	ND	0.01	ND	0.01
Physical characteristics - BOR							
Density	g/cc		0.98		0.98		0.99
pH	–		9		9.6		11.4
Physical characteristics - EOR							
Density	g/cc		0.97		0.99		0.99
pH	–		8.4		7.1		8.2
Ultimate analysis - BOR							
Carbon	wt. %						
Hydrogen	wt. %						
Nitrogen	wt. %						
Total sulfur (as S)	wt. %		0.002		0.001		0.002
Oxygen	wt. %						
Ultimate analysis - EOR							
Carbon	wt. %						
Hydrogen	wt. %						
Nitrogen	wt. %						
Total sulfur (as S)	wt. %		0.002		0.003		0.003
Oxygen	wt. %						

IN = mass flow into system (total mass at end of run less that at beginning).
OUT = mass flow out of system (total mass at end of run greater than at beginning).

TABLE A2-20. SS24 - TDU QUENCH WATER SUMMARY

Substance	Units	Condition 2 - soil			
		Flag	Run 1-BOR	Flag	Run 2-BOR
Total stream flow rate					
	kg/hr		-		-
Polychlorinated biphenyls (PCB)					
Monochlorobiphenyl (total)	µg/L		4.40		0.30
Dichlorobiphenyl (total)	µg/L		150		7.20
Trichlorobiphenyl (total)	µg/L		890		35.00
Tetrachlorobiphenyl (total)	µg/L		1500		53.00
Pentachlorobiphenyl (total)	µg/L		620		22
Hexachlorobiphenyl (total)	µg/L		46	BQL	2.3
Heptachlorobiphenyl (total)	µg/L		8.5	BQL	0.44
Octachlorobiphenyl (total)	µg/L	BQL	2.1	BQL	0.09
Nonachlorobiphenyl (total)	µg/L	BQL	0.23	ND	0.88
Decachlorobiphenyl (total)	µg/L	BQL	0.28	BQL	0.17
Total PCBs (Tri-Deca) including NDs	µg/L	<	3067	<	114
Total PCBs (Mono-Deca) including NDs	µg/L	<	3222	<	121
Total PCBs (Tri-Deca) excluding NDs	µg/L	all detected		>	113
Total PCBs (Mono-Deca) excluding NDs	µg/L	all detected		>	120
Chlorobenzenes and chlorophenols					
1,2-Dichlorobenzene	µg/L	ND	20	ND	0.98
1,3-Dichlorobenzene	µg/L	ND	20	ND	0.98
1,4-Dichlorobenzene	µg/L	ND	20	ND	0.98
Total dichlorobenzenes	µg/L	ND	60	ND	2.94
1,2,3-Trichlorobenzene	µg/L	ND	20	ND	0.98
1,3,5-Trichlorobenzene	µg/L	ND	20	ND	0.98
1,2,4-Trichlorobenzene	µg/L	ND	20	ND	0.98
Total trichlorobenzenes	µg/L	ND	60	ND	2.94
1,2,3,4-Tetrachlorobenzene	µg/L	ND	20	ND	0.98
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	ND	40	ND	2
Total tetrachlorobenzenes	µg/L	ND	60	ND	2.98
Pentachlorobenzene	µg/L	ND	20	BQL	5.1
Hexachlorobenzene	µg/L	ND	20	ALR	530
2,3-Dichlorophenol	µg/L	ND	20	ND	0.98
2,4-Dichlorophenol	µg/L	ND	20	ND	0.98
2,5-Dichlorophenol	µg/L	ND	20	ND	0.98
2,6-Dichlorophenol	µg/L	ND	20	ND	0.98
3,4-Dichlorophenol	µg/L	ND	20	ND	0.98
3,5-Dichlorophenol	µg/L	ND	20	ND	0.98
Total dichlorophenols	µg/L	ND	120	ND	5.88
2,3,4-Trichlorophenol	µg/L	ND	20	ND	19
2,3,5-Trichlorophenol	µg/L	ND	20	ND	19
2,3,6-Trichlorophenol	µg/L	ND	20	ND	19
2,4,5-Trichlorophenol	µg/L	ND	20	ND	19
2,4,6-Trichlorophenol	µg/L	ND	20	ND	19
Total trichlorophenols	µg/L	ND	100	ND	95
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	ND	40	ND	39
2,3,5,6-Tetrachlorophenol	µg/L	ND	20	ND	19
Total tetrachlorophenols	µg/L	ND	60	ND	58
Pentachlorophenol	µg/L	ND	20	ND	19
Total CB	µg/L	ND	220	ND	210
Total CP	µg/L	ND	300	ND	286

TABLE A2-20. SS24 - TDU QUENCH WATER SUMMARY (continued)

Substance	Units	Condition 2 - soil					
		Flag		Run 1-BOR	Flag		Run 2-BOR
Polycyclic aromatic hydrocarbons (PAH)							
Acenaphthene	µg/L	35	BQL	130	35	ND	20
Fluorene	µg/L	35		460	35	ND	20
Phenanthrene	µg/L	35		7400	35	ND	20
Anthracene	µg/L	35		880	35	ND	20
Fluoranthene	µg/L	35		5500	35	ND	20
Pyrene	µg/L	35		7000	35	ND	20
Benz (a) anthracene	µg/L	35		500	35	ND	20
Chrysene	µg/L	35		870	35	ND	20
Benzo (b) fluoranthene	µg/L	35		1100	35	ND	20
Benzo (k) fluoranthene	µg/L	35		390	35	ND	20
Benzo (e) pyrene	µg/L	35		1000	35	ND	20
Benzo (a) pyrene	µg/L	35		1600	35	ND	20
Perylene	µg/L	35		530	35	ND	20
Indeno (1,2,3-cd) pyrene	µg/L	35		860	35	ND	20
Dibenz (a,h) anthracene	µg/L	35	BQL	62	35	ND	20
Benzo (g,h,i) perylene	µg/L	35	BQL	2000	35	ND	20
Naphthalene	µg/L	35		14000	35	BQL	34
2-Methylnaphthalene	µg/L	35	BQL	97	35	ND	20
2-Chloronaphthalene	µg/L	35	ND	20	35	ND	20
Acenaphthlene	µg/L	35		6800	35	ND	20
Total PAHs	µg/L	35	<	51100	35	<	414
Dioxins and furans							
2378-TCDD	ng/L		ND	0.06		ND	0.04
12378-PeCDD	ng/L		ND	0.72			0.11
123478-HxCDD	ng/L			0.49			0.12
123678-HxCDD	ng/L			0.78			0.19
123789-HxCDD	ng/L			1.10			0.22
1234678-HpCDD	ng/L			12.00			3.20
OCDD	ng/L	46		110.00			28.00
2378-TCDF	ng/L			0.10		ND	0.06
12378-PeCDF	ng/L			0.64		ND	0.07
23478-PeCDF	ng/L			2.40		ND	0.07
123478-HxCDF	ng/L		ND	2.00			0.14
123678-HxCDF	ng/L			0.96		ND	0.59
123789-HxCDF	ng/L			0.19		ND	0.03
234678-HxCDF	ng/L			0.56		ND	0.05
1234678-HpCDF	ng/L			5.50			1.30
1234789-HpCDF	ng/L			2.20			0.44
OCDF	ng/L			45.00			10.00
Total TCDD	ng/L			0.84		ND	0.95
Total PeCDD	ng/L			1.90			0.11
Total HxCDD	ng/L			11.00			2.40
Total HpCDD	ng/L			24.00			6.50
Total TCDF	ng/L			23.00			0.53
Total PeCDF	ng/L			19.00			0.31
Total HxCDF	ng/L			11.00			1.00
Total HpCDF	ng/L			9.60			2.60
Total dioxins (by isomer) including NDs	ng/L		<	125.15		<	31.88
Total furans (by isomer) including NDs	ng/L		<	59.55		<	12.75
Total dioxins/furans (by isomer) inc NDs	ng/L		<	184.70		<	44.63
Total dioxins (by isomer) excluding NDs	ng/L		<	1.00		<	1.00
Total furans (by isomer) excluding NDs	ng/L		<	1.00		<	1.00
Total dioxins/furans (by isomer) excluding NDs	ng/L		<	1.00		<	1.00

TABLE A2-20. SS24 - TDU QUENCH WATER SUMMARY (continued)

Substance	Units	Condition 2 - soil			
		Flag	Run 1-BOR	Flag	Run 2-BOR
Volatile organic compounds					
Vinyl chloride	µg/L	ND	100	ND	2
Methyl chloride	µg/L		590	BQL	7
Trans-1,2-dichloroethene	µg/L	ND	100	ND	2
Cis-1,2-dichloroethene	µg/L		780	BQL	4
Chloroform	µg/L	ND	100		15
1,1,1 - Trichloroethane	µg/L	BQL	180	ND	2
Carbon tetrachloride	µg/L	ND	100	ND	2
Benzene	µg/L	BQL	240	ALR	260
1,2 - Dichloroethane	µg/L	ND	100	ND	2
Trichloroethene	µg/L		4200		24
Toluene	µg/L	BQL	450	BQL	3
1,1,2 - Trichloroethane	µg/L	ND	100	ND	2
Tetrachloroethene	µg/L	ND	100	ND	2
1,2 - Dibromoethane	µg/L	ND	100	ND	2
Chlorobenzene	µg/L	ND	100	ND	2
Ethylbenzene	µg/L	BQL	180	ND	2
M-/P-Xylene	µg/L	BQL	280	BQL	6
O-Xylene	µg/L	BQL	180	ND	2
1,3 - Dichlorobenzene	µg/L	ND	100	ND	2
1,4 - Dichlorobenzene	µg/L	ND	100	ND	2
1,2 - Dichlorobenzene	µg/L	ND	100	ND	2
Trace metals					
Antimony	µg/L	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100
Barium	µg/L		250		60
Beryllium	µg/L	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10
Chromium (total)	µg/L		61	ND	10
Copper	µg/L		93		16
Lead	µg/L		270	ND	50
Manganese	µg/L		580		64
Mercury	µg/L		1.5	ND	0.2
Nickel	µg/L		76	ND	10
Phosphorus	µg/L		1100		120
Selenium	µg/L	ND	100	ND	100
Silver	µg/L	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100
Tin	µg/L		1100		130
Zinc	µg/L		750		68
Miscellaneous					
Total organic carbon	ppmw		22.7		5.6
Total sulfur (as S)	wt. %		0.002		0.0001
Ash	wt. %		0.100		0.020
Organic halogens (as chloride)	ppbw	3	1860	3	150
Inorganic halogens (as chloride)	ppmw		76		80
Hexavalent chromium	ppmw	ND	0.01	ND	0.01

TABLE A2-20. SS24 - TDU QUENCH WATER SUMMARY (continued)

Substance	Units	Condition 2 - soil			
		Flag	Run 1-EOR	Flag	Run 2-EOR
Total stream flow rate					
	kg/hr	OUT	2.63	IN	2.69
Polychlorinated biphenyls (PCB)					
Monochlorobiphenyl (total)	µg/L		1.90	BQL	0.04
Dichlorobiphenyl (total)	µg/L		58.00	BQL	0.30
Trichlorobiphenyl (total)	µg/L		370	BQL	1.7
Tetrachlorobiphenyl (total)	µg/L		600	BQL	2.3
Pentachlorobiphenyl (total)	µg/L		270.00	BQL	0.91
Hexachlorobiphenyl (total)	µg/L		23	BQL	0.059
Heptachlorobiphenyl (total)	µg/L	BQL	4.7	ND	7.2
Octachlorobiphenyl (total)	µg/L	BQL	1.3	ND	3.6
Nonachlorobiphenyl (total)	µg/L	BQL	0.25	ND	0.9
Decachlorobiphenyl (total)	µg/L		1.6	ND	0.5
Total PCBs (Tri-Deca) including NDs	µg/L	<	1271	<	17.17
Total PCBs (Mono-Deca) including NDs	µg/L	<	1331	<	17.51
Total PCBs (Tri-Deca) excluding NDs	µg/L	all detected		>	4.97
Total PCBs (Mono-Deca) excluding NDs	µg/L	all detected		>	5.31
Chlorobenzenes and chlorophenols					
1,2-Dichlorobenzene	µg/L	ND	0.98	ND	0.97
1,3-Dichlorobenzene	µg/L	ND	0.98	ND	0.97
1,4-Dichlorobenzene	µg/L	ND	0.98	ND	0.97
Total dichlorobenzenes	µg/L	ND	2.94	ND	2.91
1,2,3-Trichlorobenzene	µg/L	ND	0.98	ND	0.97
1,3,5-Trichlorobenzene	µg/L	ND	0.98	ND	0.97
1,2,4-Trichlorobenzene	µg/L	ND	0.98	ND	0.97
Total trichlorobenzenes	µg/L	ND	2.94	ND	2.91
1,2,3,4-Tetrachlorobenzene	µg/L	ND	0.98	ND	0.97
1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	ND	2	ND	1.9
Total tetrachlorobenzenes	µg/L	ND	2.98	ND	2.87
Pentachlorobenzene	µg/L	BQL	5.1	BQL	1.2
Hexachlorobenzene	µg/L		790		100
2,3-Dichlorophenol	µg/L	ND	0.98	ND	0.97
2,4-Dichlorophenol	µg/L	ND	0.98	ND	0.97
2,5-Dichlorophenol	µg/L	ND	0.98	ND	0.97
2,6-Dichlorophenol	µg/L	ND	0.98	ND	0.97
3,4-Dichlorophenol	µg/L	ND	0.98	ND	0.97
3,5-Dichlorophenol	µg/L	ND	0.98	ND	0.97
Total dichlorophenols	µg/L	ND	5.88	ND	5.82
2,3,4-Trichlorophenol	µg/L	ND	25	ND	20
2,3,5-Trichlorophenol	µg/L	ND	25	ND	20
2,3,6-Trichlorophenol	µg/L	ND	25	ND	20
2,4,5-Trichlorophenol	µg/L	ND	25	ND	20
2,4,6-Trichlorophenol	µg/L	ND	25	ND	20
Total trichlorophenols	µg/L	ND	125	ND	100
2,3,4,5,- and/or 2,3,4,6-Tetrachlorophenol	µg/L	ND	50	ND	40
2,3,5,6-Tetrachlorophenol	µg/L	ND	25	ND	20
Total tetrachlorophenols	µg/L	ND	75	ND	60
Pentachlorophenol	µg/L	ND	25	ND	20
Total CB	µg/L	ND	275	ND	220
Total CP	µg/L	ND	425	ND	340

TABLE A2-20. SS24 - TDU QUENCH WATER SUMMARY (continued)

Substance	Units	Condition 2 - soil					
		Flag		Run 1-EOR	Flag		Run 2-EOR
Polycyclic aromatic hydrocarbons (PAH)							
Acenaphthene	µg/L	35	ND	0.98	35	ND	0.97
Fluorene	µg/L	35	ND	0.98	35	ND	0.97
Phenanthrene	µg/L	35	BQL	3.1	35	BQL	3.4
Anthracene	µg/L	35	ND	0.98	35	ND	0.97
Fluoranthene	µg/L	35	ND	0.98	35	BQL	1.5
Pyrene	µg/L	35	BQL	1.1	35	BQL	2.3
Benz (a) anthracene	µg/L	35	ND	0.98	35	ND	0.97
Chrysene	µg/L	35	ND	0.98	35	ND	0.97
Benzo (b) fluoranthene	µg/L	35	ND	0.98	35	ND	0.97
Benzo (k) fluoranthene	µg/L	35	ND	0.98	35	ND	0.97
Benzo (e) pyrene	µg/L	35	ND	0.98	35	ND	0.97
Benzo (a) pyrene	µg/L	35	ND	0.98	35	ND	0.97
Perylene	µg/L	35	ND	0.98	35	ND	0.97
Indeno (1,2,3-cd) pyrene	µg/L	35	ND	0.98	35	ND	0.97
Dibenz (a,h) anthracene	µg/L	35	ND	0.98	35	ND	0.97
Benzo (g,h,i) perylene	µg/L	35	ND	0.98	35	ND	0.97
Naphthalene	µg/L	35		16	35		28
2-Methylnaphthalene	µg/L	35	ND	0.98	35	ND	0.97
2-Chloronaphthalene	µg/L	35	ND	0.98	35	ND	0.97
Acenaphthlene	µg/L	35	BQL	3	35	BQL	3.1
Total PAHs	µg/L	35	<	38.9	35	<	52.85
Dioxins and furans							
2378-TCDD	ng/L		ND	0.20		ND	0.023
12378-PeCDD	ng/L			1.10		ND	0.030
123478-HxCDD	ng/L			0.720			0.018
123678-HxCDD	ng/L			1.400			0.020
123789-HxCDD	ng/L			2.000			0.034
1234678-HpCDD	ng/L			15.00			0.50
OCDD	ng/L			110.00			6.40
2378-TCDF	ng/L			0.27		ND	0.011
12378-PeCDF	ng/L			0.32		ND	0.03
23478-PeCDF	ng/L			0.80		ND	0.014
123478-HxCDF	ng/L			1.00		ND	0.018
123678-HxCDF	ng/L		ND	4.30		ND	0.43
123789-HxCDF	ng/L		ND	0.24		ND	0.016
234678-HxCDF	ng/L		ND	0.47		ND	0.0087
1234678-HpCDF	ng/L			7.20			0.20
1234789-HpCDF	ng/L			2.90			0.06
OCDF	ng/L			42.00			1.90
Total TCDD	ng/L			0.22		ND	0.51
Total PeCDD	ng/L			3.60		ND	0.42
Total HxCDD	ng/L			19.00			0.28
Total HpCDD	ng/L			24.00			1.10
Total TCDF	ng/L			6.10			0.049
Total PeCDF	ng/L			6.30			0.033
Total HxCDF	ng/L			7.20			0.045
Total HpCDF	ng/L			15.00			0.038
Total dioxins (by isomer) including NDs	ng/L		<	130.42		<	7.03
Total furans (by isomer) including NDs	ng/L			59.50		<	2.69
Total dioxins/furans (by isomer) inc NDs	ng/L		<	189.92		<	9.71
Total dioxins (by isomer) excluding NDs	ng/L		<	1.00		<	1.00
Total furans (by isomer) excluding NDs	ng/L			1.00		<	1.00
Total dioxins/furans (by isomer) excluding NDs	ng/L		<	1.00		<	1.00

TABLE A2-20. SS24 - TDU QUENCH WATER SUMMARY (continued)

Substance	Units	Condition 2 - soil			
		Flag	Run 1-EOR	Flag	Run 2-EOR
Volatile organic compounds					
Vinyl chloride	µg/L	ND	100	ND	100
Methyl chloride	µg/L		780	ND	100
Trans-1,2-dichloroethene	µg/L	ND	100	ND	100
Cis-1,2-dichloroethene	µg/L		590	ND	100
Chloroform	µg/L	BQL	100	ND	100
1,1,1 - Trichloroethane	µg/L	ND	100	ND	100
Carbon tetrachloride	µg/L	ND	100	ND	100
Benzene	µg/L	ND	100		880
1,2 - Dichloroethane	µg/L	ND	100	ND	100
Trichloroethene	µg/L		2300	ND	100
Toluene	µg/L	BQL	420		100
1,1,2 - Trichloroethane	µg/L	ND	100	ND	100
Tetrachloroethene	µg/L	ND	100	ND	100
1,2 - Dibromoethane	µg/L	ND	100	ND	100
Chlorobenzene	µg/L	ND	100	ND	100
Ethylbenzene	µg/L	BQL	120	ND	100
M-/P-Xylene	µg/L	BQL	380	ND	100
O-Xylene	µg/L	BQL	120	ND	100
1,3 - Dichlorobenzene	µg/L	ND	100	ND	100
1,4 - Dichlorobenzene	µg/L	ND	100	ND	100
1,2 - Dichlorobenzene	µg/L	ND	100	ND	100
Trace metals					
Antimony	µg/L	ND	100	ND	100
Arsenic	µg/L	ND	100	ND	100
Barium	µg/L		310		220
Beryllium	µg/L	ND	10	ND	10
Cadmium	µg/L	ND	10	ND	10
Chromium (total)	µg/L		47	ND	10
Copper	µg/L		66	ND	10
Lead	µg/L		250	ND	50
Manganese	µg/L		480	ND	10
Mercury	µg/L		0.25		0.45
Nickel	µg/L		82	ND	10
Phosphorus	µg/L		820	ND	100
Selenium	µg/L	ND	100	ND	100
Silver	µg/L	ND	10	ND	10
Thallium	µg/L	ND	100	ND	100
Tin	µg/L		530		410
Zinc	µg/L		580		28
Miscellaneous					
Total organic carbon	ppmw	54	NA		4.39
Total sulfur (as S)	wt. %		0.001		0.0011
Ash	wt. %		0.070		0.050
Organic halogens (as chloride)	ppbw	54	NA	3	41.1
Inorganic halogens (as chloride)	ppmw		320		340
Hexavalent chromium	ppmw	ND	0.01	ND	0.01

KEY TO ANNOTATED TABLES
(continued)

Footnote Number	Description	Corrective Action
1	Surrogate recoveries for the acid compounds were below quality control limits. This was caused by harsh conditions during the extraction procedure. CP for these samples should be considered estimates.	Flag CP as estimates. Possible low bias.
2	Exhibited low internal standard areas resulting in high surrogate recoveries due to matrix effect; sample was run twice to confirm matrix effect.	Flag VOC results as estimates. Possible high bias.
3	Samples analyzed or extracted out of holding time.	Flag all results as estimates. Results may be low.
4	Analysis not performed due to insufficient sample volume, analytes low on priority list. Field clearance from FW and EPA.	None; delete from completeness objective.
5	Analysis for total halogens (as Cl)	Adjust results sheet.
6	Sample diluted with 1 liter of DI water.	Correct data before reporting.
7	Samples were not spiked with surrogates before extraction.	Flag CB, CP, and PAH data. Accuracy based on internal standard recoveries.
8	Benzene saturation, very low or no internal standards detected. Results calculated from external standard method. Possible loss of all halogenated compounds due to matrix. All data qualitative (tube pairs affected).	Flag all VOC data and omit from any averaging. Results for halogenated compounds may be low.
9	Leaky autosampler caused a system failure. Data lost. Results should be considered qualitative (tube pairs affected).	Flag all VOC data and omit from any averaging.
10	Valve and line contamination from high concentrations in previous samples. Benzene, dichlorobenzene, bromoform initial calibration failure. Results for these compounds are estimates (tube pairs affected).	Flag benzene, dichlorobenzene, bromoform as estimates.
11	Broken tube, no data (tube pairs affected).	Lost VOC data.
12	High 1,2-dichloroethane-d4 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible high bias.
13	High toluene-d8 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible high bias.
14	High 4-bromoflourobenzene surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible high bias.
15	Low 1,2-dichloroethane-d4 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible low bias.
16	Low toluene-d8 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible low bias.
17	Low 4-bromoflourobenzene surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible low bias.
18	Tubes mixed between SS16 and SS14, sampled twice (tube pairs affected).	Lost VOC data.
19	Filter ripped.	Flag particulate results as estimate.
20	Post-test leak rate of 0.075 cfm.	Data for metals and particulate corrected for leak (7.1% of total sample volume).
21	Filters not weighed before digestion.	Lost particulate data. Did not meet completeness objective for particulate.
22	Faulty photomultiplier tube - Hg results questionable.	Flag Hg results.
23	NOx drift beyond control limits, data corrected for drift.	Data corrected for drift.
24	Mislabeled sample prep date, sample run out of holding time	Flag data as estimates. Results may be low.
25	Heating value analysis indicated only 66% propane, which is unreasonable. Heating value for propane from vendor was used instead.	Flag C1-C6 hydrocarbon results.
26	OCDD found in method blanks.	Flag OCDD results. Results may be high.
27	Contains a large peak with a retention time of 24.13 minutes, reported as EMPC for the tetra- and penta-. Naphthalene peak occurs at the same retention time, suggesting that these EMPC are due to naphthalene interference.	Flag penta- and tetra- results. Possible high bias due to interference from naphthalene.
28	The MS/MSD conducted on this matrix resulted in low recoveries for mono- through deca- and low precision for tri- and penta-.	Flag SS12 C3 PCB results. Possible low bias and low precision.
29	The MS/MSD conducted on this matrix resulted in low recoveries for mono-, penta-, and deca-, and low precision for mono-.	Flag SS22 C3 PCB results. Possible low bias and low precision.

KEY TO ANNOTATED TABLES
(continued)

Footnote Number	Description	Corrective Action
30	Did not meet organic halogen precision objective.	Flag SS1 and SS18 organic halogens. Low precision.
31	Did not meet sulfur precision objective.	Flag SS1 and SS18 total sulfur. Low precision.
32	Did not meet hydrogen precision objective.	Flag SS2 hydrogen. Low precision.
33	Did not meet CO2 accuracy or precision objectives.	Flag SS9 and SS14 CO2 results. Accuracy and precision did not meet objectives.
34	MS/MSD for this matrix resulted in low recoveries for acid compounds 4-nitrophenol and pentachlorophenol. Acid surrogate recoveries were also low due to matrix effect. Flag CP as estimates for this matrix.	Flag CP results as estimates for SS1. Possible low bias.
35	This matrix contained high concentrations of phenol and pyrene. MS/MSD recoveries for these two compounds could not be calculated due to relatively low spike level. 4-nitrophenol spike was below detection due to high dilution.	Flag SS11 PAH data. Accuracy and precision not documented.
36	This matrix contained high concentrations of acenaphthene and pyrene. MS/MSD recoveries for these two compounds could not be calculated due to relatively low spike level.	Flag SS12 PAH data. Accuracy and precision not documented.
37	Spiking levels in MS and MSD samples for the condition 1 matrix were too low compared to high concentrations of acenaphthene and pyrene. Percent recoveries for these two compounds could not be calculated. 4-nitrophenol spike was below detection due to high dilution.	Flag SS22 PAH data. Accuracy and precision not documented.
38	High level of benzene saturated column resulting in poor repeatability.	Flag SS11 C3 VOC data. Low precision.
39	Benzene in the MS/MSD and corresponding sample saturated the detector, causing poor repeatability.	Flag SS12 C3 data. Low precision.
40	Metals Train Field Blank contamination.	Flag results. Results may by high due to high background levels.
41	Did not meet PAH SS16 accuracy objective.	Flag SS16 PAH data. Low accuracy.
42	Low internal standards recoveries but surrogate recoveries were acceptable; data are considered good estimate (pairs affected).	Flag VOC data as good estimates.
43	No field blank data; data system fault.	Background levels are unknown; flag VOC data.
44	Benzene saturation and high levels of toluene. Internal standards were suppressed and many compounds were unidentifable. High surragote recoveries due to the suppressed IS.	Flag data as qualitative only. Probable high bias.
45	Internal standards failed to meet minimum area requirements, causing high surrogate recoveries.	Flag VOC data as estimates. Possible high bias.
46	High levels of native OCDD saturated the detector signal. This should be regarded as the minimum possible concentration.	Flag OCDD as minimum amount.
47	Laboratory blank was contaminated from previous sample that eluted through gel-permeation clean-up.	Flag PAH data as high due to contamination.
48	The low surrogate recoveries and corresponding analyte levels were due to the material absorbing to the precipitate that formed in the extract.	Flag PCB data. Possible low bias.
49	Method blank contained detections for tri- and tetra- above 10% of the sample value.	Flag PCB tri and tetra data. Results may be statistically insignificant.
50	Field duplicate yielded low precision due to high concentrations and poor repeatability.	Flag SS3 PCB data. Low precision.
51	Field duplicate yielded low precision due to high levels of native analytes, resulting in poor repeatability.	Flag VOC SS3 data. Low precision.
52	MSD resulted in high pyrene recoveries. This one result did not meet the precision objective.	Flag SS3 PAH data. Low precision and possible high bias for pyrene.
53	Peak response shift due to matrix interference, high saturation, poorly resolved peaks, coeluting interferences.	Flag PCDD/PCDF data as estimates.
54	Sample not analyzed.	Flag data.

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APPENDIX 3
DATA EVALUATION

This appendix provides supporting information for the mass balance and organic destruction efficiency discussion provided in Section 5 of the main report. The information provided in this appendix can be used to:

(1) Compute DE and DREs for PCBs, PCDD/PCDF, HCB, and PCE;
(2) Determine critical streams for PCBs, PCDD/PCDF, HCB, PCE, metals, and major elements;
(3) Compare concentrations of each PCBs, PCDD/PCDF, HCB, and PCE stream on the same basis; and
(4) Compare actual flow rates during the test runs for PCBs, PCDD/PCDF, HCB, and PCE.

For a complete discussion of the methods and assumptions used for the mass balance and destruction efficiency computations, the reader should refer to Section 5 of the main report. The detection limit and composite procedures used to present data in the remainder of this section are summarized below.

DETECTION LIMITS

(1) For the PCBs, PCDD/PCDF, HCB and PCE, detection limits for the input streams were set to zero while the full value of the detection limit was used for the output streams.

(2) For the metals and major elements, the full value of the detection limit was used for both input and output streams.

INTERPOLATING COMPOSITE CONCENTRATIONS TO RUN CONCENTRATIONS

(1) For the PCBs, PCDD/PCDF, HCB and PCE, output stream condition composite concentrations were multiplied by 3 or 2 depending on the number of runs composited to estimate the run concentrations. For the input streams, run concentrations were

assumed to equal the condition composite concentration. The following streams and substances were impacted by the compositing assumptions.

Reactor Grit	SS11: PCDD/PCDF, PCB, HCB, PCE
Scrubber Sludge	SS12: PCDD/PCDF, PCB (Condition 2 and Condition 3 Run 3 only), HCB, PCE
Scrubber Decant Water	SS13: PCDD/PCDF, PCB, HCB, PCE (Condition 3 only)
Reformed Gas Condensate	SS15: PCDD/PCDF, PCB (Condition 3 Run 2 and Condition 3 Run 3 only)

(2) No interpolating procedures were necessary for the metals and major elements.

RESULTS PRESENTATION

Tables A3-1 to A3-12 show the following information for PCBs, PCDD, PCDF, HCB, and PCE in each stream for each condition:

(1) **Percent of detected data.** This column is the ratio of the detected mass to the total mass.

(2) **Flow rates.** This column shows the actual flow rate for the test condition. Since the flow rates are based on the actual process times, they cannot be used to compute DREs and DEs.

(3) **Masses.** This column shows that total mass for each substance for each run. The mass can be used to compute DREs and DEs.

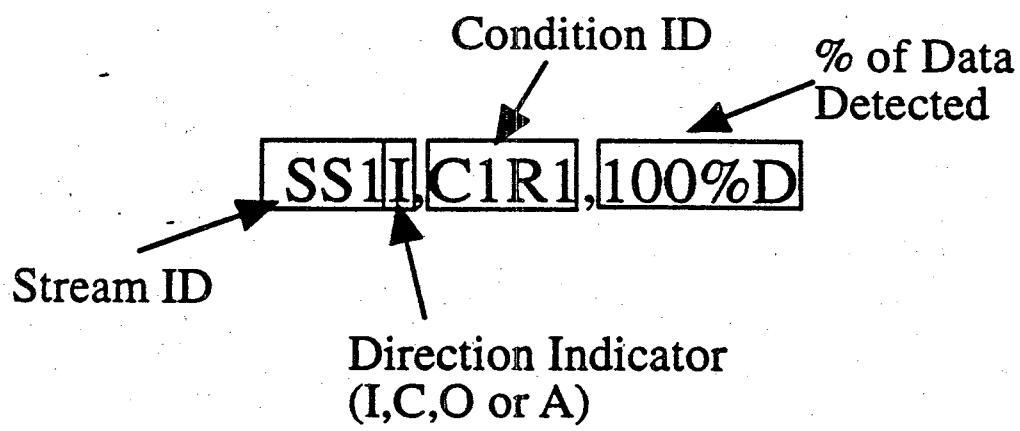
(4) **Concentrations.** This column shows the concentration of each substance for each run on a weight basis. For all streams except the internal streams, the concentrations were calculated by dividing the substance mass by the process mass. For the internal streams, the substance mass accumulated over the run was divided by the average process mass.

(5) **Stream profiles.** This column shows the mass of each substance in each stream normalized by the total input mass of the substance to the ELI reduction process. The profiles for each substance for each condition can be used to identify key output and input streams. For example, for PCBs for Condition 1 Run 1 the waste oil was the main input stream and the main output streams were the reactor grit, scrubber sludge and scrubber decant water. Both the scrubber sludge and decant water PCB levels were below the detection limit.

Partitioning describes the relative amount of a substance in each of the process streams. Figures A3-1 through A3-12 illustrate the partitioning of PCBs, PCDD, PCDF, PCE, HCB, metals, and major elements. These figures show the percentage of a substance in each stream relative to the total mass of that substance entering the system. The streams are listed in the following order:

Input (I)	Substance enters the system boundary during the test.
Contribution (C)	Substance inside the system boundary before the test starts and is depleted during the test.
Accumulation (A)	Substance inside the system boundary before the test starts and accumulates inside the system during the test.
Output (O)	Substance exits the system boundary during the test.

The input and contribution streams are both effectively inputs and the output and accumulation streams are both effectively outputs. The nomenclature included on the y-axis label is described in the following example:



The graphs can be used to determine the critical streams influencing the DRE, DE and mass balance closure calculations. For example, the PCB graph for Condition 1 Run 1 shows that over 0.01 percent of the PCB input to the system exited the system in the reactor grit (SS11). Therefore, the DE is greater than 99.9 percent (100 - 0.01) for Condition 1 Run 1.

TABLE A3-1. CONDITION 1 – POLYCHLORINATED BIPHENYLS

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C1R1	Input	SS1	Waste water	100.00		8.37E-02	5.43E-01	9.72E-01	2.19E-05
		SS2	Waste oil	100.00		4.29E+05	2.48E+06	2.38E+08	1.00E+02
		SS6	Boiler propane	100.00		5.03E-03	3.26E-02	7.50E-01	1.32E-06
		SS7	Reactor hydrogen	100.00		1.70E-04	1.10E-03	7.97E-01	4.44E-08
		SS9	Boiler air	100.00		7.70E-03	4.99E-02	3.27E-02	2.01E-06
	Output	SS11	Reactor grit	100.00		1.31E+02	8.48E+02	9.74E+05	3.42E-02
		SS12	Scrubber sludge	0.09		1.66E+01	1.08E+02	5.37E+03	4.35E-03
		SS13	Scrubber decant water	0.01		5.98E+01	3.88E+02	6.15E+02	1.56E-02
		SS16	Boiler flue gas	58.62		6.60E-02	4.28E-01	2.63E-01	1.73E-05
	Internal	SS18	Heat exchanger residual	76.96	C	1.34E+00	8.68E+00	1.41E+01	3.50E-04
		SS22	Scrubber liquor	0.00	C	2.45E-04	1.59E-03	4.51E-04	6.41E-08
C1R2	Input	SS1	Waste water	100.00		1.73E+00	1.09E+01	1.05E+01	4.68E-04
		SS2	Waste oil	100.00		4.05E+05	2.32E+06	2.38E+08	1.00E+02
		SS6	Boiler propane	100.00		5.71E-03	3.59E-02	7.50E-01	1.55E-06
		SS7	Reactor hydrogen	100.00		9.03E-05	5.68E-04	7.97E-01	2.45E-08
		SS9	Boiler air	100.00		7.25E-03	4.56E-02	3.27E-02	1.96E-06
	Output	SS11	Reactor grit	100.00		4.78E+01	3.00E+02	9.74E+05	1.29E-02
		SS12	Scrubber sludge	8.73		5.65E+00	3.55E+01	1.77E+03	1.53E-03
		SS13	Scrubber decant water	0.01		6.20E+01	3.90E+02	6.15E+02	1.68E-02
		SS16	Boiler flue gas	60.94		9.63E-03	6.05E-02	4.08E-02	2.61E-06
	Internal	SS18	Heat exchanger residual	76.96	C	1.39E+00	8.74E+00	1.41E+01	3.77E-04
		SS22	Scrubber liquor	99.99	A	7.52E-01	4.73E+00	1.34E+00	2.04E-04
C1R3	Input	SS1	Waste water	100.00		4.77E-01	3.63E+00	7.86E+00	1.64E-04
		SS2	Waste oil	100.00		3.78E+05	2.21E+06	2.38E+08	1.00E+02
		SS6	Boiler propane	100.00		6.39E-03	4.87E-02	7.50E-01	2.20E-06
		SS7	Reactor hydrogen	100.00		6.88E-05	5.24E-04	7.97E-01	2.37E-08
		SS9	Boiler air	100.00		7.15E-03	5.44E-02	3.27E-02	2.46E-06
	Output	SS11	Reactor grit	100.00		1.33E+01	1.02E+02	9.74E+05	4.59E-03
		SS12	Scrubber sludge	35.39		4.08E+00	3.11E+01	1.55E+03	1.41E-03
		SS13	Scrubber decant water	0.01		6.02E+01	4.59E+02	6.15E+02	2.07E-02
		SS16	Boiler flue gas	86.97		2.83E-02	2.16E-01	1.22E-01	9.75E-06
	Internal	SS18	Heat exchanger residual	76.96	C	1.32E+00	1.00E+01	1.41E+01	4.53E-04
		SS22	Scrubber liquor	99.99	A	7.52E-01	5.73E+00	1.61E+00	2.59E-04

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.

** DRE and DE are based on mass

Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.

Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-2. CONDITION 2 – POLYCHLORINATED BIPHENYLS

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C2R1	Input	SS3	Waste soil	100.00		2.66E+04	2.51E+05	3.27E+05	9.85E+01
		SS6	Boiler propane	100.00		7.14E-03	4.31E-02	7.50E-01	1.69E-05
		SS7	Reactor hydrogen	100.00		7.43E-05	4.48E-04	7.97E-01	1.76E-07
		SS9	Boiler air	100.00		2.57E-01	1.55E+00	9.92E-01	6.09E-04
	Output	SS10	Treated soil	100.00		1.74E+03	1.64E+04	2.15E+04	6.45E+00
		SS11	Reactor grit	49.56		3.60E-01	2.17E+00	8.71E+03	8.53E-04
		SS12	Scrubber sludge	20.28		7.04E+00	4.25E+01	1.51E+04	1.67E-02
		SS13	Scrubber decant water	0.38		8.19E+00	4.94E+01	9.31E+01	1.94E-02
		SS16	Boiler flue gas	29.29		1.67E-02	1.01E-01	6.02E-02	3.95E-05
	Internal	SS22	Scrubber liquor	98.82	A	3.04E-01	1.84E+00	5.10E-01	7.20E-04
		SS24	Desorber quench water	100.00	C	4.17E+02	3.94E+03	1.87E+03	1.55E+00
C2R2	Input	SS3	Waste soil	100.00		1.25E+04	1.02E+05	5.19E+05	9.98E+01
		SS6	Boiler propane	100.00		1.04E-02	8.58E-02	7.50E-01	8.41E-05
		SS7	Reactor hydrogen	100.00		6.78E-05	5.60E-04	7.97E-01	5.49E-07
		SS9	Boiler air	100.00		3.68E-01	3.05E+00	9.92E-01	2.99E-03
	Output	SS10	Treated soil	100.00		1.26E+02	1.03E+03	4.87E+03	1.01E+00
		SS11	Reactor grit	49.56		3.83E-01	3.16E+00	8.71E+03	3.10E-03
		SS12	Scrubber sludge	20.28		6.59E+00	5.45E+01	1.51E+04	5.34E-02
		SS13	Scrubber decant water	0.38		7.58E+00	6.27E+01	9.31E+01	6.15E-02
		SS16	Boiler flue gas	85.42		3.66E-01	3.02E+00	9.41E-01	2.96E-03
	Internal	SS22	Scrubber liquor	92.09	C	2.94E+00	2.43E+01	6.81E+00	2.38E-02
		SS24	Desorber quench water	99.99	C	2.70E+01	2.20E+02	1.05E+02	2.16E-01

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.

** DRE and DE are based on mass

Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.

Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-3. CONDITION 3 – POLYCHLORINATED BIPHENYLS

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C3R1	Input	SS1	Waste Wwater	100.00		8.75E+00	8.02E+00	3.07E+01	1.62E-04
		SS2	Waste oil	100.00		5.95E+06	4.96E+06	2.54E+08	1.00E+02
		SS6	Boiler propane	100.00		1.30E-02	9.31E-02	7.50E-01	1.88E-06
		SS7	Reactor hydrogen	100.00		5.92E-05	5.42E-05	7.97E-01	1.09E-09
		SS9	Boiler air	100.00		3.03E-02	2.17E-01	7.01E-02	4.39E-06
	Output	SS11	Reactor grit	89.93		9.62E-01	8.82E-01	9.72E+03	1.78E-05
		SS12	Scrubber sludge	5.81		6.49E+01	5.95E+01	1.97E+03	1.20E-03
		SS13	Scrubber decant water	2.99		2.90E+01	2.66E+01	1.23E+02	5.36E-04
		SS15	Tank condensate	0.19		2.49E+00	2.29E+00	1.23E+04	4.61E-05
		SS16	Boiler flue gas	94.90		2.97E-01	2.14E+00	6.61E-01	4.31E-05
	Internal	SS18	Heat exchanger residual	98.81	C	9.74E+00	8.93E+00	1.44E+01	1.80E-04
		SS22	Scrubber liquor	100.00	A	4.68E+00	4.29E+00	1.22E+00	8.66E-05
C3R2	Input	SS1	Waste water	100.00		2.19E-01	6.18E-01	3.53E+00	3.22E-06
		SS2	Waste oil	100.00		7.68E+06	1.92E+07	2.53E+08	1.00E+02
		SS6	Boiler propane	100.00		7.42E-03	9.48E-02	7.50E-01	4.94E-07
		SS7	Reactor hydrogen	100.00		4.36E-05	1.23E-04	7.97E-01	6.40E-10
		SS9	Boiler air	100.00		1.89E-02	2.42E-01	7.01E-02	1.26E-06
	Output	SS11	Reactor grit	89.93		9.86E-01	2.78E+00	9.72E+03	1.45E-05
		SS12	Scrubber sludge	22.26		1.30E+00	3.66E+00	7.29E+01	1.91E-05
		SS13	Scrubber decant water	2.99		4.62E+01	1.30E+02	1.23E+02	6.77E-04
		SS15	Tank condensate	0.06		1.65E+01	4.64E+01	4.26E+04	2.42E-04
		SS16	Boiler flue gas	96.50		5.46E-01	6.98E+00	1.93E+00	3.64E-05
	Internal	SS18	Heat exchanger residual	98.81	C	3.06E+00	8.62E+00	1.44E+01	4.49E-05
		SS22	Scrubber liquor	81.82	A	7.57E+01	2.13E+02	5.93E+01	1.11E-03
C3R3	Input	SS1	Waste water	100.00		1.86E-01	4.82E-01	3.50E+00	3.44E-06
		SS2	Waste oil	100.00		5.84E+06	1.40E+07	2.53E+08	1.00E+02
		SS6	Boiler propane	100.00		8.74E-03	2.06E-01	7.50E-01	1.47E-06
		SS7	Reactor hydrogen	100.00		6.81E-05	1.77E-04	7.97E-01	1.26E-09
		SS9	Boiler air	100.00		2.06E-02	4.86E-01	7.01E-02	3.47E-06
	Output	SS11	Reactor grit	89.93		9.83E-01	2.56E+00	9.72E+03	1.83E-05
		SS12	Scrubber sludge	7.06		2.49E+01	6.48E+01	1.61E+03	4.62E-04
		SS13	Scrubber decant water	2.99		5.48E+01	1.43E+02	1.23E+02	1.02E-03
		SS15	Tank condensate	0.06		3.12E+01	8.12E+01	4.26E+04	5.79E-04
		SS16	Boiler flue gas	38.97		2.10E-02	4.96E-01	6.83E-02	3.54E-06
	Internal	SS18	Heat exchanger residual	98.81	C	4.13E+00	1.07E+01	1.44E+01	7.66E-05
		SS22	Scrubber liquor	100.00	C	1.45E+00	3.77E+00	1.05E+00	2.69E-05

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.

** DRE and DE are based on mass

Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.

Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-4. CONDITION 1 – PERCHLOROETHYLENE

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C1R1	Input	SS1	Waste water	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2	Waste oil	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2 SPIKE	PCE spike	100.00		3.90E+05	2.25E+06	1.00E+09	1.00E+02
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		1.89E-01	1.23E+00	8.02E-01	5.44E-05
	Output	SS11	Reactor grit	0.00		8.70E-04	5.64E-03	6.48E+00	2.50E-07
		SS12	Scrubber sludge	0.00		3.68E-02	2.39E-01	1.19E+01	1.06E-05
		SS13	Scrubber decant water	0.00		9.82E+00	6.37E+01	1.01E+02	2.82E-03
		SS16	Boiler flue gas	100.00		9.28E-01	6.02E+00	3.69E+00	2.67E-04
	Internal	SS18	Heat exchanger residual	0.00	A	0.00E+00	0.00E+00	NA	0.00E+00
		SS22	Scrubber liquor	0.00	C	1.17E-05	7.55E-05	2.14E-05	3.35E-09
C1R2	Input	SS1	Waste water	100.00		3.37E-01	2.12E+00	2.04E+00	9.47E-05
		SS2	Waste oil	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2 SPIKE	PCE spike	100.00		3.90E+05	2.24E+06	1.00E+09	1.00E+02
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		1.78E-01	1.12E+00	8.02E-01	5.00E-05
	Output	SS11	Reactor grit	0.00		3.18E-04	2.00E-03	6.48E+00	8.94E-08
		SS12	Scrubber sludge	0.00		4.01E-02	2.52E-01	1.25E+01	1.13E-05
		SS13	Scrubber decant water	0.00		4.07E+00	2.56E+01	4.04E+01	1.15E-03
		SS16	Boiler flue gas	100.00		3.40E-01	2.13E+00	1.44E+00	9.55E-05
	Internal	SS18	Heat exchanger residual	50.00	A	0.00E+00	0.00E+00	NA	0.00E+00
		SS22	Scrubber liquor	0.00	A	3.92E-06	2.46E-05	6.97E-06	1.10E-09
C1R3	Input	SS1	Waste water	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2	Waste oil	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2 SPIKE	PCE spike	100.00		3.81E+05	2.23E+06	1.00E+09	1.00E+02
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		1.75E-01	1.34E+00	8.02E-01	6.00E-05
	Output	SS11	Reactor grit	0.00		8.88E-05	6.76E-04	6.48E+00	3.04E-08
		SS12	Scrubber sludge	0.00		3.66E-02	2.79E-01	1.39E+01	1.25E-05
		SS13	Scrubber decant water	0.00		1.98E+01	1.51E+02	2.02E+02	6.77E-03
		SS16	Boiler flue gas	100.00		6.18E-01	4.71E+00	2.65E+00	2.11E-04
	Internal	SS18	Heat exchanger residual	0.00	A	0.00E+00	0.00E+00	NA	0.00E+00
		SS22	Scrubber liquor	0.00	A	3.92E-06	2.98E-05	8.37E-06	1.34E-09

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.

** DRE and DE are based on mass

Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.

Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-5. CONDITION 2 – HEXACHLOROBENZENE

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C2R1	Input	SS3	Waste soil	100.00		3.42E+02	3.24E+03	4.22E+03	3.40E-02
		SS3 SPIKE	HCB spike	100.00		1.01E+06	9.53E+06	1.00E+09	1.00E+02
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		1.42E-01	8.56E-01	5.47E-01	8.99E-06
	Output	SS10	Treated soil	100.00		2.80E+05	2.65E+06	3.46E+06	2.78E+01
		SS11	Reactor grit	100.00		2.54E-01	1.53E+00	6.14E+03	1.61E-05
		SS12	Scrubber sludge	100.00		7.72E+00	4.66E+01	1.66E+04	4.89E-04
		SS13	Scrubber decant water	0.00		3.56E+00	2.15E+01	4.04E+01	2.25E-04
		SS16	Boiler flue gas	100.00		1.28E-01	7.69E-01	4.60E-01	8.08E-06
	Internal	SS22	Scrubber liquor	0.00	C	6.06E-01	3.66E+00	1.02E+00	3.84E-05
		SS24	Desorber quench water	50.00	A	6.22E+02	5.87E+03	2.78E+03	6.16E-02
C2R2	Input	SS3	Waste soil	100.00		2.28E+02	1.86E+03	9.49E+03	3.85E-02
		SS3 SPIKE	HCB spike	100.00		5.92E+05	4.83E+06	1.00E+09	9.99E+01
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		2.03E-01	1.68E+00	5.47E-01	3.48E-05
	Output	SS10	Treated soil	0.00		8.55E-01	6.97E+00	3.30E+01	1.44E-04
		SS11	Reactor grit	100.00		2.69E-01	2.23E+00	6.14E+03	4.61E-05
		SS12	Scrubber sludge	100.00		7.22E+00	5.97E+01	1.66E+04	1.24E-03
		SS13	Scrubber decant water	0.00		3.29E+00	2.72E+01	4.04E+01	5.63E-04
		SS16	Boiler flue gas	0.00		1.68E-01	1.39E+00	4.32E-01	2.88E-05
	Internal	SS22	Scrubber liquor	0.00	A	1.93E-04	1.60E-03	4.48E-04	3.31E-08
		SS24	Desorber quench water	100.00	C	1.79E+02	1.46E+03	6.99E+02	3.02E-02

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.

** DRE and DE are based on mass

Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.

Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-6. CONDITION 3 – PERCHLOETHYLENE

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C3R1	Input	SS1	Waste water	100.00		2.64E+00	2.42E+00	9.26E+00	3.72E-04
		SS2	Waste oil	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2 SPIKE	PCE spike	100.00		7.78E+05	6.49E+05	1.00E+09	1.00E+02
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		3.92E-01	2.82E+00	9.08E-01	4.34E-04
	Output	SS11	Reactor grit	0.00		5.82E-03	5.33E-03	5.88E+01	8.22E-07
		SS12	Scrubber sludge	0.00		1.04E-01	9.54E-02	3.17E+00	1.47E-05
		SS13	Scrubber decant water	100.00		2.86E+00	2.62E+00	1.21E+01	4.04E-04
		SS15	Tank condensate	100.00		1.62E+00	1.49E+00	8.00E+03	2.29E-04
		SS16	Boiler flue gas	100.00		5.79E-01	4.16E+00	1.29E+00	6.42E-04
	Internal	SS18	Heat exchanger residual	50.00	C	1.57E+00	1.44E+00	2.33E+00	2.22E-04
		SS22	Scrubber liquor	0.00	A	2.00E-05	1.83E-05	5.19E-06	2.82E-09
C3R2	Input	SS1	Waste water	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2	Waste oil	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2 SPIKE	PCE spike	100.00		7.84E+05	1.96E+06	1.00E+09	1.00E+02
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		2.45E-01	3.13E+00	9.08E-01	1.60E-04
	Output	SS11	Reactor grit	0.00		5.97E-03	1.68E-02	5.88E+01	8.57E-07
		SS12	Scrubber sludge	0.00		2.83E-02	7.96E-02	1.58E+00	4.06E-06
		SS13	Scrubber decant water	100.00		4.55E+00	1.28E+01	1.21E+01	6.53E-04
		SS15	Tank condensate	100.00		6.19E+00	1.74E+01	1.60E+04	8.89E-04
		SS16	Boiler flue gas	100.00		9.56E-01	1.22E+01	3.39E+00	6.24E-04
	Internal	SS18	Heat exchanger residual	50.00	C	4.94E-01	1.39E+00	2.33E+00	7.09E-05
		SS22	Scrubber liquor	0.00	C	6.38E-06	1.80E-05	4.99E-06	9.17E-10
C3R3	Input	SS1	Waste water	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2	Waste oil	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS2 SPIKE	PCE spike	100.00		7.94E+05	1.91E+06	1.00E+09	1.00E+02
		SS6	Boiler propane	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS7	Reactor hydrogen	0.00		0.00E+00	0.00E+00	NA	0.00E+00
		SS9	Boiler air	100.00		2.67E-01	6.30E+00	9.08E-01	3.31E-04
	Output	SS11	Reactor grit	0.00		5.95E-03	1.55E-02	5.88E+01	8.12E-07
		SS12	Scrubber sludge	0.00		3.67E-02	9.55E-02	2.38E+00	5.01E-06
		SS13	Scrubber decant water	100.00		5.40E+00	1.40E+01	1.21E+01	7.37E-04
		SS15	Tank condensate	100.00		1.17E+01	3.05E+01	1.60E+04	1.60E-03
		SS16	Boiler flue gas	100.00		1.43E+00	3.38E+01	4.66E+00	1.77E-03
	Internal	SS18	Heat exchanger residual	50.00	C	6.66E-01	1.73E+00	2.33E+00	9.09E-05
		SS22	Scrubber liquor	100.00	C	1.82E+01	4.72E+01	1.31E+01	2.48E-03

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.

** DRE and DE are based on mass

Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.

Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-7. CONDITION 1 -- DIOXINS

Condition	Site Type	ID	Description	Detected (%)		Actual rate (mg/hr)	Mass** (mg)	Concentration * (ppb wt)	Profile (%)
C1R1	Input	SS1	Waste water	100.00		1.31E-05	8.51E-05	1.52E-04	4.50E-02
		SS2	Waste oil	100.00		3.26E-02	1.89E-01	1.81E+01	9.99E+01
	Output	SS11	Reactor grit	23.57		3.95E-06	2.56E-05	2.94E-02	1.35E-02
		SS12	Scrubber sludge	80.01		7.82E-03	5.07E-02	2.52E+00	2.68E+01
		SS13	Scrubber decant water	4.50		3.73E-04	2.42E-03	3.84E-03	1.28E+00
		SS16	Boiler flue gas	100.00		1.79E-04	1.16E-03	7.14E-04	6.16E-01
	Internal	SS18	Heat exchanger residual	100.00	C	2.35E-05	1.52E-04	2.47E-04	8.06E-02
		SS22	Scrubber liquor	100.00	A	1.35E-04	8.76E-04	2.48E-04	4.63E-01
C1R2	Input	SS1	Waste water	100.00		1.17E-04	7.33E-04	7.07E-04	4.14E-01
		SS2	Waste oil	100.00		3.08E-02	1.76E-01	1.81E+01	9.95E+01
	Output	SS11	Reactor grit	23.57		1.44E-06	9.07E-06	2.94E-02	5.11E-03
		SS12	Scrubber sludge	80.01		8.52E-03	5.35E-02	2.66E+00	3.02E+01
		SS13	Scrubber eecant water	4.50		3.87E-04	2.43E-03	3.84E-03	1.37E+00
		SS16	Boiler flue gas	91.63		3.63E-05	2.28E-04	1.53E-04	1.28E-01
	Internal	SS18	Heat exchanger residual	100.00	C	2.44E-05	1.54E-04	2.47E-04	8.66E-02
		SS22	Scrubber liquor	33.43	A	1.56E-05	9.81E-05	2.78E-05	5.53E-02
C1R3	Input	SS1	Waste water	100.00		4.13E-05	3.15E-04	6.80E-04	1.86E-01
		SS2	Waste oil	100.00		2.88E-02	1.68E-01	1.81E+01	9.97E+01
	Output	SS11	Reactor grit	23.57		4.03E-07	3.07E-06	2.94E-02	1.82E-03
		SS12	Scrubber sludge	80.01		7.77E-03	5.92E-02	2.95E+00	3.51E+01
		SS13	Scrubber decant water	4.50		3.76E-04	2.86E-03	3.84E-03	1.70E+00
		SS16	Boiler flue gas	97.85		2.33E-05	1.78E-04	1.00E-04	1.05E-01
	Internal	SS18	Heat exchanger residual	100.00	C	2.31E-05	1.76E-04	2.47E-04	1.04E-01
		SS22	Scrubber liquor	33.43	A	1.56E-05	1.19E-04	3.34E-05	7.05E-02

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.
** DRE and DE are based on mass
Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.
Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-8. CONDITION 2 -- DIOXINS

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C2R1	Input	SS3	Waste soil	100.00		4.06E-01	3.84E+00	5.01E+00	6.79E-01
		SS3 SPIKE	HCB spike	100.00		5.94E+01	5.61E+02	5.89E+04	9.93E+01
	Output	SS10	Treated soil	100.00		3.43E+01	3.24E+02	4.23E+02	5.73E+01
		SS11	Reactor grit	100.00		4.79E-05	2.89E-04	1.16E+00	5.11E-05
		SS12	Scrubber sludge	100.00		1.26E-01	7.60E-01	2.70E+02	1.35E-01
		SS13	Scrubber decant water	8.01		4.86E-04	2.93E-03	5.52E-03	5.19E-04
		SS16	Boiler flue gas	97.83		5.09E-05	3.07E-04	1.84E-04	5.44E-05
	Internal	SS22	Scrubber liquor	100.00	A	7.11E-04	4.29E-03	1.19E-03	7.59E-04
		SS24	Desorber quench water	100.00	A	2.28E-03	2.15E-02	1.02E-02	3.81E-03
C2R2	Input	SS3	Waste soil	100.00		4.29E-02	3.49E-01	1.78E+00	1.23E-01
		SS3 SPIKE	HCB spike	100.00		3.49E+01	2.84E+02	5.89E+04	9.99E+01
	Output	SS10	Treated soil	100.00		7.04E-02	5.73E-01	2.72E+00	2.01E-01
		SS11	Reactor grit	100.00		5.08E-05	4.20E-04	1.16E+00	1.48E-04
		SS12	Scrubber sludge	100.00		1.18E-01	9.74E-01	2.70E+02	3.42E-01
		SS13	Scrubber decant water	8.01		4.50E-04	3.72E-03	5.52E-03	1.31E-03
		SS16	Boiler flue gas	96.25		2.93E-05	2.42E-04	7.53E-05	8.51E-05
	Internal	SS22	Scrubber liquor	49.49	C	1.01E-05	8.34E-05	2.34E-05	2.93E-05
		SS24	Desorber quench water	98.51	C	7.61E-03	6.20E-02	2.97E-02	2.18E-02

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.
** DRE and DE are based on mass
Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.
Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-9. CONDITION 3 – DIOXINS

Condition	Site			Detected		Rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C3R1	Input	SS1	Waste water	100.00		1.20E-03	1.10E-03	4.21E-03	3.30E-01
		SS2	Waste oil	100.00		3.97E-01	3.31E-01	1.70E+01	9.96E+01
	Output	SS11	Reactor grit	7.43		1.61E-04	1.47E-04	1.62E+00	4.43E-02
		SS12	Scrubber sludge	77.26		2.29E-02	2.10E-02	6.96E-01	6.31E+00
		SS13	Scrubber decant water	44.44		1.24E-04	1.14E-04	5.26E-04	3.42E-02
		SS15	Tank condensate	4.45		6.56E-06	6.02E-06	3.24E-02	1.81E-03
		SS16	Boiler flue gas	100.00		3.50E-05	2.51E-04	7.78E-05	7.56E-02
	Internal	SS18	Heat exchanger residual	100.00	C	3.55E-04	3.26E-04	5.27E-04	9.80E-02
		SS22	Scrubber liquor	100.00	A	1.48E-02	1.36E-02	3.85E-03	4.09E+00
C3R2	Input	SS1	Waste water	100.00		6.18E-06	1.74E-05	9.94E-05	1.36E-03
		SS2	Waste oil	100.00		5.13E-01	1.28E+00	1.69E+01	1.00E+02
	Output	SS11	Reactor grit	7.43		1.65E-04	4.64E-04	1.62E+00	3.62E-02
		SS12	Scrubber sludge	77.26		6.21E-03	1.75E-02	3.48E-01	1.37E+00
		SS13	Scrubber decant water	44.44		1.97E-04	5.55E-04	5.26E-04	4.33E-02
		SS15	Tank condensate	4.45		1.25E-05	3.52E-05	3.24E-02	2.75E-03
		SS16	Boiler flue gas	96.99		3.10E-05	3.96E-04	1.10E-04	3.09E-02
	Internal	SS18	Heat exchanger residual	100.00	C	1.12E-04	3.14E-04	5.27E-04	2.45E-02
		SS22	Scrubber liquor	67.43	A	7.47E-04	2.10E-03	5.85E-04	1.64E-01
C3R3	Input	SS1	Waste water	100.00		7.92E-06	2.06E-05	1.49E-04	2.18E-03
		SS2	Waste oil	100.00		3.90E-01	9.35E-01	1.69E+01	9.88E+01
	Output	SS11	Reactor grit	7.43		1.64E-04	4.27E-04	1.62E+00	4.51E-02
		SS12	Scrubber sludge	77.26		8.07E-03	2.10E-02	5.22E-01	2.22E+00
		SS13	Scrubber decant water	44.44		2.34E-04	6.09E-04	5.26E-04	6.43E-02
		SS15	Tank condensate	4.45		2.37E-05	6.16E-05	3.24E-02	6.51E-03
		SS16	Boiler flue gas	97.56		2.24E-05	5.28E-04	7.28E-05	5.58E-02
	Internal	SS18	Heat exchanger residual	100.00	C	1.51E-04	3.92E-04	5.27E-04	4.14E-02
		SS22	Scrubber liquor	100.00	C	4.04E-03	1.05E-02	2.92E-03	1.11E+00

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.
** DRE and DE are based on mass
Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.
Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-10. CONDITION 1 – FURANS

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C1R1	Input	SS1	Waste water	100.00		7.56E-06	4.90E-05	8.77E-05	2.64E-04
		SS2	Waste oil	100.00		3.21E+00	1.86E+01	1.78E+03	1.00E+02
	Output	SS11	Reactor grit	100.00		4.32E-05	2.80E-04	3.22E-01	1.51E-03
		SS12	Scrubber sludge	75.88		1.45E-03	9.41E-03	4.68E-01	5.07E-02
		SS13	Scrubber decant water	5.07		3.95E-04	2.56E-03	4.07E-03	1.38E-02
		SS16	Boiler flue gas	100.00		2.02E-04	1.31E-03	8.05E-04	7.07E-03
	Internal	SS18	Heat exchanger residual	100.00	C	2.58E-05	1.67E-04	2.71E-04	8.99E-04
		SS22	Scrubber liquor	100.00	C	3.37E-05	2.19E-04	6.20E-05	1.18E-03
C1R2	Input	SS1	Waste water	100.00		9.84E-05	6.18E-04	5.96E-04	3.56E-03
		SS2	Waste oil	100.00		3.03E+00	1.74E+01	1.78E+03	1.00E+02
	Output	SS11	Reactor grit	100.00		1.58E-05	9.92E-05	3.22E-01	5.72E-04
		SS12	Scrubber sludge	75.88		1.58E-03	9.93E-03	4.94E-01	5.72E-02
		SS13	Scrubber decant water	5.07		4.10E-04	2.58E-03	4.07E-03	1.48E-02
		SS16	Boiler flue gas	100.00		1.33E-05	8.34E-05	5.62E-05	4.80E-04
	Internal	SS18	Heat exchanger residual	100.00	C	2.68E-05	1.68E-04	2.71E-04	9.69E-04
		SS22	Scrubber liquor	58.73	A	1.20E-04	7.55E-04	2.14E-04	4.35E-03
C1R3	Input	SS1	Waste water	100.00		1.35E-05	1.03E-04	2.22E-04	6.22E-04
		SS2	Waste oil	100.00		2.83E+00	1.66E+01	1.78E+03	1.00E+02
	Output	SS11	Reactor grit	100.00		4.41E-06	3.36E-05	3.22E-01	2.03E-04
		SS12	Scrubber sludge	75.88		1.44E-03	1.10E-02	5.46E-01	6.63E-02
		SS13	Scrubber decant water	5.07		3.98E-04	3.03E-03	4.07E-03	1.83E-02
		SS16	Boiler flue gas	33.31		8.37E-07	6.38E-06	3.60E-06	3.85E-05
	Internal	SS18	Heat exchanger residual	100.00	C	2.53E-05	1.93E-04	2.71E-04	1.17E-03
		SS22	Scrubber liquor	58.73	A	1.20E-04	9.16E-04	2.57E-04	5.53E-03

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.
** DRE and DE are based on mass
Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.
Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-11. CONDITION 2 -- FURANS

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C2R1	Input	SS3	Waste soil	100.00		7.68E-01	7.26E+00	9.47E+00	3.59E+00
		SS3 SPIKE	HCB spike	100.00		2.06E+01	1.95E+02	2.04E+04	9.64E+01
	Ouput	SS10	Treated soil	100.00		9.57E+00	9.05E+01	1.18E+02	4.48E+01
		SS11	Reactor grit	100.00		1.18E-04	7.12E-04	2.86E+00	3.53E-04
		SS12	Scrubber sludge	100.00		2.02E-01	1.22E+00	4.32E+02	6.02E-01
		SS13	Scrubber decant water	6.35		4.14E-04	2.50E-03	4.71E-03	1.24E-03
		SS16	Boiler flue gas	100.00		3.51E-05	2.11E-04	1.26E-04	1.05E-04
	Internal	SS22	Scrubber liquor	100.00	C	1.39E-03	8.37E-03	2.33E-03	4.15E-03
		SS24	Desorber quench water	100.00	C	6.75E-03	6.38E-02	3.02E-02	3.16E-02
C2R2	Input	SS3	Waste soil	100.00		1.87E-01	1.52E+00	7.76E+00	1.52E+00
		SS3 SPIKE	HCB spike	100.00		1.21E+01	9.86E+01	2.04E+04	9.85E+01
	Output	SS10	Treated soil	100.00		3.92E-02	3.19E-01	1.51E+00	3.19E-01
		SS11	Reactor grit	100.00		1.25E-04	1.04E-03	2.86E+00	1.03E-03
		SS12	Scrubber sludge	100.00		1.89E-01	1.56E+00	4.32E+02	1.56E+00
		SS13	Scrubber decant water	6.35		3.84E-04	3.17E-03	4.71E-03	3.17E-03
		SS16	Boiler flue gas	58.82		6.23E-06	5.15E-05	1.60E-05	5.14E-05
	Internal	SS22	Scrubber liquor	100.00	C	8.92E-05	7.38E-04	2.07E-04	7.37E-04
		SS24	Desorber quench water	100.00	C	3.13E-03	2.55E-02	1.22E-02	2.54E-02

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.
** DRE and DE are based on mass
Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.
Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

TABLE A3-12. CONDITION 3 – FURANS

Condition	Site			Detected		Actual rate	Mass**	Concentration *	Profile
	Type	ID	Description	(%)		(mg/hr)	(mg)	(ppb wt)	(%)
C3R1	Input	SS1	Waste water	100.00		5.27E-04	4.83E-04	1.85E-03	1.23E-03
		SS2	Waste oil	100.00		4.73E+01	3.94E+01	2.02E+03	1.00E+02
	Output	SS11	Reactor grit	0.64		3.65E-04	3.35E-04	3.69E+00	8.49E-04
		SS12	Scrubber sludge	100.00		1.77E-02	1.63E-02	5.40E-01	4.13E-02
		SS13	Scrubber decant water	0.00		4.49E-04	4.11E-04	1.90E-03	1.04E-03
		SS15	Tank condensate	0.00		5.06E-06	4.64E-06	2.49E-02	1.18E-05
		SS16	Boiler flue gas	100.00		2.06E-05	1.48E-04	4.57E-05	3.75E-04
	Internal	SS18	Heat exchanger residual	100.00	A	6.15E-04	5.64E-04	9.12E-04	1.43E-03
		SS22	Scrubber liquor	100.00	A	1.56E-02	1.43E-02	4.05E-03	3.63E-02
C3R2	Input	SS1	Waste water	100.00		7.48E-07	2.11E-06	1.20E-05	1.38E-06
		SS2	Waste oil	100.00		6.11E+01	1.53E+02	2.01E+03	1.00E+02
	Output	SS11	Reactor grit	0.64		3.74E-04	1.05E-03	3.69E+00	6.91E-04
		SS12	Scrubber sludge	100.00		4.82E-03	1.36E-02	2.70E-01	8.89E-03
		SS13	Scrubber decant water	0.00		7.14E-04	2.01E-03	1.90E-03	1.32E-03
		SS15	Tank condensate	0.00		9.63E-06	2.71E-05	2.49E-02	1.78E-05
		SS16	Boiler flue gas	100.00		5.74E-05	7.34E-04	2.03E-04	4.81E-04
	Internal	SS18	Heat exchanger residual	100.00	A	1.93E-04	5.44E-04	9.12E-04	3.56E-04
		SS22	Scrubber liquor	100.00	C	2.56E-03	7.21E-03	2.00E-03	4.73E-03
C3R3	Input	SS1	Waste water	100.00		1.39E-06	3.62E-06	2.63E-05	3.25E-06
		SS2	Waste oil	100.00		4.64E+01	1.11E+02	2.01E+03	1.00E+02
	Output	SS11	Reactor grit	0.64		3.73E-04	9.71E-04	3.69E+00	8.71E-04
		SS12	Scrubber sludge	100.00		6.26E-03	1.63E-02	4.05E-01	1.46E-02
		SS13	Scrubber decant water	0.00		8.48E-04	2.20E-03	1.90E-03	1.98E-03
		SS15	Tank condensate	0.00		1.83E-05	4.75E-05	2.49E-02	4.26E-05
		SS16	Boiler flue gas	52.38		3.44E-06	8.12E-05	1.12E-05	7.29E-05
	Internal	SS18	Heat exchanger residual	100.00	A	2.61E-04	6.78E-04	9.12E-04	6.08E-04
		SS22	Scrubber liquor	100.00	C	4.61E-03	1.20E-02	3.33E-03	1.08E-02

* Concentration for internal streams expressed as total accumulation divided by average process mass for run.

** DRE and DE are based on mass

Contribution (C) = Substance inside the system boundary before the test starts and is depleted during the test.

Accumulation (A) = Substance inside the system boundary before the test starts and accumulates inside the system during the test.

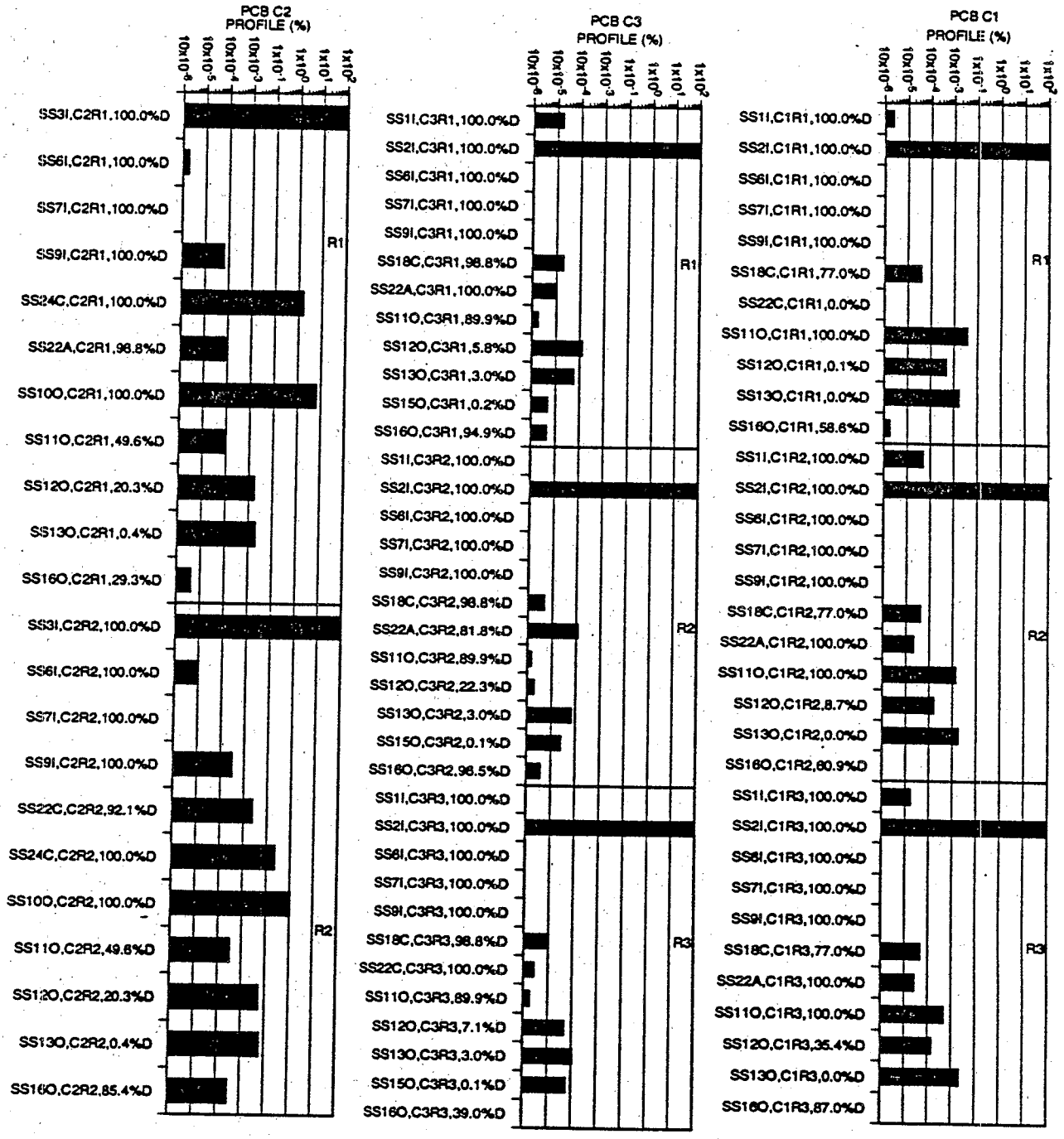


Figure A3-1. Partitioning of PCBs.

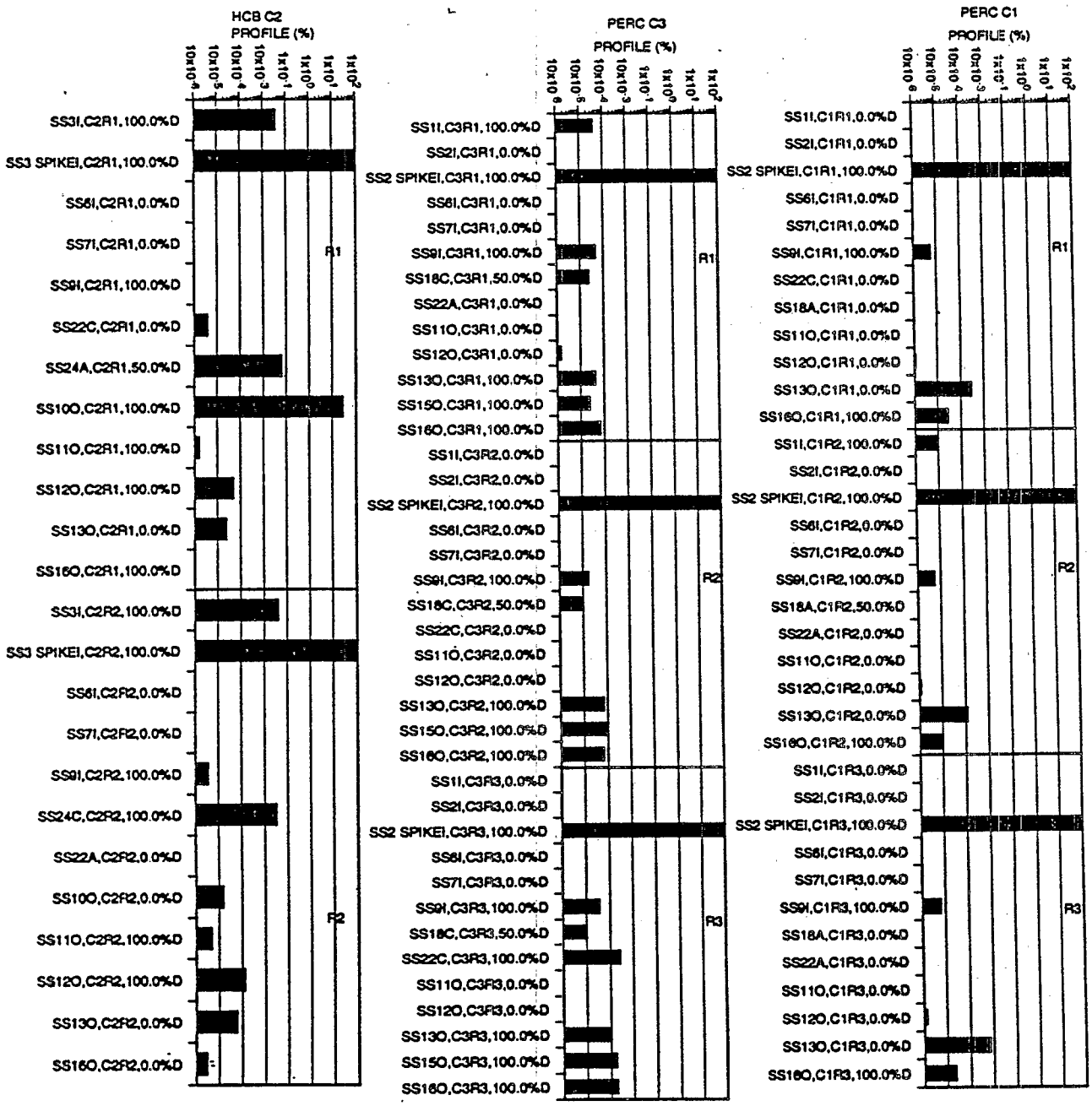


Figure A3-2. Partitioning of PCE and HCB.

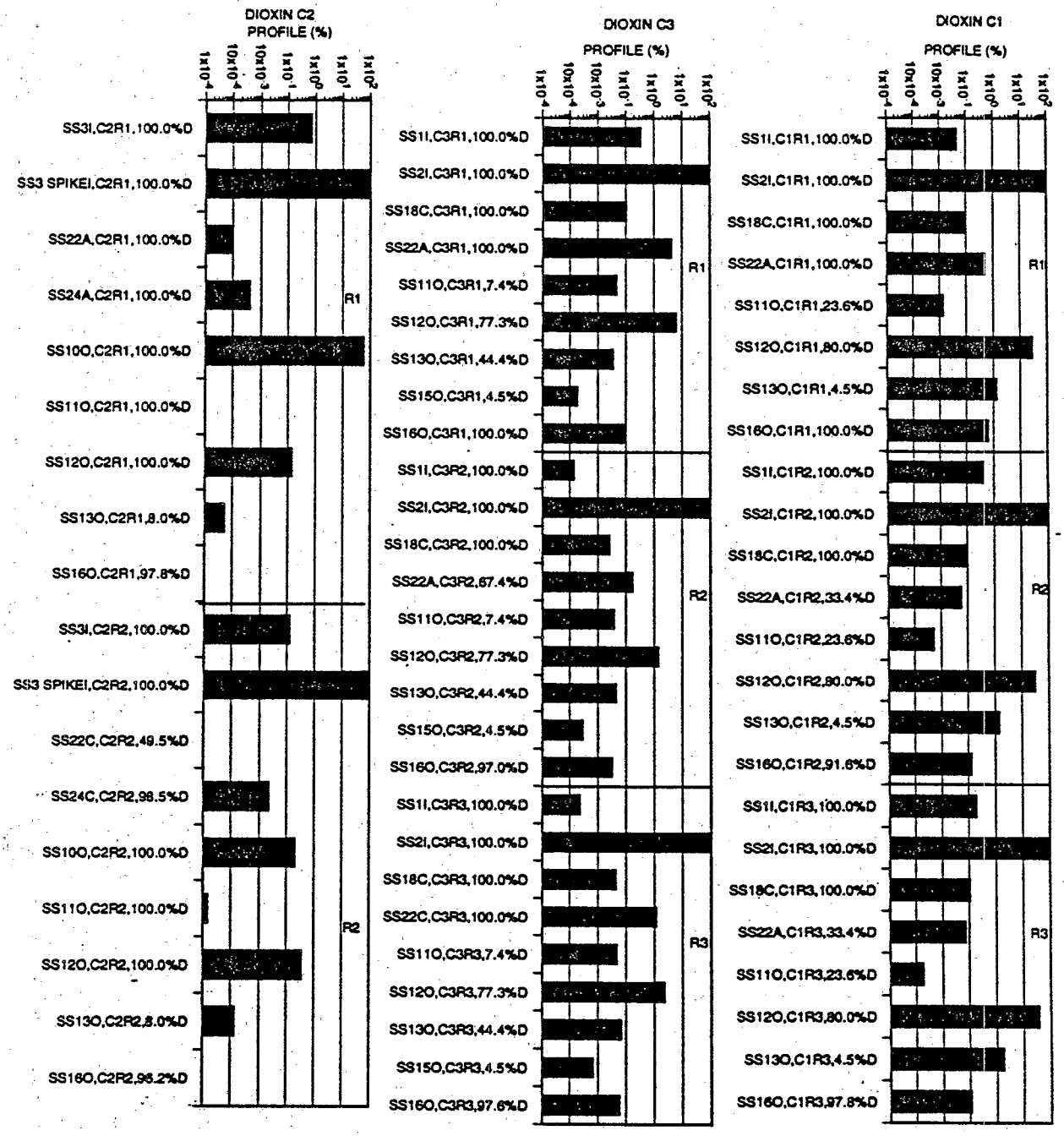


Figure A3-3. Partitioning of dioxins.

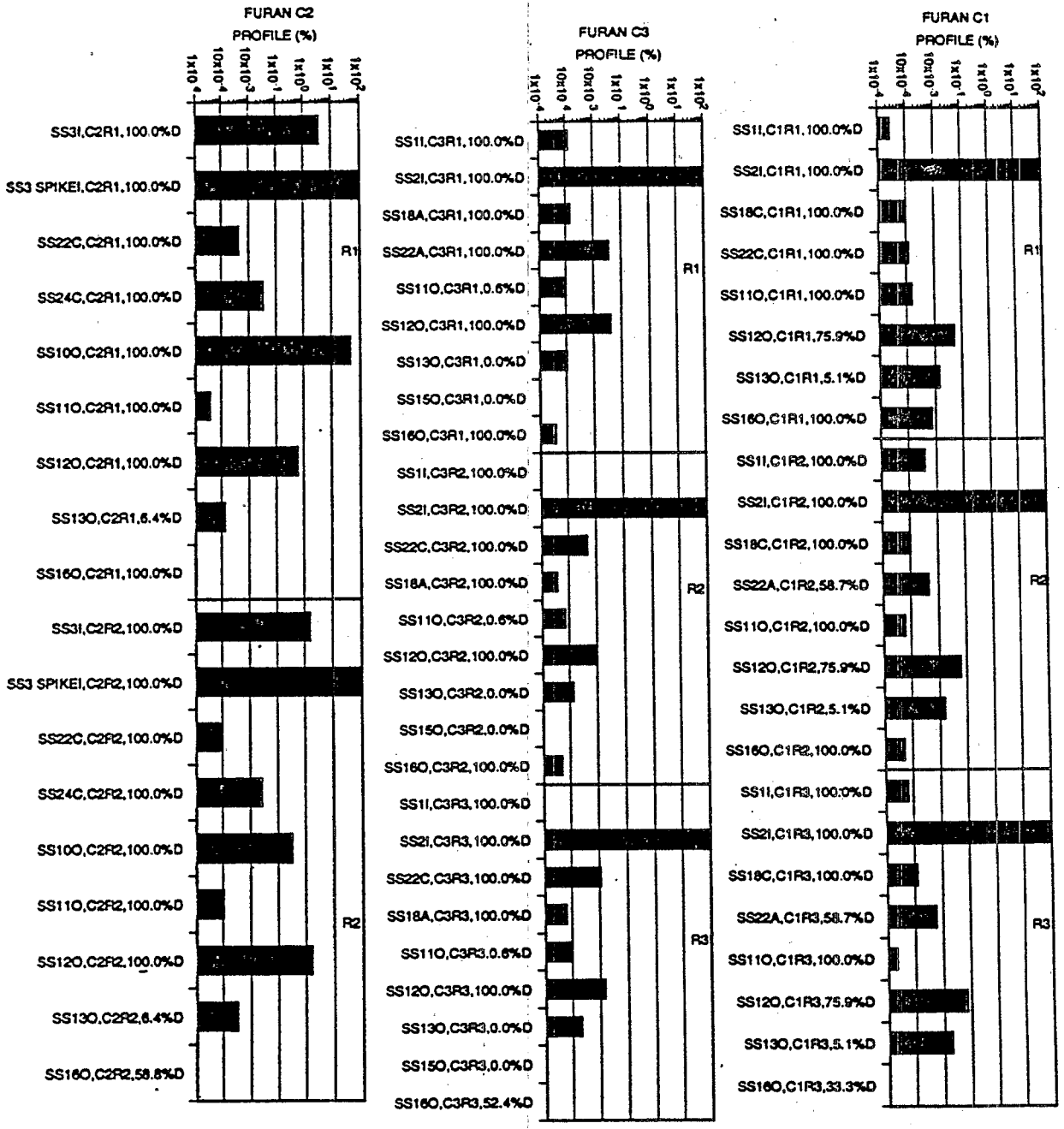


Figure A3-4. Partitioning of furans.

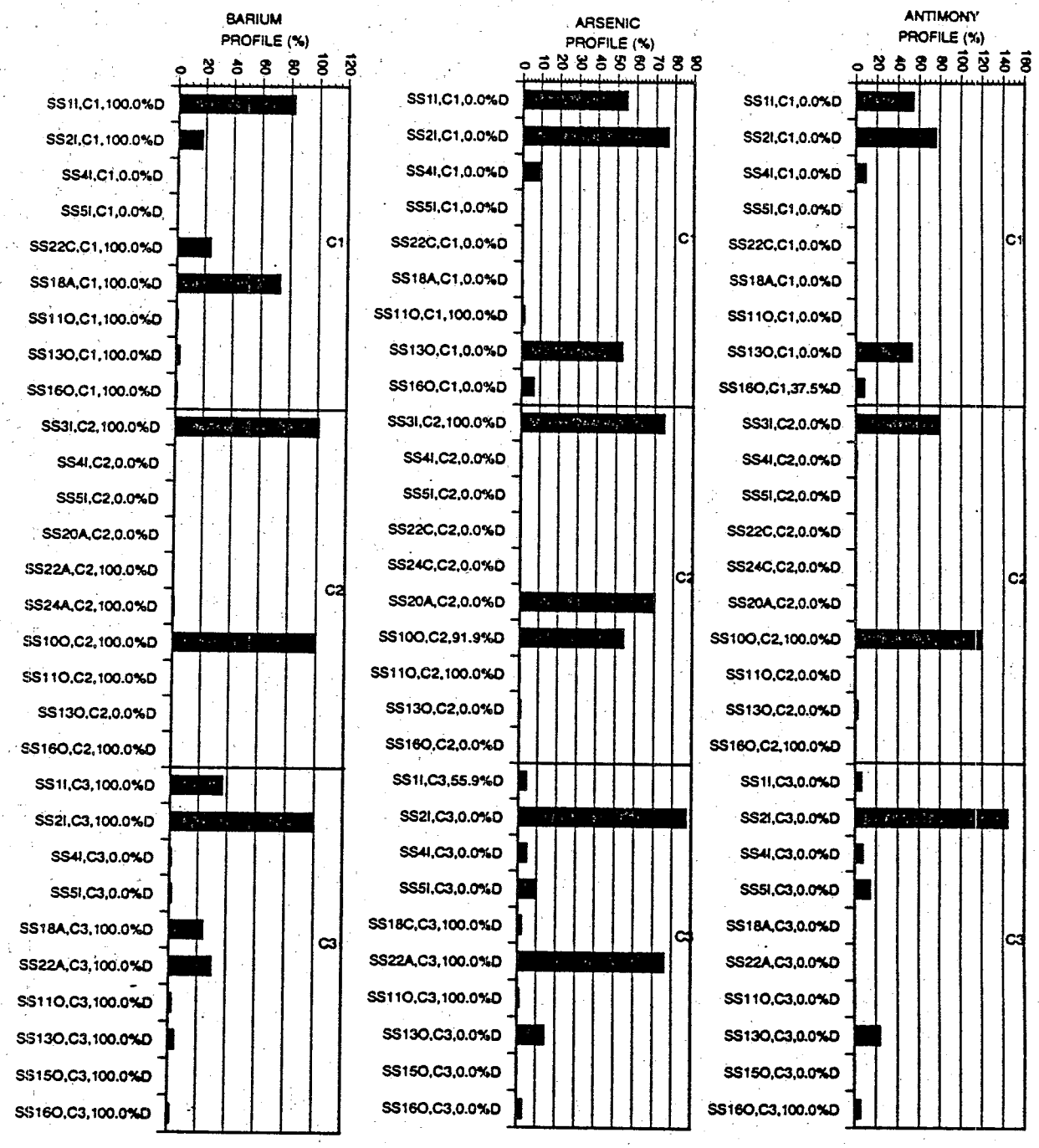


Figure A3-5. Partitioning of antimony, arsenic, and barium.

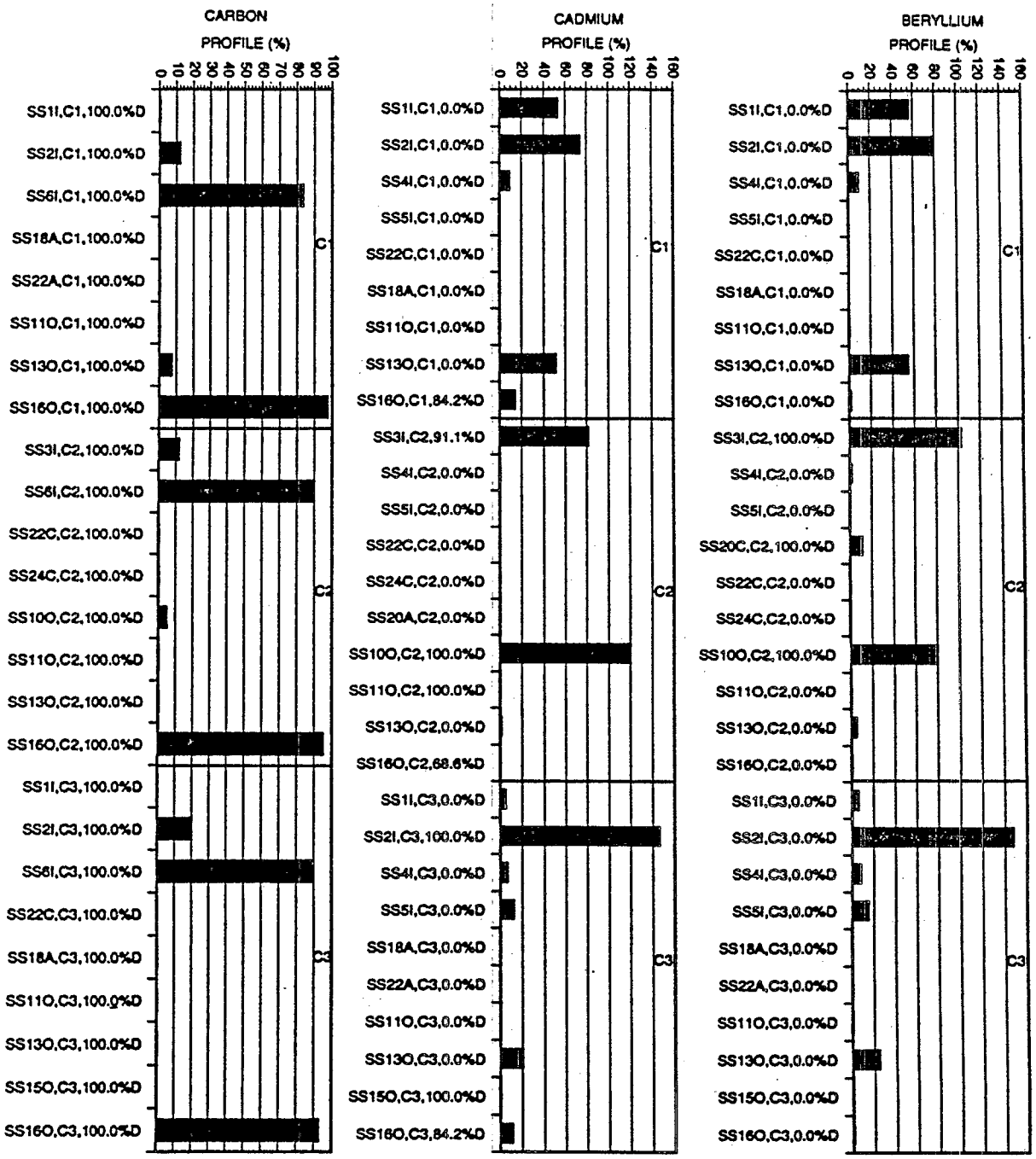


Figure A3-6. Partitioning of beryllium, cadmium, and carbon.

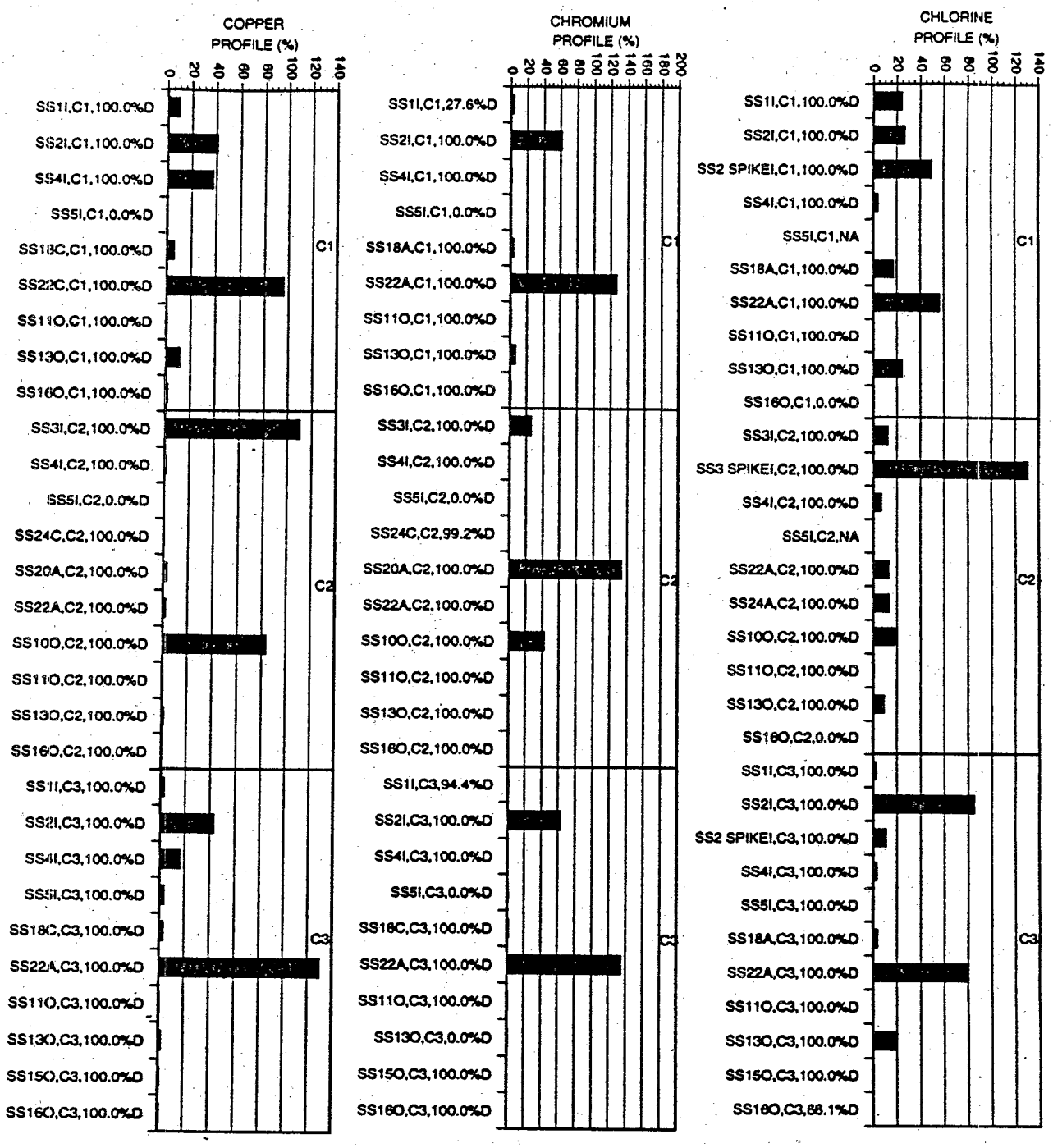


Figure A3-7. Partitioning of chlorine, chromium, and copper.

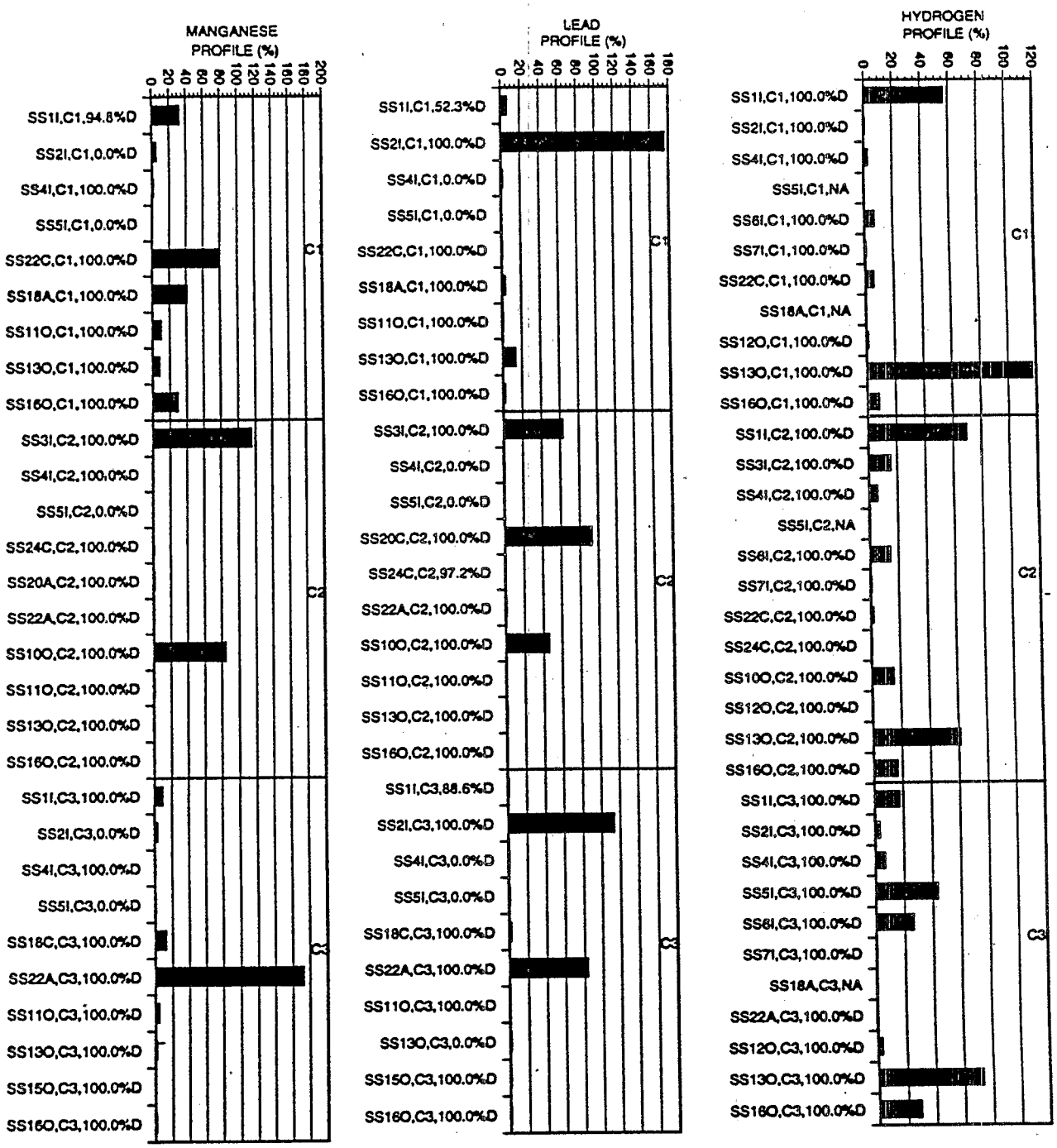


Figure A3-8. Partitioning of hydrogen, lead, and manganese.

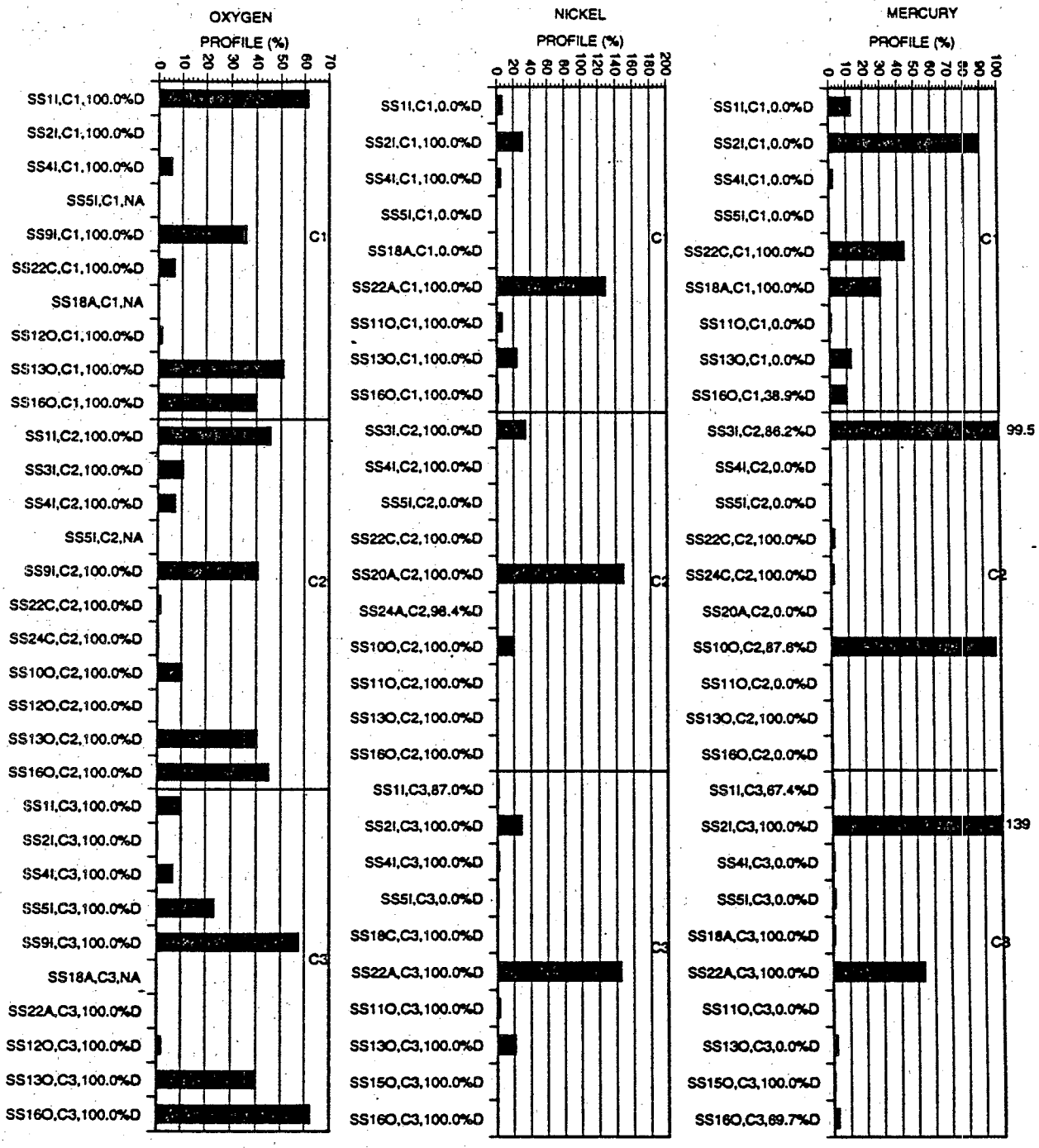


Figure A3-9. Partitioning of mercury, nickel, and oxygen.

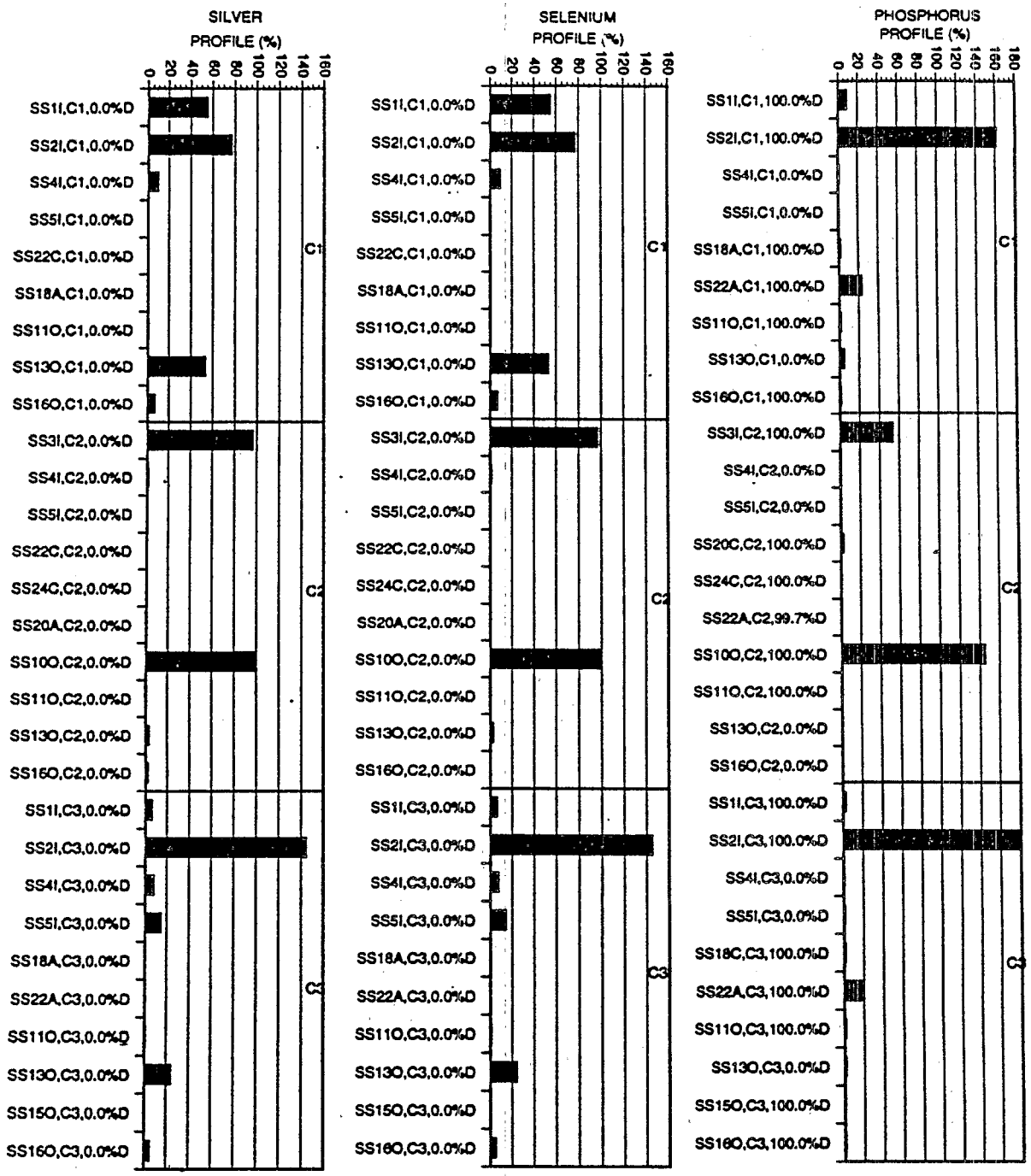


Figure A3-10. Partitioning of phosphorous, selenium, and silver.

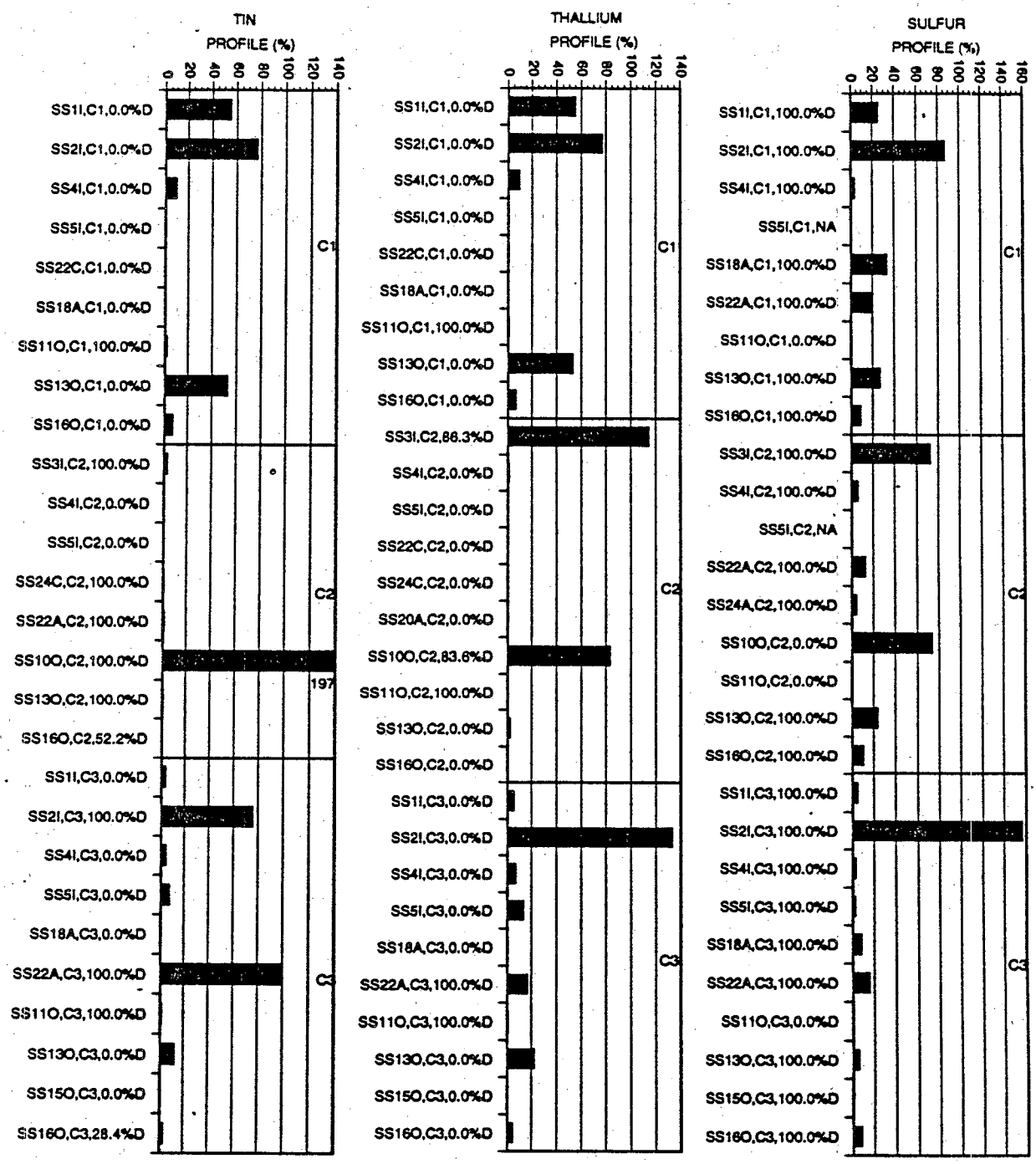


Figure A3-11. Partitioning of sulfur, thallium, and tin.

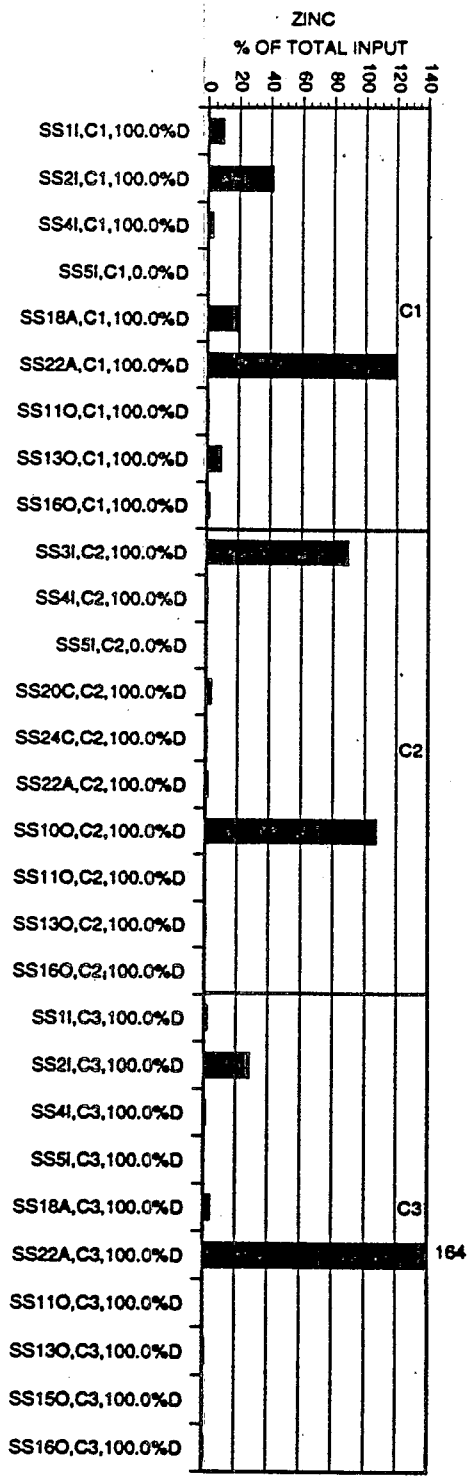


Figure A3-12. Partitioning of zinc.

APPENDIX 4
INTERNAL QUALITY ASSURANCE

The measurements in this Demonstration were performed according to a Category II Quality Assurance Project Plan. This appendix presents detailed results of internal QA/QC activities performed during the Demonstration. These activities were quite comprehensive in scope to document and quantify the quality of critical measurements for each sample stream. A summary of the quality assurance samples and impact on the test results is provided below. This is followed by a detailed listing of QA/QC results for each measurement and matrix. At the end of this appendix, equipment calibration information is provided.

QA SAMPLES

Included in this demonstration were collection and analysis of field QA samples such as

- Reagent blanks - samples of all reagents (filters, chemicals, etc.) used in the field taken directly from the original containers. This provides a check for contamination introduced by the raw reagents used to charge sampling equipment and recover samples;

- Proof blanks - samples from flue gas sampling equipment obtained by charging and recovering the trains in the field lab, after cleaning but before collecting any field samples. This checks for contamination due to inadequate pre-test cleaning and/or recovery procedures;

- Recovery blanks - samples of reagents and reagent mixtures used to recover samples from the sampling equipment, taken from the containers (squeeze bottles, etc.) used for recovery. This checks for contamination introduced during sample recovery;

- Field blanks - samples which were exposed to all of the field sampling and recovery procedures except for actual collection of samples. For gas sampling methods, this consisted of setup of the equipment at the sampling location including a leak check, then recovery of the train using the

same procedures as a sample. This provides an overall check of the field preparation, sampling, and recovery procedures for contamination;

- Trip blanks - sample reagents that were prepared in the laboratory and sent to the field with reagents used to collect samples, stored in the same location as field reagents during the test program, then sent back to laboratory with the field samples and analyzed. This checks for contamination introduced during sample shipping and storage.

- Field spikes - known quantities of a target analyte which were introduced to the sampling equipment then recovered and analyzed to determine the total recovery of the spike. This provides a measure of overall measurement accuracy;

- Field duplicates - duplicate samples obtained from the same location at the same time (usually by dividing a larger sample) and submitted to the laboratory for the same analytical procedure. This provides a measure of overall measurement precision.

Additional QA procedures performed in the laboratory included:

- Method blanks - samples of clean reagents introduced to the analyzer to check for bias or contamination in the analytical procedure;

- Duplicate analysis - duplicate injection of a sample into the analyzer to provide a measure of analytical precision;

- Laboratory control spikes/duplicates - a known quantity of the target analyte added to a clean sample matrix to provide a measure the analytical accuracy in the absence of interferences from the field sample matrix. The spike is repeated to determine precision;

- Surrogate additions - a known quantity of substances similar to but distinguishable from the target analytes added to the sample reagents (e.g., XAD-2 and Tenax sorbent resins) before sampling. The amount of the surrogate compounds recovered indicates the magnitude of potential bias introduced during sampling and laboratory analysis procedures;

- Internal/alternate standard additions - a known quantity of substances similar to but distinguishable from the target analytes added to the samples in the laboratory before sample preparation. The

amount of sample recovered indicates the magnitude of potential bias introduced during laboratory preparation and analysis procedures;

- Method performance checks - known laboratory standards introduced to the analyzer to document the accuracy of the analytical instrument before analyzing any field samples.

- Matrix spikes/duplicates - a known quantity of the target analyte added to a field sample to provide a measure of the analytical accuracy in the actual sample matrix. The spike is repeated to determine precision.

- Capture efficiency checks - analysis of individual gas sampling train components to determine the potential for low bias introduced by breakthrough of the target analyte.

The third category of QA samples was the blind analysis of audit samples provided by outside organizations. These provided a measure of measurement accuracy.

The QA samples collected and analyzed during this test program are summarized in Table A4-1. The samples collected in the field were either archived for future investigation or analyzed. For each measurement or sample matrix, this table shows: the QA sample type; a description of the sample; the analytical frequency; the archiving frequency; and the indicator of data quality for which the result was used.

SUMMARY OF QA/QC RESULTS

The resulting impact of the activities described above is summarized in Table A4-2a for each sampling location and for each test run or condition. For the majority of the tests, the results complied with the quality assurance objectives and no corrective action of any kind was required. These results are noted in the table as "OK". Where the results deviated from the quality assurance objectives or where they may otherwise be questionable, corrective action ranging from correcting the results to discarding them entirely was taken. The type of corrective action was dependent on the nature of the deviation. In most cases, the nature of the deviation was minor and the corrective action required was simply to flag the result and handle it in a specific manner. Recognizing the broad interest in the Demonstration, this will enable the report to be used for a wide range of purposes. Where a number appears in Table A4-2a for a particular measurements, the reader is referred to the footnote key provided in Table A4-2b. Table A4-2b describes the QA/QC sample result and the corrective action which was taken.

DETAILED QA/QC RESULTS

Boiler Flue Gas

In general, the data collected at the boiler stack (SS16) are considered to be of very high quality and satisfied all of the critical Demonstration project objectives. For those samples which were collected isokinetically, Figure A4-1 presents the isokinetic rate achieved for each test compared to the method criterion of 90-110 percent. All results were within the acceptance limits. Figure A4-2 presents the moisture content of the flue gas determined from each of the sample trains, showing excellent comparability of the results obtained with different sample trains. In addition to those QA/QC samples specified in the methods, other QA/QC samples such as proof blanks and duplicates analysis were processed. The following section presents and discusses results from all of these samples.

Semivolatile Organic Compounds—

Glassware proof and field blank results for the semivolatile organic sampling train are shown in Table A4-3. Overall, the results from the field and proof blanks are considered excellent. Proof blank samples were obtained for every set of SVOC glassware. One proof blank was analyzed for PCBs, PCDD/PCDF, PAH, and CB/CP under this Demonstration project. PCB congeners were not detected at levels significantly above the detection limit in either the proof blank or the field blank and these results are considered acceptable. Proof blanks and field blanks were free from significant levels of dioxins and furans. Octachlorinated dioxins were detected in the proof blank; this is a known artifact of the analysis and should be disregarded. PAH compounds also were not detected in any of the samples, except naphthalene was detected in the field blank. Naphthalene is a known XAD-2 contaminant and the results should not be considered significant, except that naphthalene results should be considered only as estimates. Although U.S. EPA test methods were used for this Demonstration, the remaining proof blanks were analyzed by ELI for PCBs and PCDD/PCDF to satisfy the QA requirements of Environment Canada test methods. The results, reported separately by ELI, indicated concentrations of PCBs, dioxins, and furans were below the maximum allowable concentrations of the Environment Canada test methods. Results for SVOC method blanks are given in Table A4-4 for every test run. No significant concentrations of PCBs, PCDD/PCDF, PAH, CB, or CP were found in the method blanks, with any detected levels only slightly above the detection limits (except for octachlorinated dioxins and naphthalene, which are artifacts as noted above). These results indicate the SVOC results are free from significant contamination problems.

Surrogate, internal standard, and alternate standard recoveries are shown in Tables A4-5, Table A4-6, and Table A4-7, respectively. Most of the recoveries were within the criteria specified in the test methods and therefore these results are considered very good. The occasional result which falls outside of the method criteria is not considered significant. Results for the laboratory control spikes and laboratory control spike duplicates are given in Table A4-8. These results were used to calculate the accuracy and precision for the flue gas SVOC measurements, which satisfied all of the quality assurance objectives. A duplicate analysis was performed on one of the sampling trains, and results are given in Table A4-9. The concentrations of SVOCs were too low to in this duplicate sample (near or below the detection limits) to permit reliable determination of precision, except for PCDD/PCDF. The precision of PCDD/PCDF calculated using this duplicate analysis also satisfied the quality assurance objectives. These results demonstrated that the accuracy, precision, and overall quality of the key SVOC results – PCB, PCDD, and PCDF – were adequate to demonstrate all of the project objectives.

Volatile Organic Compounds—

Results for the VOST field and trip blanks, given in Table A4-10 and Table A4-11, were excellent since all results were below the detection limits (except two spurious results which were detected but below the quantitation limit). VOST surrogate recoveries for Conditions 2 and 3 are shown in Table A4-12. These recoveries are excellent with only an occasional result falling outside the control limits. During Condition 1, the Tenax sorbent traps inadvertently were not spiked with surrogates before sampling. It became very apparent, however, that this was not the case, and surrogates had to be spiked after sampling but before analysis. Although this does cloud the VOST data for Condition 1, identical sampling and analytical procedures were used during the other two conditions and most recoveries were acceptable for these tests. Recovery of laboratory control spikes for the VOST samples also was generally excellent, as seen in Table A4-13.

Results of the EPA audit sample analysis are compared to the true values in Table A4-14. The audit consisted of a cylinder with the known concentrations of gas sampled through the entire VOST train. It should be noted that this result is a check of the entire sampling system. Results for the audit were well within the program objective, except for the vinyl chloride. Based on these results, the quality of the VOC measurements was sufficient to satisfy all of the project objectives. Vinyl chloride results may be biased high.

Metals—

Proof blank and field blank results for trace metals are summarized in Table A4-15. The proof blank showed clean glassware for all metals except copper, manganese and mercury. The levels of copper

and manganese were very close to the detection limit and were not considered significant. Two additional proofs were prepared and still resulted in significant detections of mercury. Upon further investigation, the detection of mercury was found to be due to an interference from the HCl rinse of the train. The HCl rinse of the permanganate impingers had not been purged with nitrogen prior to analysis, resulting in interference and false detections. Corrective action was implemented and additional proofs were supplied to both the main laboratory for the Demonstration (Twin Cities Testing) and to a second laboratory (Calscience Environmental Laboratories Inc.) for comparative purposes. These final proof blank analyses showed acceptable results.

The multiple metals train field blank did indicate contamination of some trace metals at generally very low levels (2 to 15 µg, except for tin at 74 µg). Table A4-16 compares the field blank levels to the levels detected in the field samples in both absolute terms and as a percentage of the field samples. This shows that the contamination levels were comparable in most cases to the levels measured in the field samples. Most of the contamination was present in the front half of the train. Since the glassware proof was clean, the contamination was most likely located in the filter. Levels of antimony, barium, chromium, copper, lead, phosphorus, silver, tin, and zinc were present in the field blank sample. Since the absolute levels of most trace metals measured in the flue gas were very low and had little contribution to overall trace metals mass balances, the suspected contamination does not adversely impact the achievement of the project objectives. However, trace metals emissions data may overly conservative due to the potential high bias in the results.

One sample train was analyzed in duplicate. Results of these analyses are given in Table A4-17. Based on these results, the precision of the trace metals measured above the detection limits in both analyses was very good.

Hydrogen Chloride—

QA sample results for the HCl sample train are given in Table A4-18. The glassware proof demonstrated glassware cleanliness, and both the high level and the low level EPA audit sample results satisfied the acceptance criteria. To quantify capture efficiency of the first versus the second impinger and hence the potential for breakthrough of HCl, the first and second impinger of one sample train was analyzed separately; however, concentration of chloride in both portions was below detection limits so that the capture efficiency could not be determined. HCl was not detected in the field blanks. Field duplicates were prepared by combining the two impingers of a sample train then splitting the combined sample for separate analysis. This was done for two samples. The results for the Condition 1 samples were below detection limits and could not be used; however, results for the Condition 3 sample were

above the detection limits and the relative percent difference for the field duplicate was 4.4 percent – well within the acceptance criteria for the Demonstration. These results indicate the quality of the HCl emission measurements is sufficient to satisfy all the project objectives.

Continuous Emission Monitoring—

Stratification of NO_X and O_2 concentrations at the boiler stack is shown in Table A4-19. The maximum deviation at one traverse point from the average concentration was 3.18 percent, well below the criterion of 10 percent. A response time check performed on all of the analyzers showed good response times except for SO_2. Due to the low range (0-100 ppm) and the low levels of SO_2 in the flue gas, this is not considered significant. Since the stack was under negative pressure, a check for dilution due to in-leakage through the various sets of ports was performed. The results given in Table A4-21 indicate that some in-leakage was present. This was accounted for in the data reduction. A cyclonic flow check was performed on the stack. Results of this check are given in Table A4-22. The average swirl angle was 5 degrees, well within the method criterion of 10 degrees.

Figures A4-3, A4-4, and A4-5 present the results of daily span drift, zero drift, and bias checks performed on the continuous emissions monitoring system. The results were within the acceptance limits for all tests except for Condition 1 Run 2, where drift for the NO_X and SO_2 analyzers exceeded the limit slightly Data were corrected for drift for this run with no significant change to the uncertainty of the measurements.

Process Gas Streams

In addition to the boiler flue gas, samples of several process gas streams were collected. Since the data from these locations were used for engineering evaluation purposes, quality assurance objectives were not specified. Results of QA/QC sample analysis are compared to quality assurance objectives for boiler flue gas for reference only. Sampling procedures at these locations were based upon the standard reference method procedures, with modifications to accommodate conditions such as high pressure, high temperature, and hydrogen-rich atmospheres. It should be noted that some of these samples contained very high in levels of native organics. For example, naphthalene loading in samples of the TDU off-gas (SS19) was on the order of milligrams. These high levels caused a number of analytical problems ranging from instrument saturation, failed internal standards, analyte masking, and precipitates forming in the sample extracts. There were a number of problems associated with all of the process gas samples except for the combustion air samples. Since these results were used only to

facilitate an engineering evaluation of system performance, the achievement of the primary objectives of the Demonstration was not adversely affected by these results.

Semivolatile Organic Compounds—

Internal standard recoveries, alternate standard recoveries, and surrogate recoveries for process gas samples are provided in Tables A4-23 through A4-28. Results for propane (SS6), hydrogen (SS7), and combustion air (SS9) were generally within method criteria. Most of the difficulties were experienced with samples of reformed gas (SS14) and TDU off-gas (SS19) because of the high levels of native analytes in these samples. Despite these problems, more than three-fourths of the SVOC standard recoveries for the reformed gas and TDU off-gas samples were near or within the quality assurance objectives, with recoveries generally on the low side rather than high. Thus, these data are suitable for the engineering purposes for which they are intended.

Volatile Organic Compounds—

Surrogate recoveries for the process gas VOST samples are provided in Table A4-29. Results for propane (SS6), hydrogen (SS7), and combustion air (SS9) were generally within method criteria. It should be noted that sampling of propane (SS6) was conducted using a Tedlar bag rather than with a modified VOST set-up since the propane was expected to interfere with the collection of VOCs on the Tenax resin. As with the SVOCs, most of the difficulties were experienced with samples of reformed gas (SS14) and TDU off-gas (SS19) due to the high levels of native analytes in these samples. Where matrix interferences did not prevent quantification of surrogate compounds, slightly more than 60 percent of the recoveries for reformed gas and TDU off-gas were near or within the quality assurance objectives for boiler flue gas. The recoveries for Condition 2 were significantly better than for Conditions 1 and 3. The VOC data for samples of reformed gas collected during Conditions 1 and 3 may be questionable.

Fixed Gases—

An audit sample was provided by EPA for process gas fixed gases analysis. The results of the audit sample analysis are compared to the true value in Table A4-30. Oxygen and carbon monoxide concentrations were within ±10 percent (considered acceptable), but the result for carbon dioxide was not. The results indicate that results for carbon dioxide concentration in the process gas samples may be biased low by 5 to 15 percent. This result does not adversely impact achievement of the primary objectives of the program, but may indicate a high bias in the calculated heating value for reformed gas of 5 to 15 percent. Characterization of the reformed gas for use as a fuel was a secondary objective.

Solid and Liquid Streams

The potential for background contamination of liquid and solid samples was significant because of the relatively high concentrations of target analytes in some of the streams. In order to quantify background contamination, solid and liquid field blanks were collected at the waste water sampling location (SS1) and the treated soil sampling location (SS10). For the liquid field blank, a bottle of deionized H_2O was carried to the SS1 sample location and treated in exactly the same manner as an actual sample. The bottle was opened to the atmosphere for the same amount of time as the SS1 sample, and the blank was split and composited following the normal procedure used for actual samples. At SS10, a bottle of clean laboratory sand was treated similarly. Results for these two field blanks are given in Table A4-31 and Table A4-32. The results show that the samples were free from significant contamination and that sampling procedures were reliable.

Duplicate samples were collected and analyzed for waste water (SS1), waste oil (SS2), contaminated soil (SS3), and scrubber liquor (SS22). The results of these duplicates were used to calculate precision measurements at these locations. The concentrations of each analyte detected in the samples and their respective duplicates, the average value, and the relative percent difference are given in Tables A4-33, A4-34, and A4-35. The relative percent difference satisfied the Demonstration objectives in most cases, except when analytes were detected at concentrations near the method detection limits. These exceptions are not considered significant. The chlorine content of the waste oil (Table A4-34) did not meet the precision objective based on the field duplicate results and the resulting uncertainty in these numbers may be significant. However, since good chlorine mass balance closure was achieved in Conditions 1 and 3, the duplicate result may be in error rather than the original analysis. The precision of the PCB measurements in the contaminated soil (SS3) fell slightly outside the precision objective based on the field duplicate results. Several other results for the contaminated soil showed similar differences. This is most likely due to the heterogeneous nature of the soil rather than measurement error and therefore has no adverse impact on the Demonstration results.

Polychlorinated Biphenyls—

PCB matrix spike and matrix spike duplicate results are given in Table A4-36 and Table A4-37 presents surrogate recoveries for liquid and solid samples. The recoveries of spikes and surrogates satisfied the objectives of the Demonstration and the test methods, except for the reactor grit (SS11) and scrubber sludge (SS12), for which there were a number of the matrix spike results which did not meet the criteria. The PCB content in the reactor grit sample was much greater than anticipated, therefore the spiking level was too low to obtain accurate spike recovery results. The limited quantity of this

sample precluded repetition of the spiking tests. The scrubber sludge samples also proved to be a difficult matrix, with high matrix spike recoveries for Condition 2 and low matrix spike recoveries for Condition 3. Therefore, the accuracy of the PCB measurements for these samples was based on surrogate recovery results instead. All surrogate recoveries satisfied the method criteria. Although these results do not affect the DRE objective for PCB, they could affect the engineering objective for DE of PCB. Since (1) the matrix spike/matrix spike duplicate results for some of the PCB congeners met the QA objective, (2) all surrogate recoveries were within allowable limits, and (3) levels of PCBs were detected in other output streams besides reactor grit, the reliability of the PCB DE results is considered adequate for engineering purposes.

Chlorobenzenes, Chlorophenols, and Polycyclic Aromatic Hydrocarbons—

Matrix spike and matrix spike duplicate results are shown in Table A4-38 for CB, CP, and PAH in solid and liquid samples. Surrogate recoveries are listed in Table A4-39. The results were generally acceptable with a few exceptions. The objective for precision of chlorophenols in waste water (SS1) and heat exchanger residue (SS18) was not achieved. Chlorophenols showed low and variable recoveries for the matrix spikes that were performed on these samples. In particular, pentachlorophenol was subject to low recoveries. Low recoveries for these acid organic compounds were observed in a number of samples. This is believed to be due to the high levels of other aromatic organics (e.g., naphthalene) and/or harsh conditions during the extraction stage of analysis. Although this increases the uncertainty of this measurement, chlorophenols were not a critical analyte; therefore, this does not significantly impact conclusions related to the primary objectives of the project. The results may indicate a low bias for some of the chlorophenols and increased uncertainty of these measurements.

Volatile Organic Compounds—

Matrix spike and matrix spike duplicate results for the solid and liquid samples are given in Table A4-40. High levels of benzene in a number of the samples interfered with quantifying the MS/MSD levels. The precision achieved for PCE in the scrubber sludge (SS12) was barely outside the program objectives. This result does not significantly impact the conclusions regarding PCE destruction since this stream was always insignificant in the data analysis. The accuracy for VOCs at the same location was significantly above the QA objective. This occurred due to the relatively high levels of benzene in the samples. The high level of benzene caused instrument saturation; hence, dilution of the samples was required to bring the benzene concentration within the range of the analytical instrument. This resulted in dilution of other VOC compounds to such low levels that spiked compounds could not be measured with confidence. This in turn, resulted in high recoveries for the other VOC compounds, some as high as 6,014 percent. Although this does impact the secondary project objective relative to residuals characterization

to determine disposal requirements, the results indicate a probable high bias in the reported VOC concentrations, and hence could be considered conservative. Conclusions regarding the primary project objective for destruction efficiency of PCE are considered valid because PCE accuracy satisfied the QA objective. VOCs in reactor grit (SS11) samples were subject to similar problems due to the high levels of benzene.

PCDD and PCDF—

Laboratory control spikes were used to determine accuracy for the PCDD/PCDF measurements in solid and liquid samples. Results are given in Table A4-41. All recoveries satisfied the QA objectives.

Other QA Results—

A trace metals matrix spike was performed on the scrubber liquor (SS22). Recovery of the matrix spike satisfied the QA objectives, as shown in Table A4-42. The accuracy determined from this sample was also applied to the scrubber decant water (SS13) since these matrices are very similar. QA results for organic halogens in solid and liquid samples are shown in Table A4-43. Ultimate analysis QA results are shown in Table A4-44. Total organic carbon QA results are given in Table A4-45. Additional organic halogen, total organic carbon, ash, total sulfur, and total halogen QA results are given in Table A4-46 and Table A4-47. Most of the results presented in these tables satisfied the QA objectives and no significant problems are noted.

EQUIPMENT CALIBRATION

All sampling equipment was calibrated before use in the field. A post-test calibration was also conducted on the dry gas meters. Calibration worksheets and certification sheets are given at the end of this section in the following order:

- VOST train (Method 0030) calibrations (includes dry gas meter, thermocouples)
- HCl train (Method 26) calibrations (includes dry gas meter, thermocouples, magnahelic gauges)
- SVOC train (Method 0010) calibrations (includes dry gas meter, thermocouples, magnahelic gauges, nozzles)
- Metals train (Method 29) calibrations (includes dry gas meter, thermocouples, magnahelic gauges, nozzles, and pitot tubes)

- Process weight calibrations (calibrations for the scales used to measure liquid and solid stream flow rates)

- Gaseous process calibration (all equipment used for SS6, SS7, SS9, SS14, and SS19)

- CEM gas certifications

- Additional calibrations (back-up equipment).

TABLE A4-1. QUALITY ASSURANCE SAMPLES

Measurement or Matrix	QA Sample Type	Description	Analytical Frequency	Archive Frequency	Data Quality Indicator
Gaseous SVOC Measurements	Field Blank (Qty - 2)	Complete train	1 time after 1st run	1 time after 7th run	-----
(QA/QC results for SS16 sampling trains applied to process gas samples also)	Proof blank	Complete train excluding XAD resin	One complete train analyzed for Demonstration, all other trains analyzed by ELI	—	-----
	Reagent Blanks	Filters (lot of 3), spiked XAD, and DI water	1 time if high field blank	Prior to test and each new lot	-----
	Recovery Blanks	Acetone, methylene chloride, and toluene	1 time if high field blank	Prior to test and each new lot	-----
	Duplicate Analysis	Sample extract	1 time (Test 2/Run 2)	—	Precision
	Method Blank	Analytical blank	1 time	—	-----
	Laboratory Control Spike	XAD-2 spiked with target compounds, in the laboratory	1 time	—	Accuracy
	Surrogate and internal standard recoveries also used for accuracy calculations.				
Metals Measurements at SS16	Proof Blank	Complete Train	1 time prior to test	—	-----
	Field Blanks (Qty - 2)	Complete Train	1 time after 2nd run	1 time after 7th run	-----
	Reagent Blanks (Metals)	Filters(lot of 3), 5% HNO3/10% H2O2, 4% KMnO4/10%H2SO4	1 time if high field blank	Prior to test and each new lot	-----
	Reagent Blanks (Particulate)	Filters (lot of 3), Acetone	1 time if high field blank	Prior to test and each new lot	-----
	Recovery Blank	Acetone, 0.1 N HNO3, 8 N HCl	1 time if high field blank	Prior to test and each new lot	-----
	Lab Matrix Spike	Digested sample	1 time	—	Accuracy
	Duplicate Analysis	Digested Sample	1 time (Test 2/Run1)	—	Precision
	Audit Sample (Metals)	1 low level and 1 high level filter spiked all target metals excluding tin	1 time prior to test	—	Accuracy
	Audit Sample (Hg)	Permanganate Solution spiked with Hg	1 time prior to test	—	Accuracy
	Field Spike (Particulate)	Known amount of particulate poured into the sample train	1 time	—	Accuracy
Gaseous VOC Measurements	Field Blanks (Qty - 2)	One pair of tubes	2 times, 1 for each shipment of tubes	—	-----
(QA/QC results for SS16 sampling trains will be applied to process gas samples also)	Trip Blanks (Qty - 2)	One pair of tubes	2 times, 1 for each shipment of tubes	—	-----

TABLE A4-1. QUALITY ASSURANCE SAMPLES (continued)

Measurement or Matrix	QA Sample Type	Description	Analytical Frequency	Archive Frequency	Data Quality Indicator
Measurements (continued)	Performance Check	Laboratory gas standard	1 time prior to test	----	Accuracy
	Audit Sample	carbon tetrachloride, chloroform, perchloroethylene, vinyl chloride, benzene	1 time prior to test	----	Accuracy
SS16	Proof Blank	Complete Train	1 time prior to test	----	------
	Field Blank (Qty - 2)	Complete Train	1 time after 2nd run	1 time after 7th run	------
	Reagent Blanks	0.1 N H2SO4, 0.1 N NaOH	1 time if high field blank	Prior to test and each new lot	------
	Recovery Blanks	Deionized H2O	1 time if high field blank	Prior to test and each new lot	------
	Capture Efficiency	1st and 2nd Impinger analyzed separate from the 3rd impinger	1 time (Test 2/Run 3)	-----	------
	Audit Sample	Liquid sample	1 time prior to test	----	Accuracy
	Duplicate	Split 1st, 2nd, and 3rd Impinger catches in the field	1 time (Test 2/Run 1)	-----	Precision
Fixed Gases at SS9 and SS14	Audit Sample	Gas canister from EPA	1 time prior to test	-----	Accuracy
Waste Water, SS1, SS18	Field Blank (Qty - 2)	Deionized H2O	1 time for test condition 1	test condition 3	-----
	Duplicate	Duplicate sample collected	Test 1 for PCB Analysis	-----	Precision, PCB
	Duplicate	Duplicate sample collected	Test 1 for Metals Analysis	-----	Precision, Metals
	Duplicate	Duplicate sample collected	Test 1 for Total Organic Carbon Analysis	-----	Precision, TOC
	Duplicate	Duplicate sample collected	Test 2 for CB, CP Analysis	-----	Precision, CB, CP
	Duplicate	Duplicate sample collected	Test 2 for Total Sulfur Analysis	-----	Precision, Total Sulfur
	Duplicate	Duplicate sample collected	Test 3 for VOC Analysis	-----	Precision, VOC
	Duplicate	Duplicate sample collected	Test 3 for Inorganic Halogen Analysis	-----	Precision, Inorganic Halogens
	Duplicate	Duplicate sample collected	Test 3 for Organic Halogen Analysis	-----	Precision, Organic Halogens
	Matrix Spike	For PCB's	Once for the program	-----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for the program	-----	CB, CP, PAH
	Matrix Spike	For VOC	Once for the program	-----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for the program	-----	Analytical Precision, PCB

TABLE A4-1. QUALITY ASSURANCE SAMPLES (continued)

Measurement or Matrix	QA Sample Type	Description	Analytical Frequency	Archive Frequency	Data Quality Indicator
Waste Water, SS1, SS18 (continued)	Matrix Spike Duplicate	For CB, CP, and PAH	Once for the program	-----	Precision, CB, CP, PAH
	Matrix Spike Duplicate	For VOC	Once for the program	-----	Analytical Precision, VOC
	Audit Sample	Spiked for Total Sulfur analysis	1 time prior to test	----	Accuracy, Total Sulfur
	Audit Sample	Spiked for Total Inorganic Halogen analysis	1 time prior to test	----	Accuracy, Inorganic Halogens
	Audit Sample	Spiked for Total Organic Carbon analysis	1 time prior to test	----	Total Organic Carbon
Decant Water, SS13	Matrix Spike	For PCB's	Once for each test condition	-----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for each test condition	-----	CB, CP, PAH
	Matrix Spike	For VOC	Once for each test condition	-----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for each test condition	-----	Precision, PCB
	Matrix Spike Duplicate	For CB, CP, and PAH	Once for each test condition	-----	CB, CP, PAH
	Matrix Spike Duplicate	For VOC	Once for each test condition	-----	Precision, VOC
Scrubber Liquor, SS22	Matrix Spike	For PCB's	Once for each test condition	-----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for each test condition	-----	CB, CP, PAH
	Matrix Spike	For VOC	Once for each test condition	-----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for each test condition	-----	Precision, PCB
	Matrix Spike Duplicate	For CB, CP, and PAH	Once for each test condition	-----	CB, CP, PAH
	Matrix Spike Duplicate	For VOC	Once for each test condition	-----	Precision, VOC
Quench Water, SS24	Matrix Spike	For PCB's	Once for each test condition	-----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for each test condition	-----	CB, CP, PAH
	Matrix Spike	For VOC	Once for each test condition	-----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for each test condition	-----	Precision, PCB
	Matrix Spike Duplicate	For CB, CP, and PAH	Once for each test condition	-----	CB, CP, PAH
	Matrix Spike Duplicate	For VOC	Once for each test condition	-----	Precision, VOC
Waste Oil, SS2	Duplicate	Duplicate sample collected	Test 1 for CB, CP Analysis	-----	Precision, CB,CP
	Duplicate	Duplicate sample collected	Test 1 for Metals Analysis	-----	Precision, Metals

TABLE A4-1. QUALITY ASSURANCE SAMPLES (continued)

Measurement or Matrix	QA Sample Type	Description	Analytical Frequency	Archive Frequency	Data Quality Indicator
Waste Oil, SS2 (continued)	Duplicate	Duplicate sample collected	Test 1 for Total Sulfur Analysis	-----	Precision, Total Sulfur
	Duplicate	Duplicate sample collected	Test 3 for PCB Analysis	-----	Precision, PCB
	Duplicate	Duplicate sample collected	Halogens Analysis	-----	Total Halogens
	Duplicate	Duplicate sample collected	Test 3 for VOC Analysis	-----	Precision, VOC
	Duplicate	Duplicate sample collected	Test 3 for Ultimate Analysis	-----	Precision, Ultimate
	Matrix Spike	For PCB's	Once for the program	-----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for the program	-----	CB, CP, PAH
	Matrix Spike	For VOC	Once for the program	-----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for the program	-----	Analytical Precision, PCB
	Matrix Spike Duplicate	For CB, CP, and PAH	Once for the program	-----	Precision, CB, CP, PAH
	Matrix Spike Duplicate	For VOC	Once for the program	-----	Analytical Precision, VOC
Soil, SS3, SS10	Field Blank	Sand	1 time for Test 3	-----	-----
	Duplicate	Duplicate sample collected	Test 2 for CB, CP Analysis	-----	Precision, CB,CP
	Duplicate	Duplicate sample collected	Test 2 for Metals Analysis	-----	Precision, Metals
	Duplicate	Duplicate sample collected	Test 2 for Total Sulfur Analysis	-----	Precision, Total Sulfur
	Duplicate	Duplicate sample collected	Test 2 for PCB Analysis	-----	Precision, PCB
	Duplicate	Duplicate sample collected	Halogens Analysis	-----	Total Halogens
	Duplicate	Duplicate sample collected	Test 2 for VOC Analysis	-----	Precision, VOC
	Duplicate	Duplicate sample collected	Test 2 for Ultimate Analysis	-----	Precision, Ultimate
	Matrix Spike	For PCB's	Once for the test condition 2	-----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for the test condition 2	-----	CB, CP, PAH
	Matrix Spike	For VOC	Once for the test condition 2	-----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for the test condition 2	-----	Analytical Precision, PCB
	Matrix Spike Duplicate	For CB, CP, and PAH	Once for the test condition 2	-----	Precision, CB, CP, PAH

TABLE A4-1. QUALITY ASSURANCE SAMPLES (continued)

Measurement or Matrix	QA Sample Type	Description	Analytical Frequency	Archive Frequency	Data Quality Indicator
Soil, SS3, SS10 (continued)	Matrix Spike Duplicate	For VOC	Once for the test condition 2	----	Analytical Precision, VOC
	Audit Sample	Ash Analysis	prior to test	----	Ash
Reactor grit, SS11	Matrix Spike	For PCB's	Once for the test condition 2 and 3	----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for the test condition 2 and 3	----	CB, CP, PAH
	Matrix Spike	For VOC	Once for the test condition 2 and 3	----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for the test condition 2 and 3	----	Precision, PCB
	Matrix Spike Duplicate	For CB, CP, and PAH	Once for the test condition 2 and 3	----	CB, CP, PAH
	Matrix Spike Duplicate	For VOC	Once for the test condition 2 and 3	----	Precision, VOC
	Matrix spikes not conducted on test condition 1 due to a limited amount of sample				
Scrubber sludge, SS12	Matrix Spike	For PCB's	Once for the test condition 2 and 3	----	Accuracy, PCB
	Matrix Spike	For CB, CP, and PAH	Once for the test condition 2 and 3	----	CB, CP, PAH
	Matrix Spike	For VOC	Once for the test condition 2 and 3	----	Accuracy, VOC
	Matrix Spike Duplicate	For PCB's	Once for the test condition 2 and 3	----	Precision, PCB
	Matrix Spike Duplicate	For CB, CP, and PAH	Once for the test condition 2 and 3	----	CB, CP, PAH
	Matrix Spike Duplicate	For VOC	Once for the test condition 2 and 3	----	Precision, VOC
	Matrix spikes not conducted on test condition 1 due to a limited amount of sample				

TABLE A4-2. SAMPLING AND ANALYTICAL PROBLEMS IDENTIFIED BY THE INTERNAL QA/QC ACTIVITIES

Sample location	Analytes	Test Condition #1			Test Condition #2		Test Condition #3		
		Run #1 12-Oct-92	Run #2 17-Oct-92	Run #3 19-Oct-92	Run #1 1-Dec-92	Run #2 7-Dec-92	Run #1 24-Oct-92	Run #2 26-Oct-92	Run #3 28-Oct-92
SS1	VOC	OK	OK	OK			OK	OK	OK
	CP, CB	1,34	34	34			34	34	34
	PAH	OK	OK	OK			OK	OK	OK
	Density	OK	OK	OK			OK	OK	OK
	Total organic carbon	OK	OK	OK			OK	OK	OK
	pH	OK	OK	OK			OK	OK	OK
	Total sulfur (as S)	31	31	31			31	31	31
	Organic halogens (as chloride)	30	30	30			30	30	30
	Inorganic halogens (as chloride)	OK	OK	OK			OK	OK	OK
	PCDD/PCDF	OK	OK	OK			OK	OK	OK
	PCB	OK	OK	OK			OK	OK	OK
	Metals	OK	OK	OK			OK	OK	OK
	Hexavalent chromium	OK	OK	OK			OK	OK	OK
SS2	VOC	OK					OK		
	CP, CB	OK					OK		
	PAH	OK					OK		
	Ash	OK					OK		
	Ultimate analysis	32					32		
	Total halogens (as chloride)	OK					OK		
	PCDD/PCDF	OK					OK		
	PCB	OK					OK		
	Hexavalent chromium	OK					OK		
	Metals	OK					OK		
	Total sulfur (as S)	31					31		
	Heating Value (Btu/lb)	OK					OK		
SS3	VOC				51	51			
	CP, CB				OK	OK			
	PAH				52	47, 52			
	PCDD/PCDF				OK	OK			
	PCB				50	50			
	Total halogens (as chloride)				5,3,30	5,30			
	Organic halogens (as chloride)				OK	OK			
	Metals				OK	OK			
	Total sulfur (as S)				OK	OK			
	Ash				OK	OK			
	TCLP volatiles				3	OK			
	TCLP metals				3	OK			
	Total organic carbon				OK	OK			
	Hexavalent chromium				OK	OK			
SS4	Total sulfur (as S)	OK							
	Density	OK							
	pH	OK							
	Hexavalent chromium	OK							
	Organic halogens (as chloride)	3							
	Inorganic halogens (as chloride)	OK							
	Metals	OK							
SS5	Total sulfur (as S)	OK			OK		OK		
	Density	OK			OK		OK		
	pH	OK			OK		OK		
	Hexavalent chromium	OK			OK		OK		
	Organic halogens (as chloride)	3			OK		3		
	Inorganic halogens (as chloride)	OK			OK		OK		
	Metals	OK			OK		OK		
SS6	VOC	OK							
	Sulfur compounds	OK							
	Heating value	25							
	PCB	OK							
	CP, CB	OK							
SS7	VOC	OK							
	PCB	OK							
	CP, CB	OK							
SS9	VOC	9(4)			OK	42(2)	OK		
	PCB	OK			OK	OK	OK		
	CP, CB	OK			OK	OK	OK		
	Fixed gases	33			33	33	33		
	Sulfur compounds	OK			OK	OK	OK		

TABLE A4-2. SAMPLING AND ANALYTICAL PROBLEMS IDENTIFIED BY THE INTERNAL QA/QC ACTIVITIES (continued)

Sample location	Analytes	Test Condition #1			Test Condition #2		Test Condition #3		
		Run #1 12-Oct-92	Run #2 17-Oct-92	Run #3 19-Oct-92	Run #1 1-Dec-92	Run #2 7-Dec-92	Run #1 24-Oct-92	Run #2 26-Oct-92	Run #3 28-Oct-92
SS10	VOC				3	3			
	CP, CB				OK	OK			
	PAH				OK	OK			
	PCDD/PCDF				OK	OK			
	PCB				48	OK			
	Organic halogens (as chloride)				5	5			
	Inorganic halogens (as chloride)				OK	OK			
	Metals				OK	OK			
	Total sulfur (as S)				OK	OK			
	Ash				OK	OK			
	TCLP volatiles				3	OK			
	TCLP metals				OK	OK			
	Total organic carbon				OK	OK			
	Hexavalent chromium				OK	OK			
SS11	VOC	OK			45		2, 38		
	CP, CB	3			OK		OK		
	PCDD/PCDF	OK			OK		OK		
	PCB	OK			OK		OK		
	PAH	3			35		35		
	Organic halogens (as chloride)	4			OK		3		
	Inorganic halogens (as chloride)	4			OK		5		
	Metals	4			4		OK		
	Total sulfur (as S)	4			OK		OK		
	Ash	4			OK		OK		
	TCLP volatiles	4			OK		4		
	TCLP metals	4			OK		OK		
	Total organic carbon	4			OK		3		
	Hexavalent chromium	4			OK		OK		
SS12	VOC	OK			45		39		
	CP, CB	OK			OK		OK		
	Ultimate analysis	4			4		4		
	Organic halogens (as chloride)	4			4		4		
	Inorganic halogens (as chloride)	4			4		4		
	PCDD/PCDF	OK			OK		OK		
	PCB	OK			OK		28		
	PAH	OK			35		36		
	Metals	4			4		4		
	Total sulfur (as S)	4			4		4		
	TCLP volatiles	4			4		4		
	TCLP metals	4			4		4		
	Hexavalent chromium	4			4		4		
	Density	4			4		4		
	pH	4			4		4		
SS13	VOC	OK	3	3	OK		39		
	CP, CB	OK			OK		1		
	PAH	OK			35		OK		
	Ultimate	OK			OK		OK		
	Total organic carbon	OK			OK		OK		
	Organic halogens (as chloride)	3			OK		3		
	Inorganic halogens (as chloride)	OK			OK		OK		
	PCDD/PCDF	OK			OK		OK		
	PCB	OK			49		OK		
	Metals	OK			OK		OK		
	Total sulfur (as S)	OK			OK		OK		
	Hexavalent chromium	OK			OK		OK		
	Density	OK			OK		OK		
	pH	OK			OK		OK		
SS14	VOC	8(1,2,3)	OK	8(4), 12(2,3), 13(1,2,4), 14(2,3)	15(1,2,3,4), 16(1,2,3,4), 17(4)	15(1,2,3,4), 44(1,2,3,4)	8(2), 10(2), 15(2), 16(2), 18(1)	8(2,4), 11(1,3), 10(2,4), 13(2), 14(4), 15(2,4)	10(1,2,3), 8(1,2,3), 16(2), 14(1,2,3)
	PCB	OK	27	OK	OK	OK	OK	OK	OK
	CP, CB	OK	OK	OK	OK	OK	OK	OK	OK
	PCDD/PCDF	26	26	26	26	26, 29	26	26	26

TABLE A4-2. SAMPLING AND ANALYTICAL PROBLEMS IDENTIFIED BY THE INTERNAL QA/QC ACTIVITIES (continued)

Sample location	Analytes	Test Condition #1			Test Condition #2		Test Condition #3		
		Run #1 12-Oct-92	Run #2 17-Oct-92	Run #3 19-Oct-92	Run #1 1-Dec-92	Run #2 7-Dec-92	Run #1 24-Oct-92	Run #2 26-Oct-92	Run #3 28-Oct-92
SS14 (cont)	Fixed gases	33	33	33	33	33	33	33	33
	Sulfur compounds	OK	OK	OK	OK	OK	OK	OK	OK
	Heating value	OK	OK	OK	OK	OK	OK	OK	OK
SS15	VOC						6, 24	OK	
	CP, CB						4	OK	
	PAH						4	OK	
	Organic halogens (as chloride)						4	3	
	Inorganic halogens (as chloride)						4	OK	
	PCDD/PCDF						4	OK	
	PCB						6	OK	
	Hexavalent chromium						4	4	
	Metals						4	OK	
	Total sulfur (as S)						4	OK	
	Total organic carbon						4	OK	
SS16	VOC	OK	OK	OK	42(3,4), 43	42(3,4), 43	8(3), 15(3), 18(2)	10(1,2,4), 11(3)	10(1,2,3,4)
	PCB	OK	OK	OK	OK	OK	OK	OK	OK
	CP, CB	OK	OK	OK	OK	OK	OK	OK	OK
	PCDD/PCDF	26	26	26	26	26	26	26	26
	PAH	41	41	41	41	41	41	41	41
	Trace metals	40	20,40	22,40	40	40	22,40	40	40
	Particulate	19	20	OK	19	OK	OK	21	21
	HCl	OK	OK	OK	3	OK	OK	OK	OK
	Opacity	OK	OK	OK	OK	OK	OK	OK	OK
	O2	OK	OK	OK	OK	OK	OK	OK	OK
	CO2	OK	OK	OK	OK	OK	OK	OK	OK
	CO	OK	OK	OK	OK	OK	OK	OK	OK
	NOx	OK	23	OK	OK	OK	OK	OK	OK
	SO2	OK	OK	OK	OK	OK	OK	OK	OK
	THC	OK	OK	OK	OK	OK	OK	OK	OK
SS19	VOC				8(1,2,3,4), 15(1,2,3,4), 16(1,2,3,4), 17(3)	15(1,2,3,4), 17(4), 44(1,2,3,4)			
	PCB				OK	OK			
	CP, CB				OK	OK			
	PCDD/PCDF				26, 53	26, 53			
SS18	VOC	OK	3	OK				OK	
	CP, CB		OK					OK	
	PAH		OK					OK	
	Organic halogens (as chloride)		3, 30					3, 30	
	Inorganic halogens (as chloride)		OK					OK	
	PCDD/PCDF		OK					OK	
	PCB		OK					OK	
	Hexavalent chromium		OK					OK	
	Metals		OK					OK	
	Total sulfur (as S)		31					31	
	Total organic carbon		OK					3	
SS20	Metals				OK	OK			

Sample location	Analytes	Run #1 12-Oct-92 BOR	Run #1 12-Oct-92 EOR	Run #2 17-Oct-92 BOR	Run #2 17-Oct-92 EOR	Run #3 19-Oct-92 BOR	Run #3 19-Oct-92 EOR	Run #1 1-Dec-92 BOR	Run #1 1-Dec-92 EOR	Run #2 7-Dec-92 BOR	Run #2 7-Dec-92 EOR	Run #1 24-Oct-92 BOR	Run #1 24-Oct-92 EOR	Run #2 26-Oct-92 BOR	Run #2 26-Oct-92 EOR	Run #3 28-Oct-92 BOR	Run #3 28-Oct-92 EOR
SS22	VOC	3,39	39	3		OK		3		OK	OK	OK	OK	24	OK	OK	OK
	CP, CB	1	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	PAH	37	37	37		37		35		35	35	OK	OK	OK	OK	OK	OK
	Ultimate	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	Total organic carbon	OK	OK	3		3		OK		OK	OK	OK	OK	OK	OK	OK	OK
	Organic halogens (as chloride)	3	OK	3		OK		3		3	3	3	3	3	3	11	11
	Inorganic halogens (as chloride)	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	PCDD/PCDF	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	PCB	OK	OK	OK		OK		OK		OK	OK	29	29	29	29	29	29
	Hexavalent chromium	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	Metals	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	Total sulfur (as S)	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	Density	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK
	pH	OK	OK	OK		OK		OK		OK	OK	OK	OK	OK	OK	OK	OK

TABLE A4-2. SAMPLING AND ANALYTICAL PROBLEMS IDENTIFIED BY THE INTERNAL QA/QC ACTIVITIES (continued)

Sample location	Analytes	Test Condition #1			Test Condition #2				Test Condition #3		
		Run #1 12-Oct-92	Run #2 17-Oct-92	Run #3 19-Oct-92	Run #1 1-Dec-92		Run #2 7-Dec-92		Run #1 24-Oct-92	Run #2 26-Oct-92	Run #3 28-Oct-92
					BOR	EOR	BOR	EOR			
SS24	VOC				OK	OK	OK	OK			
	CP, CB				OK	OK	OK	OK			
	PAH				35	35	35	35			
	PCDD/PCDF				46	OK	OK	OK			
	PCB				OK	OK	OK	OK			
	Organic halogens (as chloride)				3	OK	54	3			
	Inorganic halogens (as chloride)				OK	OK	OK	OK			
	Metals				OK	OK	OK	OK			
	Total sulfur (as S)				OK	OK	OK	OK			
	Ash				OK	OK	OK	OK			
	Total organic carbon				OK	OK	54	OK			
	Hexavalent chromium				OK	OK	OK	OK			

TABLE A4-2b. KEY TO ANNOTATED TABLES

Footnote Number	Description	Corrective Action
1	Surrogate recoveries for the acid compounds were below quality control limits. This was caused by harsh conditions during the extraction procedure. CP for these samples should be considered estimates.	Flag CP as estimates. Possible low bias.
2	Exhibited low internal standard areas resulting in high surrogate recoveries due to matrix effect; sample was run twice to confirm matrix effect.	Flag VOC results as estimates. Possible high bias.
3	Samples analyzed or extracted out of holding time.	Flag all results as estimates. Results may be low.
4	Analysis not performed due to insufficient sample volume, analytes low on priority list. Field clearance from FW and EPA.	None; delete from completeness objective.
5	Analysis for total halogens (as Cl)	Adjust results sheet.
6	Sample diluted with 1 liter of DI water.	Correct data before reporting.
7	Samples were not spiked with surrogates before extraction.	Flag CB, CP, and PAH data. Accuracy based on internal standard recoveries.
8	Benzene saturation, very low or no internal standards detected. Results calculated from external standard method. Possible loss of all halogenated compounds due to matrix. All data qualitative (tube pairs affected).	Flag all VOC data and omit from any averaging. Results for halogenated compounds may be low.
9	Leaky autosampler caused a system failure. Data lost. Results should be considered qualitative (tube pairs affected).	Flag all VOC data and omit from any averaging.
10	Valve and line contamination from high concentrations in previous samples. Benzene, dichlorobenzene, bromoform initial calibration failure. Results for these compounds are estimates (tube pairs affected).	Flag benzene, dichlorobenzene, bromoform as estimates.
11	Broken tube, no data (tube pairs affected).	Lost VOC data.
12	High 1,2-dichloroethane-d4 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible high bias.
13	High toluene-d8 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible high bias.
14	High 4-bromoflourobenzene surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible high bias.
15	Low 1,2-dichloroethane-d4 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible low bias.
16	Low toluene-d8 surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible low bias.
17	Low 4-bromoflourobenzene surrogate failure due to unknown matrix interferences (tube pairs affected).	Flag VOC data. Possible low bias.
18	Tubes mixed between SS16 and SS14, sampled twice (tube pairs affected).	Lost VOC data.
19	Filter ripped.	Flag particulate results as estimate.
20	Post-test leak rate of 0.075 cfm.	Data for metals and particulate corrected for leak (7.1% of total sample volume).
21	Filters not weighed before digestion.	Lost particulate data. Did not meet completeness objective for particulate.
22	Faulty photomultiplier tube - Hg results questionable.	Flag Hg results.
23	NOx drift beyond control limits, data corrected for drift.	Data corrected for drift.
24	Mislabeled sample prep date, sample run out of holding time	Flag data as estimates. Results may be low.
25	Heating value analysis indicated only 66% propane, which is unreasonable. Heating value for propane from vendor was used instead.	Flag C1-C6 hydrocarbon results.
26	OCDD found in method blanks.	Flag OCDD results. Results may be high.
27	Contains a large peak with a retention time of 24.13 minutes, reported as EMPC for the tetra- and penta-. Naphthalene peak occurs at the same retention time, suggesting that these EMPC are due to naphthalene interference.	Flag penta- and tetra- results. Possible high bias due to interference from naphthalene.
28	The MS/MSD conducted on this matrix resulted in low recoveries for mono- through deca- and low precision for tri- and penta-.	Flag SS12 C3 PCB results. Possible low bias and low precision.
29	The MS/MSD conducted on this matrix resulted in low recoveries for mono-, penta-, and deca-, and low precision for mono-.	Flag SS22 C3 PCB results. Possible low bias and low precision.

TABLE A4-2b. KEY TO ANNOTATED TABLES (continued)

Footnote Number	Description	Corrective Action
30	Did not meet organic halogen precision objective.	Flag SS1 and SS18 organic halogens. Low precision.
31	Did not meet sulfur precision objective.	Flag SS1 and SS18 total sulfur. Low precision.
32	Did not meet hydrogen precision objective.	Flag SS2 hydrogen. Low precision.
33	Did not meet CO2 accuracy or precision objectives.	Flag SS9 and SS14 CO2 results. Accuracy and precision did not meet objectives.
34	MS/MSD for this matrix resulted in low recoveries for acid compounds 4-nitrophenol and pentachlorophenol. Acid surrogate recoveries were also low due to matrix effect. Flag CP as estimates for this matrix.	Flag CP results as estimates for SS1. Possible low bias.
35	This matrix contained high concentrations of phenol and pyrene. MS/MSD recoveries for these two compounds could not be calculated due to relatively low spike level. 4-nitrophenol spike was below detection due to high dilution.	Flag SS11 PAH data. Accuracy and precision not documented.
36	This matrix contained high concentrations of acenaphthene and pyrene. MS/MSD recoveries for these two compounds could not be calculated due to relatively low spike level.	Flag SS12 PAH data. Accuracy and precision not documented.
37	Spiking levels in MS and MSD samples for the condition 1 matrix were too low compared to high concentrations of acenaphthene and pyrene. Percent recoveries for these two compounds could not be calculated. 4-nitrophenol spike was below detection due to high dilution.	Flag SS22 PAH data. Accuracy and precision not documented.
38	High level of benzene saturated column resulting in poor repeatability.	Flag SS11 C3 VOC data. Low precision.
39	Benzene in the MS/MSD and corresponding sample saturated the detector, causing poor repeatability.	Flag SS12 C3 data. Low precision.
40	Metals Train Field Blank contamination.	Flag results. Results may by high due to high background levels.
41	Did not meet PAH SS16 accuracy objective.	Flag SS16 PAH data. Low accuracy.
42	Low internal standards recoveries but surrogate recoveries were acceptable; data are considered good estimate (pairs affected).	Flag VOC data as good estimates.
43	No field blank data; data system fault.	Background levels are unknown; flag VOC data.
44	Benzene saturation and high levels of toluene. Internal standards were suppressed and many compounds were unidentifable. High surragote recoveries due to the suppressed IS.	Flag data as qualitative only. Probable high bias.
45	Internal standards failed to meet minimum area requirements, causing high surrogate recoveries.	Flag VOC data as estimates. Possible high bias.
46	High levels of native OCDD saturated the detector signal. This should be regarded as the minimum possible concentration.	Flag OCDD as minimum amount.
47	Laboratory blank was contaminated from previous sample that eluted through gel-permeation clean-up.	Flag PAH data as high due to contamination.
48	The low surrogate recoveries and corresponding analyte levels were due to the material absorbing to the precipitate that formed in the extract.	Flag PCB data. Possible low bias.
49	Method blank contained detections for tri- and tetra- above 10% of the sample value.	Flag PCB tri and tetra data. Results may be statistically insignificant.
50	Field duplicate yielded low precision due to high concentrations and poor repeatability.	Flag SS3 PCB data. Low precision.
51	Field duplicate yielded low precision due to high levels of native analytes, resulting in poor repeatability.	Flag VOC SS3 data. Low precision.
52	MSD resulted in high pyrene recoveries. This one result did not meet the precision objective.	Flag SS3 PAH data. Low precision and possible high bias for pyrene.
53	Peak response shift due to matrix interference, high saturation, poorly resolved peaks, coeluting interferences.	Flag PCDD/PCDF data as estimates.
54	Sample not analyzed.	Flag data.

TABLE A4-3. SS16 SVOC QA BLANK RESULTS

PCB	Proof blank (µg)		Field blank (µg)	
SS16				
TOTAL MONO PCB	ND	0.001	ND	0.003
TOTAL DI PCB	EMPC/B	0.40	EMPC	0.100
TOTAL TRI PCB	EMPC/B	0.21	ND	0.080
TOTAL TETRA PCB	ND	0.001	ND	0.008
TOTAL PENTA PCB	ND	0.001	EMPC	0.020
TOTAL HEXA PCB	ND	0.001	ND	0.010
TOTAL HEPTA PCB	ND	0.001		0.020
TOTAL OCTA PCB	ND	0.001	ND	0.001
TOTAL NONA PCB	ND	0.001	ND	0.010
DECA PCB	ND	0.001	ND	0.040
TOTAL PCB		N/A		0.020
TOTAL PCB + EMPC		0.61		0.140
Minimum				**0.001**
Maximum				**0.140**
Average				**0.038**

ND - Not detected
EMPC - Estimated maximum possible concentration
N/A - Not applicable
B - Method blank contains levels greater than 20%

TABLE A4-3. SS16 SVOC QA BLANK RESULTS (continued)

PCDD/PCDF	Proof blank (ng)		Field blank (ng)	
SS16				
2378 TCDD	ND	0.01	ND	0.008
12378 PeCDD	ND	0.02	ND	0.010
123478 HxCDD	ND	0.02	ND	0.008
123678 HxCDD	ND	0.01	ND	0.005
123789 HxCDD	ND	0.02	ND	0.008
1234678 HpCDD	ND	0.02	E/B	0.040
OCDD		0.49	B	0.610
2378 TCDF		0.02	ND	0.005
12378 PeCDF	ND	0.01	ND	0.008
23478 PeCDF	ND	0.01	ND	0.008
123478 HxCDF	ND	0.02	ND	0.005
123678 HxCDF	ND	0.01	ND	0.005
234678 HxCDF	ND	0.02	E	0.006
123789 HxCDF	ND	0.02	ND	0.008
1234678 HpCDF	ND	0.01	ND	0.005
1234789 HpCDF	ND	0.02	ND	0.008
OCDF	ND	0.02	ND	0.010
TOTAL TCDD	ND	0.01	ND	0.008
TOTAL PeCDD	ND	0.02	ND	0.010
TOTAL HxCDD	ND	0.02	ND	0.008
TOTAL HpCDD	ND	0.02		0.030
TOTAL TCDF		0.08	ND	0.005
TOTAL PeCDF	ND	0.01	ND	0.008
TOTAL HxCDF	ND	0.01	E	0.005
TOTAL HpCDF	ND	0.01	ND	0.005
Minimum		**0.010**		**0.005**
Maximum		**0.490**		**0.610**
Average		**0.037**		**0.033**

ND - Not detected
E - Estimated
B - Method blank contains levels greater than 20%

TABLE A4-3. SS16 SVOC QA BLANK RESULTS (continued)

PAH	Proof blank (µg)		Field blank (µg)	
SS16				
Naphthalene	ND	0.13	E	15.98
2-Methylnaphthalene	ND	0.21	ND	3.68
2-Cl-Naphthalene	ND	0.27	ND	3.58
Acenaphthylene	ND	0.17	ND	2.75
Acenapthene	ND	0.29	ND	3.84
Fluorene	ND	0.22	ND	3.54
Phenanthrene	ND	0.17	ND	2.06
Anthracene	ND	0.16	ND	2.19
Fluoranthene	ND	0.13	ND	2.07
Pyrene	ND	0.17	ND	1.91
Benzo (a) anthracene	ND	0.20	ND	2.44
Chrysene	ND	0.20	ND	2.63
Benzo (b) fluoranthene	ND	0.25	ND	2.54
Benzo (k) fluoranthene	ND	0.24	ND	2.37
Benzo (e) pyrene	ND	0.27	ND	2.70
Benzo (a) pyrene	ND	0.28	ND	2.77
Perylene	ND	0.31	ND	2.76
Indeno (1,2,3-cd) pyrene	ND	0.44	ND	3.08
Dibenz (a,h) anthracene	ND	0.42	ND	3.20
Benzo (g,h,i) perylene	ND	0.38	ND	3.04
Minimum				**1.91**
Maximum				**15.98**
Average				**3.46**

ND - Not detected
E - Estimated

TABLE A4-3. SS16 SVOC QA BLANK RESULTS
(continued)

CB, CP	Field blank (µg)	
SS16		
2-CHLOROPHENOL	ND	8.27
3/4 CHLOROPHENOL	ND	5.88
1,3 DICHLOROBENZENE	ND	7.08
1,4 DICHLOROBENZENE	ND	6.96
1,2 DICHLOROBENZENE	ND	6.73
2,4 DICHLOROPHENOL	ND	7.80
1,2,3,5-TETRACHLOROBENZENE	ND	4.82
1,2,4,5-TETRACHLOROBENZENE	ND	4.82
1,2,3-TRICHLOROBENZENE	ND	6.43
1,3,5-TRICHLOROBENZENE	ND	6.93
2,3 DICHLOROPHENOL	ND	8.27
2,5 DICHLOROPHENOL	ND	8.75
2,6 DICHLOROPHENOL	ND	7.49
1,2,4-TRICHLOROBENZENE	ND	7.02
1,2,3,4-TETRACHLOROBENZENE	ND	5.88
2,3,4,5-TETRACHLOROPHENOL	ND	8.18
2,3,4 TRICHLOROPHENOL	ND	9.34
2,3,5,6-TETRACHLOROPHENOL	ND	9.76
2,3,5 TRICHLOROPHENOL	ND	10.53
2,3,6 TRICHLOROPHENOL	ND	9.67
3,4 DICHLOROPHENOL	ND	7.83
3,5 DICHLOROPHENOL	ND	7.00
2,4,6 TRICHLOROPHENOL	ND	10.09
2,4,5 TRICHLOROPHENOL	ND	9.77
PENTACHLOROBENZENE	ND	5.59
HEXACHLOROBENZENE	ND	5.61
PENTACHLOROPHENOL	ND	10.19
Minimum		**4.82**
Maximum		**10.53**
Average		**7.66**

ND = Not detected

TABLE A4-4. SS16 SVOC METHOD BLANK RESULTS

PCB Condition and run	METHOD BLANK RESULTS (µg)															
	C1R1		C1R2		C1R3		C2R1		C2R2		C3R1		C3R2		C3R3	
TOTAL MONO PCB	ND	0.02	ND	0.003	ND	0.003	ND	0.005	ND	0.04	ND	0.003	ND	0.003	ND	0.01
TOTAL DI PCB	EMPC	0.63	ND	0.003	EMPC	0.320	EMPC	0.040		0.30	EMPC	0.260	EMPC	0.260	EMPC	0.51
TOTAL TRI PCB	EMPC	0.36	ND	0.005	EMPC	0.200	ND	0.008	EMPC	0.20	ND	0.008	ND	0.008	EMPC	0.32
TOTAL TETRA PCB	ND	0.04	ND	0.008	ND	0.008	ND	0.010	ND	0.10	ND	0.010	ND	0.010	ND	0.02
TOTAL PENTA PCB	ND	0.06	EMPC	0.020	ND	0.010	EMPC	0.080	ND	0.20	EMPC	0.060	EMPC	0.060	ND	0.03
TOTAL HEXA PCB	ND	0.06	ND	0.008	ND	0.008	ND	0.020	ND	0.20	ND	0.020	ND	0.020	ND	0.20
TOTAL HEPTA PCB	ND	0.06	ND	0.008	ND	0.008	ND	0.010	ND	0.10	ND	0.010	ND	0.010	ND	0.02
TOTAL OCTA PCB	ND	0.05	ND	0.008	ND	0.008	ND	0.020	ND	0.10	ND	0.010	ND	0.010	ND	0.02
TOTAL NONA PCB	ND	0.07	ND	0.010	ND	0.010	ND	0.010	ND	0.10	ND	0.010	ND	0.010	ND	0.04
DECA PCB	ND	0.30	ND	0.040	ND	0.040	ND	0.050	ND	0.50	ND	0.050	ND	0.050	ND	0.20
TOTAL PCB	N/A		N/A		N/A		N/A			0.30	N/A		N/A		N/A	
TOTAL PCB + EMPC		0.99		0.020		0.520		0.120		0.50		0.330		0.330		0.83

ND - Not detected
EMPC - Estimated maximum possible concentration
N/A - Not available

TABLE A4-4. SS16 SVOC METHOD BLANK RESULTS (continued)

PCDD / PCDF Condition and run	METHOD BLANK RESULTS (ng)																	
	C1R1		C1R2		Dup C1R2		C1R3		C2R1		Dup C2R1		C2R2		SS19 C2R2		C3R1/R2		C3R3	
2378 TCDD	ND	0.003	ND	0.02	ND	0.02	ND	0.03	ND	0.01	NA		ND	0	NA		ND	0.01	ND	0.008
12378 PeCDD	ND	0.003	ND	0.03	ND	0.01	ND	0.04	ND	0.02	NA		ND	0.1	NA		ND	0.01	ND	0.01
123478 HxCDD	ND	0.008	ND	0.03	ND	0.01	ND	0.04	ND	0.02	ND	0.2	ND	0.1	ND	0.5	ND	0.02	ND	0.01
123678 HxCDD	ND	0.005	ND	0.02	ND	0.008	ND	0.03	ND	0.01	ND	0.2	ND	0.1	ND	0.4	ND	0.01	ND	0.01
123789 HxCDD	ND	0.008	ND	0.03	ND	0.01	ND	0.04	ND	0.02	ND	0.2	ND	0.1	ND	0.4	ND	0.01	ND	0.01
1234678 HpCDD	E	0.02	E	0.09		0.04		0.05	ND	0.02	ND	0.4	ND	0.1	ND	0.6		0.03	ND	0.02
OCDD		0.37		1.9		0.53		0.44		0.4	E	0.8		0.4	ND	0.9		0.36		0.21
2378 TCDF		0.03	ND	0.01	ND	0.01	E	0.02	ND	0.01	NA		ND	0	NA		ND	0.008	ND	0.005
12378 PeCDF	ND	0.005	ND	0.02	ND	0.01		0.03	ND	0.01	NA		ND	0	NA		ND	0.01	ND	0.008
23478 PeCDF	ND	0.005	ND	0.02	ND	0.01	ND	0.03	ND	0.01	NA		ND	0	NA		ND	0.01	ND	0.008
123478 HxCDF	ND	0.005	ND	0.02	ND	0.08	ND	0.03	ND	0.01	ND	0.1	ND	0	ND	0.3	ND	0.01	ND	0.01
123678 HxCDF	ND	0.003	ND	0.01	ND	0.05	ND	0.02	ND	0.01	ND	0.1	ND	0	ND	0.2	ND	0.008	ND	0.008
234678 HxCDF	ND	0.005	ND	0.02	E	0.01	ND	0.03	ND	0.01	ND	0.1	ND	0	ND	0.3	E	0.01	ND	0.008
123789 HxCDF	ND	0.005	ND	0.02	ND	0.01	ND	0.03	ND	0.01	ND	0.2	ND	0.1	ND	0.4	ND	0.01	ND	0.01
1234678 HpCDF	ND	0.005	ND	0.02	ND	0.008	ND	0.02	ND	0.01	ND	0.2	ND	0	ND	0.3	ND	0.01	ND	0.008
1234789 HpCDF	ND	0.008	ND	0.03	ND	0.01	ND	0.04	ND	0.02	ND	0.3	ND	0.1	ND	0.5	ND	0.02	ND	0.02
OCDF		0.01	ND	0.04	ND	0.02	ND	0.04	ND	0.03	ND	0.4	ND	0.1	ND	0.8	ND	0.02	ND	0.02
TOTAL TCDD		0.06	ND	0.02	ND	0.02	ND	0.03	ND	0.01	NA		ND	0	NA		ND	0.01	ND	0.008
TOTAL PeCDD	ND	0.008	ND	0.03	ND	0.01	ND	0.04	ND	0.02	NA		ND	0.1	NA		ND	0.01	E	0.02
TOTAL HxCDD	ND	0.008	ND	0.02	ND	0.01	ND	0.03	ND	0.01	ND	0.2	ND	0.1	ND	0.4	ND	0.01	E	0.06
TOTAL HpCDD	E	0.02		0.07		0.07		0.05	ND	0.02	ND	0.4	ND	0.1	ND	0.6		0.05	ND	0.02
TOTAL TCDF		0.13	ND	0.01	ND	0.01	E	0.02	ND	0.01	NA		ND	0	NA		ND	0.008	ND	0.005
TOTAL PeCDF	E	0.006	ND	0.02	ND	0.01	ND	0.03	ND	0.01	NA		ND	0	NA		ND	0.01	ND	0.008
TOTAL HxCDF	ND	0.005	ND	0.02	E	0.01	ND	0.03	ND	0.01	ND	0.1	ND	0	ND	0.3	E	0.01	ND	0.008
TOTAL HpCDF	ND	0.005	ND	0.02	ND	0.008	ND	0.03	ND	0.01	ND	0.2	ND	0.1	ND	0.3	ND	0.01	ND	0.01

ND - Not detected
E - Estimated
NA - Not available

TABLE A4-4. SS16 SVOC METHOD BLANK RESULTS (continued)

PAH Condition and run	METHOD BLANK RESULTS (µg)													
	C1R1		C1R2		C1R3		C2R1		C2R2		C3R1		C3R3	
Naphthalene	E	384.27	E	27.31	E	3.10	E	3.49	ND	0.53	ND	5.40	ND	0.57
2-Methylnaphthalene	ND	0.80	ND	3.36	ND	0.95	ND	0.74	ND	0.74	ND	6.73	ND	0.75
2-Cl-Naphthalene	ND	1.05	ND	2.96	ND	0.71	ND	1.00	ND	0.93	ND	7.36	ND	0.73
Acenaphthylene	ND	0.65	ND	2.27	ND	0.55	ND	0.64	ND	0.59	ND	4.90	ND	0.47
Acenapthene	ND		ND	3.17	ND	0.74	ND	1.03	ND	0.95	ND	7.41	ND	0.83
Fluorene	ND	0.97	ND	2.92	ND	0.67	ND	0.85	ND	0.79	ND	6.52	ND	0.63
Phenanthrene	ND	0.69	ND	1.95	ND	0.45	ND	0.52	ND	0.43	ND	4.39	ND	0.44
Anthracene	ND	0.68	ND	2.07	ND	0.51	ND	0.50	ND	0.41	ND	4.23	ND	0.44
Fluoranthene	ND	0.52	ND	1.96	ND	0.45	ND	0.36	ND	0.29	ND	4.09	ND	0.47
Pyrene	ND	0.56	ND	2.20	ND	0.43	ND	0.33	ND	0.19	ND	4.73	ND	0.58
Benzo (a) anthracene	ND	0.60	ND	2.80	ND	0.53	ND	0.29	ND	0.17	ND	6.58	ND	0.75
Chrysene	ND	0.65	ND	3.02	ND	0.57	ND	0.31	ND	0.18	ND	7.46	ND	0.82
Benzo (b) fluoranthene	ND	0.53	ND	3.32	ND	0.51	ND	0.23	ND	0.14	ND	8.05	ND	1.18
Benzo (k) fluoranthene	ND	0.53	ND	3.09	ND	0.48	ND	0.23	ND	0.14	ND	7.93	ND	1.24
Benzo (e) pyrene	ND	0.54	ND	3.53	ND	0.55	ND	0.24	ND	0.15	ND	7.80	ND	1.20
Benzo (a) pyrene	ND	0.57	ND	3.62	ND	0.54	ND	0.25	ND	0.15	ND	7.96	ND	1.29
Perylene	ND	0.66	ND	3.61	ND	0.56	ND	0.34	ND	0.21	ND	8.44	ND	1.90
Indeno (1,2,3-cd) pyrene	ND	0.55	ND	4.03	ND	0.58	ND	0.21	ND	0.13	ND	6.61	ND	1.73
Dibenz (a,h) anthracene	ND	0.64	ND	4.19	ND	0.62	ND	0.25	ND	0.15	ND	7.48	ND	1.74
Benzo (g,h,i) perylene	ND	0.59	ND	3.97	ND	0.56	ND	0.23	ND	0.14	ND	7.25	ND	1.63

ND = Not detected; E = Estimated

TABLE A4-4. SS16 SVOC METHOD BLANK RESULTS (continued)

CB/CP Condition and run	METHOD BLANK RESULTS (µg)							
	C1R1	C1R2	C1R3	C2R1	C2R2	C3R1	C3R2	C3R3
2-CHLOROPHENOL	ND 3.94	ND 7.62	ND 2.02	ND 4.85	ND 4.27	ND 1.95	ND 1.95	ND 0.35
3/4 CHLOROPHENOL	ND 3.42	ND 5.42	ND 0.88	ND 2.44	ND 2.15	ND 0.40	ND 0.40	ND 0.07
1,3 DICHLOROBENZENE	ND 3.01	ND 6.52	ND 1.57	ND 4.49	ND 3.95	ND 1.77	ND 1.77	ND 0.32
1,4 DICHLOROBENZENE	ND 3.05	ND 6.41	ND 1.57	ND 4.48	ND 3.94	ND 1.79	ND 1.79	ND 0.32
1,2 DICHLOROBENZENE	ND 3.24	ND 6.20	ND 1.59	ND 4.55	ND 4.01	ND 1.85	ND 1.85	ND 0.33
2,4 DICHLOROPHENOL	ND 4.25	ND 7.12	ND 1.84	ND 5.58	ND 4.97	ND 1.64	ND 1.64	ND 0.27
1,2,3,5-TETRACHLOROBENZENE	ND 2.32	ND 4.40	ND 0.56	ND 3.14	ND 2.79	ND 0.78	ND 0.78	ND 0.26
1,2,4,5-TETRACHLOROBENZENE	ND 2.32	ND 4.40	ND 0.56	ND 3.58	ND 3.18	ND 0.78	ND 0.78	ND 0.26
1,2,3-TRICHLOROBENZENE	ND 2.95	ND 5.87	ND 1.33	ND 5.06	ND 4.50	ND 1.78	ND 1.78	ND 0.30
1,3,5-TRICHLOROBENZENE	ND 3.08	ND 6.33	ND 1.50	ND 4.64	ND 4.13	ND 1.63	ND 1.63	ND 0.27
2,3 DICHLOROPHENOL	ND 3.73	ND 7.55	ND 1.94	ND 7.15	ND 6.37	ND 1.96	ND 1.96	ND 0.33
2,5 DICHLOROPHENOL	ND 4.07	ND 7.98	ND 2.02	ND 6.01	ND 5.36	ND 2.05	ND 2.05	ND 0.34
2,6 DICHLOROPHENOL	ND 3.69	ND 6.84	ND 1.73	ND 5.50	ND 4.89	ND 0.74	ND 0.74	ND 0.12
1,2,4-TRICHLOROBENZENE	ND 2.91	ND 6.41	ND 1.52	ND 4.69	ND 4.17	ND 1.64	ND 1.64	ND 0.27
1,2,3,4-TETRACHLOROBENZENE	ND 2.08	ND 4.85	ND 1.63	ND 4.14	ND 3.53	ND 1.66	ND 1.66	ND 0.30
2,3,4,5-TETRACHLOROPHENOL	ND 3.46	ND 6.75	ND 1.81	ND 5.75	ND 4.90	ND 1.86	ND 1.86	ND 0.33
2,3,4 TRICHLOROPHENOL	ND 3.74	ND 7.71	ND 1.81	ND 7.16	ND 6.09	ND 2.40	ND 2.40	ND 0.43
2,3,5,6-TETRACHLOROPHENOL	ND 4.51	ND 8.06	ND 1.85	ND 5.69	ND 4.85	ND 3.00	ND 3.00	ND 0.54
2,3,5 TRICHLOROPHENOL	ND 4.26	ND 8.69	ND 1.78	ND 7.00	ND 5.96	ND 2.62	ND 2.62	ND 0.47
2,3,6 TRICHLOROPHENOL	ND 3.61	ND 7.99	ND 1.44	ND 6.77	ND 5.77	ND 2.33	ND 2.33	ND 0.42
3,4 DICHLOROPHENOL	ND 3.31	ND 6.46	ND 1.45	ND 6.87	ND 5.85	ND 1.83	ND 1.83	ND 0.33
3,5 DICHLOROPHENOL	ND 2.96	ND 5.78	ND 1.80	ND 6.23	ND 5.30	ND 0.77	ND 0.77	ND 0.14
2,4,6 TRICHLOROPHENOL	ND 3.84	ND 8.33	ND 1.80	ND 7.05	ND 6.00	ND 2.36	ND 2.36	ND 0.42
2,4,5 TRICHLOROPHENOL	ND 3.94	ND 8.06	ND 1.81	ND 7.27	ND 6.19	ND 2.11	ND 2.11	ND 0.38
PENTACHLOROBENZENE	ND 2.06	ND 4.62	ND 1.03	ND 3.23	ND 2.75	ND 1.69	ND 1.69	ND 0.30
HEXACHLOROBENZENE	ND 2.25	ND 5.30	ND 1.17	ND 3.02	ND 2.75	ND 2.27	ND 2.27	ND 0.39
PENTACHLOROPHENOL	ND 5.30	ND 9.64	ND 2.65	ND 6.65	ND 6.04	ND 5.18	ND 5.18	ND 0.88

ND - Not detected

TABLE A4-5. SS16 SVOC SURROGATE RECOVERIES

Sample ID	SURROGATE RECOVERY (%)				
	37Cl-2,3,7,8-TCDD	13C12-2,3,4,7,8-PeCDF	13C12-1,2,3,4,7,8-HxCDF	13C12-1,2,3,4,7,8-HxCDD	13C12-1,2,3,4,7,8,9-HpCDF
SS16					
Condition 1					
Run 1	102	102	116	116	101
Run 2	115	115	121	124	119
Run 3	1.33	2.48	2.03	1.43	2.45
Average	**72.78**	**73.16**	**79.68**	**80.48**	**74.15**
RSD %	**85.49**	**84.14**	**84.45**	**85.21**	**84.62**
SS16					
Condition 2					
Run 1	120	117	113	118	147
Run 2	117	107	116	117	125
Average	**118.50**	**112.00**	**114.50**	**117.50**	**136.00**
RPD %	**2.53**	**8.93**	**2.62**	**0.85**	**16.18**
SS16					
Condition 3					
Run 1	82.2	97.9	92.4	118	96.7
Run 2	73.2	87	91.9	130	97.1
Run 3	94	119	131	106	122
Average	**83.13**	**101.30**	**105.10**	**118.00**	**105.27**
RSD %	**12.55**	**16.06**	**21.34**	**10.17**	**13.77**

TABLE A4-5. SS16 SVOC SURROGATE RECOVERIES (continued)

Sample ID		SURROGATE RECOVERY (%) Terphenyl-D14
SS16		
	Condition 1	
	Run 1	87.50
	Run 2	70.90
	Run 3	64.40
	Average	**74.27**
	RSD %	**16.04**
SS16		
	Condition 2	
	Run 1	56.30
	Run 2	58.20
	Average	**57.25**
	RSD %	**2.35**
SS16	**Condition 3**	
	Run 1	63.10
	Run 2	58.70
	Run 3	92.70
	Average	**71.50**
	RSD %	**25.86**

TABLE A4-6 SS16 SVOC INTERNAL STANDARD RECOVERIES

Sample ID	INTERNAL STANDARD RECOVERY (%)	
	3434-13C PCB	2233556613C PCB
SS16		
Condition 1		
Run 1	37.40	29.80
Run 2	83.00	57.40
Run 3	134.00	102.00
Average	**84.80**	**63.07**
RSD %	**56.99**	**57.77**
Condition 2		
Run 1	89.40	79.80
Run 2	45.80	46.00
Average	**67.60**	**62.90**
RPD %	**64.50**	**53.74**
Condition 3		
Run 1	105.00	103.00
Run 2	114.00	116.00
Run 3	154.00	116.00
Average	**124.33**	**111.67**
RSD %	**20.98**	**6.72**

TABLE A4-6. SS16 SVOC INTERNAL STANDARD RECOVERIES (continued)

SAMPLE ID	INTERNAL STANDARD RECOVERY (%)								
	13C12- 2,3,7,8-TCDD	13C12- 1,2,3,7,8-PeCDD	13C12- 1,2,3,6,7,8-HxCDD	13C12- 1,2,3,4,6,7,8-HpCDD	13C12- OCDD	13C12- 2,3,7,8-TCDF	13C12- 1,2,3,7,8-PeCDF	13C12- 1,2,3,6,7,8-HxCDF	13C12- 1,2,3,4,6,7,8-HpCDF
SS16									
Condition 1									
Run 1	84.1	73.9	98.1	113	89.8	91.3	75.5	93.3	101
Run 2	51.3	59.8	74.4	79.6	63.1	50.8	54.7	64.1	71.7
Run 3	79.7	125	93.5	103	103	81.4	94	77.5	85.7
Average	71.70	86.23	88.67	98.53	85.30	74.50	74.73	78.30	86.13
RSD %	24.83	39.78	14.17	17.40	23.83	28.34	26.31	18.67	17.01
Condition 2									
Run 1	68.6	71.5	77.2	72.4	61.5	72.5	66.5	72.4	63.7
Run 2	64	53.4	88.7	69	50.2	69.4	50.7	89.8	67.7
Average	66.30	62.45	82.95	70.70	55.85	70.95	58.60	81.10	65.70
RPD %	6.94	28.98	13.86	4.81	20.23	4.37	26.96	21.45	6.09
Condition 3									
Run 1	71.7	112	83.9	93.1	89.9	74.3	80.3	72	78.9
Run 2	65.2	97.5	90	93.2	80.6	70.9	74	71.1	75.5
Run 3	45.7	86.6	62.2	48.6	29.7	50.9	43.1	58.6	43.3
Average	60.87	98.70	78.70	78.30	66.73	65.37	65.80	67.23	65.90
RSD %	22.23	12.91	18.57	32.85	48.56	19.34	30.26	11.14	29.81

TABLE A4-6. SS16 SVOC INTERNAL STANDARD RECOVERIES (continued)

Sample ID	INTERNAL STANDARD RECOVERY (%) Pyrene-D10
SS16	
Condition 1	
Run 1	111.50
Run 2	94.70
Run 3	98.40
Average	**101.53**
RSD %	**8.69**
SS16	
Condition 2	
Run 1	52.00
Run 2	53.60
Average	**52.80**
RPD %	**3.03**
SS16	
Condition 3	
Run 1	62.20
Run 2	88.10
Run 3	104.50
Average	**84.93**
RSD %	**25.11**

TABLE A4-7. SS16 SVOC ALTERNATE STANDARD RECOVERIES

Sample ID	ALTERNATE STANDARD RECOVERY (%) 224455-13C HEXA
SS16	
Condition 1	
Run 1	24.60
Run 2	55.60
Run 3	85.80
Average	**55.33**
RSD %	**55.30**
Condition 2	
Run 1	86.80
Run 2	39.40
Average	**63.10**
RPD %	**75.12**
Condition 3	
Run 1	111.00
Run 2	113.00
Run 3	84.60
Average	**102.87**
RSD %	**15.41**

TABLE A4-7. SS16 SVOC ALTERNATE STANDARD RECOVERIES (continued)

Sample ID	ALTERNATE STANDARD RECOVERY (%)	
	13C12-1,2,3,7,8,9-HxCDF	13C12-2,3,4,6,7,8-HxCDF
SS16		
Condition 1		
Run 1	94.1	102
Run 2	74.2	83.9
Run 3	91.9	88.4
Average	**86.73**	**91.43**
RSD %	**12.58**	**10.31**
Condition 2		
Run 1	80.7	75.6
Run 2	92.1	90.5
Average	**86.40**	**83.05**
RPD %	**13.19**	**17.94**
Condition 3		
Run 1	93.2	81.4
Run 2	94.9	96.5
Run 3	59.5	62.2
Average	**82.53**	**80.03**
RSD %	**24.19**	**21.48**

TABLE A4-7. SS16 SVOC ALTERNATE STANDARD RECOVERIES (continued)

Sample ID	ALTERNATE STANDARD RECOVERY (%)		
	Nitrobenzene-D5	2-fluorobiphenyl	Anthracene-D10
SS16			
Condition 1			
Run 1	94.60	91.30	122.40
Run 2	82.40	79.60	96.20
Run 3	93.60	82.40	74.90
Average	**90.20**	**84.43**	**97.83**
RSD %	**7.51**	**7.24**	**24.32**
Condition 2			
Run 1	68.60	66.30	62.20
Run 2	56.80	57.60	47.10
Average	**62.70**	**61.95**	**54.65**
RPD %	**18.82**	**14.04**	**27.63**
Condition 3			
Run 1	47.40	48.20	86.40
Run 2	49.90	47.00	88.10
Run 3	77.20	58.50	76.20
Average	**58.17**	**51.23**	**83.57**
RSD %	**28.42**	**12.34**	**7.70**

TABLE A4-8. SS16 SVOC LCS/LCSD RESULTS

CB, CP	LC spike recovery (%)	LC spike duplicate recovery (%)	Average recovery (%)	Relative % difference
TOTAL MONO PCB	46.00	39.00	**42.50**	**16.47**
TOTAL DI PCB	75.00	68.00	**71.50**	**9.79**
TOTAL TRI PCB	79.30	72.00	**75.65**	**9.65**
TOTAL TETRA PCB	70.00	65.00	**67.50**	**7.41**
TOTAL PENTA PCB	95.10	80.90	**88.00**	**16.14**
TOTAL HEXA PCB	85.00	77.90	**81.45**	**8.72**
TOTAL HEPTA PCB	85.40	78.80	**82.10**	**8.04**
TOTAL OCTA PCB	87.30	80.20	**83.75**	**8.48**
TOTAL NONA PCB	76.00	72.00	**74.00**	**5.41**
DECA PCB	68.00	66.00	**67.00**	**2.99**
Minimum			**42.50**	**2.99**
Maximum			**88.00**	**16.47**
Average			**73.35**	**9.31**

PCB	LC spike (µg)	LC spike duplicate (µg)	Average recovery (µg)	Relative % difference
TOTAL MONO PCB	0.46	0.39	**0.43**	**16.47**
TOTAL DI PCB	0.75	0.68	**0.72**	**9.79**
TOTAL TRI PCB	0.84	0.72	**0.78**	**15.38**
TOTAL TETRA PCB	1.40	1.30	**1.35**	**7.41**
TOTAL PENTA PCB	2.00	1.70	**1.85**	**16.22**
TOTAL HEXA PCB	1.70	1.60	**1.65**	**6.06**
TOTAL HEPTA PCB	2.60	2.40	**2.50**	**8.00**
TOTAL OCTA PCB	2.70	2.50	**2.60**	**7.69**
TOTAL NONA PCB	3.80	3.60	**3.70**	**5.41**
DECA PCB	3.40	3.30	**3.35**	**2.99**
TOTAL PCB	19.60	18.20	**18.90**	**7.41**
TOTAL PCB + EMPC	22.80	21.10	**21.95**	**7.74**
Minimum			**0.43**	**2.99**
Maximum			**21.95**	**16.47**
Average			**4.98**	**9.21**

TABLE A4-8. SS16 SVOC LCS/LCSD RESULTS (continued)

CB, CP	LC spike recovery (%)	LC spike duplicate recovery (%)	Average recovery (%)	Relative % difference
2-CHLOROPHENOL	120.02	75.58	**97.80**	**45.44**
1,3 DICHLOROBENZENE	108.71	76.92	**92.82**	**34.25**
1,4 DICHLOROBENZENE	110.74	75.61	**93.18**	**37.70**
1,2 DICHLOROBENZENE	130.55	90.14	**110.35**	**36.62**
2,4 DICHLOROPHENOL	129.19	86.17	**107.68**	**39.95**
1,2,4-TRICHLOROBENZENE	125.58	83.32	**104.45**	**40.46**
2,4,6 TRICHLOROPHENOL	106.50	81.04	**93.77**	**27.15**
2,4,5 TRICHLOROPHENOL	110.90	88.60	**99.75**	**22.36**
HEXACHLOROBENZENE	116.99	100.06	**108.53**	**15.60**
Minimum			**92.82**	**15.60**
Maximum			**110.35**	**45.44**
Average			**100.92**	**33.28**

TABLE A4-8. SS16 SVOC LCS/LCSD RESULTS
(continued)

PCDD / PCDF	LC spike recovery (%)
2378 TCDD	115.00
12378 PeCDD	85.00
123478 HxCDD	120.00
123678 HxCDD	100.00
123789 HxCDD	88.00
1234678 HpCDD	102.00
OCDD	102.00
2378 TCDF	106.00
12378 PeCDF	109.00
23478 PeCDF	103.00
123478 HxCDF	99.00
123678 HxCDF	97.00
234678 HxCDF	87.00
123789 HxCDF	89.00
1234678 HpCDF	93.00
1234789 HpCDF	84.00
OCDF	105.00

TABLE 4-8. SS16 SVOC LCS/LCSD RESULTS (continued)

PAH	LC spike recovery (%)	LC spike duplicate recovery (%)	Average recovery (%)	Relative % difference
Naphthalene	88.10	70.32	**79.21**	**22.45**
2-Methylnaphthalene	84.70	73.74	**79.22**	**13.83**
2-Chloroaphthalene	86.64	75.03	**80.84**	**14.36**
Acenaphthylene	91.39	79.62	**85.51**	**13.77**
Acenapthene	86.12	75.74	**80.93**	**12.83**
Fluorene	89.54	80.86	**85.20**	**10.19**
Phenanthrene	96.04	92.12	**94.08**	**4.17**
Anthracene	92.75	85.20	**88.98**	**8.49**
Fluoranthene	110.28	111.56	**110.92**	**1.15**
Pyrene	96.52	92.29	**94.41**	**4.48**
Benzo (a) anthracene	97.05	89.82	**93.44**	**7.74**
Chrysene	98.45	90.81	**94.63**	**8.07**
Benzo (b) fluoranthene	94.92	93.82	**94.37**	**1.17**
Benzo (k) fluoranthene	94.59	96.14	**95.37**	**1.63**
Benzo (a) pyrene	93.64	96.00	**94.82**	**2.49**
Indeno (1,2,3-cd) pyrene	98.39	112.30	**105.35**	**13.20**
Dibenzo (a,h) anthracene	100.35	119.05	**109.70**	**17.05**
Benzo (g,h,i) perylene	98.48	110.16	**104.32**	**11.20**
Minimum			**79.21**	**1.15**
Maximum			**110.92**	**22.45**
Average			**92.85**	**9.35**

TABLE A4-8. SS16 SVOC LCS/LCSD RESULTS (continued)

PAH	LC spike recovery (%)		LC spike duplicate recovery (%)		Average recovery (%)	Relative % difference
Naphthalene	E	75.62	E	70.27	**72.95**	**7.33**
2-Methylnaphthalene	E	66.36	E	61.70	**64.03**	**7.28**
2-Chloroaphthalene	E	67.00	E	64.69	**65.85**	**3.51**
Acenaphthylene	E	70.92	E	68.65	**69.79**	**3.25**
Acenapthene	E	65.64	E	65.55	**65.60**	**0.14**
Fluorene	E	73.33	E	74.01	**73.67**	**0.92**
Phenanthrene	E	77.57	E	81.11	**79.34**	**4.46**
Anthracene	E	66.44	E	73.69	**70.07**	**10.35**
Fluoranthene	E	75.35	E	80.34	**77.85**	**6.41**
Pyrene	E	80.[illegible]	E	85.53	**82.84**	**6.51**
Benzo (a) anthracene	E	104.[illegible]	E	112.18	**108.11**	**7.54**
Chrysene	E	82.[illegible]	E	89.97	**86.23**	**8.69**
Benzo (b) fluoranthene	E	94.35	E	103.63	**98.99**	**9.37**
Benzo (k) fluoranthene	E	86.99	E	91.04	**89.02**	**4.55**
Benzo (a) pyrene	E	74.73	E	81.67	**78.20**	**8.87**
Indeno (1,2,3-cd) pyrene	E	73.12	E	28.03	**50.58**	**89.15**
Dibenzo (a,h) anthracene	E	42.18	E	72.53	**57.36**	**52.92**
Benzo (g,h,i) perylene	E	72.68	E	73.63	**73.16**	**1.30**
Minimum					**50.58**	**0.14**
Maximum					**108.11**	**89.15**
Average					**75.75**	**12.92**

E - Estimated

TABLE A4-9. SS16 SVOC DUPLICATE SUMMARY

CB, CP	Sample (µg)		Duplicate (µg)		Average (µg)	Relative % difference
SS16 C3R1						
TOTAL MONO PCB	ND	0.02	ND	0.01	**0.01**	**85.71**
TOTAL DI PCB	EMPC	1.20	EMPC	1.20	**1.20**	**0.00**
TOTAL TRI PCB	ND	0.03	ND	0.01	**0.02**	**100.00**
TOTAL TETRA PCB	EMPC	3.60	ND	0.02	**1.81**	**197.79**
TOTAL PENTA PCB	EMPC	0.42	EMPC	0.44	**0.43**	**4.65**
TOTAL HEXA PCB	ND	0.04	ND	0.02	**0.03**	**66.67**
TOTAL HEPTA PCB	ND	0.03	ND	0.02	**0.03**	**40.00**
TOTAL OCTA PCB	ND	0.03	ND	0.02	**0.03**	**40.00**
TOTAL NONA PCB	ND	0.03	ND	0.02	**0.03**	**40.00**
DECA PCB	ND	0.10	ND	0.07	**0.09**	**35.29**
TOTAL PCB	N/A		N/A			
TOTAL PCB + EMPC		5.20		1.70	**3.45**	**101.45**
Minimum					**0.01**	**0.00**
Maximum					**3.45**	**197.79**
Average					**0.65**	**64.69**

ND - Not detected; EMPC - Estimated maximun possible concentration
N/A - Not available

TABLE A4-9. SS16 SVOC DUPLICATE SUMMARY (continued)

PCDD / PCDF	Field sample (ng)	Field sample duplicate (ng)	Average (ng)	Relative % difference
C3R1: SS16				
2378 TCDD	ND	ND		
12378 PeCDD	ND	ND		
123478 HxCDD	ND	ND		
123678 HxCDD	0.01	0.01	**0.01**	**33.33**
123789 HxCDD	0.01	0.01	**0.01**	**13.33**
1234678 HpCDD	0.06	0.05	**0.05**	**5.50**
OCDD	0.51	0.5	**0.51**	**0.79**
2378 TCDF	0.02	0.02	**0.02**	**24.39**
12378 PeCDF	0.02	0.02	**0.02**	**5.71**
23478 PeCDF	0.01	0.01	**0.01**	**0.00**
123478 HxCDF	0.03	0.03	**0.03**	**3.92**
123678 HxCDF	0.01	0.01	**0.01**	**26.09**
234678 HxCDF	0.02	0.02	**0.02**	**15.38**
123789 HxCDF	ND	0.01		
1234678 HpCDF	0.05	0.05	**0.05**	**1.94**
1234789 HpCDF	0.01	0.01	**0.01**	**10.53**
OCDF	0.05	0.05	**0.05**	**0.00**
Minimum			**0.01**	**0.00**
Maximum			**0.51**	**33.33**
Average			**0.06**	**10.84**

ND - Not detected

TABLE A4-9. SS16 SVOC DUPLICATE SUMMARY (continued)

PAH	Field sample (µg)	Field sample duplicate (µg)	Average (µg)	Relative % difference
C3R1: SS16				
Naphthalene	ND 6.18	ND 6.73	**6.46**	**8.52**
2-Methylnaphthalene	ND 7.71	ND 8.40	**8.06**	**8.57**
2-Cl-Naphthalene	ND 8.60	ND 9.15	**8.88**	**6.20**
Acenaphthylene	ND 5.73	ND 6.09	**5.91**	**6.09**
Acenapthene	ND 8.66	ND 9.21	**8.94**	**6.16**
Fluorene	ND 7.62	ND 8.10	**7.86**	**6.11**
Phenanthrene	ND 5.21	ND 5.60	**5.41**	**7.22**
Anthracene	ND 5.02	ND 5.40	**5.21**	**7.29**
Fluoranthene	ND 4.86	ND 5.22	**5.04**	**7.14**
Pyrene	ND 5.09	ND 5.27	**5.18**	**3.47**
Benzo (a) anthracene	ND 7.07	ND 7.33	**7.20**	**3.61**
Chrysene	ND 8.03	ND 8.32	**8.18**	**3.55**
Benzo (b) fluoranthene	ND 7.97	ND 8.97	**8.47**	**11.81**
Benzo (k) fluoranthene	ND 7.85	ND 8.83	**8.34**	**11.75**
Benzo (e) pyrene	ND 7.73	ND 8.69	**8.21**	**11.69**
Benzo (a) pyrene	ND 7.89	ND 8.87	**8.38**	**11.69**
Perylene	ND 8.36	ND 9.40	**8.88**	**11.71**
Indeno (1,2,3-cd) pyrene	ND 6.55	ND 7.37	**6.96**	**11.78**
Dibenz (a,h) anthracene	ND 7.40	ND 8.33	**7.87**	**11.82**
Benzo (g,h,i) perylene	ND 7.18	ND 8.08	**8.88**	**11.82**
Minimum			**5.04**	**3.47**
Maximum			**8.94**	**11.82**
Average			**7.41**	**8.40**

ND - Not detected

TABLE A4-9. SS16 SVOC DUPLICATE SUMMARY (continued

PAH	Field sample (µg)		Field sample duplicate (µg)		Average (µg)	Relative % difference
C2R2: SS16						
Naphthalene	E	10.74	E	10.72	**10.73**	**0.19**
2-Methylnaphthalene	ND	0.73	ND	0.75	**0.74**	**2.70**
2-Cl-Naphthalene	ND	0.84	ND	0.84	**0.84**	**0.00**
Acenaphthylene	ND	0.53	ND	0.53	**0.53**	**0.00**
Acenapthene	ND	0.86	ND	0.86	**0.86**	**0.00**
Fluorene	ND	0.71	ND	0.71	**0.71**	**0.00**
Phenanthrene	ND	0.39	ND	0.39	**0.39**	**0.00**
Anthracene	ND	0.37	ND	0.38	**0.38**	**2.67**
Fluoranthene	ND	0.27	ND	0.27	**0.27**	**0.00**
Pyrene	ND	0.17	ND	0.17	**0.17**	**0.00**
Benzo (a) anthracene	ND	0.15	ND	0.15	**0.15**	**0.00**
Chrysene	ND	0.17	ND	0.16	**0.17**	**6.06**
Benzo (b) fluoranthene	ND	0.14	ND	0.14	**0.14**	**0.00**
Benzo (k) fluoranthene	ND	0.14	ND	0.14	**0.14**	**0.00**
Benzo (e) pyrene	ND	0.14	ND	0.14	**0.14**	**0.00**
Benzo (a) pyrene	ND	0.15	ND	0.15	**0.15**	**0.00**
Perylene	ND	0.21	ND	0.21	**0.21**	**0.00**
Indeno (1,2,3-cd) pyrene	ND	0.12	ND	0.12	**0.12**	**0.00**
Dibenz (a,h) anthracene	ND	0.15	ND	0.15	**0.15**	**0.00**
Benzo (g,h,i) perylene	ND	0.14	ND	0.14	**0.21**	**0.00**
Minimum					**0.12**	**0.00**
Maximum					**10.73**	**6.06**
Average					**0.86**	**0.58**

ND = Not detected; E = Estimated

TABLE A4-9. SS16 SVOC DUPLICATE SUMMARY (continued)

PAH	Field sample (µg)	Field sample duplicate (µg)	Average (µg)	Relative % difference
C2R1: SS16				
Naphthalene	E 8.20	E 8.25	**8.23**	**0.61**
2-Methylnaphthalene	ND 0.69	ND 0.77	**0.73**	**10.96**
2-Cl-Naphthalene	ND 0.82	ND 0.87	**0.85**	**5.92**
Acenaphthylene	ND 0.52	ND 0.55	**0.54**	**5.61**
Acenapthene	ND 0.84	ND 0.89	**0.87**	**5.78**
Fluorene	ND 0.70	ND 0.73	**0.72**	**4.20**
Phenanthrene	ND 0.40	ND 0.40	**0.40**	**0.00**
Anthracene	ND 0.38	ND 0.38	**0.38**	**0.00**
Fluoranthene	ND 0.27	ND 0.27	**0.27**	**0.00**
Pyrene	ND 0.18	ND 0.17	**0.18**	**5.71**
Benzo (a) anthracene	ND 0.16	ND 0.15	**0.16**	**6.45**
Chrysene	ND 0.17	ND 0.16	**0.17**	**6.06**
Benzo (b) fluoranthene	ND 0.14	ND 0.14	**0.14**	**0.00**
Benzo (k) fluoranthene	ND 0.14	ND 0.14	**0.14**	**0.00**
Benzo (e) pyrene	ND 0.14	ND 0.14	**0.14**	**0.00**
Benzo (a) pyrene	ND 0.14	ND 0.14	**0.14**	**0.00**
Perylene	ND 0.20	ND 0.20	**0.20**	**0.00**
Indeno (1,2,3-cd) pyrene	ND 0.12	ND 0.12	**0.12**	**0.00**
Dibenz (a,h) anthracene	ND 0.15	ND 0.15	**0.15**	**0.00**
Benzo (g,h,i) perylene	ND 0.14	ND 0.13	**0.20**	**0.00**
Minimum			**0.12**	**0.00**
Maximum			**8.23**	**10.96**
Average			**0.73**	**2.56**

ND - Not detected; E - Estimated

TABLE A4-10. VOST FIELD BLANKS

Compounds	Condition 1 field blank #1	Condition 1 field blank #2	Condition 3 field blank	PQL
Vinyl chloride	ND	ND	ND	50
Methylene chloride	ND	ND	ND	50
trans-1,2-dichloroethene	ND	ND	ND	50
cis-1,2-dichloroethene	ND	ND	ND	50
Chloroform	ND	ND	ND	50
1,1,1-Trichloroethane	ND	ND	ND	50
Carbon tetrachloride	ND	ND	ND	50
Benzene	ND	ND	ND	50
1,2-Dichloroethane	ND	ND	ND	50
Trichloroethene	ND	ND	ND	50
Toluene	ND	ND	ND	50
1,1,2-Trichloroethane	ND	ND	ND	50
Tetrachloroethene	ND	ND	ND	50
1,2-Dibromethane	ND	ND	ND	50
Chlorobenzene	ND	ND	ND	50
Ethylbenzene	ND	ND	ND	50
m-/p-Xylene	16 BQL	ND	ND	100
o-Xylene	ND	ND	ND	50
1,3-Dichlorobenzene	ND	ND	ND	50
1,4-Dichlorobenzene	ND	ND	ND	50
1,2-Dichlorobenzene	ND	ND	ND	50

All results are in nanograms
BQL Below quantitation limit
ND Not detected
PQL Practical quantitation limit

TABLE A4-11. VOST TRIP BLANKS

Compounds	Condition 1 trip blank #1	Condition 1 trip blank #2	Condition 3 trip blank	PQL
Vinyl chloride	ND	ND	ND	50
Methylene chloride	ND	ND	ND	50
trans-1,2-dichloroethene	ND	ND	ND	50
cis-1,2-dichloroethene	ND	ND	ND	50
Chloroform	ND	ND	ND	50
1,1,1-Trichloroethane	ND	ND	ND	50
Carbon tetrachloride	ND	ND	ND	50
Benzene	ND	ND	12 BQL	50
1,2-Dichloroethane	ND	ND	ND	50
Trichloroethene	ND	ND	ND	50
Toluene	ND	ND	ND	50
1,1,2-Trichloroethane	ND	ND	ND	50
Tetrachloroethene	ND	ND	ND	50
1,2-Dibromethane	ND	ND	ND	50
Chlorobenzene	ND	ND	ND	50
Ethylbenzene	ND	ND	ND	50
m-/p-Xylene	ND	ND	ND	100
o-Xylene	ND	ND	ND	50
1,3-Dichlorobenzene	ND	ND	ND	50
1,4-Dichlorobenzene	ND	ND	ND	50
1,2-Dichlorobenzene	ND	ND	ND	50

All results are in nanograms
BQL Below quantitation limit
ND Not detected
PQL Practical quantitation limit

TABLE A4-12. VOST SURROGATE RECOVERIES

Test condition	Run #	Tube ID	Surrogate recoveries (%)		
			1,2-dichloroethane-d4	toluene-d8	4-bromofluorobenzene
Condition 2					
	Run 1	Tube 1 & 2	85	96	116
		Tube 3 & 4	80	94	50
		Tube 5 & 6	83	98	122
		Tube 7 & 8	80	105	70
	Run 2	Tube 1 & 2	85	110	108
		Tube 3 & 4	90	110	127
		Tube 5 & 6	86	104	107
		Tube 7 & 8	97	102	126
		Tube 9 & 10	92	112	56
		Tube 11 & 12	85	105	60
Condition 3	Run 1	Tube 1 & 2	95	100	107
		Tube 3 & 4	N/A	N/A	N/A
		Tube 5 & 6	0	101	63
		Tube 7 & 8	84	99	88
	Run 2	Tube 1 & 2	93	101	100
		Tube 3 & 4	99	103	83
		Tube 5 & 6	N/A	N/A	N/A
		Tube 7 & 8	77	98	96
	Run 3	Tube 1 & 2	88	91	105
		Tube 3 & 4	88	96	99
		Tube 5 & 6	94	100	101
		Tube 7 & 8	94	96	90

N/A - Not available due to tube breakage or sampling problem
Condition 1 tubes were not spiked with surrogates

TABLE 4-13. VOST LABORATORY CONTROL SPIKE RESULTS

Compounds (Condition 1)	Laboratory spike (ng)	Spike recovery (%)	Spike duplicate (ng)	Spike duplicate recovery (%)	Relative percent difference (%)	PQL
Vinyl chloride	250	100	240	96	2.0	50
Methylene chloride	260	104	260	104	0.0	50
trans-1,2-Dichloroethene	270	108	280	112	1.8	50
cis-1,2-Dichloroethene	280	112	280	112	0.0	50
Chloroform	250	100	250	100	0.0	50
1,1,1-Trichloroethane	260	104	260	104	0.0	50
Carbon tetrachloride	270	108	270	108	0.0	50
Benzene	280	112	240	96	7.7	50
1,2-Dichloroethane	250	100	240	96	2.0	50
Trichloroethene	260	104	270	108	1.9	50
Toluene	250	100	250	100	0.0	50
1,1,2-Trichloroethane	250	100	250	100	0.0	50
Tetrachloroethene	250	100	240	96	2.0	50
1,2-Dibromethane	260	104	270	108	1.9	50
Chlorobenzene	250	100	240	96	2.0	50
Ethylbenzene	250	100	250	100	0.0	100
m-/p-Xylene	480	96	460	92	2.1	50
o-Xylene	250	100	220	88	6.4	50
1,3-Dichlorobenzene	230	92	160	64	17.9	50
1,4-Dichlorobenzene	230	92	150	60	21.1	50
1,2-Dichlorobenzene	250	100	140	56	28.2	50

PQL Practical quantitation limit

TABLE 4-13. VOST LABORATORY CONTROL SPIKE RESULTS (continued)

Compounds (Condition 3, Run 2)	Laboratory spike (ng)	Spike recovery (%)	Spike duplicate (ng)	Spike duplicate recovery (%)	Relative percent difference (%)	PQL
Vinyl chloride	238	95	168	67	34	50
Methylene chloride	258	104	286	115	10	50
trans-1,2-Dichloroethene	251	100	278	111	10	50
cis-1,2-Dichloroethene	260	104	225	90	14	50
Chloroform	259	104	233	93	11	50
1,1,1-Trichloroethane	283	113	229	91	22	50
Carbon tetrachloride	260	124	267	107	8	50
Benzene	2461	984	238	95	165	50
1,2-Dichloroethane	163	65	209	83	24	50
Trichloroethene	360	144	223	89	47	50
Toluene	436	175	252	101	54	50
1,1,2-Trichloroethane	214	86	196	78	10	50
Tetrachloroethene	274	110	240	96	14	50
1,2-Dibromethane	217	87	199	80	8	50
Chlorobenzene	249	99	265	106	7	50
Ethylbenzene	252	10%	265	106	5	50
m-/p-Xylene	537	107	305	61	55	50
o-Xylene	246	98	289	115	16	50
1,3-Dichlorobenzene	215	86	427	171	66	50
1,4-Dichlorobenzene	227	91	602	241	90	50
1,2-Dichlorobenzene	197	79	496	198	86	50

PQL Practical quantitation limit

TABLE 4-13. VOST LABORATORY CONTROL SPIKE RESULTS (continued)

Compounds (Condition 3, Run 3)	Laboratory spike (ng)	Spike recovery (%)	Spike duplicate (ng)	Spike duplicate recovery (%)	Relative percent difference (%)	PQL
Vinyl chloride	250	88	240	81	8	50
Methylene chloride	260	93	260	104	5	50
trans-1,2-Dichloroethene	270	90	280	97	7	50
cis-1,2-Dichloroethene	280	92	280	99	7	50
Chloroform	250	94	250	99	5	50
1,1,1-Trichloroethane	260	94	260	103	5	50
Carbon tetrachloride	270	91	270	102	11	50
Benzene	280	285	240	165	53	50
1,2-Dichloroethane	250	103	240	106	3	50
Trichloroethene	260	88	270	92	4	50
Toluene	250	103	250	102	1	50
1,1,2-Trichloroethane	250	97	250	98	1	50
Tetrachloroethene	250	101	240	99	2	50
1,2-Dibromethane	260	96	270	100	4	50
Chlorobenzene	250	99	240	103	4	50
Ethylbenzene	250	96	250	101	4	50
m-/p-Xylene	480	101	460	107	6	50
o-Xylene	250	94	220	102	8	50
1,3-Dichlorobenzene	230	51	160	110	73	50
1,4-Dichlorobenzene	230	49	150	113	79	50
1,2-Dichlorobenzene	250	31	140	92	99	50

PQL Practical quantitation limit

TABLE A4-14. SS16 VOC AUDIT RESULTS

Compound	Tube 1 (ng)		Tube 2 (ng)		Average (ng)		RPD (%)	EPA true value (ng)	EPA reported bias (%)
Vinyl chloride	ALR	47.14	ALR	43.32	ALR	45.23	8.45	19.6	130.77
Methylene chloride	BQL	0.373	BQL	0.345	BQL	0.359		---	---
Chloroform	ALR	37.96	ALR	41.58	ALR	39.77	9.10	33.8	17.66
Carbon tetrachloride		10.6		11.73		11.165	10.12	9.1	22.69
Benzene	ALR	31.91	ALR	34.66	ALR	33.285	8.26	27.5	21.04
Toluene		1.42		0.808		1.114		---	---
Tetrachloroethene		8.19		8.98		8.585	9.20	10.2	-15.83
					Average		9.03		35.26

ALR - Above linear range
BQL - Below quantitation limit

TABLE A4-15. SS16 METALS FIELD BLANK AND PROOF RESULTS

Metal	Field blank Condition 1 Run 3				Original proof TCT			
	Front half		Back half		Front half		Back half	
Antimony		14.00	ND	10.00	ND	10.00	ND	10.00
Arsenic	ND	10.00	ND	10.00	ND	10.00	ND	10.00
Barium		4.30	ND	1.00	ND	1.00	ND	1.00
Beryllium	ND	0.10	ND	1.00	ND	0.10	ND	1.00
Cadmium	ND	1.00	ND	1.00	ND	1.00	ND	1.00
Chromium		1.70	ND	1.00	ND	1.00	ND	1.00
Copper		2.60	ND	1.00	ND	1.00		1.40
Lead		9.60	ND	5.00	ND	5.00	ND	5.00
Manganese	ND	1.00	ND	1.00	ND	1.00		1.10
Mercury	ND	0.02	ND	0.02	ND	0.09	ND	0.01
Nickel	ND	1.00	ND	1.00	ND	1.00	ND	1.00
Phosporus		10.00	ND	10.00	NA	-----	NA	-----
Selenium	ND	10.00	ND	10.00	ND	10.00	ND	10.00
Silver		1.50	ND	1.00	ND	1.00	ND	1.00
Thalium	ND	10.00	ND	10.00	ND	10.00	ND	10.00
Tin		74.00	ND	10.00	NA	-----	NA	-----
Zinc		11.00		9.00		1.10	ND	1.00

Mercury results

	Field blank		Original proof		Proof #1		Proof #2		Final proof	
				TCT		TCT		TCT		CEL
Fourth impinger	ND	0.02	ND	0.2		-----		-----		-----
KMnO4 catch	ND	0.09	ND	0.2	ND	0.2	ND	0.2	ND	20
HCl rinse	ND	0.03		1.3		1.4		5.1	ND	20

All results in micrograms
ND - Not detected; PQL reported
NA - Not available
TCT - Twin City Testing
CEL - Calscience Laboratories

TABLE A4-16. METALS FIELD BLANK RESULTS AS A PERCENTAGE OF THE INDIVIDUAL RUNS

Front half	Field blank	C1 R1		C1 R2		C1 R3		C3 R1		C3 R2		C3 R3		C2 R1		C2 R2	
	µg	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%
Antimony	14.0	15.0	93	ND	140	15.0	93	11.0	127	13.0	108	15.0	93	13.0	108	14.0	100
Barium	4.3	6.7	64	2.7	159	5.7	75	4.0	108	3.9	110	4.9	88	5.6	77	4.2	102
Chromium	1.7	2.2	77	1.8	94	2.6	65	1.8	94	4.9	35	2.4	71	2.5	68	5.1	33
Copper	2.6	4.1	63	1.5	173	3.6	72	3.4	76	5.0	52	5.1	51	6.6	39	3.8	68
Lead	9.7	24.0	40	7.9	123	16.0	61	11.0	88	12.0	81	15.0	65	16	61	20	49
Phosporus	10.0	ND	100	ND	100	14.0	71	13.0	77	17.0	59	17.0	59	ND	100	ND	100
Silver	1.5	ND	150	ND	150	ND	150	ND	150	ND	150	ND	150	ND	150	ND	150
Tin	74.0	ND	740	ND	740	ND	740	ND	740	ND	740	ND	740	13	569	ND	740
Zinc	11.0	81.0	14	26.0	42	30.0	37	52.0	21	25.0	44	210	5	32	63	20	100

Back half	Field blank	C1 R1		C1 R2		C1 R3		C3 R1		C3 R2		C3 R3	
	µg	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%	µg	FB%
Zinc	9.0	14.0	64	8.2	110	4.5	200	4.8	188	12.0	75	14.0	64

Front half & back half recovered together for Condition 2.

Front half field blank percentage for zinc is calculated from the sum of the front half and back half results.

ND - Not detected

TABLE A4-17. SS16 METALS DUPLICATE

Metal	C2R2-SS16 F. H., Filter, and B. H. (µg)	C2R2-SS16 F. H., Filter, and B. H. duplicate (µg)	Average (µg)	Relative % difference (%)	PQL (µg)
Antimony	14	13	15.5	7.4	10.0
Arsenic	ND	ND	---	---	10.0
Barium	4.2	4.3	4.25	2.3	1.0
Beryllium	ND	ND	---	---	1.0
Cadmium	2.6	3.4	3.0	26	1.0
Copper	3.8	3.7	3.75	2.6	1.0
Chromium	5.1	4.8	4.95	16.0	1.0
Lead	20	ND	---	---	5.0
Manganese	2.0	ND	---	---	1.0
Mercury	ND	ND	---	---	0.04
Nickel	2.4	2.2	2.3	8.6	1.0
Selenium	ND	ND	---	---	10.0
Silver	ND	ND	---	---	10.0
Thallium	ND	ND	---	---	10.0
Zinc	20	19	19.5	5.1	1.0

PQL - Pratical quantitation limit
ND - Not detected

TABLE A4-18. SS16 HCl QA RESULTS

QA description	Results	Comments
Glassware proof	ND 1800 ng	OK
Audit samples		
High		
1:25 dilution	24 mg/l	passed criteria
1:50 dilution	12 mg/l	passed criteria
Low		
1:25 dilution	1.9 mg/l	passed criteria
1:50 dilution	0.92 mg/l	passed criteria
Capture efficiency		
Imp. 1 & 2	ND 2000 ng	not detected
Imp. 3	ND 640 ng	not detected
Field blank	ND 4.1 ng	not detected
Duplicate		
C1R3	ND —	not detected
C3R3	4.4% RPD	within criteria

RPD Relative percent difference

TABLE A4-19. STRATIFICATION CHECK

Point	Five minute average		Time	Percent difference	
	NOx	O2		NOx	O2
1	54.4	8.77	16:25-16:30	-1.8	3.18
2	55.7	8.40	16:30-16:35	0.54	-1.18
3	56.0	8.41	16:35-16:40	1.1	-1.06
4	55.6	8.40	16:40-16:45	0.36	-1.18
Average	55.40	8.50			

TABLE A4-20. RESPONSE TIMES (TO 95% OF SPAN)

Gas	R.T. (min.)	Gas	R.T. (min.)
O2	<1	NOx	<1
CO2	<1	THC	<1
CO	<1	SO2	>40

TABLE A4-21. OXYGEN DILUTION CHECK OF ALL STACK PORTS

Port sampled	Sample time	Average O2
CEM port	13:02 - 13:06	7.51
Metals port	13:07 - 13:12	7.11
CEM port	13:15 - 13:23	7.46
Organics port	13:24 - 13:28	8.82
CEM port	13:29 - 13:33	7.28
VOST port	13:34 - 13:39	7.02
CEM port	13:40 - 13:49	6.91
HCl port	13:50 - 13:54	8.34
CEM port	13:55 - 14:04	7.22
Pitot port	14:05 - 14:13	7.92
CEM port	14:14 - 14:18	7.51

Port sampled	Average CEM port O2	Average port O2	Percent difference
Metals	7.49	7.11	-5.07
Organics	7.37	8.82	19.7
VOST	7.10	7.02	-1.1
HCl	7.07	8.34	18
Pitot	7.37	7.92	7.46

TABLE A4-22. CYCLONIC FLOW CHECK

Traverse point	dP (inches H20)	Swirl angle (degrees)
A1	0.005	5
A2	0.005	6
A3	0.01	4
A4	0.015	7
B1	0.02	6
B2	0.01	5
B3	0.015	4
B4	0.01	3
Average		5

TABLE A4-23. INTERNAL STANDARD RECOVERY SUMMARY FOR PCB MEASUREMENTS IN PROCESS GAS SAMPLES

Sample ID	INTERNAL STANDARD RECOVERY (%)	
	3434-13C PCB	2233556613C PCB
SS6		
Condition 2		
Run 2	92.30	86.70
SS7		
Condition 2		
Run 2	63.60	63.30
SS9		
Condition 1		
Run 2	123.00	69.80
Condition 2		
Run 2	55.90	51.90
Condition 3		
Run 1	55.90	56.50
SS14		
Condition 1		
Run 1	197.00	88.80
Run 2	56.80	41.40
Run 3	206.00	76.00
Condition 2		
Run 1	N/A	N/A
Run 2	71.40	20.20
Condition 3		
Run 1	51.00	70.20
Run 2	N/A	N/A
Run 3	280.00	99.80

N/A - Not available

TABLE A4-24. INTERNAL STANDARD RECOVERY SUMMARY FOR PCDD/PCDF MEASUREMENTS IN PROCESS GAS SAMPLES

SAMPLE ID	INTERNAL STANDARD RECOVERY (%)								
	13C12-2,3,7,8-TCDD	13C12-1,2,3,7,8-PeCDD	13C12-1,2,3,6,7,8-HxCDD	13C12-1,2,3,4,6,7,8-HpCDD	13C12-OCDD	13C12-2.3.7.8-TCDF	13C12-1,2,3,7,8-PeCDF	13C12-1,2,3,6,7,8-HxCDF	13C12-1,2,3,4,6,8,9-HpCDF
SS14									
Condition 1									
Run 1	98.6	99.8	56.7	96.7	96.5	101	98.7	9.5	16.7
Run 2	63.8	90	26.2	67.7	64	53.9	22.5	1.4	1.38
Run 3	109	113	98	130	116	116	74.8	27.9	45.5
Average	90.47	100.93	60.30	98.13	92.17	90.30	65.33	12.93	21.19
RSD %	26.17	11.44	59.76	31.77	28.50	35.88	59.65	105.00	105.70
Condition 2									
Run 1	65.9	47.4	64.1	57.1	39.5	69.5	49.4	20	
Run 2	90.6	43.8	49.6	73.2	45.8	94.4	48.3	6.3	
Average	78.25	45.60	56.85	65.15	42.65	81.95	48.85	13.15	
Dev. %	31.57	7.89	25.51	24.71	14.77	30.38	2.25	104.18	
Condition 3									
Run 1	68.2	101	73.3	66.5	42	70.7	75.4	45.1	43.6
Run 2	68.6	82.4	69.5	74.3	60.8	68.7	53.3	20.1	27.4
Run 3	104	121	77.9	76.4	51.7	93.6	65.4	17.4	15.5
Average	80.27	101.47	73.57	72.40	51.50	77.67	64.70	27.53	28.83
RSD %	25.61	19.03	5.72	7.20	18.26	17.81	17.10	55.47	48.92
SS19									
Condition 2									
Run 1	48.4	69	47	39.6	42.7	54.1	57	65	34.9
Run 2	77.3	176	68.4	57.7	43.5	110	62.5	56.9	
Average	62.85	122.50	57.70	48.65	43.10	82.05	59.75	60.95	34.90
RPD	45.98	87.35	37.09	37.20	1.86	68.13	9.21	13.29	200.00

TABLE A4-25. INTERNAL STANDARD RECOVERY SUMMARY FOR CHLOROBENZENE AND CHLOROPHENOL MEASUREMENTS IN PROCESS GAS SAMPLES

Sample ID	INTERNAL STANDARD RECOVERY (%)				
	Phenol-D5	1,4-dibromobenzene-D4	Nitrobenzene-D5	2-fluorobiphenyl	1,3,5-trichlorobenzene-D3
SS6					
Condition 2					
Run 2	205.5	86.1	95.4	77.2	83.0
SS7					
Condition 2					
Run 2	75.8	80.5	89.2	78.3	80.5
SS9					
Condition 1					
Run 2	40.4	88.3	64.9	68.5	79.4
Condition 3					
Run 1	52.3	74.1	70.4	80.5	52.2
Condition 2					
Run 1	58.6	57.0	63.4	70.3	58.3
SS14					
Condition 1					
Run 1	5742.0	9019.0	0.0	89.3	111.5
Run 2	174.4	33.3	0.0	95.2	55.7
Run 3	0.0	19.3	12.1	69.1	83.4
Average	1972.1	3023.9	4.0	84.5	83.5
RSD %	165.6	171.7	173.2	16.2	33.4
Condition 3					
Run 1	90.2	NA	NA	104.6	NA
Run 2	46.4	NA	NA	109.5	NA
Run 3	41.1	54.2	48.7	66.6	40.9
Average	59.2	54.2	48.7	93.6	40.9
RSD %	45.5	N/A	N/A	25.1	N/A
Condition 2					
Run 1	64.3	28.5	81.4	68.0	88.9
Run 2	58.0	41.3	38.9	55.6	29.0
Average	61.2	34.9	60.2	61.8	59.0
RSD %	7.3	25.9	50.0	14.2	71.9
SS19					
Condition 2					
Run 1	33.40	89.70	208.2	105.7	102.5
Run 2	56.50	52.80	131.1	60.9	65.4
Average	45.0	71.3	169.7	83.3	84.0
RPD %	51.4	51.8	45.4	53.8	44.2

TABLE A4-26. ALTERNATE STANDARD RECOVERY SUMMARY FOR PCDD AND PCDF MEASUREMENTS IN PROCESS GAS SAMPLES

Sample ID	ALTERNATE STANDARD RECOVERY (%)	
	13C12-1,2,3,7,8,9-HxCDF	13C12-2,3,4,6,7,8-HxCDF
SS14		
Condition 1		
Run 1	83.6	92
Run 2	85.5	73
Run 3	97.3	106
Average	88.80	90.33
RSD %	8.36	18.34
Condition 3		
Run 1	75.5	83
Run 2	85.3	97
Run 3	87.1	83.5
Average	82.63	87.83
RSD %	7.55	9.04
Condition 2		
Run 1	87.5	81.4
Run 2	85.9	79.6
Average	86.70	80.50
Dev. %	1.85	2.24
SS19		
Condition 2		
Run 1	35	50.4
Run 2	61.8	60.2
Average	48.40	55.30
RPD	55.37	17.72

RPD - Relative percent difference

TABLE A4-27. ALTERNATE STANDARD RECOVERY SUMMARY FOR POLYCHLOROBIPHENYL MEASUREMENTS IN PROCESS GAS SAMPLES

Sample ID	ALTERNATE STANDARD RECOVERY (%)
	224455-13C HEXA
SS14	
Condition 1	
Run 1	69.00
Run 2	38.20
Run 3	49.40
Average	52.20
RSD %	29.87
Condition 3	
Run 1	56.00
Run 2	—
Run 3	56.80
Average	56.40
RPD %	1.42
SS14	
Condition 2	
Run 1	—
Run 2	23.60

TABLE A4-28. SURROGATE SPIKE RECOVERY SUMMARY FOR PCDD AND PCDF MEASUREMENTS IN PROCESS GAS SAMPLES

Sample ID	SURROGATE RECOVERY (%)				
	37Cl-2,3,7,8-TCDD	13Cl2-2,3,4,7,8-PeCDF	13Cl2-1,2,3,4,7,8-HxCDF	13Cl2-1,2,3,4,7,8-HxCDD	13Cl2-1,2,3,4,7,8,9-HpCDF
SS14					
Condition 1					
Run 1	98.1	96.3	79.8	130	493
Run 2	112	505	93.5	161	4410
Run 3	113	145	105	123	225
Average	107.70	248.77	92.77	138.00	1709.33
RSD %	7.73	89.74	13.60	14.65	137.05
Condition 3					
Run 1	71.2	84.7	53.4	102	63.3
Run 2	80	83.2	22.7	98.9	74.9
Run 3	88.2	144	89.6	107	80.5
Average	79.80	103.97	55.23	102.63	72.90
RSD %	10.65	33.35	60.63	3.98	12.03
Condition 2					
Run 1	124	113	113	124	575
Run 2	102	116	122	114	984
Average	113.00	114.50	117.50	119.00	779.50
RPD %	19.47	2.62	7.66	8.40	52.47
SS19					
Condition 2					
Run 1	172	74.7	104	156	214
Run 2	332	80.7	114	133	
Average	252.00	77.70	109.00	144.50	214.00
RPD %	63.49	7.72	9.17	15.92	200.00

TABLE A4-29. VOC SURROGATE RECOVERIES IN PROCESS GAS SAMPLES

Sample location	Test condition	Run #	Tube ID	Surrogate Recoveries (%)		
				1,2-dichloroethane-d4	toluene-d8	4-bromofluorobenzene
SS6	Condition 2		Bag	49	98	100
SS7	Condition 2		Tube 1 & 2	83	98	128
			Tube 3 & 4	84	93	103
			Tube 5 & 6	91	99	129
			Tube 7 & 8	90	99	121
SS9	Condition 3		Tube 1 & 2	70	93	147
			Tube 3 & 4	72	94	143
			Tube 5 & 6	63	94	129
			Tube 7 & 8	70	93	139
	Condition 2		Tube 1 & 2	100	112	138
			Tube 3 & 4	94	108	119
			Tube 5 & 6	95	112	137
			Tube 7 & 8	101	120	128
SS14	Condition 1	Run 3	Tube 1 & 2	139	235	88
			Tube 3 & 4	4300	161	244
			Tube 5 & 6	27000	100	520
			Tube 7 & 8	0	186	147
	Condition 3	Run 1	Tube 1 & 2	N/A	N/A	N/A
			Tube 3 & 4	0	0	88
		Run 2	Tube 1 & 2	N/A	N/A	N/A
			Tube 3 & 4	0	1664	41
			Tube 5 & 6	N/A	N/A	N/A
			Tube 7 & 8	0	49	196
		Run 3	Tube 1 & 2	7279	93	558
			Tube 3 & 4	1309	9	580
			Tube 5 & 6	3984	100	185
	Condition 2	Run 1	Tube 1 & 2	85	96	116
			Tube 3 & 4	80	94	50
			Tube 5 & 6	83	98	122
			Tube 7 & 8	80	105	70
		Run 1	Tube 1 & 2	85	110	108
			Tube 3 & 4	90	110	127
			Tube 5 & 6	86	104	107
			Tube 7 & 8	97	102	126
			Tube 9 & 10	92	112	56
			Tube 11 & 12	85	105	60
SS19	Condition 2	Run 1	Tube 1 & 2	INT	INT	204
			Tube 3 & 4	INT	INT	142
			Tube 5 & 6	INT	INT	0
			Tube 7 & 8	INT	INT	INT
		Run 1	Tube 1 & 2	INT	157	99
			Tube 3 & 4	INT	50	3
			Tube 5 & 6	INT	74	17
			Tube 7 & 8	INT	40	ND

N/A - Not applicable
ND - Not detected
INT - Matrix interferences resulted in inability to quantify surrogates.

TABLE A4-30. FIXED GASES AUDIT SAMPLE

Analyte	Audit Value	Analysis Concentration
Hydrogen (H_2)	—	ND
Oxygen (O_2)	12	11.8
Nitrogen (N_2)	—	81.1
Methane (CH_4)	—	ND
Carbon monoxide (CO)	0.6	0.57
Carbon dioxide (CO_2)	7	6.08

ND - Not Detected

TABLE A4-31. SS1-WASTE WATER FIELD BLANK RESULTS

Compound	Analyte	Units	Result	
Volatile organic compounds (VOC)	Vinyl chloride	µg/L	ND	2
	Methyl chloride	µg/L	ND	2
	Trans-1,2-dichloroethene	µg/L	ND	2
	Cis-1,2-dichloroethene	µg/L	ND	2
	Chloroform	µg/L		20
	1,1,1-Trichloroethane	µg/L	ND	2
	Carbon tetrachloride	µg/L	ND	2
	Benzene	µg/L	BQL	5
	1,2-Dichloroethane	µg/L	ND	2
	Trichloroethene	µg/L	ND	2
	Toluene	µg/L	ND	2
	1,2,3-Trichloroethane	µg/L	ND	2
	Tetrachloroethene	µg/L	ND	2
	1,2-Dibromoethane	µg/L	ND	2
	Chlorobenzene	µg/L	ND	2
	Ethylbenzene	µg/L	ND	2
	m-p-Xylene	µg/L	ND	2
	o-Xylene	µg/L	ND	2
	1,3-Dichlorobenzene	µg/L	ND	2
	1,4-Dichlorobenzene	µg/L	ND	2
	1,2-Dichorobenzene	µg/L	ND	2
Chlorophenols (CP)	2,3-Dichlorophenol	µg/L	ND	12.00
	2,4-Dichlorophenol	µg/L	ND	12.00
	2,5-Dichlorophenol	µg/L	ND	12.00
	2,6-Dichlorophenol	µg/L	ND	12.00
	3,4-Dichlorophenol	µg/L	ND	12.00
	3,5-Dichlorophenol	µg/L	ND	12.00
	Total dichlorophenols	µg/L	ND	12.00
	2,3,4-Trichlorophenol	µg/L	ND	12.00
	2,3,5-Trichlorophenol	µg/L	ND	12.00
	2,4,6-Trichlorophenol	µg/L	ND	12.00
	Total trichlorophenols	µg/L	ND	12.00
	2,3,4,5- and/or 2,3,4,6- Tetrachlorophenol	µg/L	ND	12.00
	2,3,5,6-Tetrachlorophenol	µg/L	ND	12.00
	Total tetrachlorophenols	µg/L	ND	12.00
	Pentachlorophenol	µg/L	ND	12.00
Chlorobenzenes (CB)	1,2-Dichlorobenzene	µg/L	ND	12.00
	1,3-Dichlorobenzene	µg/L	ND	12.00
	1,4-Dichlorobenzene	µg/L	ND	12.00
	Total dichlorobenzenes	µg/L	ND	12.00
	1,2,3-Trichlorobenzene	µg/L	ND	12.00
	1,3,5-Trichlorobenzene	µg/L	ND	12.00
	1,2,4-Trichlorobenzene	µg/L	ND	12.00
	Total tetrachlorobenzene	µg/L	ND	12.00
	1,2,3,5- and/or 1,2,4,5-Tetrachlorobenzene	µg/L	ND	24.00
	Total tetrachlorobenzenes	µg/L	ND	12.00
	Pentachlorobenzene	µg/L	ND	12.00
	Hexachlorobenzene	µg/L	ND	12.00

TABLE A4-31. SS1-WASTE WATER FIELD BLANK RESULTS (continued)

Compound	Analyte	Units	Result	
Polycyclic aromatic hydrocarbons (PAH)	Acenaphthene	µg/L	ND	9.90
	Fluorene	µg/L	ND	9.90
	Phenanthrene	µg/L	ND	9.90
	Anthracene	µg/L	ND	9.90
	Fluoranthene	µg/L	ND	9.90
	Pyrene	µg/L	ND	9.90
	Benz (a) anthracene	µg/L	ND	9.90
	Chrysene	µg/L	ND	9.90
	Benzo (b) fluoranthene	µg/L	ND	9.90
	Benzo (k) fluoranthene	µg/L	ND	9.90
	Benzo (e) pyrene	µg/L	ND	9.90
	Benzo (a) pyrene	µg/L	ND	9.90
	Perylene	µg/L	ND	9.90
	Indeno (1,2,3-cd) pyrene	µg/L	ND	9.90
	Dibenz (a,h) anthracene	µg/L	ND	9.90
	Benzo (g,h,i) perylene	µg/L	ND	9.90
	Naphthalene	µg/L	ND	9.90
	2-Methylnaphthalene	µg/L	ND	9.90
	2-Chloronaphthalene	µg/L	ND	9.90
	Acenaphthlene	µg/L	ND	9.90
Density		g/cc		0.96
Total organic carbon		mg/L		1.92
pH		pH		6
Total sulfur (as S)		%		0.018
Organic halogens (as chloride)		µg/L		13.1
Inorganic halogens (as chloride)		mg/L	ND	0.1
PCDD/PCDF	2378 TCDD	ng/L	ND	0.0100
	12378 PeCDD	ng/L	ND	0.0069
	123478 HxCDD	ng/L	ND	0.0020
	123678 HxCDD	ng/L	ND	0.0031
	123789 HxCDD	ng/L	ND	0.0063
	1234678 HpCDD	ng/L		0.0059
	OCDD	ng/L	F	0.0620
	2378 TCDF	ng/L	ND	0.0067
	12378 PeCDF	ng/L	ND	0.0110
	23478 PeCDF	ng/L	ND	0.0032
	123478 HxCDF	ng/L	ND	0.0029
	123678 HxCDF	ng/L	ND	0.0016
	234678 HxCDF	ng/L	ND	0.0050
	123789 HxCDF	ng/L		0.0019
	1234678 HpCDF	ng/L	ND	0.0044
	1234789 HpCDF	ng/L	ND	0.0039
	OCDF	ng/L	ND	0.0089
	Total TCDD	ng/L	ND	0.2000
	Total PeCDD	ng/L	ND	0.0966
	Total HxCDD	ng/L	F	0.0032
	Total HpCDD	ng/L	F	0.0093
	Total TCDF	ng/L	ND	0.2546
	Total PeCDF	ng/L	ND	0.1988
	Total HxCDF	ng/L		0.0050

TABLE A4-31. SS1-WASTE WATER FIELD BLANK RESULTS (continued)

Compound	Analyte	Units	Result	
PCDD/PCDF (continued)	Total HpCDF	ng/L		0.0029
	Total PCDD (by isomer)	ng/L	<	0.0342
	Total PCDF (by isomer)	ng/L	<	0.0495
	Total PCDD/PCDF (by isomer)	ng/L	,	0.0837
	Total PCDD	ng/L		0.3911
	Total PCDF	ng/L		0.4702
	Total PCDD/PCDF	ng/L		0.8613
Polychlorinated biphenyls (PCB)	Total monochlorobiphenyls	µg/L	ND	0.34
	Total dichlorobiphenyls	µg/L	ND	1.4
	Total trichlorobiphenyls	µg/L	ND	2.7
	Total tetrachlorobiphenyls	µg/L	ND	9.5
	Total pentachlorobiphenyls	µg/L	ND	10
	Total hexachlorobiphenyls	µg/L	ND	9.5
	Total heptachlorobiphenyls	µg/L	ND	8.2
	Total octachlorobiphenyls	µg/L	ND	4.1
	Total nonachlorobiphenyls	µg/L	ND	1
	Total decachlorobiphenyls	µg/L	ND	0.57
Hexavalent chromium		mg/L	ND	0.001
Metals	Ag	µg/L	ND	10
	As	µg/L	ND	100
	Ba	µg/L	ND	10
	Be	µg/L	ND	10
	Cd	µg/L	ND	10
	Cr	µg/L	ND	10
	Cu	µg/L	ND	10
	Hg	µg/L	ND	0.2
	Mn	µg/L	ND	10
	Ni	µg/L	ND	10
	P	µg/L	ND	100
	Pb	µg/L	ND	50
	Sb	µg/L	ND	100
	Se	µg/L	ND	100
	Sn	µg/L	ND	100
	Tl	µg/L	ND	100
	Zn	µg/L	ND	10

BQL-Below quanitation limits
ND-Non detect

TABLE A4-32. SS10-TREATED SOIL FIELD BLANK

Compound	Analyte	Units	Result	
Volatile organic compounds (VOC)	Vinyl chloride	µg/kg	ND	2
	Methyl chloride	µg/kg	ND	2
	Trans-1,2-dichloroethene	µg/kg	ND	2
	Cis-1,2-dichloroethene	µg/kg	ND	2
	Chloroform	µg/kg	ND	2
	1,1,1-Trichloroethane	µg/kg	ND	2
	Carbon tetrachloride	µg/kg	ND	2
	Benzene	µg/kg	ND	2
	1,2-Dichloroethane	µg/kg	ND	2
	Trichloroethene	µg/kg	BQL	4
	Toluene	µg/kg	ND	2
	1,1,2-Trichloroethane	µg/kg	ND	2
	Tetrachloroethene	µg/kg	ND	2
	1,2-Dibromoethane	µg/kg	ND	2
	Chlorobenzene	µg/kg	ND	2
	Ethylbenzene	µg/kg	ND	2
	m-p-Xylene	µg/kg	ND	2
	o-Xylene	µg/kg	ND	2
	1,3-Dichlorobenzene	µg/kg	ND	2
	1,4-Dichlorobenzene	µg/kg	ND	2
	1,2-Dichlorobenzene	µg/kg	ND	2
Chlorophenols (CP)	2,3-Dichlorophenol	µg/kg	ND	33.00
	2,4-Dichlorophenol	µg/kg	ND	33.00
	2,5-Dichlorophenol	µg/kg	ND	33.00
	2,6-Dichlorophenol	µg/kg	ND	33.00
	3,4-Dichlorophenol	µg/kg	ND	33.00
	3,5-Dichlorophenol	µg/kg	ND	33.00
	Total dichlorophenols	µg/kg	ND	198.00
	2,3,4-Trichlorophenol	µg/kg	ND	33.00
	2,3,5-Trichlorophenol	µg/kg	ND	33.00
	2,3,6-Trichlorophenol	µg/kg	ND	33.00
	2,4,5-Trichlorophenol	µg/kg	ND	33.00
	2,4,6-Trichlorophenol	µg/kg	ND	33.00
	Total trichlorophenols	µg/kg	ND	165.00
	2,3,4,5- and/or 2,3,4,6-Tetrachlorophenol	µg/kg	ND	66.00
	2,3,5,6-Tetrachlorophenol	µg/kg	ND	33.00
	Total tetrachlorophenols	µg/kg	ND	99.00
	Pentachlorophenol	µg/kg	ND	33.00
Chlorobenzenes (CB)	1,2-Dichlorobenzene	µg/kg	ND	33.00
	1,3-Dichlorobenzene	µg/kg	ND	33.00
	1,4-Dichlorobenzene	ug/kg	ND	33.00
	Total dichlorobenzenes	µg/kg	ND	99.00
	1,2,3-Trichlorobenzene	µg/kg	ND	33.00
	1,3,5-Trichlorobenzene	µg/kg	ND	33.00
	1,2,4-Trichlorbenzene	µg/kg	ND	33.00
	Total trichlorobenzenes	µg/kg	ND	99.00
	1,2,3,4-Tetrachlorobenzene	µg/kg	ND	33.00
	1,2,3,5-and/or 1,2,4,5-Tetrachlorobenzenes	µg/kg	ND	66.00
	Total tetrachlorobenzenes	µg/kg	ND	99.00
	Pentachlorobenzene	µg/kg	ND	33.00
	Hexachlorobenzene	µg/kg		330.00

TABLE A4-32. SS10-TREATED SOIL FIELD BLANK (continued)

Compound	Analyte	Units	Result	
Polycyclic aromatic hydrocarbons (PAH)	Acenaphthene	µg/kg	ND	33.00
	Fluorene	µg/kg	ND	33.00
	Phenanthrene	µg/kg	ND	33.00
	Anthracene	µg/kg	ND	33.00
	Fluoranthene	µg/kg	ND	33.00
	Pyrene	µg/kg	ND	33.00
	Benz (a) anthracene	µg/kg	ND	33.00
	Chrysene	µg/kg	ND	33.00
	Benzo (b) fluoranthene	µg/kg	ND	33.00
	Benzo (k) fluoranthene	µg/kg	ND	33.00
	Benzo (e) pyrene	µg/kg	ND	33.00
	Benzo (a) pyrene	µg/kg	ND	33.00
	Perylene	µg/kg	ND	33.00
	Indeno (1,2,3-cd) pyrene	µg/kg	ND	33.00
	Benzo (g,h,i) perylene	µg/kg	ND	33.00
	Naphthalene	µg/kg	ND	33.00
	2-Methylnaphthalene	µg/kg	ND	33.00
	2-Chloronaphthalene	µg/kg	ND	33.00
	Acenaphthlene	µg/kg	ND	33.00
Ash		%		0.99
Total organic carbon		mg/kg		105
Total sulfur (as S)		%		<0.01
Total halogens (as chlorine)		%		0.16
PCDD/PCDF	2378 TCDD	ng/kg	ND	4.70
	12378 PeCDD	ng/kg	ND	3.10
	123478 HxCDD	ng/kg	ND	0.79
	123678 HxCDD	ng/kg	ND	1.20
	123789 HxCDD	ng/kg	ND	1.00
	1234678 HpCDD	ng/kg	ND	4.20
	OCDD	ng/kg		8.30
	2378 TCDF	ng/kg	ND	2.70
	12378 PeCDF	ng/kg	ND	5.70
	23478 PeCDF	ng/kg	ND	2.70
	123478 HxCDF	ng/kg	ND	0.94
	123678 HxCDF	ng/kg	ND	0.61
	234678 HxCDF	ng/kg	ND	1.20
	123789 HxCDF	ng/kg	ND	1.10
	1234678 HpCDF	ng/kg	ND	1.60
	1234789 HpCDF	ng/kg	ND	2.00
	OCDF	ng/kg	ND	7.50
	Total TCDD	ng/kg	ND	103.40
	Total PeCDD	ng/kg	ND	43.40
	Total HxCDD	ng/kg	ND	9.97
	Total HpCDD	ng/kg	ND	8.40
	Total TCDF	ng/kg	ND	102.60
	Total PeCDF	ng/kg	ND	117.60
	Total HxCDF	ng/kg	ND	15.40
	Total HpCDF	ng/kg		7.20
	Total PCDD (by isomer)	ng/kg	<	14.99
	Total PCDF (by isomer)	ng/kg	<	26.05

TABLE A4-32. SS10-TREATED SOIL FIELD BLANK (continued)

Compound	Analyte	Units	Result	
PCDD/PCDF (continued)	Total PCDD/PCDF (by isomer)	ng/kg	<	41.04
	Total PCDD	ng/kg	<	173.47
	Total PCDF	ng/kg	<	250.30
	Total PCDD/PCDF	ng/kg	<	423.77
Polychlorinated biphenols (PCB)	Total monochlorobiphenyls	µg/kg	ND	10.00
	Total dichlorobiphenyls	µg/kg		0.43
	Total trichlorobiphenyls	µg/kg		4.80
	Total tetrachlorobiphenyls	µg/kg		12.00
	Total pentachlorobiphenyls	µg/kg		4.60
	Total hexachlorobiphenyls	µg/kg	ND	280.00
	Total heptachlorobicphenyls	µg/kg	ND	240.00
	Total octachlorobiphenyls	µg/kg	ND	120.00
	Total nonachlorobiphenyls	µg/kg	ND	30.00
	Total decachlorobiphenyls	µg/kg	ND	17.00
Hexavalent chromium		mg/kg	ND	0.01
Metals	Ag	mg/kg	ND	0.74
	As	mg/kg	ND	7.4
	Ba	mg/kg	ND	0.74
	Be	mg/kg	ND	0.07
	Cd	mg/kg	ND	0.74
	Cr	mg/kg	ND	0.74
	Cu	mg/kg	ND	0.74
	Hg	mg/kg	ND	0.15
	Mn	mg/kg	ND	0.74
	Ni	mg/kg	ND	0.74
	P	mg/kg	ND	7.4
	Pb	mg/kg	ND	3.7
	Sb	mg/kg	ND	7.4
	Se	mg/kg	ND	7.4
	Sn	mg/kg	ND	7.4
	Tl	mg/kg	ND	7.4
	Zn	mg/kg	ND	0.74
TCLP metals	Ag	µg/L	ND	100
	As	µg/L	ND	1400
	Ba	µg/L	ND	10
	Cd	µg/L	ND	10
	Cr	µg/L	ND	50
	Pb	µg/L	ND	0.4
	Hg	µg/L	ND	100
	Se	µg/L	ND	10

BQL-Below quanitation limits
ND-Non detect

TABLE A4-33. SS1 FIELD SAMPLE DUPLICATE SUMMARY

PCB	Field sample (ppb)	Field sample duplicate (ppb)	Average (ppb)	Relative % difference
SS1 - Condition 1				
Total monochlorobiphenyls	ND	ND	N/A	N/A
Total dichlorobiphenyls	3.10	2.90	3.00	6.67
Total trichlorobiphenyls	2.50	2.20	2.35	12.77
Total tetrachlorobiphenyls	1.80	1.60	1.70	11.76
Total pentachlorobiphenyls	0.54	0.47	0.51	13.86
Total hexachlorobiphenyls	0.01	0.02	0.02	58.06
Total heptachlorobiphenyls	ND	ND	N/A	N/A
Total octachlorobiphenyls	ND	ND	N/A	N/A
Total nonachlorobiphenyls	ND	ND	N/A	N/A
Total decachlorobiphenyls	ND	ND	N/A	N/A
Minimum			0.02	6.67
Maximum			3.00	58.06
Average			1.51	20.62
SS1 - Condition 3				
Total monochlorobiphenyls	0.019	0.018	0.02	5.41
Total dichlorobiphenyls	0.62	0.61	0.62	1.63
Total trichlorobiphenyls	1.00	1.00	1.00	0.00
Total tetrachlorobiphenyls	1.2	1.3	1.25	8.00
Total pentachlorobiphenyls	0.55	0.5	0.53	9.52
Total hexachlorobiphenyls	0.057	0.052	0.05	9.17
Total heptachlorobiphenyls	ND	ND	N/A	N/A
Total octachlorobiphenyls	ND	ND	N/A	N/A
Total nonachlorobiphenyls	ND	ND	N/A	N/A
Total decachlorobiphenyls	ND	ND	N/A	N/A
Minimum			0.02	0.00
Maximum			1.25	9.52
Average			0.58	5.62

ND: Not detected
N/A: Not applicable

TABLE A4-33. SS1-FIELD SAMPLE DUPLICATE SUMMARY (continued)

CB/CP	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS1						
1,2-Dichlorobenzene	ND	1.20	ND	1.20	1.20	0.00
1,3-Dichlorobenzene	ND	1.20	ND	1.20	1.20	0.00
1,4-Dichlorobenzene	ND	1.20	ND	1.20	1.20	0.00
Total dichlorobenzenes	ND		ND			
1,2,3-Trichlorobenzene	ND	1.20	ND	1.20	1.20	0.00
1,3,5-Trichlorobenzene	ND	1.20	ND	1.20	1.20	0.00
1,2,4-Trichlorobenzene	ND	1.20	ND	1.20	1.20	0.00
Total trichlorobenzenes	ND		ND			
1,2,3,4-Tetrachlorobenzene	ND	1.20	ND	1.20	1.20	0.00
1,2,3,5- and/or 1,2,4,5-Tetrachloro-	ND	2.50	ND	2.50	2.50	0.00
Total tetrachlorobenzenes	ND		ND			
Pentachlorobenzene	ND	1.20	ND	1.20	1.20	0.00
Hexachlorobenzene	ND	1.20	ND	1.20	1.20	0.00
2,3-Dichlorophenol	ND	1.20	ND	1.20	1.20	0.00
2,4-Dichlorophenol	ND	1.20	ND	1.20	1.20	0.00
2,5-Dichlorophenol	ND	1.20	ND	1.20	1.20	0.00
2,6-Dichlorophenol	ND	1.20	ND	1.20	1.20	0.00
3,4-Dichlorophenol	ND	1.20	ND	1.20	1.20	0.00
3,5-Dichlorophenol	ND	1.20	ND	1.20	1.20	0.00
Total dichlorophenols	ND		ND			
2,3,4-Trichlorophenol	ND	1.20	ND	1.20	1.20	0.00
2,3,5-Trichlorophenol	ND	1.20	ND	1.20	1.20	0.00
2,3,6-Trichlorophenol	ND	1.20	ND	1.20	1.20	0.00
2,4,5-Trichlorophenol	ND	1.20	ND	1.20	1.20	0.00
2,4,6-Trichlorophenol	ND	1.20	ND	1.20	1.20	0.00
Total trichlorophenols	ND		ND			
2,3,4,5,- and/or 2,3,4,6-Tetrachloro-phenol	ND	2.50	ND	2.50	2.50	0.00
2,3,5,6-Tetrachlorophenol	ND	1.20	ND	1.20	1.20	0.00
Total tetrachlorophenols	ND		ND			
Pentachlorophenol	ND	1.20	ND	1.20	1.20	0.00
Minimum					1.20	0.00
Maximum					2.50	0.00
Average					1.31	0.00

ND : Not detected

TABLE A4-33. SS-FIELD SAMPLE DUPLICATE SUMMARY (continued)

PAH	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS1						
Acenaphthene	ND	9.90	ND	9.80	9.85	1.02
Fluorene	ND	9.90	ND	9.80	9.85	1.02
Phenanthrene	ND	9.90	ND	9.80	9.85	1.02
Anthracene	ND	9.90	ND	9.80	9.85	1.02
Fluoranthene	ND	9.90	ND	9.80	9.85	1.02
Pyrene	ND	9.90	ND	9.80	9.85	1.02
Benzo (a) anthracene	ND	9.90	ND	9.80	9.85	1.02
Chrysene	ND	9.90	ND	9.80	9.85	1.02
Benzo (b) fluoranthene	ND	9.90	ND	9.80	9.85	1.02
Benzo (k) fluoranthene	ND	9.90	ND	9.80	9.85	1.02
Benzo (e) pyrene	ND	9.90	ND	9.80	9.85	1.02
Benzo (a) pyrene	ND	9.90	ND	9.80	9.85	1.02
Perylene	ND	9.90	ND	9.80	9.85	1.02
Indeno (1,2,3-cd) pyrene	ND	9.90	ND	9.80	9.85	1.02
Dibenz (a,h) anthracene	ND	9.90	ND	9.80	9.85	1.02
Benzo (g,h,i) perylene	ND	9.90	ND	9.80	9.85	1.02
Naphthalene	ND	9.90	ND	9.80	9.85	1.02
2-Methylnaphthalene	ND	9.90	ND	9.80	9.85	1.02
2-Chloronaphthalene	ND	9.90	ND	9.80	9.85	1.02
Acenapthylene	ND	9.90	ND	9.80	9.85	1.02
Minimum					9.85	1.02
Maximum					9.85	1.02
Average					9.85	1.02
SURROGATE RECOVERY						
2-Fluorophenol		44.00		31.00	37.50	34.67
Phenol -d5		34.00		30.00	32.00	12.50
2-Chlorophenol -d4		60.00		54.00	57.00	10.53
1,2-Dichlorobenzene -d4		49.00		39.00	44.00	22.73
Nitrobenzene -d5		68.00		62.00	65.00	9.23
2-Fluorobiphenyl		53.00		43.00	48.00	20.83
2,4,6-Tribromophenol		72.00		38.00	55.00	61.82
Terphenyl -d14		73.00		71.00	72.00	2.78
Minimum					32.00	2.78
Maximum					72.00	61.82
Average					51.31	21.89

ND : Not detected

TABLE A4-33. SS1-FIELD SAMPLE DUPLICATE SUMMARY (continued)

VOC	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS1						
Vinyl chloride	ND	2	ND	2	2.00	0.00
Methyl chloride		14		13	13.50	7.41
Trans-1,2-Dichloroethene	ND	2	ND	2	2.00	0.00
Cis-1,2-Dichloroethene	ND	2	ND	2		
Chloroform	ND	2	ND	2	2.00	0.00
1,1,1-Trichloroethane	ND	2	ND	2	2.00	0.00
Carbon Tetrachloride	ND	2	ND	2	2.00	0.00
Benzene	ND	2	ND	2		
1,2-Dichloroethane	ND	2	ND	2	2.00	0.00
Trichloroethene	BQL	2	ND	2	2.00	0.00
Toluene	ND	2	BQL	3		
1,1,2-Trichloroethane	ND	2	ND	2	2.00	0.00
Tetrachloroethene	ND	2	ND	2	2.00	0.00
1,2-Dibromoethane	ND	2	ND	2	2.00	0.00
Chlorobenzene	ND	2	ND	2	2.00	0.00
Ethylbenzene	ND	2	ND	2	2.00	0.00
m-p-Xylene	ND	2	ND	2	2.00	0.00
o-Xylene	ND	2	ND	2	2.00	0.00
1,3-Dichlorobenzene	ND	2	ND	2	2.00	0.00
1,4-Dichlorobenzene	ND	2	ND	2		
1,2-Dichlorobenzene	ND	2	ND	2	2.00	0.00
Minimum					2.00	0.00
Maximum					13.50	7.41
Average					2.68	0.44

VOC	Units	Field sample	Field sample duplicate	Average	Relative % difference
SS1					
Total organic carbon	mg/L	8.86	9.07	8.97	2.34
Organic halogens (as chloride)	µg/L	136.00	45900	23018.00	198.82
Inorganic halogens (as chloride)	mg/L	1900.00	1800	1850.00	5.41

ND : Not detected
BQL : Below quantitation limit

TABLE A4-34. SS2 FIELD SAMPLE DUPLICATE SUMMARY

PCB	Field sample (ppb)	Field sample duplicate (ppb)	Average (ppb)	Relative % difference
SS2 - Condition 1				
Total monochlorobiphenyls	260000.00	270000.00	265000.00	3.77
Total dichlorobiphenyls	11000000.00	12000000.00	11500000.00	8.70
Total trichlorobiphenyls	66000000.00	71000000.00	68500000.00	7.30
Total tetrachlorobiphenyls	100000000.00	120000000.00	110000000.00	18.18
Total pentachlorobiphenyls	40000000.00	43000000.00	41500000.00	7.23
Total hexachlorobiphenyls	5000000.00	4900000.00	4950000.00	2.02
Total heptachlorobiphenyls	860000.00	830000.00	845000.00	3.55
Total octachlorobiphenyls	230000.00	220000.00	225000.00	4.44
Total nonachlorobiphenyls	45000.00	43000.00	44000.00	4.55
Total decachlorobiphenyls	ND	1300.00	1300.00	N/A
Minimum			1300.00	2.02
Maximum			110000000.00	18.18
Average			23783030.00	6.64
SS2 - Condition 3				
Total monochlorobiphenyls	270000.00	290000.00	280000.00	7.14
Total dichlorobiphenyls	12000000.00	13000000.00	12500000.00	8.00
Total trichlorobiphenyls	75000000.00	66000000.00	70500000.00	12.77
Total tetrachlorobiphenyls	110000000.00	130000000.00	120000000.00	16.67
Total pentachlorobiphenyls	43000000.00	46000000.00	44500000.00	6.74
Total hexachlorobiphenyls	5100000.00	5500000.00	5300000.00	7.55
Total heptachlorobiphenyls	800000.00	850000.00	825000.00	6.06
Total octachlorobiphenyls	220000.00	230000.00	225000.00	4.44
Total nonachlorobiphenyls	41000.00	44000.00	42500.00	7.06
Total decachlorobiphenyls	1200.00	1400.00	1300.00	15.38
Minimum			1300.00	4.44
Maximum			120000000.00	16.67
Average			25417380.00	9.18

ND - Not detected
N/A - Not applicable

TABLE A4-34. SS2-FIELD SAMPLE DUPLICATE SUMMARY (continued)

CB/CP	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS2						
1,2-Dichlorobenzene	BQL	11000	ND	9600	10300	13.59
1,3-Dichlorobenzene	ND	9300	ND	9600	9450	3.17
1,4-Dichlorobenzene	BQL	57000	BQL	49000	53000	15.09
Total dichlorobenzenes		68000		49000		
1,2,3-Trichlorobenzene	BQL	20000	BQL	17000	18500	16.22
1,3,5-Trichlorobenzene	ND	9300	ND	9600	9450	3.17
1,2,4-Trichlorobenzene		100000	BQL	83000	91500	18.58
Total trichlorobenzenes		120000		100000		
1,2,3,4-Tetrachlorobenzene	ND	9300	ND	9600	9450	3.17
1,2,3,5- and/or 1,2,4,5-Tetrachloro-benzene	ND	19000	ND	19000	19000	0.00
Total tetrachlorobenzenes	ND		ND			
Pentachlorobenzene	ND	9300	ND	9600	9450	3.17
Hexachlorobenzene	BQL	9300	ND	9600	9450	3.17
2,3-Dichlorophenol	ND	9300	ND	9600	9450	3.17
2,4-Dichlorophenol	ND	9300	ND	9600	9450	3.17
2,5-Dichlorophenol	ND	9300	ND	9600	9450	3.17
2,6-Dichlorophenol	ND	9300	ND	9600	9450	3.17
3,4-Dichlorophenol	ND	9300	ND	9600	9450	3.17
3,5-Dichlorophenol	ND	9300	ND	9600	9450	3.17
Total dichlorophenols	ND		ND			
2,3,4-Trichlorophenol	ND	9300	ND	9600	9450	3.17
2,3,5-Trichlorophenol	ND	9300	ND	9600	9450	3.17
2,3,6-Trichlorophenol	ND	9300	ND	9600	9450	3.17
2,4,5-Trichlorophenol	ND	9300	ND	9600	9450	3.17
2,4,6-Trichlorophenol	ND	9300	ND	9600	9450	3.17
Total trichlorophenols	ND		ND			
2,3,4,5,- and/or 2,3,4,6-Tetrachloro-phenol	ND	19000	ND	19000	19000	0.00
2,3,5,6-Tetrachlorophenol	ND	9300	ND	9600	9450	3.17
Total tetrachlorophenols	ND		ND			
Pentachlorophenol	ND	9300	ND	9600	9450	3.17
Minimum					9450	0.00
Maximum					91500	18.58
Average					15892	5.03

ND : Not detected
BQL : Below quantitation limit

TABLE A4-34. SS2-FIELD SAMPLE DUPLICATE SUMMARY
(continued)

PAH	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS1						
Acenaphthene	ND	93000	ND	96000	94500	3.17
Fluorene	ND	93000	BQL	21000	57000	126.32
Phenanthrene	ND	93000	ND	96000	94500	3.17
Anthracene	ND	93000	ND	96000	94500	3.17
Fluoranthene	ND	93000	ND	96000	94500	3.17
Pyrene	ND	93000	BQL	10000	51500	161.17
Benzo (a) anthracene	ND	93000	ND	96000	94500	3.17
Chrysene	ND	93000	ND	96000	94500	3.17
Benzo (b) fluoranthene	ND	93000	ND	96000	94500	3.17
Benzo (k) fluoranthene	ND	93000	ND	96000	94500	3.17
Benzo (e) pyrene	ND	93000	ND	96000	94500	3.17
Benzo (a) pyrene	ND	93000	ND	96000	94500	3.17
Perylene	ND	93000	ND	96000	94500	3.17
Indeno (1,2,3-cd) pyrene	ND	93000	ND	96000	94500	3.17
Dibenz (a,h) anthracene	ND	93000	ND	96000	94500	3.17
Benzo (g,h,i) perylene	ND	93000	ND	96000	94500	3.17
Naphthalene	BQL	58000	BQL	49000	53500	16.82
2-Methylnaphthalene		95000	BQL	79000	87000	18.39
2-Chloronaphthalene	ND	93000	ND	96000	94500	3.17
Acenapthylene	ND	93000	ND	96000	94500	3.17
Minimum					51500	3.17
Maximum					94500	161.17
Average					88050	18.67
SURROGATE RECOVERY						
2-Fluorophenol		84		98	91	15.38
Phenol -d5		86		86	86	0.00
2-Chlorophenol -d4		90		92	91	2.20
1,2-Dichlorobenzene -d4		96		95	96	1.05
Nitrobenzene -d5		88		77	83	13.33
2-Fluorobiphenyl		88		90	89	2.25
2,4,6-Tribromophenol		80		95	88	17.14
Terphenyl -d14		94		93	94	1.07
Minimum					83	0.00
Maximum					96	17.14
Average					90	6.55

ND - Not detected
BQL - Below quantitation limit

TABLE A4-34. SS2-FIELD SAMPLE DUPLICATE SUMMARY (continued)

VOC	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS2						
Vinyl chloride	ND	2000	ND	2000	2000.00	0.00
Methyl chloride		38000		35000	36500.00	8.22
Trans-1,2-Dichloroethene	ND	2000	ND	2000	2000.00	0.00
Cis-1,2-Dichloroethene		20000		19000	19500.00	5.13
Chloroform	ND	2000	ND	2000	2000.00	0.00
1,1,1-Trichloroethane	ND	2000	ND	2000	2000.00	0.00
Carbon tetrachloride	ND	2000	ND	2000	2000.00	0.00
Benzene	BQL	3400	ND	2000	2700.00	51.85
1,2-Dichloroethane	ND	2000	ND	2000	2000.00	0.00
Trichloroethene		180000		190000	185000.00	5.41
Toluene		15000	BQL	8100	11550.00	59.74
1,1,2-Trichloroethane	ND	2000	ND	2000	2000.00	0.00
Tetrachloroethene	ND	2000	ND	2000	2000.00	0.00
1,2-Dibromoethane	ND	2000	ND	2000	2000.00	0.00
Chlorobenzene	ND	2000	ND	2000	2000.00	0.00
Ethylbenzene	BQL	5300	BQL	3000	4150.00	55.42
m-p-Xylene		16000		110000	63000.00	149.21
o-Xylene	BQL	4900	BQL	2900	3900.00	51.28
1,3-Dichlorobenzene	ND	2000	ND	2000	2000.00	0.00
1,4-Dichlorobenzene	ND	2000	ND	2000	2000.00	0.00
1,2-Dichlorobenzene	ND	2000	ND	2000	2000.00	0.00
Minimum					2000.00	0.00
Maximum					185000.00	149.21
Average					16776.19	18.39

ND - Not detected

BQL - Below quantitation limit

TABLE A4-34. SS2-FIELD SAMPLE DUPLICATE SUMMARY (continued)

VOC	Units	Field sample	Field sample duplicate	Average	Relative % difference
SS2					
Total halogens	%	21.66	17.81	19.74	19.51
Ultimate analysis					
Carbon	%	62.06	61.17	61.62	1.44
Hydrogen	%	7.78	9.28	8.53	17.58
Nitrogen	%	0.04	0.04	0.04	0.00
Chlorine	%	10.45	4.85	7.65	73.20
Fluorine	%	< 0.01	< 0.01	0.01	0.00
Phosphate	%	< 0.01	< 0.01	0.01	0.00
Oxygen	%	19.09	22.91	21.00	18.19
Total sulfur	%	0.58	1.75	1.17	100.43
Metals					
Ag	µg/L	ND 1	ND 1.00	1.00	0.00
As	µg/L	ND 10	ND 10.00	10.00	0.00
Ba	µg/L	5.7	5.80	5.75	1.74
Be	µg/L	ND 1	ND 1.00	1.00	0.00
Cd	µg/L	ND 1	1.20	1.10	18.18
Cr	µg/L	16	18.00	17.00	11.76
Cu	µg/L	8.2	8.40	8.30	2.41
Hg	µg/L	ND 0.1	ND 0.10	0.10	0.00
Mn	µg/L	ND 1	ND 1.00	1.00	0.00
Ni	µg/L	3.5	3.80	3.65	8.22
P	µg/L	270	290.00	280.00	7.14
Pb	µg/L	110	120.00	115.00	8.70
Sb	µg/L	ND 10	ND 10.00	10.00	0.00
Se	µg/L	ND 10	ND 10.00	10.00	0.00
Sn	µg/L	ND 10	ND 10.00	10.00	0.00
Tl	µg/L	ND 10	ND 10.00	10.00	0.00
Zn	µg/L	88	92.00	90.00	4.44

ND - Not detected

TABLE A4-35. SS3, SS22 FIELD SAMPLE DUPLICATE SUMMARY

PCB	Field sample (ppb)	Field sample duplicate (ppb)	Average (ppb)	Relative % difference
SS3 - Condition 2				
Total monochlorobiphenyls	510.00	1000.00	755.00	64.90
Total dichlorobiphenyls	22000.00	44000.00	33000.00	66.67
Total trichlorobiphenyls	130000.00	270000.00	200000.00	70.00
Total tetrachlorobiphenyls	210000.00	420000.00	315000.00	66.67
Total pentachlorobiphenyls	92000.00	190000.00	141000.00	69.50
Total hexachlorobiphenyls	9600.00	18000.00	13800.00	60.87
Total heptachlorobiphenyls	1700.00	3100.00	2400.00	58.33
Total octachlorobiphenyls	580.00	700.00	640.00	18.75
Total nonachlorobiphenyls	230.00	ND	230.00	N/A
Total decachlorobiphenyls	ND	ND	N/A	N/A
Minimum			230.00	18.75
Maximum			315000.00	70.00
Average			78536.11	59.46
SS22 - Condition 2				
Total monochlorobiphenyls	0.052	0.037	0.04	33.71
Total dichlorobiphenyls	0.062	0.079	0.07	24.11
Total trichlorobiphenyls	0.17	0.13	0.15	26.67
Total tetrachlorobiphenyls	0.16	0.12	0.14	28.57
Total pentachlorobiphenyls	0.011	9.40	4.71	199.53
Total hexachlorobiphenyls	ND	ND	N/A	N/A
Total heptachlorobiphenyls	ND	ND	N/A	N/A
Total octachlorobiphenyls	ND	ND	N/A	N/A
Total nonachlorobiphenyls	ND	ND	N/A	N/A
Total decachlorobiphenyls	ND	ND	N/A	N/A
Minimum			0.04	24.11
Maximum			4.71	199.53
Average			1.02	62.52

ND: Not detected
N/A: Not applicable

TABLE A4-35. SS3, SS22-FIELD SAMPLE DUPLICATE SUMMARY (continued)

CB/CP	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS3 - Condition 2, Run 1						
1,2-Dichlorobenzene	ND	990.00	ND	950.00	970.00	4.12
1,3-Dichlorobenzene	ND	990.00	ND	950.00	970.00	4.12
1,4-Dichlorobenzene	ND	990.00	ND	950.00	970.00	4.12
Total dichlorobenzenes	ND		ND			
1,2,3-Trichlorobenzene	ND	990.00	ND	950.00	970.00	4.12
1,3,5-Trichlorobenzene	ND	990.00	ND	950.00	970.00	4.12
1,2,4-Trichlorobenzene	ND	990.00	ND	950.00	970.00	4.12
Total trichlorobenzenes	ND		ND			
1,2,3,4-Tetrachlorobenzene	ND	990.00	ND	950.00	970.00	4.12
1,2,3,5- and/or 1,2,4,5-Tetrachloro-benzene	ND	2000.00	ND	950.00	1475.00	71.19
Total tetrachlorobenzenes	ND		ND			
Pentachlorobenzene	ND	990.00	ND	950.00	970.00	4.12
Hexachlorobenzene	BQL	1600.00		11000.00	6300.00	149.21
2,3-Dichlorophenol	ND	990.00	ND	950.00	970.00	4.12
2,4-Dichlorophenol	ND	990.00	ND	950.00	970.00	4.12
2,5-Dichlorophenol	ND	990.00	ND	950.00	970.00	4.12
2,6-Dichlorophenol	ND	990.00	ND	950.00	970.00	4.12
3,4-Dichlorophenol	ND	990.00	ND	950.00	970.00	4.12
3,5-Dichlorophenol	ND	990.00	ND	950.00	970.00	4.12
Total dichlorophenols	ND		ND			
2,3,4-Trichlorophenol	ND	990.00	ND	950.00	970.00	4.12
2,3,5-Trichlorophenol	ND	990.00	ND	950.00	970.00	4.12
2,3,6-Trichlorophenol	ND	990.00	ND	950.00	970.00	4.12
2,4,5-Trichlorophenol	ND	990.00	ND	950.00	970.00	4.12
2,4,6-Trichlorophenol	ND	990.00	ND	950.00	970.00	4.12
Total trichlorophenols	ND		ND			
2,3,4,5,- and/or 2,3,4,6-Tetrachloro-phenol	ND	2000.00	ND	950.00	1475.00	71.19
2,3,5,6-Tetrachlorophenol	ND	990.00	ND	950.00	970.00	4.12
Total tetrachlorophenols	ND		ND			
Pentachlorophenol	ND	990.00	ND	950.00	970.00	4.12
Minimum					970.00	4.12
Maximum					6300.00	149.21
Average					1234.17	15.76

ND : Not detected

TABLE 4-35. SS3, SS22-FIELD SAMPLE DUPLICATE SUMMARY (continued)

CB/CP	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS3 - Condition 2, Run 2						
1,2-Dichlorobenzene	ND	890	ND	1000	945	11.64
1,3-Dichlorobenzene	ND	890	ND	1000	945	11.64
1,4-Dichlorobenzene	ND	890	ND	1000	945	11.64
Total dichlorobenzenes	ND		ND			
1,2,3-Trichlorobenzene	ND	890	ND	1000	945	11.64
1,3,5-Trichlorobenzene	ND	890	ND	1000	945	11.64
1,2,4-Trichlorobenzene	ND	890	ND	1000	945	11.64
Total trichlorobenzenes	ND		ND			
1,2,3,4-Tetrachlorobenzene	ND	890	ND	1000	945	11.64
1,2,3,5- and/or 1,2,4,5-Tetrachloro-benzene	ND	1800	ND	2100	1950	15.38
Total Tetrachlorobenzenes	ND		ND			
Pentachlorobenzene	ND	890	ND	1000	945	11.64
Hexachlorobenzene		13000		23000	18000	55.56
2,3-Dichlorophenol	ND	890	ND	1000	945	11.64
2,4-Dichlorophenol	ND	890	ND	1000	945	11.64
2,5-Dichlorophenol	ND	890	ND	1000	945	11.64
2,6-Dichlorophenol	ND	890	ND	1000	945	11.64
3,4-Dichlorophenol	ND	890	ND	1000	945	11.64
3,5-Dichlorophenol	ND	890	ND	1000	945	11.64
Total dichlorophenols	ND		ND			
2,3,4-Trichlorophenol	ND	890	ND	1000	945	11.64
2,3,5-Trichlorophenol	ND	890	ND	1000	945	11.64
2,3,6-Trichlorophenol	ND	890	ND	1000	945	11.64
2,4,5-Trichlorophenol	ND	890	ND	1000	945	11.64
2,4,6-Trichlorophenol	ND	890	ND	1000	945	11.64
Total trichlorophenols	ND		ND			
2,3,4,5,- and/or 2,3,4,6-Tetrachloro-phenol	ND	1800	ND	2100	1950	15.38
2,3,5,6-Tetrachlorophenol	ND	890	ND	1000	945	11.64
Total tetrachlorophenols	ND		ND			
Pentachlorophenol	ND	890	ND	1000	945	11.64
Minimum					945	11.64
Maximum					18000	55.56
Average					1739	13.78

ND : Not detected

TABLE A4-35. SS3, SS22-FIELD SAMPLE DUPLICATE SUMMARY (continued)

PAH	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS3 - Condition 2, Run 1						
Acenaphthene	ND	990.00	ND	950.00	970.00	4.12
Fluorene	ND	990.00	ND	950.00	970.00	4.12
Phenanthrene	BQL	2900.00	BQL	2000.00	2450.00	36.73
Anthracene	ND	990.00	ND	950.00	970.00	4.12
Fluoranthene	BQL	2400.00	BQL	1700.00	2050.00	34.15
Pyrene	BQL	1900.00	BQL	1400.00	1650.00	30.30
Benzo (a) anthracene	ND	990.00	ND	950.00	970.00	4.12
Chrysene	ND	990.00	ND	950.00	970.00	4.12
Benzo (b) fluoranthene	ND	990.00	ND	950.00	970.00	4.12
Benzo (k) fluoranthene	ND	990.00	ND	950.00	970.00	4.12
Benzo (e) pyrene	ND	990.00	ND	950.00	970.00	4.12
Benzo (a) pyrene	ND	990.00	ND	950.00	970.00	4.12
Perylene	ND	990.00	ND	950.00	970.00	4.12
Indeno (1,2,3-cd) pyrene	ND	990.00	ND	950.00	970.00	4.12
Dibenz (a,h) anthracene	ND	990.00	ND	950.00	970.00	4.12
Benzo (g,h,i) perylene	ND	990.00	ND	950.00	970.00	4.12
Naphthalene	BQL	1800.00	BQL	960.00	1380.00	60.87
2-Methylnaphthalene	BQL	1000.00	ND	950.00	975.00	5.13
2-Chloronaphthalene	ND	990.00	ND	950.00	970.00	4.12
Acenapthylene	ND	990.00	ND	950.00	970.00	4.12
Minimum					970.00	4.12
Maximum					2450.00	60.87
Average					1152.75	11.45
SURROGATE RECOVERY						
2-Fluorophenol	BQL	78.00	BQL	71.00	74.50	9.40
Phenol -d5	BQL	90.00	BQL	84.00	87.00	6.90
2-Chlorophenol -d4	BQL	84.00	BQL	82.00	83.00	2.41
1,2-Dichlorobenzene -d4	BQL	77.00	BQL	75.00	76.00	2.63
Nitrobenzene -d5	BQL	85.00	BQL	84.00	84.50	1.18
2-Fluorobiphenyl	BQL	96.00	BQL	87.00	91.50	9.84
2,4,6-Tribromophenol	BQL	91.00	BQL	87.00	89.00	4.49
Terphenyl -d14	BQL	99.00	BQL	94.00	96.50	5.18
Minimum					74.50	1.18
Maximum					96.50	9.84
Average					85.25	5.25

ND: Not detected
BQL: Below quantitation limit

TABLE A4-35. SS3, SS22-FIELD SAMPLE DUPLICATE SUMMARY (continued)

PAH	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS3 - Condition 2, Run 2						
Acenaphthene	ND	890.00	ND	1000.00	945.00	11.64
Fluorene	ND	890.00	ND	1000.00	945.00	11.64
Phenanthrene	ND	890.00	BQL	4600.00	2745.00	135.15
Anthracene	ND	890.00	ND	1000.00	945.00	11.64
Fluoranthene	ND	890.00	BQL	4000.00	2445.00	127.20
Pyrene	ND	890.00	BQL	3400.00	2145.00	117.02
Benzo (a) anthracene	ND	890.00	BQL	1600.00	1245.00	57.03
Chrysene	ND	890.00	BQL	1300.00	1095.00	37.44
Benzo (b) fluoranthene	ND	890.00	BQL	1600.00	1245.00	57.03
Benzo (k) fluoranthene	ND	890.00	ND	1000.00	945.00	11.64
Benzo (e) pyrene	ND	890.00	ND	1000.00	945.00	11.64
Benzo (a) pyrene	ND	890.00	BQL	1300.00	1095.00	37.44
Perylene	ND	890.00	ND	1000.00	945.00	11.64
Indeno (1,2,3-cd) pyrene	ND	890.00	ND	1000.00	945.00	11.64
Dibenz (a,h) anthracene	ND	890.00	ND	1000.00	945.00	11.64
Benzo (g,h,i) perylene	ND	890.00	ND	1000.00	945.00	11.64
Naphthalene	ND	890.00	BQL	1200.00	1045.00	29.67
2-Methylnaphthalene	ND	890.00	BQL	1100.00	995.00	21.11
2-Chloronaphthalene	ND	890.00	ND	1000.00	945.00	11.64
Acenapthylene	ND	890.00	ND	1000.00	945.00	11.64
Minimum					945.00	11.64
Maximum					2745.00	135.15
Average					1222.50	37.36
SURROGATE RECOVERY						
2-Fluorophenol	BQL	66.00	BQL	76.00	71.00	14.08
Phenol -d5	BQL	81.00	BQL	89.00	85.00	9.41
2-Chlorophenol -d4	BQL	75.00	BQL	83.00	79.00	10.13
1,2-Dichlorobenzene -d4	BQL	62.00	BQL	73.00	67.50	16.30
Nitrobenzene -d5	BQL	76.00	BQL	87.00	81.50	13.50
2-Fluorobiphenyl	BQL	86.00	BQL	92.00	89.00	6.74
2,4,6-Tribromophenol	BQL	92.00	BQL	98.00	95.00	6.32
Terphenyl -d14	BQL	101.00	BQL	104.00	102.50	2.93
Minimum					67.50	2.93
Maximum					102.50	16.30
Average					83.81	9.93

ND: Not detected
BQL: Below quantitation limit

TABLE A4-35. SS3, SS22-FIELD SAMPLE DUPLICATE SUMMARY (continued)

VOC	Field sample (ppb)		Field sample duplicate (ppb)		Average (ppb)	Relative % difference
SS3						
Vinyl chloride	ALR	4900	ALR	59000	31950.00	169.33
Methyl chloride	ALR	18000	ALR	6800	12400.00	90.32
Trans-1,2-Dichloroethene	ND	30	ND	30	NA	NA
Cis-1,2-Dichloroethene	ND	31000	ALR	15000	23000.00	69.57
Chloroform	ND	30	ND	30	NA	NA
1,1,1-Trichloroethane	ND	30	ND	30	NA	NA
Carbon Tetrachloride	ND	30	ND	30	NA	NA
Benzene	BQL	42	ND	30	NA	NA
1,2-Dichloroethane	ND	30	ND	30	NA	NA
Trichloroethene	ALR	98000	ALR	57000	77500.00	52.90
Toluene	ALR	9100		2300	5700.00	119.30
1,1,2-Trichloroethane	ND	30	ND	30	NA	NA
Tetrachloroethene	ND	30	ND	30	NA	NA
1,2-Dibromoethane	ND	30	ND	30	NA	NA
Chlorobenzene	BQL	46	ND	30	NA	NA
Ethylbenzene	ALR	5100	ALR	4500	4800.00	12.50
m-p-Xylene	ALR	6800	ALR	5600	6200.00	19.35
o-Xylene	ALR	4500	ALR	4000	4250.00	11.76
1,3-Dichlorobenzene	ND	30	ND	30	NA	NA
1,4-Dichlorobenzene	BQL	93	ND	30	NA	NA
1,2-Dichlorobenzene	ND	30	ND	30	NA	NA
Minimum					4250.00	11.76
Maximum					77500.00	169.33
Average					20725.00	68.13

	Units	Field sample	Field sample duplicate	Average (ppb)	Relative % difference
SS3					
Total organic carbon	mg/kg	18100	18500	18300.00	2.19
Total sulfur	%	ND	ND		
Total halogens (as chlorine	%	0.34	0.05	0.20	148.72
SS22					
Total sulfur	%	0.0026	0.0031	0.00	17.54

ND : Not detected
BQL : Below quantitation limit
ALR : Above linear range
NA : Not available

TABLE A4-35. SS3, SS22 FIELD SAMPLE DUPLICATE SUMMARY (continued)

Metals	Field sample (ppm)	Field sample duplicate (ppm)	Average (ppm)	Relative % difference
SS3				
Ag	ND 7.4	1	NA	NA
As	27	16	21.50	51.16
Ba	110	100	105.00	9.52
Be	0.45	0.36	0.41	22.22
Cd	2.1	1.2	1.65	54.55
Cr	75	27	51.00	94.12
Cu	99	45	72.00	75.00
Hg	0.26	0.19	0.23	31.11
Mn	410	290	350.00	34.29
Ni	65	19	42.00	109.52
P	630	370	500.00	52.00
Pb	270	170	220.00	45.45
Sb	ND 7.4	ND 7.4	NA	NA
Se	ND 7.4	ND 7.4	NA	NA
Sn	95	45	70.00	71.43
Tl	13	ND 7.4	NA	NA
Zn	360	330	345.00	8.70
Minimum			0.23	8.70
Maximum			500.00	109.52
Average			136.83	50.70

ND: Not detected
N/A: Not available

TABLE A4-36. PCB MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY

	PCB	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS1	**Conditions 1-3**				
	Total monochlorobiphenyls	70	70	70.00	0.00
	Total dichlorobiphenyls	140	140	140.00	0.00
	Total trichlorobiphenyls	145	155	150.00	6.67
	Total tetrachlorobiphenyls	95	100	97.50	5.13
	Total pentachlorobiphenyls	90	95	92.50	5.41
	Total hexachlorobiphenyls	79	79	79.00	0.00
	Total heptachlorobiphenyls	77	77	77.00	0.00
	Total octachlorobiphenyls	70	70	70.00	0.00
	Total nonachlorobiphenyls	na	na	na	na
	Total decachlorobiphenyls	84	84	84.00	0.00
	Minimum			70.00	0.00
	Maximum			150.00	6.67
	Average			95.56	1.91
SS3	**Condition 2- Run 2**				
	Total monochlorobiphenyls	44	136	90.00	102.22
	Total dichlorobiphenyls	na	na	na	na
	Total trichlorobiphenyls	na	na	na	na
	Total tetrachlorobiphenyls	na	na	na	na
	Total pentachlorobiphenyls	na	na	na	na
	Total hexachlorobiphenyls	na	na	na	na
	Total heptachlorobiphenyls	na	na	na	na
	Total octachlorobiphenyls	na	na	na	na
	Total nonachlorobiphenyls	na	na	na	na
	Total decachlorobiphenyls	61	42	51.50	36.89
	Minimum			51.50	36.89
	Maximum			90.00	102.22
	Average			70.75	69.56
SS11	**Condition 2**				
	Total monochlorobiphenyls	-347	-306	-326.50	12.56
	Total dichlorobiphenyls	-265	-265	-265.00	0.00
	Total trichlorobiphenyls	-388	-347	-367.50	11.16
	Total tetrachlorobiphenyls	-232	-192	-212.00	18.87
	Total pentachlorobiphenyls	-71	-81	-76.00	13.16
	Total hexachlorobiphenyls	24	37	30.50	42.62
	Total heptachlorobiphenyls	27	36	31.50	28.57
	Total octachlorobiphenyls	25	30	27.50	18.18
	Total nonachlorobiphenyls	na	na	na	na
	Total decachlorobiphenyls	25	30	27.50	18.18
	Minimum			-367.50	0.00
	Maximum			31.50	42.62
	Average			-125.56	18.14

TABLE A4-36. PCB MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

PCB	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS11 Condition 3				
Total monochlorobiphenyls	-211.00	-222.00	-216.50	5.08
Total dichlorobiphenyls	-158.00	-89.00	-123.50	55.87
Total trichlorobiphenyls	-53.00	-111.00	-82.00	70.73
Total tetrachlorobiphenyls	13.00	-33.00	-10.00	460.00
Total pentachlorobiphenyls	26.00	0.00	13.00	200.00
Total hexachlorobiphenyls	44.00	41.00	42.50	7.06
Total heptachlorobiphenyls	45.00	41.00	43.00	9.30
Total octachlorobiphenyls	38.00	39.00	38.50	2.60
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	38.00	43.00	40.50	12.35
Minimum			-216.50	2.60
Maximum			43.00	460.00
Average			-28.28	91.44
SS12 Condition 2				
Total monochlorobiphenyls	163.00	123.00	143.00	27.97
Total dichlorobiphenyls	233.00	178.00	205.50	26.76
Total trichlorobiphenyls	478.00	306.00	392.00	43.88
Total tetrachlorobiphenyls	323.00	283.00	303.00	13.20
Total pentachlorobiphenyls	52.00	52.00	52.00	0.00
Total hexachlorobiphenyls	7.00	6.00	6.50	15.38
Total heptachlorobiphenyls	121.00	93.00	107.00	26.17
Total octachlorobiphenyls	86.00	80.00	83.00	7.23
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	35.00	68.00	51.50	64.08
Minimum			6.50	0.00
Maximum			392.00	64.08
Average			149.28	24.96
SS12 Condition 3				
Total monochlorobiphenyls	6.00	4.00	5.00	40.00
Total dichlorobiphenyls	28.00	19.00	23.50	38.30
Total trichlorobiphenyls	32.00	14.00	23.00	78.26
Total tetrachlorobiphenyls	14.00	16.00	15.00	13.33
Total pentachlorobiphenyls	-3.00	0.00	-1.50	200.00
Total hexachlorobiphenyls	11.00	11.00	11.00	0.00
Total heptachlorobiphenyls	11.00	11.00	11.00	0.00
Total octachlorobiphenyls	10.00	10.00	10.00	0.00
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	11.00	11.00	11.00	0.00
Minimum			-1.50	0.00
Maximum			23.50	200.00
Average			12.00	41.10

TABLE A4-36. PCB MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

PCB	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS13 Condition 1-Run 1				
Total monochlorobiphenyls	33.00	40.00	36.50	19.18
Total dichlorobiphenyls	43.00	53.00	48.00	20.83
Total trichlorobiphenyls	46.00	54.00	50.00	16.00
Total tetrachlorobiphenyls	40.00	43.00	41.50	7.23
Total pentachlorobiphenyls	43.00	43.00	43.00	0.00
Total hexachlorobiphenyls	43.00	39.00	41.00	9.76
Total heptachlorobiphenyls	44.00	38.00	41.00	14.63
Total octachlorobiphenyls	41.00	53.00	47.00	25.53
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	37.00	35.00	36.00	5.56
Minimum			36.00	0.00
Maximum			50.00	25.53
Average			42.67	13.19
SS13 Condition 2				
Total monochlorobiphenyls	31	19	25.00	48.00
Total dichlorobiphenyls	38	31	34.50	20.29
Total trichlorobiphenyls	41	29	35.00	34.29
Total tetrachlorobiphenyls	38	28	33.00	30.30
Total pentachlorobiphenyls	37	31	34.00	17.65
Total hexachlorobiphenyls	40	31	35.50	25.35
Total heptachlorobiphenyls	38	30	34.00	23.53
Total octachlorobiphenyls	33	26	29.50	23.73
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	31	24	27.50	25.45
Minimum			25.00	17.65
Maximum			35.50	48.00
Average			32.00	27.62
SS13 Condition 3-Run 3				
Total monochlorobiphenyls	39.00	52.00	45.50	28.57
Total dichlorobiphenyls	43.00	62.00	52.50	36.19
Total trichlorobiphenyls	44.00	64.00	54.00	37.04
Total tetrachlorobiphenyls	40.00	55.00	47.50	31.58
Total pentachlorobiphenyls	41.00	55.00	48.00	29.17
Total hexachlorobiphenyls	40.00	55.00	47.50	31.58
Total heptachlorobiphenyls	37.00	50.00	43.50	29.89
Total octachlorobiphenyls	34.00	41.00	37.50	18.67
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	33.00	39.00	36.00	16.67
Minimum			36.00	16.67
Maximum			54.00	37.04
Average			45.78	28.82

TABLE A4-36. PCB MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

PCB	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS22 Condition 1-Run 1				
Total monochlorobiphenyls	69	80	74.50	14.77
Total dichlorobiphenyls	73	78	75.50	6.62
Total trichlorobiphenyls	68	69	68.50	1.46
Total tetrachlorobiphenyls	55	60	57.50	8.70
Total pentachlorobiphenyls	60	60	60.00	0.00
Total hexachlorobiphenyls	48	46	47.00	4.26
Total heptachlorobiphenyls	43	40	41.50	7.23
Total octachlorobiphenyls	40	37	38.50	7.79
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	42	40	41.00	4.88
Minimum			38.50	0.00
Maximum			75.50	14.77
Average			56.00	6.19
SS22 Condition 2-Run 2				
Total monochlorobiphenyls	23	27	25.00	16.00
Total dichlorobiphenyls	32	35	33.50	8.96
Total trichlorobiphenyls	30	36	33.00	18.18
Total tetrachlorobiphenyls	27	31	29.00	13.79
Total pentachlorobiphenyls	29	34	31.50	15.87
Total hexachlorobiphenyls	30	35	32.50	15.38
Total heptachlorobiphenyls	30	32	31.00	6.45
Total octachlorobiphenyls	27	29	28.00	7.14
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	25	29	27.00	14.81
Minimum			25.00	6.45
Maximum			33.50	18.18
Average			30.06	12.96
SS22 Condition 3-Run 3				
Total Monochlorobiphenyls	-15.00	2.00	-6.50	261.54
Total dichlorobiphenyls	37.00	46.00	41.50	21.69
Total trichlorobiphenyls	36.00	45.00	40.50	22.22
Total tetrachlorobiphenyls	41.00	41.00	41.00	0.00
Total pentachlorobiphenyls	-6.00	6.00	0.00	na
Total hexachlorobiphenyls	31.00	36.00	33.50	14.93
Total heptachlorobiphenyls	28.00	41.00	34.50	37.68
Total octachlorobiphenyls	26.00	38.00	32.00	37.50
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	18.00	21.00	19.50	15.38
Minimum			-6.50	0.00
Maximum			41.50	261.54
Average			26.22	51.37

TABLE A4-36. PCB MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

PCB	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS24 **Condition 2**				
Run 2				
Total monochlorobiphenyls	61	38	49.50	46.46
Total dichlorobiphenyls	121	31	76.00	118.42
Total trichlorobiphenyls	303	408	355.50	29.54
Total tetrachlorobiphenyls	100	450	275.00	127.27
Total pentachlorobiphenyls	250	250	250.00	0.00
Total hexachlorobiphenyls	90	90	90.00	0.00
Total heptachlorobiphenyls	69	74	71.50	6.99
Total octachlorobiphenyls	60	66	63.00	9.52
Total nonachlorobiphenyls	na	na	na	na
Total decachlorobiphenyls	62	64	63.00	3.17
Minimum			49.50	0.00
Maximum			355.50	127.27
Average			143.72	37.93

na - Not available

TABLE A4-37. PCB SURROGATE RECOVERY SUMMARY

SAMPLE ID		SURROGATE RECOVERY (%)		
		2-Fluorobiphenyl	Tetrachlorobiphenyl-C13	Octachlorobiphenyl-C13
SS1	**Condition 1**			
	Run 1	61.00	66.00	59.00
	Run 2	59.00	56.00	53.00
	Run 3	16.50	33.50	32.00
	Average	**45.50**	**51.83**	**48.00**
	RSD %	**55.24**	**32.11**	**29.54**
	Condition 3			
	Run 1	43.00	58.00	59.00
	Run 2	43.00	76.00	71.00
	Run 3	44.00	80.00	78.00
	Average	**43.33**	**71.33**	**69.33**
	RSD %	**1.33**	**16.43**	**13.86**
SS2	**Condition 1**			
	Run 1	76.00	156.00	76.50
	Condition 3			
	Run 1	78.00	145.50	73.00
SS3	**Condition 2**			
	Run 1	38.00	126.00	65.00
	Run 2	36.00	115.50	57.50
	Average	37.00	120.75	61.25
	RPD %	5.41	8.70	12.24
SS10	**Condition 2**			
	Run 1	6.00	12.00	32.50
	Run 2	28.00	43.00	52.00
	Average	**17.00**	**27.50**	**42.25**
	RPD %	**129.41**	**112.73**	**46.15**

TABLE A4-37. PCB SURROGATE RECOVERY SUMMARY (continued)

SAMPLE ID		SURROGATE RECOVERY (%)		
		2-Fluorobiphenyl	Tetrachlorobiphenyl-C13	Octachlorobiphenyl-C13
SS11	**Condition 1**			
	Run 1-3	61.00	140.00	121.00
	Condition 2			
	Runs 1&2	58.00	61.00	61.00
	Condition 3			
	Run 1-3	55.00	86.00	87.00
SS12	**Condition 1**			
	Run 1-3	54.00	57.00	68.00
	Condition 2			
	Runs 1&2	45.00	69.00	64.00
	Condition 3			
	Run 1-3	43.00	58.00	78.00
SS13	**Condition 1**			
	Run 3	43.00	44.00	44.00
	Condition 2			
	Runs 1&2	22.00	39.00	33.00
	Condition 3			
	Run 3	46.00	80.00	76.00
SS15-BR	**Condition 3**			
	Run 2	21.00	53.00	50.00
	Run 3	23.00	82.00	76.00
	Average	**22.00**	**67.50**	**63.00**
	RPD %	**9.09**	**42.96**	**41.27**

TABLE A4-37. PCB SURROGATE RECOVERY SUMMARY
(continued)

SAMPLE ID		SURROGATE RECOVERY (%)		
		2-Fluorobiphenyl	Tetrachlorobiphenyl-C13	Octachlorobiphenyl-C13
SS15	**Condition 3**			
	Run 1	60.00	78.00	83.00
	Runs 2 & 3 *	40.00	0.00	40.00
	Average	**50.00**	**39.00**	**61.50**
	RSD %	40.00	200.00	69.92
SS18	**Condition 1**			
	Run 1-3	54.00	63.00	60.00
	Condition 3			
	Run 1-3	66.00	83.00	81.00
SS22	**Condition 1**			
	Run 1	99.00	100.00	94.00
	Run 2	113.00	122.00	127.00
	Run 3	70.00	90.00	90.00
	Average	**94.00**	**104.00**	**103.67**
	RSD %	**23.33**	**15.74**	**19.59**

* Surrogates for this composite were diluted out, values shown are estimates

TABLE A4-37. PCB SURROGATE RECOVERY SUMMARY (continued)

SAMPLE ID		SURROGATE RECOVERY (%)		
		2-Fluorobiphenyl	Tetrachlorobiphenyl-C13	Octachlorobiphenyl-C13
SS22	**Condition 2**			
	Run 1	30.50	35.00	30.00
	Run 2			
	BOR	23.00	43.00	39.00
	EOR	25.00	41.00	38.00
	Average	**26.17**	**39.67**	**35.67**
	RSD %	**14.84**	**10.50**	**13.83**
	Condition 3			
	BOC			
	Run 1	58.00	60.00	58.00
	Run 2	67.00	79.00	78.00
	Run 3	83.00	82.00	86.00
	EOC			
	Run 1	56.00	62.00	63.00
	Run 2	61.00	81.00	83.00
	Run 3	76.00	70.00	81.00
	Average	**66.83**	**72.33**	**74.83**
	RSD %	**16.04**	**13.51**	**15.39**
SS24	**Condition 2**			
	Run 1			
	BOR	62.00	113.00	72.50
	EOR	39.00	67.00	44.50
	Run 2			
	BOR	51.00	74.00	70.00
	EOR	46.00	83.00	78.00
	Average	49.50	84.25	66.25
	RSD %	19.55	24.04	22.46

TABLE A4-38. CB, CP, AND PAH MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY

PAH,CB/CP	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS1				
Phenol	25.00	31.00	28.00	21.43
2-Chlorophenol	44.00	59.00	51.50	29.13
1,4-Dichlorobenzene	72.00	82.00	77.00	12.99
1,2,4-Trichlorobenzene	70.00	78.00	74.00	10.81
4-Chloro-3-methylphenol	65.00	69.00	67.00	5.97
Acenaphthene	72.00	76.00	74.00	5.41
4-Nitrophenol	0.00	5.00	2.50	200.00
Hexachlorobenzene	84.00	84.00	84.00	0.00
Pentachlorophenol	0.00	2.00	1.00	200.00
Pyrene	106.00	102.00	104.00	3.85
SS2				
Phenol	78.00	74.00	76.00	5.26
2-Chlorophenol	78.00	75.00	76.50	3.92
1,4-Dichlorobenzene	88.00	83.00	85.50	5.85
1,2,4-Trichlorobenzene	85.00	86.00	85.50	1.17
4-Chloro-3-methylphenol	90.00	86.00	88.00	4.55
Acenaphthene	91.00	88.00	89.50	3.35
4-Nitrophenol	72.00	70.00	71.00	2.82
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	62.00	52.00	57.00	17.54
Pyrene	81.00	82.00	81.50	1.23
SS3				
Phenol	64.00	71.00	67.50	10.37
2-Chlorophenol	64.00	65.00	64.50	1.55
1,4-Dichlorobenzene	55.00	65.00	60.00	16.67
1,2,4-Trichlorobenzene	73.00	78.00	75.50	6.62
4-Chloro-3-methylphenol	76.00	71.00	73.50	6.80
Acenaphthene	86.00	100.00	93.00	15.05
4-Nitrophenol	67.00	65.00	66.00	3.03
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	28.00	26.00	27.00	7.41
Pyrene	118.00	239.00	178.50	67.79
SS11 - Condition 3				
Phenol	NC	NC		
2-Chlorophenol	54.00	66.00	60.00	20.00
1,4-Dichlorobenzene	48.00	65.00	56.50	30.09
1,2,4-Trichlorobenzene	56.00	70.00	63.00	22.22
4-Chloro-3-methylphenol	26.00	26.00	26.00	0.00
Acenaphthene	NC	83.00	83.00	NA
4-Nitrophenol	0.00	0.00	0.00	0.00
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	114.00	89.00	101.50	24.63
Pyrene	NC	NC	NA	NA

TABLE A4-38. CB, CP, AND PAH MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (CONTINUED)

PAH,CB/CP	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS11 - Condition 2				
Phenol	73.00	64.00	68.50	13.14
2-Chlorophenol	73.00	73.00	73.00	0.00
1,4-Dichlorobenzene	73.00	68.00	70.50	7.09
1,2,4-Trichlorobenzene	77.00	68.00	72.50	12.41
4-Chloro-3-methylphenol	64.00	55.00	59.50	15.13
Acenaphthene	95.00	91.00	93.00	4.30
4-Nitrophenol	0.00	16.00	8.00	200.00
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	55.00	70.00	62.50	24.00
Pyrene	NC	NC	NA	NA
SS12 - Condition 3				
Phenol	65.00	69.00	67.00	5.97
2-Chlorophenol	65.00	69.00	67.00	5.97
1,4-Dichlorobenzene	60.00	60.00	60.00	0.00
1,2,4-Trichlorobenzene	100.00	100.00	100.00	0.00
4-Chloro-3-methylphenol	100.00	106.00	103.00	5.83
Acenaphthene	NC	NC	NA	NA
4-Nitrophenol	65.00	69.00	67.00	5.97
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	57.00	61.00	59.00	6.78
Pyrene	NC	NC	NA	NA
SS12-Condition 2				
Phenol	66.00	70.00	68.00	5.88
2-Chlorophenol	57.00	70.00	63.50	20.47
1,4-Dichlorobenzene	53.00	62.00	57.50	15.65
1,2,4-Trichlorobenzene	67.00	66.00	66.50	1.50
4-Chloro-3-methylphenol	70.00	70.00	70.00	0.00
Acenaphthene	130.00	121.00	125.50	7.17
4-Nitrophenol	NC	NC	NA	NA
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	13.00	112.00	62.50	158.40
Pyrene	NC	NC	NA	NA
SS13 - Condition 1				
Phenol	82.00	24.00		
2-Chlorophenol	78.00	66.00	72.00	16.67
1,4-Dichlorobenzene	73.00	65.00	69.00	11.59
1,2,4-Trichlorobenzene	64.00	65.00	64.50	1.55
4-Chloro-3-methylphenol	71.00	47.00	59.00	40.68
Acenaphthene	79.00	81.00	80.00	NA
4-Nitrophenol	0.00	0.00	0.00	0.00
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	51.00	49.00	50.00	4.00
Pyrene	161.00	123.00	NA	NA

TABLE A4-38. CB, CP, AND PAH MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (CONTINUED)

PAH,CB/CP	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS13 - Condition 2				
Phenol	13.00	45.00	29.00	110.34
2-Chlorophenol	69.00	55.00	62.00	22.58
1,4-Dichlorobenzene	72.00	61.00	66.50	16.54
1,2,4-Trichlorobenzene	74.00	53.00	63.50	33.07
4-Chloro-3-methylphenol	73.00	46.00	59.50	45.38
Acenaphthene	90.00	61.00	75.50	38.41
4-Nitrophenol	28.00	23.00	25.50	19.61
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	59.00	35.00	47.00	51.06
Pyrene	NC	NC	NA	NA
SS13 - Condition 3				
Phenol	63.00	48.00	55.50	27.03
2-Chlorophenol	72.00	75.00	73.50	4.08
1,4-Dichlorobenzene	73.00	64.00	68.50	13.14
1,2,4-Trichlorobenzene	75.00	73.00	74.00	2.70
4-Chloro-3-methylphenol	66.00	72.00	69.00	8.70
Acenaphthene	113.00	120.00	116.50	6.01
4-Nitrophenol	33.00	31.00	32.00	6.25
Hexachlorobenzene	NS	NS	NA	NA
Pentachlorophenol	63.00	64.00	63.50	1.57
Pyrene	109.00	125.00	NA	NA
SS22 - Condition 1				
Phenol	41.00	NC	41.00	NA
2-Chlorophenol	86.00	83.00	84.50	3.55
1,4-Dichlorobenzene	86.00	90.00	88.00	4.55
1,2,4-Trichlorobenzene	73.00	69.00	71.00	5.63
4-Chloro-3-methylphenol	135.00	110.00	122.50	20.41
Acenaphthene	286.00	59.00	172.50	NA
4-Nitrophenol	0.00	0.00	0.00	0.00
Hexachlorobenzene	80.00	94.00	NA	NA
Pentachlorophenol	51.00	51.00	51.00	0.00
Pyrene	NC	NC	NA	NA
SS22 - Condition 2 BOR				
Phenol	20.00	20.00	20.00	0.00
2-Chlorophenol	61.00	59.00	60.00	3.33
1,4-Dichlorobenzene	76.00	76.00	76.00	0.00
1,2,4-Trichlorobenzene	67.00	67.00	67.00	0.00
4-Chloro-3-methylphenol	42.00	39.00	40.50	7.41
Acenaphthene	94.00	102.00	98.00	8.16
4-Nitrophenol	0.00	18.00	9.00	200.00
Hexachlorobenzene	90.00	92.00	NA	NA
Pentachlorophenol	55.00	53.00	54.00	3.70
Pyrene	245.00	367.00	NA	NA

TABLE A4-38. CB, CP, AND PAH MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (CONTINUED)

PAH,CB/CP	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS22 - Condition 2 BOR				
Phenol	34.00	35.00	34.50	2.90
2-Chlorophenol	76.00	69.00	72.50	9.66
1,4-Dichlorobenzene	63.00	62.00	62.50	1.60
1,2,4-Trichlorobenzene	63.00	60.00	61.50	4.88
4-Chloro-3-methylphenol	65.00	64.00	64.50	1.55
Acenaphthene	98.00	104.00	101.00	5.94
4-Nitrophenol	0.00	0.00	0.00	NA
Hexachlorobenzene	92.00	98.00	NA	NA
Pentachlorophenol	70.00	70.00	70.00	0.00
Pyrene	20.00	140.00	NA	NA
SS24 - Condition 2-Run 1				
Phenol	61.00	61.00	61.00	NA
2-Chlorophenol	73.00	86.00	79.50	16.35
1,4-Dichlorobenzene	73.00	88.00	80.50	18.63
1,2,4-Trichlorobenzene	90.00	100.00	95.00	10.53
4-Chloro-3-methylphenol	86.00	96.00	91.00	10.99
Acenaphthene	41.00	102.00	71.50	NA
4-Nitrophenol	0.00	0.00	0.00	0.00
Hexachlorobenzene	94.00	92.00	NA	NA
Pentachlorophenol	38.00	18.00	28.00	71.43
Pyrene	NC	NC	NA	NA
SS24 - Condition 2-Run 2				
Phenol	28.00	31.00	29.50	10.17
2-Chlorophenol	69.00	70.00	69.50	1.44
1,4-Dichlorobenzene	62.00	66.00	64.00	6.25
1,2,4-Trichlorobenzene	66.00	68.00	67.00	2.99
4-Chloro-3-methylphenol	73.00	77.00	75.00	5.33
Acenaphthene	76.00	72.00	74.00	5.41
4-Nitrophenol	39.00	22.00	30.50	55.74
Hexachlorobenzene	NC	NC	NA	NA
Pentachlorophenol	107.00	95.00	101.00	11.88
Pyrene	120.00	116.00	NA	NA

NS - Not Spiked
NA - Not Available
NC - Could not be Calculated
Notes:

1 2-chlorophenol and pentachlorophenol used to calculate CP precision and accuracy
2 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, and hexachlorobenzene used to calculate CB precision and accuracy
3 Acenaphthene and pyrene used to calculate PAH precision and accuracy
4 When hexachlorobenzene was not spiked, 1,2,4-trichlorobenzene was used as an indicator to present hexachlorobenzene accuracy and precision

TABLE A4-39. CB, CP AND PAH SURROGATE RECOVERY SUMMARY

SAMPLE ID	SURROGATE RECOVERY (%) 2-Fluorophenol	Phenol - d5	2-Chlorophenol-d4	1,2-Dichlorobenzene-d4	Nitrobenzene-d5	2-Fluorobiphenyl	2,4,6-Tribromophenol	Terphenyl-d14
SS1								
Condition 1								
Run 1	5.00	21.00	20.00	73.00	89.00	78.00	1.00	84.00
Run 2	38.00	30.00	64.00	65.00	67.00	64.00	47.00	66.00
Run 3	44.00	34.00	60.00	49.00	68.00	53.00	72.00	73.00
Condition 3								
Run 1	1.00	2.00	3.00	46.00	53.00	50.00	2.00	55.00
Run 2	42.00	28.00	70.00	53.00	67.00	56.00	78.00	64.00
Run 3	28.00	17.00	53.00	56.00	58.00	58.00	75.00	61.00
SS2								
Condition 1								
Run 1	84.00	86.00	90.00	96.00	88.00	88.00	80.00	94.00
Condition 3								
Run 1	91.00	95.00	94.00	99.00	96.00	93.00	85.00	126.00
SS3								
Condition 2								
Run 1	BQL 78.00	BQL 90.00	BQL 84.00	BQL 77.00	BQL 85.00	BQL 96.00	BQL 91.00	BQL 99.00
Run 2	BQL 66.00	BQL 81.00	BQL 75.00	BQL 62.00	BQL 76.00	BQL 86.00	BQL 92.00	BQL 101.00
SS10								
Condition 2								
Run 1	BQL 29.00	BQL 44.00	BQL 40.00	BQL 22.00	BQL 26.00	BQL 80.00	BQL 49.00	BQL 98.00
Run 2	73.00	81.00	76.00	72.00	77.00	82.00	86.00	90.00
SS11								
Condition 1								
Run 1,2,3	59.00	68.00	63.00	61.00	65.00	76.00	91.00	92.00
Condition 2								
Run 1,2	BQL 63.00	BQL 49.00	BQL 68.00	BQL 68.00	BQL 54.00	BQL 117.00	BQL 100.00	BQL 60.00
SS12								
Condition 2								
Run 1,2	BQL 23.00	BQL 28.00	BQL 27.00	BQL 27.00	BQL 29.00	BQL 44.00	BQL 37.00	BQL 42.00
SS13								
Condition 2								
Run 1,2	BQL 57.00	BQL 42.00	BQL 80.00	BQL 71.00	BQL 77.00	BQL 71.00	BQL 74.00	BQL 97.00
Condition 3								
Run 1,2,3	7.00	11.00	38.00	70.00	62.00	75.00	17.00	80.00
SS18								
Condition 1								
Run 1,2,3	37.00	26.00	65.00	55.00	66.00	66.00	90.00	76.00
Condition 3								
Run 1,2,3	48.00	32.00	70.00	70.00	74.00	70.00	85.00	75.00

TABLE A4-39. CB, CP AND PAH SURROGATE RECOVERY SUMMARY (continued)

SAMPLE ID	SURROGATE RECOVERY (%) 2-Fluorophenol		Phenol - d5		2-Chlorophenol-d4		1,2-Dichlorobenzene-d4		Nitrobenzene-d5		2-Fluorobiphenyl		2,4,6-Tribromophenol		Terphenyl-d14	
SS22 Beginning of run																
Condition 1																
Run 1		9.00		7.00		35.00		63.00		69.00		68.00		8.00		70.00
Run 2		51.00		32.00		84.00		88.00		88.00		85.00		97.00		83.00
Condition 2																
Run 1	BQL	23.00	BQL	16.00	BQL	46.00	BQL	55.00	BQL	43.00	BQL	59.00	BQL	57.00	BQL	70.00
Run 2	BQL	39.00	BQL	27.00	BQL	65.00	BQL	62.00	BQL	64.00	BQL	72.00	BQL	70.00	BQL	89.00
Condition 3																
Run 1		24.00		19.00		59.00		67.00		73.00		68.00		37.00		75.00
Run 2	BQL	43.00	BQL	29.00	BQL	78.00	BQL	62.00	BQL	75.00	BQL	66.00	BQL	66.00	BQL	86.00
Run 3	BQL	33.00	BQL	23.00	BQL	67.00	BQL	78.00	BQL	83.00	BQL	86.00	BQL	79.00	BQL	89.00
SS22 End of run																
Condition 1																
Run 1		9.00		7.00		35.00		63.00		69.00		68.00		8.00		70.00
Run 3	BQL	56.00	BQL	47.00	BQL	85.00	BQL	54.00	BQL	94.00	BQL	55.00	BQL	69.00	BQL	93.00
Condition 2																
Run 2	BQL	47.00	BQL	35.00	BQL	72.00	BQL	59.00	BQL	72.00	BQL	69.00	BQL	67.00	BQL	95.00
Condition 3																
Run 1	BQL	36.00	BQL	18.00	BQL	63.00	BQL	67.00	BQL	78.00	BQL	75.00	BQL	70.00	BQL	82.00
Run 2	BQL	56.00	BQL	38.00	BQL	82.00	BQL	69.00	BQL	82.00	BQL	70.00	BQL	79.00	BQL	90.00
SS24 Beginning of run																
Condition 2																
Run 1	BQL	42.00	BQL	31.00	BQL	78.00	BQL	84.00	BQL	99.00	BQL	85.00	BQL	75.00	BQL	106.00
Run 2	BQL	49.00	BQL	34.00	BQL	71.00	BQL	64.00	BQL	75.00	BQL	76.00	BQL	82.00	BQL	105.00
SS24 End of run																
Condition 2																
Run 1	BQL	39.00	BQL	33.00	BQL	62.00	BQL	37.00	BQL	59.00	BQL	50.00	BQL	66.00	BQL	63.00
Run 2		38.00		25.00		70.00		53.00		70.00		62.00		79.00		107.00

BQL - Below quantitation limit

TABLE A4-40. VOC MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY

VOC	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS1 - Conditions 1-3				
1,1-dichloroethene	82	94	**88.00**	**13.64**
Trichloroethene	96	104	**100.00**	**8.00**
Benzene	106	118	**112.00**	**10.71**
Toluene	96	108	**102.00**	**11.76**
Chlorobenzene	108	118	**113.00**	**8.85**
Minimum			**88.00**	**8.00**
Maximum			**113.00**	**13.64**
Average			**103.00**	**10.59**
SS2 - Conditions 1-3				
1,1-dichloroethene	172	72	**122.00**	**81.97**
Trichloroethene	60	140	**100.00**	**80.00**
Benzene	103	85	**94.00**	**19.15**
Toluene	98	68	**83.00**	**36.14**
Chlorobenzene	108	94	**101.00**	**13.86**
Minimum			**83.00**	**13.86**
Maximum			**122.00**	**81.97**
Average			**100.00**	**46.22**
SS3 - Condition 2				
1,1-dichloroethene	0	147	**73.50**	**200.00**
Trichloroethene	0	0	**0.00**	**NA**
Benzene	101	160	**130.50**	**45.21**
Toluene	0	0	**0.00**	**NA**
Chlorobenzene	138	112	**125.00**	**20.80**
Minimum			**0.00**	**20.80**
Maximum			**130.50**	**200.00**
Average			**65.80**	**88.67**

NA - Not applicable

Note:

Since perchloroethylene was not used as a matrix spike compound, trichloroethene was used as the indicator when presenting accuracy and precision for perchloroethylene

TABLE A4-40. VOC MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

VOC	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS11-Condition 3				
1,1-dichloroethene	88	90	**89.00**	**2.25**
Trichloroethene	108	88	**98.00**	**20.41**
Benzene	0	0	**0.00**	**NA**
Toluene	240	182	**211.00**	**27.49**
Chlorobenzene	98	102	**100.00**	**4.00**
Minimum			**0.00**	**2.25**
Maximum			**211.00**	**27.49**
Average			**99.60**	**13.54**
SS11-Condition 2				
1,1-dichloroethene	74	0	**37.00**	**200.00**
Trichloroethene	0	0	**0.00**	**NA**
Benzene	112	20	**66.00**	**139.39**
Toluene	200	618	**409.00**	**102.20**
Chlorobenzene	110	116	**113.00**	**5.31**
Minimum			**0.00**	**5.31**
Maximum			**409.00**	**200.00**
Average			**125.00**	**111.73**

NA - Not applicable

Note:

Since perchloroethylene was not used as a matrix spike compound, trichloroethene was used as the indicator when presenting accuracy and precision for perchloroethylene

TABLE A4-40. VOC MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

VOC	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS12-Condition 3				
1,1-dichloroethene	205	112	**158.50**	**58.68**
Trichloroethene	52	151	**101.50**	**97.54**
Benzene	12000	29	**6014.50**	**199.04**
Toluene	0	0	**0.00**	**NA**
Chlorobenzene	100	33	**66.50**	**100.75**
Minimum			**0.00**	**58.68**
Maximum			**6014.50**	**199.04**
Average			**1268.20**	**114.00**
SS12-Condition 2				
1,1-dichloroethene	311	24	**167.50**	**171.34**
Trichloroethene	81	78	**79.50**	**3.77**
Benzene	58	0	**29.00**	**200.00**
Toluene	84	78	**81.00**	**7.41**
Chlorobenzene	104	107	**105.50**	**2.84**
Minimum			**29.00**	**2.84**
Maximum			**167.50**	**200.00**
Average			**92.50**	**77.07**

NA - Not applicable

Note:

Since perchloroethylene was not used as a matrix spike compound, trichloroethene was used as the indicator when presenting accuracy and precision for perchloroethylene

TABLE A4-40. VOC MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

VOC	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS13-Condition 1				
1,1-dichloroethene	76	68	**72.00**	**11.11**
Trichloroethene	84	88	**86.00**	**4.65**
Benzene	80	52	**66.00**	**42.42**
Toluene	108	112	**110.00**	**3.64**
Chlorobenzene	112	96	**104.00**	**15.38**
Minimum			**66.00**	**3.64**
Maximum			**110.00**	**42.42**
Average			**87.60**	**15.44**
SS13-Condition 2				
1,1-dichloroethene	60	66	**63.00**	**9.52**
Trichloroethene	122	142	**132.00**	**15.15**
Benzene	102	114	**108.00**	**11.11**
Toluene	90	92	**91.00**	**2.20**
Chlorobenzene	92	94	**93.00**	**2.15**
Minimum			**63.00**	**2.15**
Maximum			**132.00**	**15.15**
Average			**97.40**	**8.03**
SS13-Condition 3				
1,1-dichloroethene	119	119	**119.00**	**0.00**
Trichloroethene	117	119	**118.00**	**1.69**
Benzene	750	869	**809.50**	**14.70**
Toluene	129	129	**129.00**	**0.00**
Chlorobenzene	119	118	**118.50**	**0.84**
Minimum			**118.00**	**0.00**
Maximum			**809.50**	**14.70**
Average			**258.80**	**3.45**

NA - Not applicable

Note:

Since perchloroethylene was not used as a matrix spike compound, trichloroethene was used as the indicator when presenting accuracy and precision for perchloroethylene

TABLE A4-40. VOC MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SUMMARY (continued)

VOC	Matrix spike recovery (%)	Matrix spike duplicate recovery (%)	Average recovery (%)	Relative % difference
SS22-Condition 1				
1,1-dichloroethene	102	90	**96.00**	**12.50**
Trichloroethene	96	90	**93.00**	**6.45**
Benzene	4000	3800	**3900.00**	**5.13**
Toluene	280	260	**270.00**	**7.41**
Chlorobenzene	120	118	**119.00**	**1.68**
Minimum			**93.00**	**1.68**
Maximum			**3900.00**	**12.50**
Average			**895.60**	**6.63**
SS22-Condition 2				
1,1-dichloroethene	64	64	**64.00**	**0.00**
Trichloroethene	140	160	**150.00**	**13.33**
Benzene	114	116	**115.00**	**1.74**
Toluene	94	96	**95.00**	**2.11**
Chlorobenzene	100	94	**97.00**	**6.19**
Minimum			**64.00**	**0.00**
Maximum			**150.00**	**13.33**
Average			**104.20**	**4.67**
SS22-Condition 3				
1,1-dichloroethene	84	80	**82.00**	**4.88**
Trichloroethene	88	90	**89.00**	**2.25**
Benzene	30	30	**30.00**	**0.00**
Toluene	114	110	**112.00**	**3.57**
Chlorobenzene	110	110	**110.00**	**0.00**
Minimum			**30.00**	**0.00**
Maximum			**112.00**	**4.88**
Average			**84.60**	**2.14**
SS24-Condition 2				
1,1-dichloroethene	66	62	**64.00**	**6.25**
Trichloroethene	160	132	**146.00**	**19.18**
Benzene	122	114	**118.00**	**6.78**
Toluene	96	94	**95.00**	**2.11**
Chlorobenzene	98	100	**99.00**	**2.02**
Minimum			**64.00**	**2.02**
Maximum			**146.00**	**19.18**
Average			**104.40**	**7.27**

NA - Not applicable

Note:

Since perchloroethylene was not used as a matrix spike compound, trichloroethene was used as the indicator when presenting accuracy and precision for perchloroethylene

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 1 - run 2 liquids			
2378-TCDF	0.18	90	SS22
Total TCDF	0.18	90	TC T #1026
2378-TCDD	0.18	90	
Total TCDD	0.18	90	
12378-PeCDF	0.94	94	
23478-PeCDF	0.89	89	
Total PeCDF	1.80	90	
12378-PeCDD	0.93	93	
Total PeCDD	0.93	93	
123478-HxCDF	0.86	86	
123678-HxCDF	0.99	99	
123789-HxCDF	0.80	80	
234678-HxCDF	0.89	89	
Total HxCDF	3.50	88	
123478-HxCDD	1.00	100	
123678-HxCDD	0.87	87	
123789-HxCDD	0.81	81	
Total HxCDD	2.70	90	
1234678-HpCDF	0.85	85	
1234789-HpCDF	0.86	86	
Total HpCDF	1.70	85	
1234678-HpCDD	0.91	91	
Total HpCDD	0.91	91	
OCDF	2.00	100	
OCDD	1.70	85	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 1 - run 1 liquids			
2378-TCDF	0.22	110	SS22 EOR TCT #1028
Total TCDF	0.22	110	
2378-TCDD	0.20	100	
Total TCDD	0.20	100	
12378-PeCDF	1.10	110	
23478-PeCDF	1.00	100	
Total PeCDF	2.10	105	
12378-PeCDD	1.00	100	
Total PeCDD	1.00	100	
123478-HxCDF	1.00	100	
123678-HxCDF	0.97	97	
123789-HxCDF	0.96	96	
234678-HxCDF	0.99	99	
Total HxCDF	3.90	98	
123478-HxCDD	0.84	94	
123678-HxCDD	1.10	110	
123789-HxCDD	0.94	94	
Total HxCDD	3.00	100	
1234678-HpCDF	1.00	100	
1234789-HpCDF	1.00	100	
Total HpCDF	2.00	100	
1234678-HpCDD	1.00	100	
Total HpCDD	1.00	100	
OCDF	2.10	1.5	
OCDD	2.00	100	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 1 - run 1 liquids			
2378-TCDF	0.18	90	SS1
Total TCDF	0.18	90	TCT #1026
2378-TCDD	0.18	90	
Total TCDD	0.18	90	
12378-PeCDF	0.94	94	
23478-PeCDF	0.89	89	
Total PeCDF	1.80	90	
12378-PeCDD	0.93	93	
Total PeCDD	0.93	93	
123478-HxCDF	0.86	86	
123678-HxCDF	0.99	99	
123789-HxCDF	0.80	80	
234678-HxCDF	0.89	89	
Total HxCDF	3.50	88	
123478-HxCDD	1.00	100	
123678-HxCDD	0.87	87	
123789-HxCDD	0.81	81	
Total HxCDD	2.70	90	
1234678-HpCDF	0.85	85	
1234789-HpCDF	0.86	86	
Total HpCDF	1.70	85	
1234678-HpCDD	0.91	91	
Total HpCDD	0.91	91	
OCDF	2.00	100	
OCDD	1.70	85	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 1 - run 1 solids			
2378-TCDF	0.18	90	SS22
Total TCDF	0.18	90	TC T #1026
2378-TCDD	0.19	95	
Total TCDD	0.19	95	
12378-PeCDF	1.00	100	
23478-PeCDF	0.95	95	
Total PeCDF	2.00	100	
12378-PeCDD	0.90	90	
Total PeCDD	0.90	90	
123478-HxCDF	1.00	100	
123678-HxCDF	0.97	97	
123789-HxCDF	0.88	88	
234678-HxCDF	0.96	96	
Total HxCDF	3.80	95	
123478-HxCDD	1.00	100	
123678-HxCDD	0.90	90	
123789-HxCDD	0.70	70	
Total HxCDD	2.60	87	
1234678-HpCDF	0.91	91	
1234789-HpCDF	0.93	93	
Total HpCDF	1.80	90	
1234678-HpCDD	0.93	93	
Total HpCDD	0.93	93	
OCDF	1.90	95	
OCDD	1.70	85	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 1 - run 3 liquids			
2378-TCDF	0.18	90	SS1, 13, 18
Total TCDF	0.18	90	SS22
2378-TCDD	0.18	90	TCT # 1026
Total TCDD	0.18	90	
12378-PeCDF	0.94	94	
23478-PeCDF	0.89	89	
Total PeCDF	1.80	90	
12378-PeCDD	0.93	93	
Total PeCDD	0.93	93	
123478-HxCDF	0.86	86	
123678-HxCDF	0.99	99	
123789-HxCDF	0.80	80	
234678-HxCDF	0.89	89	
Total HxCDF	3.50	88	
123478-HxCDD	1.00	100	
123678-HxCDD	0.87	87	
123789-HxCDD	0.81	81	
Total HxCDD	2.70	90	
1234678-HpCDF	0.85	85	
1234789-HpCDF	0.86	86	
Total HpCDF	1.70	85	
1234678-HpCDD	0.91	91	
Total HpCDD	0.91	91	
OCDF	2.00	100	
OCDD	1.70	85	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 1 - run 3 solids			
2378-TCDF	0.18	90	SS11, 12 TCT 1105A
Total TCDF	0.18	90	
2378-TCDD	0.16	80	
Total TCDD	0.16	80	
12378-PeCDF	1.00	100	
23478-PeCDF	0.96	96	
Total PeCDF	2.00	100	
12378-PeCDD	0.98	98	
Total PeCDD	0.98	98	
123478-HxCDF	0.93	93	
123678-HxCDF	0.97	93	
123789-HxCDF	0.91	97	
234678-HxCDF	3.70	91	
Total HxCDF	13.00	93	
123478-HxCDD	1.10	130	
123678-HxCDD	1.00	110	
123789-HxCDD	3.40	100	
Total HxCDD	0.92	113	
1234678-HpCDF	0.96	92	
1234789-HpCDF	1.90	96	
Total HpCDF	0.90	95	
1234678-HpCDD	0.90	90	
Total HpCDD	1.90	90	
OCDF	1.80	95	
OCDD	1.80	90	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 3 - run 1 solids			
2378-TCDF	0.22	110	SS2
Total TCDF	0.22	110	TCT 1102A
2378-TCDD	0.23	115	
Total TCDD	0.23	115	
12378-PeCDF	1.20	120	
23478-PeCDF	1.10	110	
Total PeCDF	2.30	115	
12378-PeCDD	1.10	110	
Total PeCDD	1.10	110	
123478-HxCDF	1.20	120	
123678-HxCDF	1.10	110	
123789-HxCDF	1.10	110	
234678-HxCDF	1.20	120	
Total HxCDF	4.60	115	
123478-HxCDD	1.10	110	
123678-HxCDD	1.00	100	
123789-HxCDD	0.94	94	
Total HxCDD	3.00	100	
1234678-HpCDF	1.10	110	
1234789-HpCDF	1.10	110	
Total HpCDF	2.20	110	
1234678-HpCDD	1.00	100	
Total HpCDD	1.00	100	
OCDF	1.90	95	
OCDD	2.20	110	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 2 - run 1 liquids			
2378-TCDF	0.18	90	SS22, 24 BOR TCT #1209
Total TCDF	0.18	90	
2378-TCDD	0.16	80	
Total TCDD	0.16	80	
12378-PeCDF	0.95	95	
23478-PeCDF	0.94	94	
Total PeCDF	1.90	95	
12378-PeCDD	0.88	88	
Total PeCDD	0.88	88	
123478-HxCDF	0.93	93	
123678-HxCDF	0.92	92	
123789-HxCDF	0.89	89	
234678-HxCDF	0.92	92	
Total HxCDF	3.70	93	
123478-HxCDD	1.10	110	
123678-HxCDD	0.87	87	
123789-HxCDD	0.89	89	
Total HxCDD	2.90	97	
1234678-HpCDF	0.81	81	
1234789-HpCDF	0.84	84	
Total HpCDF	1.70	85	
1234678-HpCDD	0.90	90	
Total HpCDD	0.90	90	
OCDF	1.60	80	
OCDD	1.60	80	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 2 - run 1 solids			
2378-TCDF	0.20	100	SS3
Total TCDF	0.20	100	TCT #1209B
2378-TCDD	0.18	90	
Total TCDD	0.18	90	
12378-PeCDF	1.00	100	
23478-PeCDF	1.00	100	
Total PeCDF	2.00	100	
12378-PeCDD	0.87	87	
Total PeCDD	0.87	87	
123478-HxCDF	0.98	98	
123678-HxCDF	0.99	99	
123789-HxCDF	0.96	96	
234678-HxCDF	0.84	84	
Total HxCDF	3.80	95	
123478-HxCDD	1.00	100	
123678-HxCDD	0.91	91	
123789-HxCDD	0.86	86	
Total HxCDD	2.80	93	
1234678-HpCDF	0.84	84	
1234789-HpCDF	0.85	85	
Total HpCDF	1.70	85	
1234678-HpCDD	0.94	94	
Total HpCDD	0.94	94	
OCDF	1.90	95	
OCDD	1.60	80	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 2 - run 1 liquids			
2378-TCDF	0.21	105	SS22, SS24 Archives TCT #1217
Total TCDF	0.21	105	
2378-TCDD	0.23	115	
Total TCDD	0.23	115	
12378-PeCDF	1.20	120	
23478-PeCDF	1.10	110	
Total PeCDF	2.30	115	
12378-PeCDD	1.10	110	
Total PeCDD	1.10	110	
123478-HxCDF	1.20	120	
123678-HxCDF	1.20	120	
123789-HxCDF	1.10	110	
234678-HxCDF	1.10	110	
Total HxCDF	4.60	115	
123478-HxCDD	1.10	110	
123678-HxCDD	1.10	110	
123789-HxCDD	0.91	91	
Total HxCDD	3.10	103	
1234678-HpCDF	0.99	99	
1234789-HpCDF	1.00	100	
Total HpCDF	2.00	100	
1234678-HpCDD	1.10	110	
Total HpCDD	1.10	110	
OCDF	2.30	115	
OCDD	2.10	105	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 2 - run 1, 2 solids			
2378-TCDF	0.20	100	SS3
Total TCDF	0.20	100	SS10 C2R1
2378-TCDD	0.17	85	SS10 C2R2
Total TCDD	0.17	85	SS10 FB
12378-PeCDF	0.97	97	TCT #1215A
23478-PeCDF	0.98	98	
Total PeCDF	2.00	100	
12378-PeCDD	0.80	80	
Total PeCDD	0.80	80	
123478-HxCDF	1.00	100	
123678-HxCDF	0.98	98	
123789-HxCDF	0.95	95	
234678-HxCDF	0.95	95	
Total HxCDF	3.90	98	
123478-HxCDD	0.99	99	
123678-HxCDD	0.92	92	
123789-HxCDD	0.94	94	
Total HxCDD	2.90	97	
1234678-HpCDF	0.83	83	
1234789-HpCDF	0.89	89	
Total HpCDF	1.70	85	
1234678-HpCDD	0.93	93	
Total HpCDD	0.93	93	
OCDF	2.00	100	
OCDD	1.80	90	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 2 - run 2 liquids			
2378-TCDF	0.21	105	SS13
Total TCDF	0.21	105	SS22
2378-TCDD	0.23	115	SS24
Total TCDD	0.23	115	TCT #1217
12378-PeCDF	1.20	120	
23478-PeCDF	1.10	110	
Total PeCDF	2.30	115	
12378-PeCDD	1.10	110	
Total PeCDD	1.10	110	
123478-HxCDF	1.20	120	
123678-HxCDF	1.20	120	
123789-HxCDF	1.10	110	
234678-HxCDF	1.10	110	
Total HxCDF	4.60	115	
123478-HxCDD	1.10	110	
123678-HxCDD	1.10	110	
123789-HxCDD	0.91	91	
Total HxCDD	3.10	103	
1234678-HpCDF	0.99	99	
1234789-HpCDF	1.00	100	
Total HpCDF	2.00	100	
1234678-HpCDD	1.10	110	
Total HpCDD	1.10	110	
OCDF	2.30	115	
OCDD	2.10	105	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 2 - run 2 solids			
2378-TCDF	0.19	95	SS11
Total TCDF	0.19	95	TCT #1217A
2378-TCDD	0.17	85	
Total TCDD	0.17	85	
12378-PeCDF	1.00	100	
23478-PeCDF	0.97	97	
Total PeCDF	2.00	100	
12378-PeCDD	1.00	100	
Total PeCDD	1.00	100	
123478-HxCDF	1.00	100	
123678-HxCDF	1.00	100	
123789-HxCDF	0.97	97	
234678-HxCDF	0.97	97	
Total HxCDF	3.90	98	
123478-HxCDD	0.96	96	
123678-HxCDD	0.89	89	
123789-HxCDD	0.69	69	
Total HxCDD	2.50	83	
1234678-HpCDF	0.89	89	
1234789-HpCDF	0.89	89	
Total HpCDF	1.80	90	
1234678-HpCDD	0.98	98	
Total HpCDD	0.98	98	
OCDF	2.30	115	
OCDD	1.80	90	

TABLE A4-41. PCDD/PCDF LABORATORY CONTROL SPIKE RESULTS (continued)

PCDD/PCDF	Laboratory control spike- quantity measured (ng)	Laboratory control spike recovery (%)	Samples that affect the spike
Condition 2 - run 2 solids			
2378-TCDF	0.22	110	SS12
Total TCDF	0.22	110	305937
2378-TCDD	0.25	125	
Total TCDD	0.25	125	
12378-PeCDF	1.10	110	
23478-PeCDF	1.10	110	
Total PeCDF	2.20	110	
12378-PeCDD	0.99	99	
Total PeCDD	0.99	99	
123478-HxCDF	1.20	120	
123678-HxCDF	1.10	110	
123789-HxCDF	1.10	110	
234678-HxCDF	1.20	120	
Total HxCDF	4.60	115	
123478-HxCDD	0.98	98	
123678-HxCDD	1.20	120	
123789-HxCDD	1.10	110	
Total HxCDD	3.30	110	
1234678-HpCDF	1.10	110	
1234789-HpCDF	1.10	110	
Total HpCDF	2.20	110	
1234678-HpCDD	1.10	110	
Total HpCDD	1.10	110	
OCDF	2.60	130	
OCDD	2.10	105	

TABLE A4-42. SS22 - SCRUBBER LIQUOR METALS MATRIX SPIKE RESULTS

METAL	RECOVERY (%)
Antimony	100
Arsenic	101
Barium	94
Beryllium	105
Cadmium	98
Chromium	98
Copper	94
Lead	104
Manganese	97
Mercury	NA
Nickel	100
Phosporus	101
Selenium	97
Silver	93
Thallium	80
Tin	NA
Zinc	98

TABLE A4-43. ORGANIC HALOGEN QA RESULTS

Laboratory control spikes

Test	Recovery	Recovery	Average	Blank		Locations
C1R1	101	107.0	104.0	ND	5	1, 5, 22B
	102	101.0	102.0	ND	5	22E
C1R2	102	101.0	102.0	ND	5	1, 4, 22B
C1R3	102	101.0	102.0	ND	5	1, 13, 18, 22E
C3R1	98	101.0	100.0	ND	5	1, 5, 22B, 22E
C3R2	98	101.0	100.0	ND	5	1, 22B, 22E
C3R3	98	97.0	98.0	ND	5	1, 13, 15, 18, 22B, 22E
	99	96.0	98.0	ND	5	11

QA duplicates

Duplicate	Location	Test	Value	Duplicate		RPD (%)
Field	SS1	C3R1	13.6	45900.0		200
Lab	SS1	C1R3	66.5	46.9		35
		C3R2	37.8	98.8		89
	SS5	C1R1	102.0	105.0		3
	SS11	C3R3	205.0	205.0		0
	SS13	C1R3	12.3	18.4		40
	SS22BOR	C1R1	32.7	22.9		35
	SS22EOR	C1R3	62.2	126.0		68
		C3R1	216.0	151.0		35

All values reported in ug/l (ppb)

ND: Not detected, PQL reported

1: SS1 - Waste water
4: SS4 - Caustic
5: SS5 - Scrubber make-up water
11: SS11 - Reactor grit
13: SS13 - Scrubber decant water
15: SS15 - Reformed gas condensate
18: SS18 - Heat exchanger residue
22B: SS22 BOR - Scrubber liquor (Beginning of run)
22E: SS22 EOR - Scrubber liquor (End of run)

TABLE A4-44. ULTIMATE ANALYSIS QA/QC ACTIVITIES

Batch description	Sample type	Compound	Recovery (%) or RPD (%)
C1R1	Laboratory spike	Carbon	101
		Hydrogen	94
		Nitrogen	94
		Chlorine	122
C3R1	Laboratory spike	Carbon	94
		Hydrogen	72
		Nitrogen	100
		Chlorine	96
SS22	Laboratory duplicate	Carbon	1.4
		Hydrogen	17.6
		Nitrogen	0
		Chlorine	73.2
		Flourine	0
		Phosphate	0
		Oxygen	18.2

TABLE A4-45. TOTAL ORGANIC CARBON QA RESULTS

Laboratory control spikes

Test	Recovery	Recovery	Average	Blank		Locations
C1R1	102	------	102	ND	1	1
	100	------	100	ND	1	22E
C1R2	100	100	100	ND	1	1, 22B
C1R3	98	107	103	ND	1	1, 13, 18, 22E
C3R1	100	107	104	ND	1	1, 22B, 22E
C3R2	100	107	104	ND	1	1, 22B, 22E
C3R3	100	105	103	ND	1	1, 13, 15, 18, 22B, 22E
	101	108	105	ND	1	11

QA duplicates

Duplicate	Location	Test	Value	Duplicate		RPD (%)
Field	SS1	C1R3	8.86	9.07		2.3
Lab	SS1	C1R1	21.90	21.50		1.8
		C1R3 *	9.07	8.76		3.5
		C3R3	36.30	36.50		0.5

All values reported in mg/l

ND: Not detected, PQL/10 reported

* Lab duplicate of field duplicate

1: SS1 - Waste water
11: SS11 - Reactor grit
13: SS13 - Scrubber decant water
15: SS15 - Reformed gas condensate
18: SS18 - Heat exchanger residue
22B: SS22 BOR - Scrubber liquor (Beginning of run)
22E: SS22 EOR - Scrubber liquor (End of run)

TABLE A4-46. ORGANIC HALOGEN, TOTAL ORGANIC CARBON, ASH, TOTAL SULFUR, AND TOTAL HALOGEN QA RESULTS

Analysis	QC sample type	Test condition and run number	Sample location	Units	Sample	Duplicate/ spike	RPD/Recovery (%)
Organic halogens	Lab duplicates	C2R1	SS3	ppm	392	407	3.8
			SS5	ppb	44	58.7	28.6
		C2R2	SS13	ppb	65	55.2	16.3
	Lab control spikes	C2R1	SS5, SS22, SS24	ppb	5.33	5	107
			SS3	ppm	2.58	2.5	103
		C2R2	SS13, SS22, SS24	ppb	5.02	5	105
			SS11	ppm	214	200	107
Total organic carbon	Field duplicate	C2R2	SS3	ppm	18100	18500	2.2
	Lab duplicates	C2R1	SS3	ppm	19500	21900	11.6
		C2R2	SS10	ppm	4920	4350	12.3
	Lab control spikes	C2R1	SS22, SS24	ppm	10.4	10	104
			SS3	ppm	1860	2000	93
		C2R2	SS13, SS22, SS24	ppm	10.4	10	104
			SS3, SS10	ppm	1942	2000	97
			SS11	ppm	1980	2000	99
Total sulfur	Field duplicate	C2R1	SS3	%	ND	ND	ND
		C2R2	SS13	%	0.0026	0.0031	17.5
	Lab duplicates	C2R1	SS3	%	ND	ND	ND
	Lab control spikes	C2R1	All	%	1.11	1	111
		C2R2	All	%	0.99	1	99
Total halogens	Field duplicate	C2R2	SS3	% Cl	0.34	0.05	148.7
	Lab duplicates	C2R1	SS3	% Cl	0.04	0.04	0
	Lab control spikes	C2R1	All	% Cl	0.2	0.2	100
		C2R2	All	% Cl	0.18	0.18	100
Ash	Lab duplicates	C2R1	SS3	%	62.4	60	3.9
		C2R2	SS3	%	55	56	1.8
	Lab control spikes	C2R1	All	%	7.97	8.22	97
		C2R2	All	%	7.8	8.22	94.9

ND - Not detected

TABLE 4-47. ADDITIONAL QA/QC RESULTS

Laboratory control spikes			
Species	Units	Recovery	
		C1R1	C3R1
Ash	(%)	99	99
Total sulfur	(%)	112	112
Heating value	(BTU/lb)	92	95
Ultimate analysis	Carbon (%)	101	94
	Hydrogen (%)	94	72
	Nitrogen (%)	94	100
	Chlorine (%)	122	96

QA duplicates						
Species	Units	Location	Duplicate	Value	Duplicate	RPD (%)
Inorganic halogen	ppm	SS1	Field	1900	1800	5.4
Total halogens	ppm	SS2	Field	21.66	17.81	19.5
Total sulfur	(%)	SS2	Field	0.56	1.75	100.4
	(%)	SS22	Lab	ND 0.01	ND 0.01	0.0
Ultimate analysis	Carbon (%)	SS2	Field	62.06	61.17	1.4
	Hydrogen (%)			7.78	9.28	17.6
	Nitrogen (%)			0.04	0.04	0.0
	Chlorine (%)			10.45	4.85	73.2
	Fluorine (%)			ND 0.01	ND 0.01	0.0
	Phosphate (%)			ND 0.01	ND 0.01	0.0
	Oxygen (%)			19.09	22.91	18.2
Ultimate analysis	Carbon (%)	SS22	Lab	5.03	4.95	1.6
	Hydrogen (%)			12.59	11.58	8.4
	Nitrogen (%)			0.01	0.01	0.0
	Chlorine (%)			0.10	0.11	6.6
	Fluorine (%)			ND 0.01	ND 0.01	0.0
	Phosphate (%)			ND 0.01	ND 0.01	0.0
	Oxygen (%)			82.27	83.35	1.3
Density	g/cc	SS22	Lab	1.02	1.02	0.0

ND Not detected

Ash Audit		
Sample	EPA audit Value (%)	Analysis value (%)
1034	7.5	7.29
3057	13.4	13.23

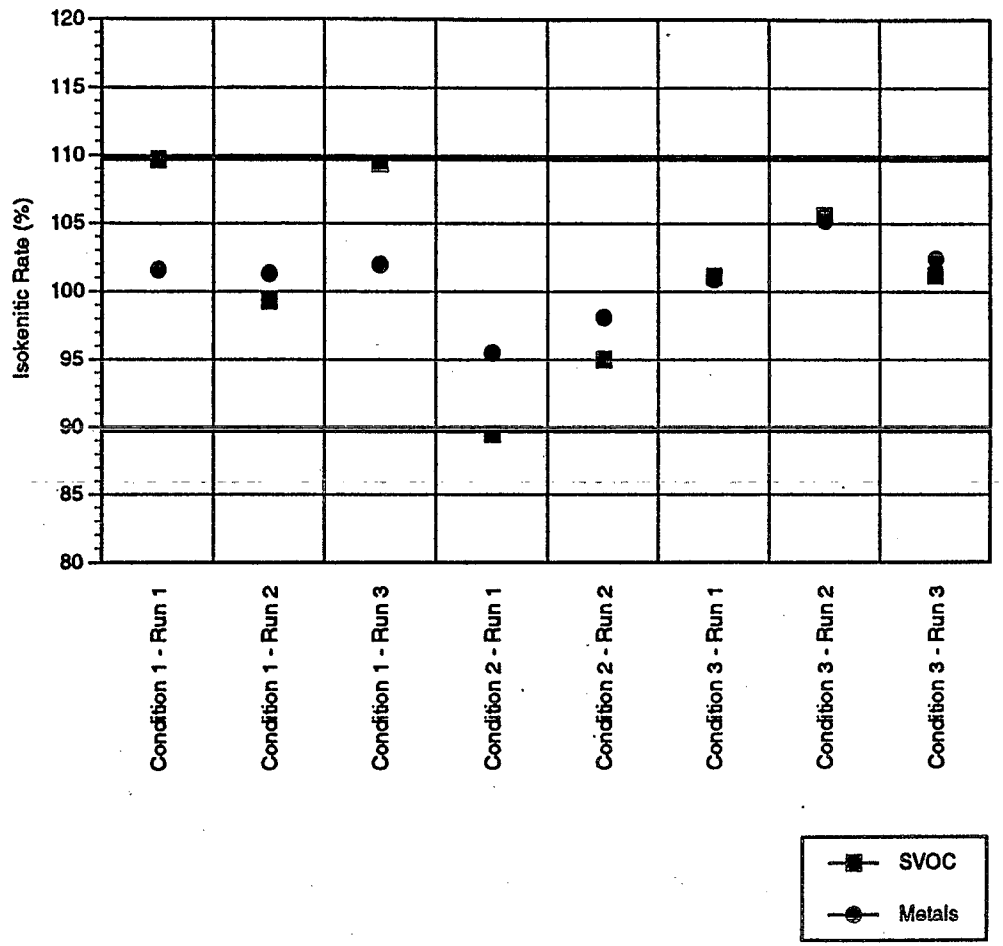


Figure A4-1. Isokinetic rate.

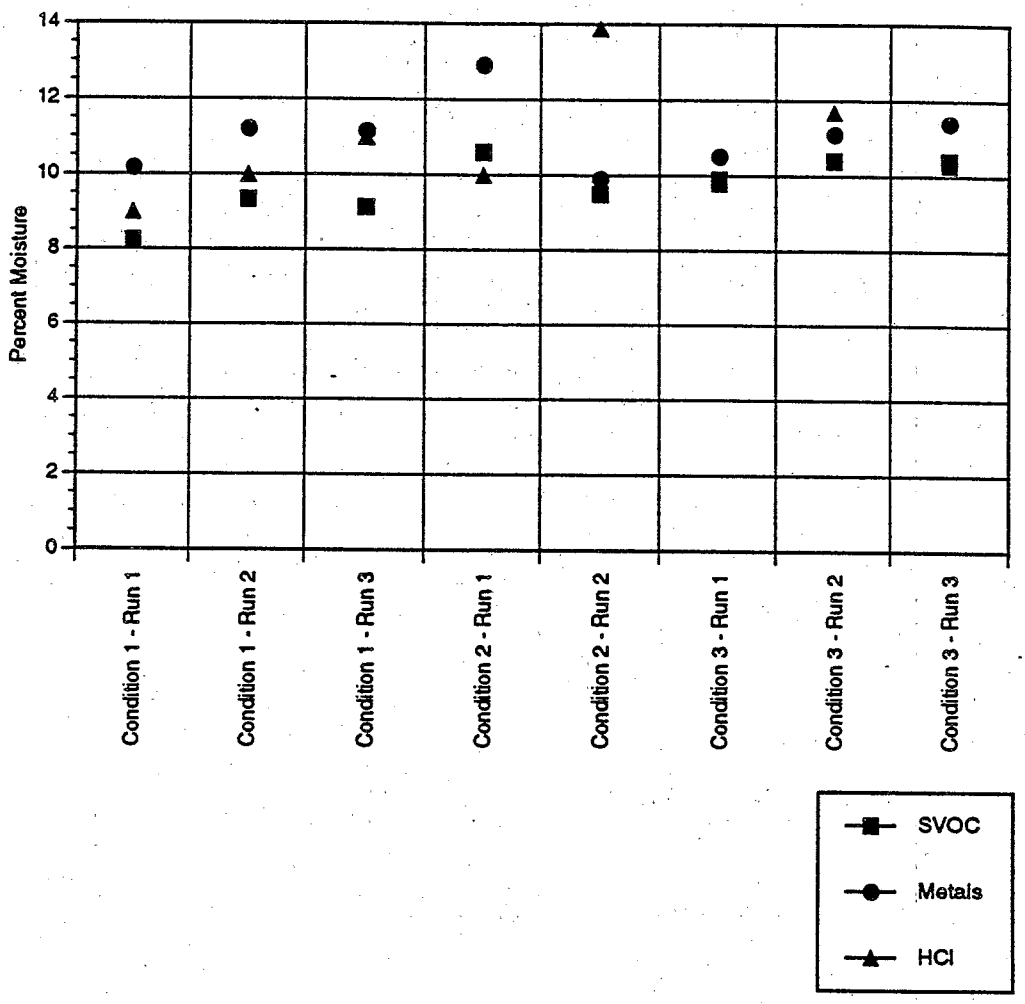


Figure A4-2. Percent moisture.

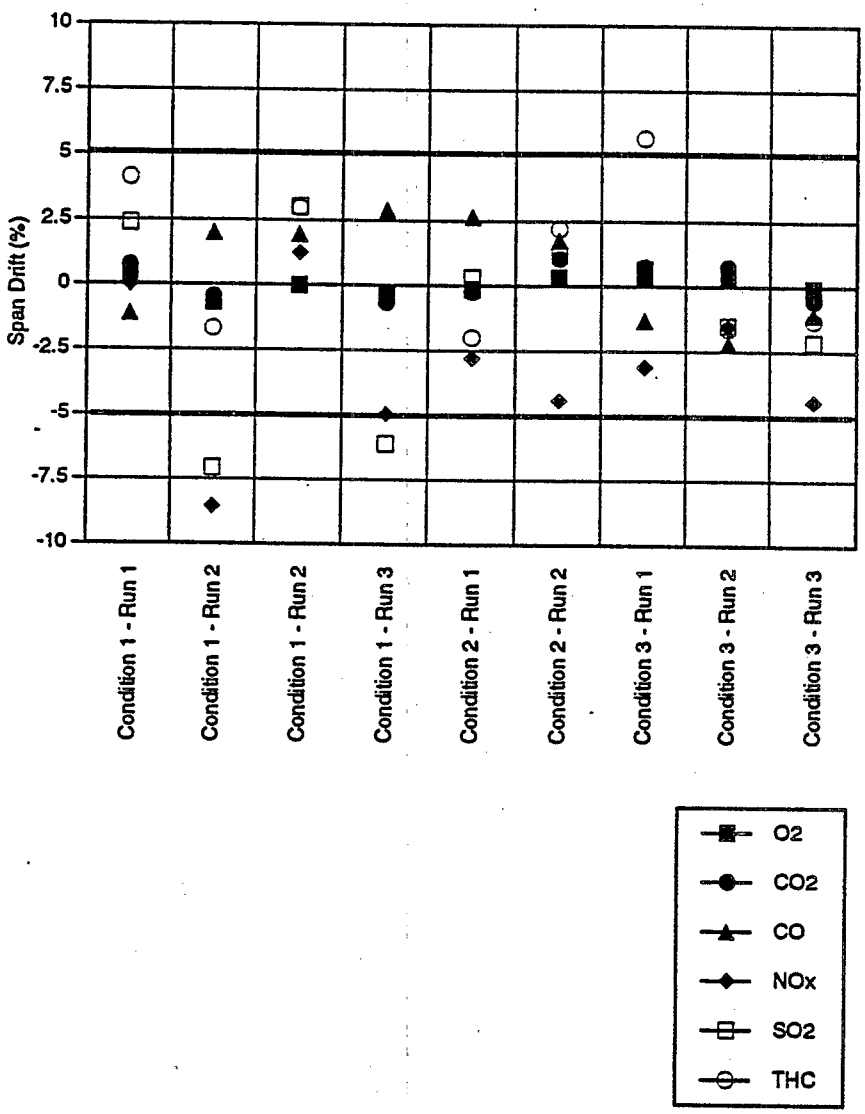


Figure A4-3. Span drift values.

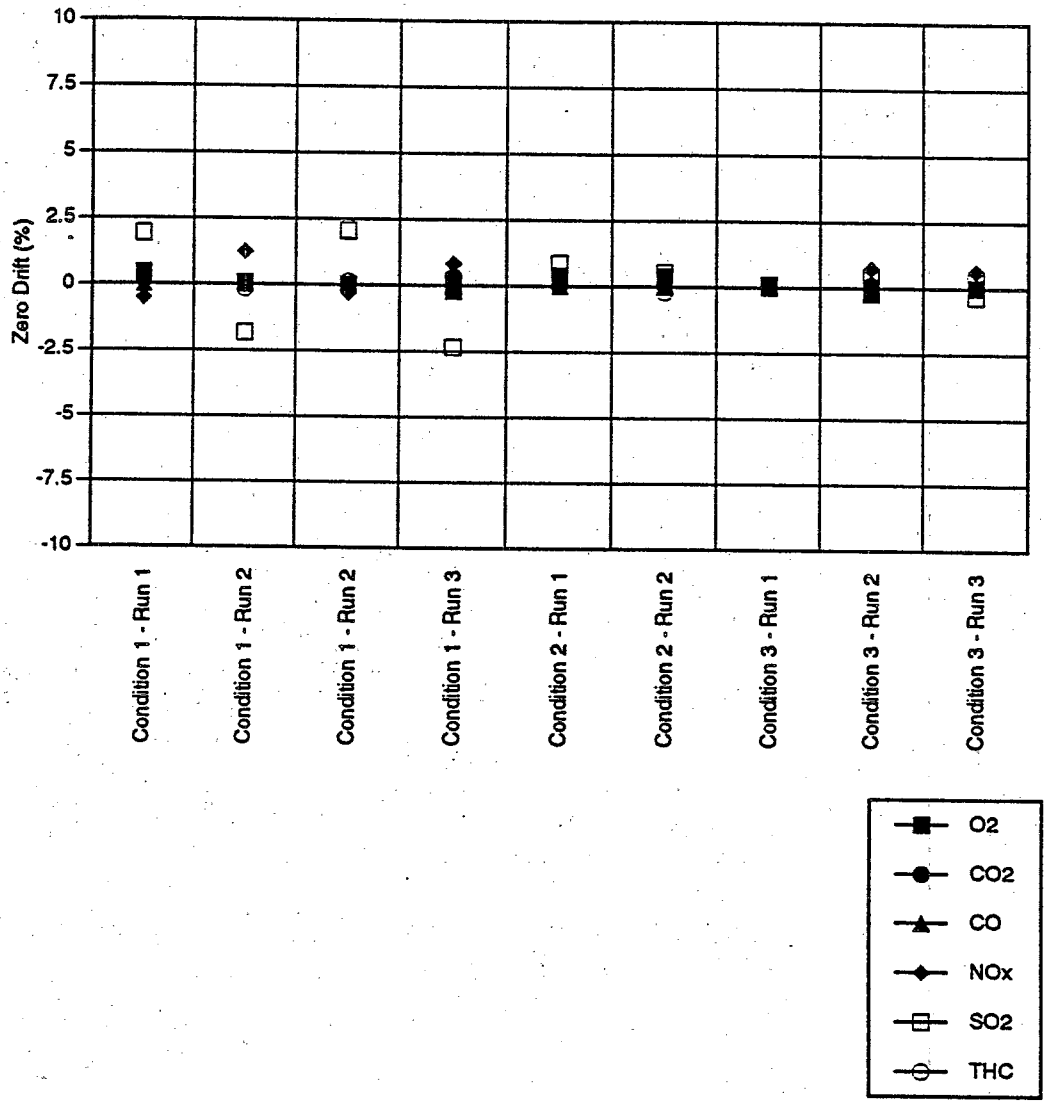


Figure A4-4. Zero drift.

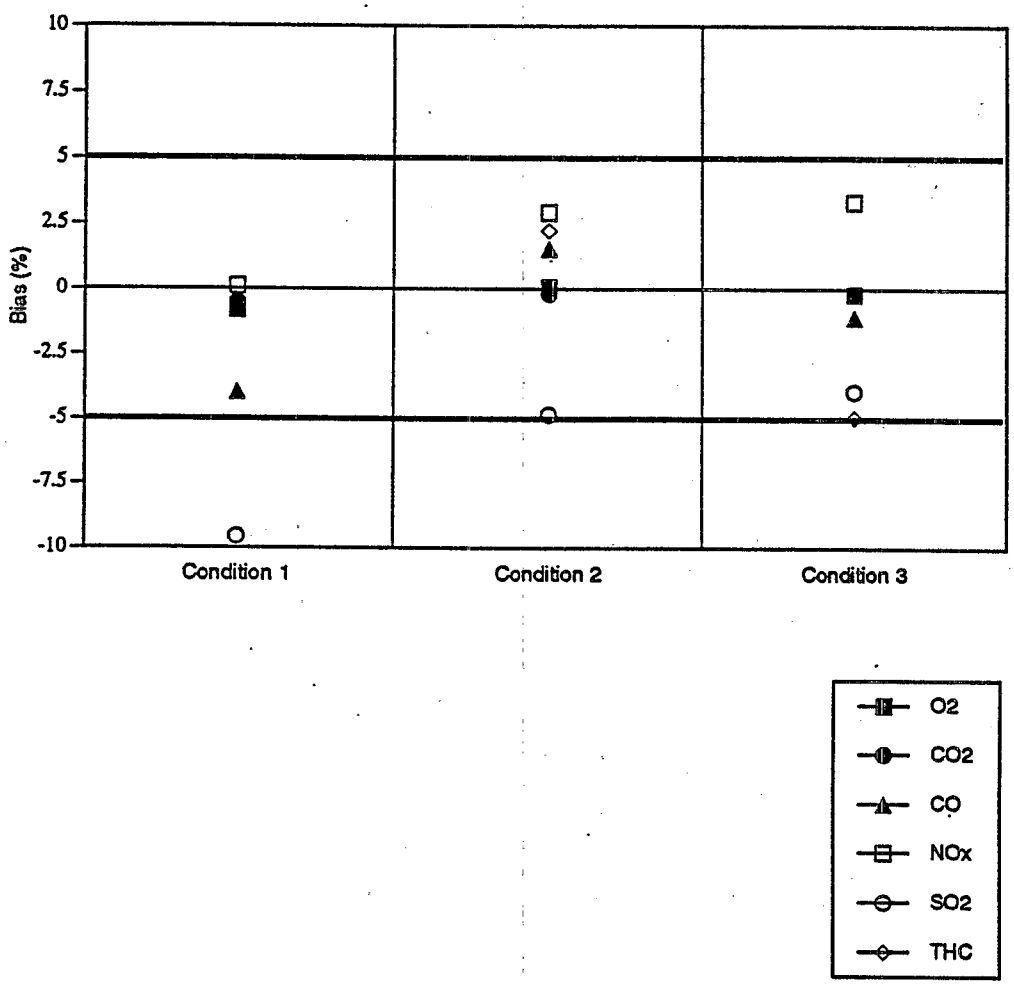


Figure A4-5. CEM bias results.

EQUIPMENT CALIBRATIONS - VOST

IMET–EER, a division of Canadeer Ltd.

GAS METER CALIBRATION SHEET

ISOTRAIN: VOST #2
DATE: SEPTEMBER 24, 1992

ROTAMETER READING	GAS METER READING START (L)	STOP (L)	NET (L)	GASOMETER READING (mm)	VOLUME (L)	SAMPLE TIME (sec)	TEMPERATURE GAS METER (F)	GASO-METER (F)	BAROMETER PRESSURE (inH2O)	VOLUME Vstd,m METER (Std.L)	Vstd,std STANDARD (Std.L)	SAMPLING RATE (Std.L/M)	Yds
15.00	363.000	373.200	10.20	31.000	10.099	1831	82	68	29.82	10.072	10.237	0.330	1.016
20.00	399.200	429.050	29.85	89.000	28.994	2080	93	70	29.82	28.889	29.278	0.833	1.013
25.00	522.000	545.000	23.00	68.000	22.152	1188	102	72	29.82	21.903	22.286	1.106	1.017

Y, AVG. 1.016

IMET-EER, a division of Canadeer Ltd.

GAS METER CALIBRATION SHEET

ISOTRAIN: VOST #2

DATE: DECEMBER 16, 1992

ROTAMETER READING	GAS METER READING START (L)	STOP (L)	NET (L)	GASOMETER READING (mm)	VOLUME (L)	SAMPLE TIME (sec)	TEMPERATURE GAS METER (F)	GASO-METER (F)	BAROMETER PRESSURE (inH2O)	VOLUME Vstd,m METER (Std.L)	Vstd,std STANDARD (Std.L)	SAMPLING RATE (Std.L/M)	Yds
10.00	911.940	918.260	6.32	21.000	6.841	2028	80	67	30	6.302	6.990	0.186	1.109
10.00	919.910	932.060	12.15	35.000	11.402	4045	85	67	29.82	11.932	11.580	0.177	0.970
10.00	932.060	943.600	11.54	35.000	11.402	3901	85	68	29.85	11.344	11.569	0.174	1.020

Y,AVG = 1.033

VOST THERMOCOUPLE CALIBRATIONS

October 2, 1992

VOST #1 – Dry Gas Meter Outlet Thermocouple

	#1		#2		#3	
	Mercury	Thermocouple	Mercury	Thermocouple	Mercury	Thermocouple
Boiling Water	210	210	210	210	210	210
Ice Water	34	31.8	34	33	34	33.2
Ambient Air	57	56.2	56	56.9	57	57.2

VOST #2 – Dry Gas Meter Outlet Thermocouple

	#1		#2		#3	
	Mercury	Thermocouple	Mercury	Thermocouple	Mercury	Thermocouple
Boiling Water	211	212	212	214	212	213
Ice Water	36	37.1	42	42.7	33	33.8
Ambient Air	68	68.5	70	70.2	70	70.5

Calibrator: Dave Diemer

DICK MUNNS COMPANY
Liquid and Gas - Flowmeter Calibration Service
10571 Calle Lee - 133 • Los Alamitos, California 90720
Telephone (213) 596-1559 • Telefax (714) 827-0823

CERTIFICATE OF CALIBRATION

:nt Name:	EER	Calibration Date:	08-06-1992
'erence Number:	V-2(Box NUMBER)	Calibration Due:	08-06-1993
rument Manufacturer:	SINGER	Calibration Fluid:	AIR 14.7 PSIA 70F
rument Description:	PD METER	Test Unit(s):	A-3
del Number:	802	NIST Traceability Per:	M-0122
ial Number:	8132	Ambient Conditions:	29.92"HGA 70F RH.45%
ed Accuracy:	+/-.5%	Data File:	EER8132
uracy Given:	AS RECEIVED		

	IND.SLPM	ACT.SLPM	
1	0.100	0.099	0.99
2	0.200	0.199	0.995
3	0.300	0.299	0.9967
4	0.400	0.399	0.9975
5	0.600	0.599	0.9983
6	0.800	0.799	0.9988
7	1.000	0.998	0.998
8	1.200	1.198	0.9983
9	1.500	1.496	0.9973

Y= 0.9967

ıarks:

nstruments used in the performance of the above calibration have direct traceability to the National Insti- of Standards and Technology (NIST). Calibration has been performed in accordance with MIL-STD- 2A.

ɔration Performed By:

:HAEL MUNNS

Approved By:

MICHAEL MUNNS

EQUIPMENT CALIBRATIONS - HCL TRAINS

IMET-EER, a division of Canadeer Ltd.

GAS METER CALIBRATION SHEET (EPA Method)

ISOTRAIN: ORANGE CONTROL BOX

DATE: SEPTEMBER 21 1992

ORIFICE PRESSURE (inH2O)	FIELD METER READIN START (ft3)	STOP (ft3)	NET Va,m (ft3)	GASOMETER READING (mm)	VOLUME Va,std (ft3)	SAMPLE TIME (sec)	TEMPERATURE FIELD METER (F)	GASO-METER (F)	BAROMETE PRESSURE (inHg)	VOLUME Vstd,m (SCF)	Vstd,std (SCF)	SAMPLE RATE Qstd,m (SCFM)	Yds	dH @
0.50	744.06	745.83	1.77	157.0	1.81	294	60	72	29.19	1.726	1.722	0.352	0.997	2.301
1.00	717.93	719.82	1.89	168.0	1.93	219	60	71	29.19	1.846	1.846	0.506	1.000	2.222
1.50	720.03	722.02	1.99	176.5	2.03	194	60	71	29.19	1.947	1.939	0.602	0.996	2.370
2.00	726.22	728.13	1.91	170.0	1.96	161	60	71	29.19	1.876	1.868	0.699	0.996	2.346
2.50	732.16	734.12	1.95	176.0	2.02	148	60	71	29.19	1.917	1.934	0.777	1.009	2.312
3.00	740.02	741.94	1.92	172.0	1.98	135	60	71	29.19	1.889	1.890	0.840	1.000	2.417

dH @ = 2.336

Y,AVG 1.000

INDEPENDENT MEASUREMENT AND TECHNOLOGY

GAS METER CALIBRATION SHEET

ISOTRAIN: ORANGE CONTROL BOX

DATE: DECEMBER 15/92, 1990

ORIFICE PRESSURE	GAS METER READING			GASOMETER		SAMPLE TIME	TEMPERATURE		BAROMETER PRESSURE	STANDARD VOLUME		SAMPLING RATE	ALPHA FACTOR
	START	STOP	NET	READING	VOLUME		GAS METER	GASO-METER		GAS METER	GASO-METER		
(inH2O)	(ft3)	(ft3)	(ft3)	(mm)	(ft3)	(sec)	(F)	(F)	(inH2O)	(SCF)	(SCF)	(SCFM)	
0.75	123.66	126.02	2.36	203.50	2.34	303	60	67	30.00	2.443	2.391	0.484	0.979
0.75	126.02	128.38	2.36	206.90	2.38	307	60	67	30.00	2.449	2.431	0.479	0.993
0.75	128.38	130.67	2.30	203.80	2.34	299	60	67	30.00	2.383	2.395	0.478	1.005

AVERAGE ALPHA VALUE : 0.992

IMPINGER EXIT T.C. CALIBRATION

ID # 36 HCl Train 30 Sep 92

IN ICE BATH

THERMOMETER	T.C.
38	37
37	37
36	36

AMBIENT

THERMOMETER	T.C.
63	62
63	62
67	67

HCl - Train

Gary Bunner

IMEI - EER
MAGNEHELIC 5-POINT CALIBRATION
DATE: AUGUST 20 1992

GREEN TRAIN - HIGH PRESSURE MAGNEHELIC
R50116LG19

MAGNEHELIC (in.H2O)	MANOMETER (mmH2O)	MANOMETER (inH2O)	PERCENT DEV.
4.30	107.00	4.21	2.07
3.50	88.00	3.46	1.02
2.45	61.00	2.40	2.02
1.55	37.20	1.46	5.83
0.53	12.20	0.48	9.30

AVERAGE DEVIATION 4.05

GREEN TRAIN - LOW PRESSURE MAGNEHELIC
R50517LG5

MAGNEHELIC (in.H2O)	MANOMETER (mmH2O)	MANOMETER (inH2O)	PERCENT DEV.
0.470	11.600	0.457	2.914
0.350	8.700	0.343	2.184
0.255	6.600	0.260	-1.854
0.155	4.100	0.161	-3.976
0.045	1.200	0.047	-4.750

AVERAGE DEVIATION -1.098

GREEN TRAIN - ORIFICE METER MAGNEHELIC
R40830JM26

MAGNEHELIC (in.H2O)	MANOMETER (mmH2O)	MANOMETER (inH2O)	PERCENT DEV.
4.500	115.000	4.528	-0.609
3.300	85.000	3.346	-1.388
2.400	61.000	2.402	-0.066
1.500	38.300	1.508	-0.522
0.650	16.400	0.646	0.671

AVERAGE DEVIATION -0.583

EQUIPMENT CALIBRATIONS - SVOC TRAINS

IMET–EER, a division of Canadeer Ltd.

GAS METER CALIBRATION SHEET (EPA Method)

ISOTRAIN: GREEN CONTROL BOX

DATE: SEPTEMBER 21 1992

ORIFICE PRESSURE (inH2O)	FIELD METER READIN START (ft3)	STOP (ft3)	NET Va,m (ft3)	GASOMETER READING (mm)	VOLUME Va,std (ft3)	SAMPLE TIME (sec)	TEMPERATURE FIELD METER (F)	GASO-METER (F)	BAROMETE PRESSURE (inHg)	VOLUME Vstd,m (SCF)	Vstd,std (SCF)	SAMPLE RATE Qstd,m (SCFM)	Yds	dH @
0.50	490.32	492.02	1.70	151.0	1.74	264	60	68	29.15	1.658	1.666	0.377	1.005	1.984
1.00	495.62	497.32	1.70	150.5	1.73	172	60	68	29.15	1.659	1.661	0.579	1.001	1.696
1.50	499.23	500.92	1.70	152.0	1.75	134	60	68	29.15	1.659	1.677	0.743	1.011	1.513
2.00	506.23	507.94	1.71	152.0	1.75	116	60	68	29.15	1.676	1.677	0.867	1.001	1.512
2.50	509.75	511.53	1.78	158.5	1.82	107	60	68	29.15	1.741	1.749	0.976	1.004	1.479
3.00	518.72	520.43	1.71	154.0	1.77	95	60	69	29.15	1.682	1.696	1.062	1.009	1.488

dH @ = 1.612

Y,AVG 1.005

INDEPENDENT MEASUREMENT AND TECHNOLOGY

GAS METER CALIBRATION SHEET

ISOTRAIN: GREEN CONTROL BOX

DATE: DECEMBER 15/92, 1990

ORIFICE PRESSURE (inH2O)	GAS METER READING START (ft3)	STOP (ft3)	NET (ft3)	GASOMETER READING (mm)	VOLUME (ft3)	SAMPLE TIME (sec)	TEMPERATURE GAS METER (F)	GASO-METER (F)	BAROMETER PRESSURE (inH2O)	STANDARD VOLUME GAS METER (SCF)	GASO-METER (SCF)	SAMPLING RATE (SCFM)	ALPHA FACTOR
0.80	183.54	185.89	2.35	205.90	2.37	264	60	67	30.00	2.438	2.419	0.554	0.992
0.80	187.59	189.96	2.36	207.20	2.38	271	60	67	30.00	2.449	2.435	0.542	0.994
0.80	189.96	192.33	2.38	206.10	2.37	263	60	67	30.00	2.465	2.422	0.562	0.982

AVERAGE ALPHA VALUE : 0.990

IMET–EER, a division of Canadeer Ltd.

GAS METER CALIBRATION SHEET

ISOTRAIN: YELLOW CONTROL BOX

DATE: SEPTEMBER 30, 1992

ORIFICE PRESSURE (inH2O)	FIELD METER READIN START (ft3)	STOP (ft3)	NET Va,m (ft3)	GASOMETER READING (mm)	VOLUME Va,std (ft3)	SAMPLE TIME (sec)	TEMPERATURE FIELD METER (F)	GASO-METER (F)	BAROMETE PRESSURE (inHg)	VOLUME Vstd,m (SCF)	Vstd,std (SCF)	SAMPLE RATE Qstd,m (SCFM)	Yds	dH @
0.50	536.00	537.50	1.50	129.6	1.49	229	60	66	30.18	1.515	1.466	0.397	0.981	1.812
1.00	537.60	539.20	1.60	139.0	1.60	172	60	66	30.18	1.618	1.594	0.564	0.985	1.778
1.50	539.30	540.80	1.50	130.0	1.50	131	60	66	30.18	1.519	1.491	0.696	0.982	1.768
2.00	540.90	542.40	1.50	133.5	1.54	115	60	66	30.18	1.520	1.531	0.793	1.007	1.723
2.50	542.50	544.00	1.50	130.4	1.50	103	60	66	30.18	1.522	1.495	0.887	0.982	1.811
3.00	544.10	545.60	1.50	130.6	1.50	94	60	66	30.18	1.524	1.498	0.973	0.983	1.804
3.50	545.70	547.20	1.50	131.0	1.51	88	60	66	30.18	1.526	1.502	1.040	0.984	1.834
4.00	547.30	548.80	1.50	129.8	1.49	83	60	66	30.18	1.528	1.488	1.104	0.974	1.899
4.50	548.90	550.40	1.50	134.0	1.54	77	60	66	30.18	1.530	1.537	1.192	1.005	1.725
5.00	550.50	552.00	1.50	133.2	1.53	73	60	66	30.18	1.531	1.527	1.259	0.997	1.744

dH @ = 1.790

Y,AVG 0.988

IMET – EER

GAS METER CALIBRATION SHEET

ISOTRAIN: YELLOW CONTROL BOX
DATE: DECEMBER 17, 1992

ORIFICE PRESSURE	GAS METER READIN			GASOMETER		SAMPLE TIME	TEMPERATURE		BAROMETE PRESSURE	STANDARD VOLUME		SAMPLIN RATE	Y VALUE
	START	STOP	NET	READING	VOLUME		GAS METER	GASO-METER		GAS METER	GASO-METER		
(inH2O)	(ft3)	(ft3)	(ft3)	(mm)	(ft3)	(sec)	(F)	(F)	(inH2O)	(SCF)	(SCF)	(SCFM)	
1.00	392.40	394.51	2.10	176.5	2.03	312	60	67	29.84	2.172	2.063	0.418	0.950
0.50	394.51	396.62	2.11	177.0	2.04	314	60	67	29.84	2.178	2.069	0.416	0.950
2.00	396.62	398.71	2.10	178.0	2.05	316	60	67	29.84	2.169	2.080	0.412	0.959

AVERAGE Y VALUE: 0.953

SVOC TC Calibration

NOTE * Reference Hg-Glass Thermometer Broken. Calibration Performed Against Previously Calibrated TC.

Plant: Middleground Landfill (Bay City, MI)

Location: SS-16, Boiler Stack

Date: 2/3 October 1992

Calibrated By: M. Furuda (Bill Fullerton)

TC No.	Ice Bath			Room T.			Boiling H_2O			Hot Oil			Note
	Ref	TC	Δ	Ref	TC	Δ	Ref	TC	Δ	Ref	TC	Δ	T = °F
0-1* (Probe)				69.2 68.9 68.8	68.1 67.9 67.8	1.1 1.0 1.0	211 212 211	211 212 213	Ø Ø 2				Δ < 1.5%
0-2* (~~Temp.~~ Xad Temp)				69.4 69.6 69.2	69.2 69.4 68.9	0.2 0.2 0.3							Δ < 3.6°F
0-3 (Imp. Our)	33 35	31 35	2 Ø	71 70	68 67	3 3	212 212	211 212	1 Ø				Δ < 3.6°F

3 Point Calibration for Low-Temp: Ice, Room Temp, Boiling H_2O

3 Point Calibration for High-Temp: Ice, ~~Hot~~ Boiling H_2O, Hot Oil.

Calibration Limit: Δ < 1.5 % at each point ~~for Probe/Stack~~ High-Temp.

Δ < 3.6 °F for Low-Temp.

IHEI - EER
MAGNEHELIC 5-POINT CALIBRATION
DATE: AUGUST 20 1992

GREEN TRAIN - HIGH PRESSURE MAGNEHELIC
R50116LG19

MAGNEHELIC (in.H2O)	MANOMETER (mmH2O)	MANOMETER (inH2O)	PERCENT DEV.
4.30	107.00	4.21	2.07
3.50	88.90	3.46	1.02
2.65	61.00	2.40	2.02
1.55	37.20	1.46	5.83
0.53	12.20	0.48	9.30

AVERAGE DEVIATION 4.05

GREEN TRAIN - LOW PRESSURE MAGNEHELIC
R50517LG5

MAGNEHELIC (in.H2O)	MANOMETER (mmH2O)	MANOMETER (inH2O)	PERCENT DEV.
0.470	11.600	0.457	2.914
0.350	8.700	0.343	2.184
0.255	6.600	0.260	-1.854
0.155	4.100	0.161	-3.976
0.045	1.200	0.047	-4.750

AVERAGE DEVIATION -1.098

GREEN TRAIN - ORIFICE METER MAGNEHELIC
R40830JM24

MAGNEHELIC (in.H2O)	MANOMETER (mmH2O)	MANOMETER (inH2O)	PERCENT DEV.
4.500	115.000	4.528	-0.609
3.300	85.000	3.346	-1.388
2.400	61.000	2.402	-0.066
1.500	38.300	1.508	-0.522
0.650	16.400	0.646	0.671

AVERAGE DEVIATION -0.383

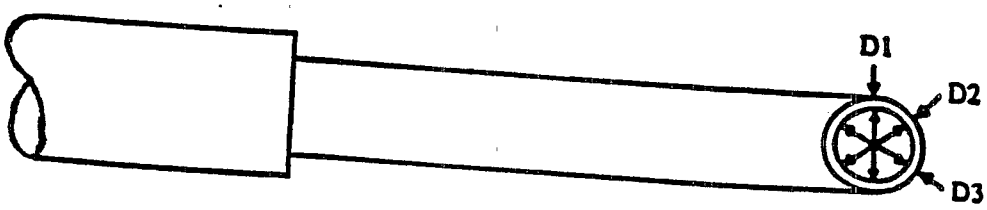
NOZZLE CALIBRATION

Sample Location: S516
Plant : FWEI / BAY CITY, MI
Inspector: MF
Date: 29 SEPT 1992
Time: PM

Nozzle Idenification Number	Nozzle Inside Diameter (inches) D1	D2	D3	ΔD	D(avg)
S1	0.498 ~~1.365~~	0.500 ~~1.37~~	0.500 ~~1.37~~	0.002	0.499
S2	0.496	0.496	0.496	Ø	0.496
S3	0.500	0.498	0.500	0.002	0.499
S4	0.498	0.500	0.500	0.002	0.499
S5	0.496	0.496	0.498	0.002	0.497
S6	0.498	0.496	0.500	0.004	0.498
S7	0.500	0.498	0.498	0.002	0.499
S8	0.498	0.502	0.500	0.004	0.500
S9	0.502	0.500	0.498	0.004	0.500

Where:

D1, D2, D3 = nozzle diameter measured on a different diameter in inches.
Accuracy within 0.001 in.
ΔD = maximum difference in any two measurements.
Tolerance = 0.004 in.
D(avg) = avg of D1, D2, D3



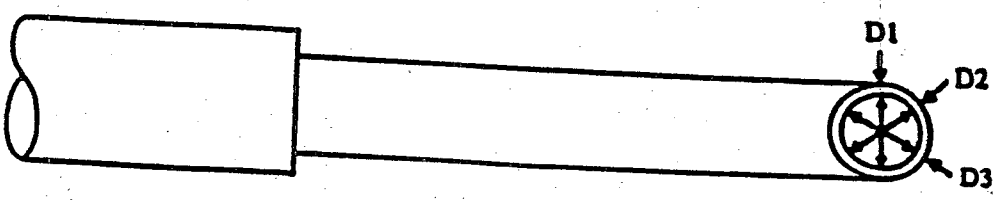
NOZZLE CALIBRATION

Sample Location: SS16
Plant : FWEI / BAY CITY, MI
Inspector: MF
Date: 30 Sept 1992
Time: AM

Nozzle Identification Number	Nozzle Inside Diameter (inches) D1	D2	D3	ΔD	D(avg)
S10	0.502	0.502	0.500	0.002	0.501
S11	0.500	0.502	0.500	0.002	0.501
S12	0.500	0.500	0.500	Ø	0.500
S13	0.498	0.500	0.502	0.004	0.500
S14	0.496	0.498	0.498	0.002	0.497
S15	0.498	0.498	0.496	0.002	0.497
S16	0.496	0.496	0.496	Ø	0.496

Where:

D1,D2,D3 = nozzle diameter measured on a different diameter in inches.
Accuracy within 0.001 in.
ΔD = maximum difference in any two measurements.
Tolerance = 0.004 inches
D (avg) = avg of D1,D2, D3



EQUIPMENT CALIBRATIONS - METALS TRAINS

DRY GAS METER COEFFICIENT CALCULATIONS AND DATA SHEET

Standard Identification (S/N): 961437
Standard Dry Gas Meter Coefficient: 0.9984
Field Dry Gas Meter I.D. (S/N): N1
Barometric Pressure (Pbar): 29.36
Ambient Temperature (degrees F): 80

Date: 21-Sep-92
Calibrated By: Andy Furlong
Calibration Type: Semi Annual x
Posttest

Approximate cfm		delta H (in. H2O)	Standard Dry Gas Meter			Field Dry Gas Meter			dH@	Yds
			Temp. Out (degrees F)	Meter Reading (cf)	Time (min)	Temp. Out (degrees F)	Meter Reading (cf)	Time (min)		
1	Start	1.00	82	160.000		90	826.038			
	End	1.00	82	162.164	4	90	828.203	4		
	Average/ Total	1.00	82	2.164	4	90	2.165	4	1.9704	1.0101
1	Start	1.00	82	164.324		91	830.382			
	End	1.00	82	166.495	4	91	832.544	4		
	Average/ Total	1.00	82	2.171	4	91	2.162	4	1.9541	1.0167
1	Start	1.00	83	166.495		91	832.544			
	End	1.00	83	168.659	4	91	834.713	4		
	Average/ Total	1.00	83	2.164	4	91	2.169	4	1.9740	1.0082
0.5	Start	0.50	84	173.000		91	838.921			
	End	0.50	84	174.550	4	91	840.5	4		
	Average/ Total	0.50	84	1.550	4	91	1.579	4	1.9310	0.9914
0.5	Start	0.50	84	179.245		92	845.199			
	End	0.50	84	180.797	4	92	846.774	4		
	Average/ Total	0.50	84	1.552	4	92	1.575	4	1.9225	0.9970
0.5	Start	0.50	84	176.123		91	842.06			
	End	0.50	84	177.672	4	91	843.638	4		
	Average/ Total	0.50	84	1.549	4	91	1.578	4	1.9335	0.9914

DRY GAS METER COEFFICIENT CALCULATIONS AND DATA SHEET

Standard Identification (S/N): 961437
Standard Dry Gas Meter Coefficient: 0.9984
Field Dry Gas Meter I.D. (S/N): N1
Barometric Pressure (Pbar): 29.36
Ambient Temperature (degrees F): 80

Date: 21-Sep-92
Calibrated By:Andy Furlong
Calibration Type: Semi Annual x
Post-test

Approximate cfm		delta H (in. H2O)	Standard Dry Gas Meter			Field Dry Gas Meter			dH@	Yds
			Temp. Out (degrees F)	Meter Reading (cf)	Time (min)	Temp. Out (degrees F)	Meter Reading (cf)	Time (min)		
2	Start	1.95	88	192.532		91	858.736			
	End	1.95	88	195.533	4	91	861.698	4		
	Average/ Total	1.95	88	3.001	4	91	2.962	4	2.0386	1.0121
2	Start	1.95	88	195.533		92	861.698			
	End	1.95	88	198.526	4	92	864.664	4		
	Average/ Total	1.95	88	2.993	4	92	2.966	4	2.0458	1.0099
2	Start	1.95	89	198.526		92	864.664			
	End	1.95	89	201.515	4	92	867.637	4		
	Average/ Total	1.95	89	2.989	4	92	2.973	4	2.0588	1.0044
1.5	Start	1.50	80	136.000		89	802.132			
	End	1.50	80	138.617	4	89	804.745	4		
	Average/ Total	1.50	80	2.617	4	89	2.613	4	2.0097	1.0128
1.5	Start	1.50	80	138.617		89	804.745			
	End	1.50	80	141.222	4	89	807.357	4		
	Average/ Total	1.50	80	2.605	4	89	2.612	4	2.0282	1.0085
1.5	Start	1.50	81	143.834		89	809.96			
	End	1.50	81	146.440	4	89	812.57	4		
	Average/ Total	1.50	81	2.606	4	89	2.61	4	2.0342	1.0078

Standard Identification (S/N): 961437
Standard Dry Gas Meter Coefficient: 0.9984
Field Dry Gas Meter I.D. (S/N): N1

Date: 21-Sep-92
Calibrated By: Andy Furlong

Calibration Type: Semi Annual x
Post-test

Approximate cfm	Standard Dry Gas Meter ID #: 961437		
	Actual Flowrate Qa,std (cfm)	Average Meter Temp., Tw (degrees F)	Corrected Flowrate Qstd,std (scfm)
2	0.750	88	0.697
	0.748	88	0.696
	0.747	89	0.693
1.5	0.654	80	0.617
	0.651	80	0.614
	0.651	81	0.614
1	0.541	82	0.509
	0.543	82	0.510
	0.541	83	0.508
0.5	0.388	84	0.363
	0.388	84	0.363
	0.387	84	0.363

EQUATIONS

Barometric Pressure (Pbar): 29.36
Ambient Temperature (degrees F): 80

Qa,std and Qa,m = Volume/Time
Qstd,std = Qa,std * Ystd * (520/(Tw+460)) * (Pbar/29.92)
Qstd,m = Qa,m * (520/(Tw+460)) * ((Pbar+dH/13.6)/29.92)
Yds = Qstd,std / Qstd,m

Acceptable criteria for *, **, and *** must be satisfied before calculating Y,avg or $\overline{Y,avg}$.

dH@ = 1.9917 $\overline{Y,avg}$ = 1.0058

Approximate cfm	Field Dry Gas Meter ID #: N1							
	Actual Flowrate Qa,m (cfm)	Average Meter Temp., Tm (degrees F)	Average Meter Pressure, dH (in. H2O)	Corrected Flowrate Qstd,m (scfm)	Coefficient Yds < (1+0.05)*	(Yds,max - Yds,max) < 0.010**	Average Coefficient Y,avg	0.98 < (Y,avg/ $\overline{Y,avg}$) < 1.02***
2	0.7405	91	2	0.689	1.0120	0.0078	1.0087	1.003
	0.7415	92	2	0.689	1.0098			
	0.74325	92	2	0.690	1.0042			
1.5	0.65325	89	1.5	0.609	1.0128	0.0050	1.0097	1.004
	0.653	89	1.5	0.609	1.0085			
	0.6525	89	1.5	0.609	1.0078			
1	0.54125	90	1	0.503	1.0101	0.0084	1.0117	1.006
	0.5405	91	1	0.502	1.0167			
	0.54225	91	1	0.503	1.0082			
0.5	0.39475	91	0.5	0.366	0.9914	0.0056	0.9933	0.988
	0.39375	92	0.5	0.364	0.9970			
	0.3945	91	0.5	0.366	0.9914			

DICK MUNNS COMPANY

Liquid and Gas - Flowmeter Calibration Service
10571 Calle Lee - 133 • Los Alamitos, California 90720
Telephone (213) 596-1559 • Telefax (714) 827-0823

CERTIFICATE OF CALIBRATION

Client Name:	E.E.R.	Calibration Date:	09-10-1992
Reference Number:	462160	Calibration Due:	09-10-1993
Instrument Manufacturer:	ROCKWELL	Calibration Fluid:	AIR 14.7 PSIA 70F
Instrument Description:	P.D.METER	Test Unit(s):	A-63
Model Number:	S-275	NIST Traceability Per:	M-0122
Serial Number:	462160	Ambient Conditions:	29.92"HGA 70F RH.44%
Rated Accuracy:	+/-1%	Data File:	462160
Accuracy Given:	WITHIN MFG. TOLERANCE		

	IND.SCFM	ACT.SCFM	
1	0.300	0.300	1.0
2	0.500	0.500	
3	0.700	0.700	
4	1.000	1.000	
5	1.250	1.250	
6	1.500	1.486	0.9907

Y=0.9984

Remarks:

All instruments used in the performance of the above calibration have direct traceability to the National Institute of Standards and Technology (NIST). Calibration has been performed in accordance with MIL-STD-45662A.

Calibration Performed By:

MICHAEL MUNNS

Approved By:

Michael Munns

MICHAEL MUNNS

CERT1

Metals | Sept 30/92 | Barry Boulin

T.C. Calibration

S.T #1

	T.C.		Thermometer	
Ice Water	35°F 35	34	39°F 34	34
Boiling Water	214°F 213	213	212°F 212	213
Boiling Oil	347 375 318		342 375 311	

Dry Gasmeter out

	T.C	Thermometer
air	64 62 64	64 63 64
Hot H_2O	164 182 198	163 181 199

101 Impingerout

	TC	Thermometer
Ice	37 37 36	37 37 36
air	62 62 65	63 63 64

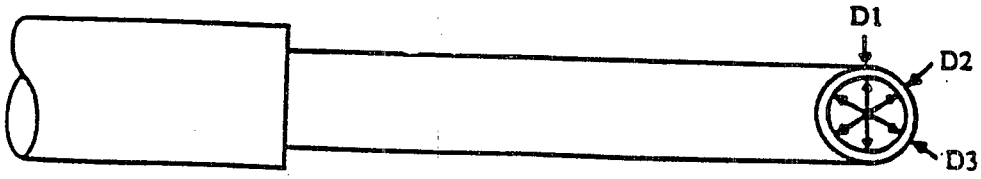
NOZZLE CALIBRATION

Sample Location:
Plant : Bay City
Inspector: B. Berlinger
Date: Sept 29
Time: 13:45

Nozzle Idenification Number	Nozzle Inside Diameter (inches) D1	D2	D3	ΔD	D(avg)
M1	.500	.498	.498	.002	.499
M2	.500	.500	.500	.000	.500
M3	.496	.496	.496	.000	.496
M4	.500	.498	.500	.002	.499

Where:

D1,D2,D3 = nozzle diameter measured on a different diameter in inches.
Accuracy within 0.001 in.
Δ = maximum difference in any two measurements.
Tolerance = 0.004 in.
D(avg) = avg of D1,D2, D3



IMET-EER

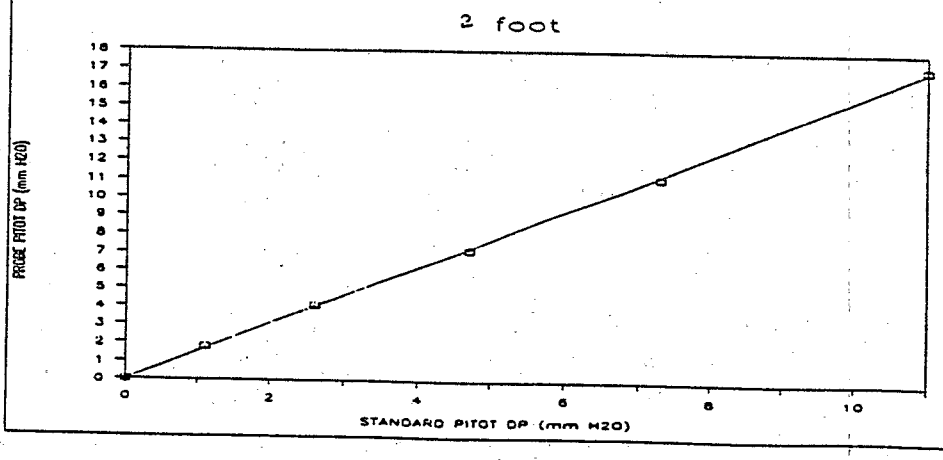
PITOT TUBE CALIBRATION REPORT

PITOT ID - 2 FOOTER

DATE - OCTOBER , 1992

FAN SPEED	STANDARD PITOT (mm H2O)	PROBE PITOT (mm H2O)
0	0.00	0.00
20	1.10	1.80
30	2.60	4.10
40	4.70	7.20
50	7.30	11.20
60	9.60	15.00

PITOT FACTOR Cp = 0.803



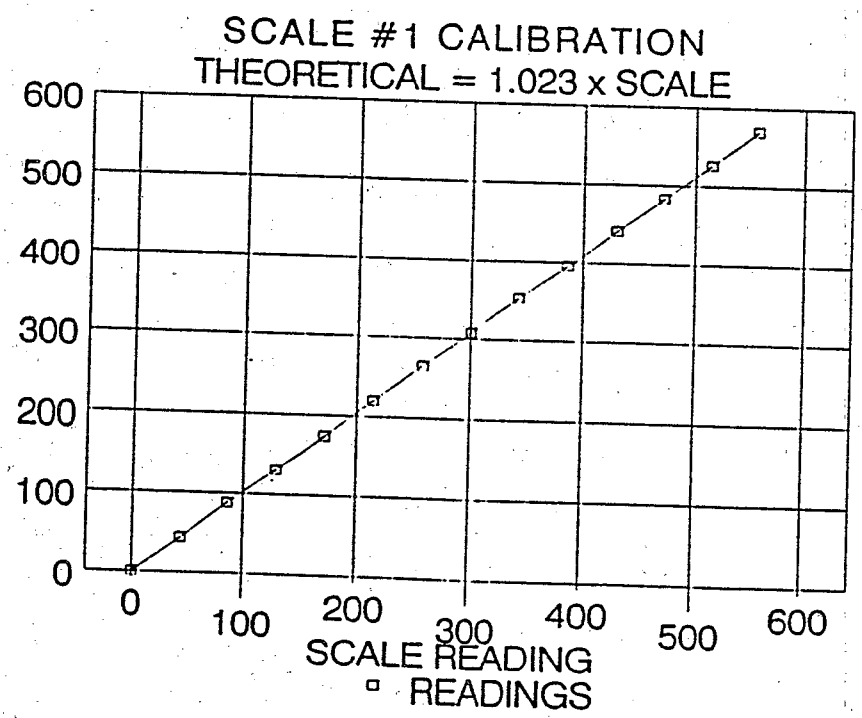
EQUIPMENT CALIBRATIONS - PROCESS WEIGHT SCALES

THEORY	SCALE
0	0
43.9	43.0
87.8	85.8
131.8	128.8
175.7	171.3
219.6	214.3
263.5	257.3
307.4	300.8
351.36	344
395.28	387
439.2	429.75
483.12	472.25
527.04	514.75
570.96	557.25

Regression Output:

Constant		0
Std Err of Y Est		0.431997
R Squared		0.999994
No. of Observations		14
Degrees of Freedom		13
X Coefficient(s)	1.023216	
Std Err of Coef.	0.000351	

THEORY = 1.023 x SCALE READING

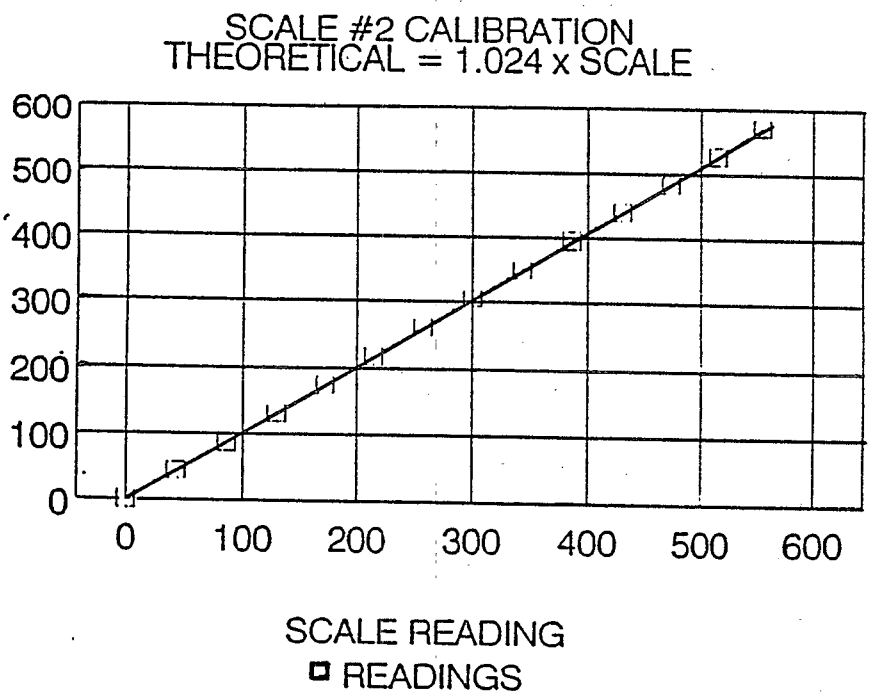


THEORY	SCALE
0	0
43.9	43.0
87.8	86.0
131.8	129.0
175.7	171.5
219.6	214.5
263.5	257.0
307.4	300.0
341.36	343
395.3	386
439.2	430
483.1	473.5
527.0	515
571.0	555.5

Regression Output:

Constant		0
Std Err of Y Est		0.844042
R Squared		0.999978
No. of Observations		14
Degrees of Freedom		13
X Coefficient(s)	1.023895	
Std Err of Coef.	0.000687	

Y = 1.024 x SCALE READING



EQUIPMENT CALIBRATIONS - PROCESS GAS SAMPLING

GASEOUS PROCESS SAMPLING

PLANT: MIDDLEGROUNDS LANDFILL BAY CITY, MI

LOCATION: —

DATE: 5 OCT 1992

CALIBRATED BY: M. FUKUDA

TC # 0-3 CALIBRATED VS. Hg-IN GLASS THERMOMETER ON 2 OCTOBER 1992

C No.	Ice Bath			Room T.			Boiling H_2O			Hot Oil			Note
	Ref	TC	Δ	Ref	TC	Δ	Ref	TC	Δ	Ref	TC	Δ	T = °F
0-3*	33	31	-2	71	68	-3	212	211	-1	—	—	—	
	35	35	∅	70	67	-3	212	212	∅				
C-1	31.8	31.6	-.2	~~68.8~~ 71.2	72.2	+1	212	212	∅	—	—	—	
	31.8	31.8	∅	71.2	71.9	+.7	212	213	+1				
	31.9	31.6	-.3	70.9	71.5	+.6	213	213	∅				
C-2	31.8	31.6	-.2	71.2	71.7	+.5	212	213	+1	—	—	—	
	31.9	31.5	-.4	71.2	71.8	+.6	212	214	+2				
	31.8	31.5	-.3	70.9	71.7	+.8	213	214	+1				
C-3	31.8	31.6	-.2	71.2	71.5	+.3	212	213	+1	—	—	—	
	31.9	31.6	-.3	71.2	70.9	-.3	212	213	+1				
	31.8	31.7	-.1	70.9	70.9	∅	213	214	+1				

POINT CALIBRATION FOR LOW-TEMP: ICE, ROOM TEMP, BOILING H_2O

POINT CALIBRATION FOR HIGH-TEMP: ICE, ~~HOT~~ BOILING H_2O, HOT OIL.

ALIBRATION LIMIT: Δ < 1.5 % AT EACH POINT

Δ < 3.6 °F.

BR OOKS INSTRUMENTS
South Harbor Blvd.
Iabra, CA
51

n: Bernie Ortmann

Voice(310)694-5504
Fax(310)690-7181

DATE 9-28-92

EER
: Andy
Tube Data

Fax:

y,

The enclosed tube data is for the conditions supplied to us as
; the ones you will see at your sight. Rather than trying to run
sheets for every combination at 4 different temperatures, you will
corection factors below. Multiply the flow from the data sheet by
actor below for the appropriate temperature in order to derive
actual flow.

2

Factor
1.000
0.972
0.962
0.954

·ds,

e Ortmann

;621 0.0189 STD.CU.FT./MIN. gas

10-05-1992

R-215-B
Spherical
CARBOLOY
1 ATMOS. & 70'F
5.

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00015 GMS/CC
14.95000 GMS/CC
0.11750 SP.GR.(GAS)
0.00905 cP

0.6621	110.0	0.5321	70.0	0.3697	30.0	0.1685
0.6593	109.0	0.5286	69.0	0.3653	29.0	0.1632
0.6565	108.0	0.5251	68.0	0.3609	28.0	0.1578
0.6536	107.0	0.5215	67.0	0.3564	27.0	0.1524
0.6508	106.0	0.5178	66.0	0.3519	26.0	0.1471
0.6479	105.0	0.5140	65.0	0.3474	25.0	0.1417
0.6450	104.0	0.5100	64.0	0.3428	24.0	0.1362
0.6421	103.0	0.5060	63.0	0.3383	23.0	0.1307
0.6392	102.0	0.5019	62.0	0.3337	22.0	0.1252
0.6362	101.0	0.4978	61.0	0.3291	21.0	0.1196
0.6332	100.0	0.4937	60.0	0.3244	20.0	0.1139
0.6302	99.0	0.4895	59.0	0.3196	19.0	0.1082
0.6271	98.0	0.4854	58.0	0.3147	18.0	0.1024
0.6239	97.0	0.4812	57.0	0.3098	17.0	0.0965
0.6207	96.0	0.4771	56.0	0.3049	16.0	0.0904
0.6175	95.0	0.4729	55.0	0.3000	15.0	0.0843
0.6140	94.0	0.4688	54.0	0.2951	14.0	0.0779
0.6105	93.0	0.4647	53.0	0.2901	13.0	0.0715
0.6070	92.0	0.4607	52.0	0.2851	12.0	0.0650
0.6035	91.0	0.4567	51.0	0.2801	11.0	0.0584
0.5999	90.0	0.4527	50.0	0.2750	10.0	0.0519
0.5963	89.0	0.4486	49.0	0.2699	9.0	0.0453
0.5928	88.0	0.4446	48.0	0.2648	8.0	0.0387
0.5892	87.0	0.4406	47.0	0.2597	7.0	0.0321
0.5857	86.0	0.4366	46.0	0.2546	6.0	0.0255
0.5822	85.0	0.4325	45.0	0.2494	5.0	0.0189
0.5787	84.0	0.4285	44.0	0.2441		
0.5752	83.0	0.4245	43.0	0.2387		
0.5718	82.0	0.4205	42.0	0.2333		
0.5685	81.0	0.4164	41.0	0.2279		
0.5652	80.0	0.4123	40.0	0.2225		
0.5619	79.0	0.4082	39.0	0.2171		
0.5586	78.0	0.4041	38.0	0.2116		
0.5553	77.0	0.3999	37.0	0.2062		
0.5521	76.0	0.3957	36.0	0.2008		
0.5488	75.0	0.3915	35.0	0.1954		
0.5455	74.0	0.3872	34.0	0.1900		
0.5422	73.0	0.3829	33.0	0.1846		
0.5389	72.0	0.3785	32.0	0.1792		
0.5355	71.0	0.3741	31.0	0.1739		

EER9

05 0.0013 STD.CU.FT./MIN. GAS

09-28-1992

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00015 GMS/CC
14.95000 GMS/CC
0.11800 SP.GR.(GAS)
0.00905 cP

R-215-AAA
Spherical
CARBOLOY
1 ATMOS. & 70'F
1.

EER9

0.0205	110.0	0.0135	70.0	0.0074	30.0	0.0030
0.0203	109.0	0.0133	69.0	0.0072	29.0	0.0030
0.0202	108.0	0.0132	68.0	0.0071	28.0	0.0029
0.0201	107.0	0.0130	67.0	0.0069	27.0	0.0028
0.0199	106.0	0.0128	66.0	0.0068	26.0	0.0028
0.0198	105.0	0.0126	65.0	0.0066	25.0	0.0027
0.0197	104.0	0.0125	64.0	0.0065	24.0	0.0026
0.0195	103.0	0.0123	63.0	0.0064	23.0	0.0026
0.0194	102.0	0.0121	62.0	0.0062	22.0	0.0025
0.0192	101.0	0.0119	61.0	0.0061	21.0	0.0024
0.0191	100.0	0.0118	60.0	0.0060	20.0	0.0024
0.0189	99.0	0.0116	59.0	0.0059	19.0	0.0023
0.0187	98.0	0.0114	58.0	0.0058	18.0	0.0022
0.0186	97.0	0.0113	57.0	0.0057	17.0	0.0022
0.0184	96.0	0.0111	56.0	0.0056	16.0	0.0021
0.0182	95.0	0.0109	55.0	0.0055	15.0	0.0020
0.0180	94.0	0.0108	54.0	0.0054	14.0	0.0019
0.0178	93.0	0.0106	53.0	0.0053	13.0	0.0019
0.0176	92.0	0.0105	52.0	0.0052	12.0	0.0018
0.0174	91.0	0.0103	51.0	0.0051	11.0	0.0017
0.0172	90.0	0.0102	50.0	0.0050	10.0	0.0017
0.0170	89.0	0.0100	49.0	0.0049	9.0	0.0016
0.0168	88.0	0.0099	48.0	0.0048	8.0	0.0015
0.0166	87.0	0.0098	47.0	0.0047	7.0	0.0014
0.0164	86.0	0.0097	46.0	0.0046	6.0	0.0014
0.0162	85.0	0.0095	45.0	0.0045	5.0	0.0013
0.0160	84.0	0.0094	44.0	0.0044		
0.0158	83.0	0.0093	43.0	0.0043		
0.0156	82.0	0.0091	42.0	0.0042		
0.0154	81.0	0.0090	41.0	0.0041		
0.0153	80.0	0.0089	40.0	0.0040		
0.0151	79.0	0.0088	39.0	0.0039		
0.0149	78.0	0.0086	38.0	0.0037		
0.0147	77.0	0.0085	37.0	0.0036		
0.0146	76.0	0.0083	36.0	0.0036		
0.0144	75.0	0.0082	35.0	0.0035		
0.0142	74.0	0.0080	34.0	0.0034		
0.0140	73.0	0.0079	33.0	0.0033		
0.0139	72.0	0.0077	32.0	0.0032		
0.0137	71.0	0.0076	31.0	0.0031		

0.5360 0.0092 STD.L/MIN. AIR 10-05-1992

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00125 GMS/CC
3.98000 GMS/CC
0 0120 GMS/CC
0 785 cP

R-215-D
Spherical
SAPPHIRE
1 ATMOS. & 70'F
3.

0.0	0.5360	110.0	0.3691	70.0	0.1841	30.0	0.0439
9.0	0.5318	109.0	0.3648	69.0	0.1801	29.0	0.0420
8.0	0.5276	108.0	0.3605	68.0	0.1760	28.0	0.0401
7.0	0.5234	107.0	0.3562	67.0	0.1720	27.0	0.0383
6.0	0.5192	106.0	0.3517	66.0	0.1680	26.0	0.0365
5.0	0.5150	105.0	0.3470	65.0	0.1640	25.0	0.0347
4.0	0.5108	104.0	0.3421	64.0	0.1600	24.0	0.0331
3.0	0.5066	103.0	0.3372	63.0	0.1559	23.0	0.0314
2.0	0.5023	102.0	0.3322	62.0	0.1519	22.0	0.0298
1.0	0.4981	101.0	0.3271	61.0	0.1479	21.0	0.0282
0.0	0.4939	100.0	0.3221	60.0	0.1438	20.0	0.0267
9.0	0.4896	99.0	0.3170	59.0	0.1398	19.0	0.0252
8.0	0.4854	98.0	0.3119	58.0	0.1358	18.0	0.0237
7.0	0.4811	97.0	0.3068	57.0	0.1318	17.0	0.0222
6.0	0.4769	96.0	0.3017	56.0	0.1278	16.0	0.0208
5.0	0.4726	95.0	0.2967	55.0	0.1238	15.0	0.0194
4.0	0.4682	94.0	0.2917	54.0	0.1199	14.0	0.0183
3.0	0.4639	93.0	0.2868	53.0	0.1160	13.0	0.0173
2.0	0.4595	92.0	0.2819	52.0	0.1121	12.0	0.0162
1.0	0.4552	91.0	0.2771	51.0	0.1082	11.0	0.0152
0.0	0.4509	90.0	0.2724	50.0	0.1045	10.0	0.0142
9.0	0.4466	89.0	0.2676	49.0	0.1007	9.0	0.0132
8.0	0.4422	88.0	0.2629	48.0	0.0970	8.0	0.0122
7.0	0.4380	87.0	0.2583	47.0	0.0934	7.0	0.0112
6.0	0.4337	86.0	0.2536	46.0	0.0899	6.0	0.0102
5.0	0.4294	85.0	0.2490	45.0	0.0864	5.0	0.0092
4.0	0.4252	84.0	0.2444	44.0	0.0832		
3.0	0.4211	83.0	0.2399	43.0	0.0800		
2.0	0.4169	82.0	0.2354	42.0	0.0769		
1.0	0.4128	81.0	0.2309	41.0	0.0738		
0.0	0.4088	80.0	0.2264	40.0	0.0708		
9.0	0.4048	79.0	0.2220	39.0	0.0679		
8.0	0.4009	78.0	0.2176	38.0	0.0650		
7.0	0.3970	77.0	0.2132	37.0	0.0622		
6.0	0.3931	76.0	0.2088	36.0	0.0594		
5.0	0.3892	75.0	0.2044	35.0	0.0567		
4.0	0.3853	74.0	0.2003	34.0	0.0540		
3.0	0.3813	73.0	0.1962	33.0	0.0514		
2.0	0.3773	72.0	0.1922	32.0	0.0488		
1.0	0.3732	71.0	0.1881	31.0	0.0464		

EER3

5995 0.0115 STD.CU.FT./MIN. AIR

09-28-1992

R-615-A
Spherical
316 SS
1 ATMOS. & 70'F
7.

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00125 GMS/CC
8.04000 GMS/CC
0.00120 GMS/CC
0.01785 cP

)	0.5995	110.0	0.4423	70.0	0.2794	30.0	0.1174
)	0.5959	109.0	0.4382	69.0	0.2752	29.0	0.1132
)	0.5923	108.0	0.4341	68.0	0.2711	28.0	0.1090
)	0.5887	107.0	0.4300	67.0	0.2670	27.0	0.1048
)	0.5851	106.0	0.4259	66.0	0.2628	26.0	0.1006
)	0.5815	105.0	0.4218	65.0	0.2587	25.0	0.0964
)	0.5778	104.0	0.4177	64.0	0.2547	24.0	0.0921
)	0.5742	103.0	0.4136	63.0	0.2506	23.0	0.0879
)	0.5705	102.0	0.4096	62.0	0.2466	22.0	0.0837
)	0.5668	101.0	0.4055	61.0	0.2426	21.0	0.0795
)	0.5631	100.0	0.4014	60.0	0.2386	20.0	0.0753
)	0.5594	99.0	0.3974	59.0	0.2347	19.0	0.0711
)	0.5556	98.0	0.3933	58.0	0.2309	18.0	0.0668
)	0.5519	97.0	0.3893	57.0	0.2270	17.0	0.0626
)	0.5481	96.0	0.3852	56.0	0.2231	16.0	0.0584
)	0.5442	95.0	0.3812	55.0	0.2193	15.0	0.0541
)	0.5403	94.0	0.3771	54.0	0.2154	14.0	0.0499
)	0.5363	93.0	0.3731	53.0	0.2116	13.0	0.0456
)	0.5323	92.0	0.3691	52.0	0.2077	12.0	0.0414
)	0.5283	91.0	0.3650	51.0	0.2038	11.0	0.0371
)	0.5243	90.0	0.3610	50.0	0.1999	10.0	0.0328
	0.5202	89.0	0.3569	49.0	0.1960	9.0	0.0286
	0.5162	88.0	0.3529	48.0	0.1920	8.0	0.0243
	0.5121	87.0	0.3489	47.0	0.1880	7.0	0.0201
	0.5081	86.0	0.3449	46.0	0.1840	6.0	0.0158
	0.5040	85.0	0.3408	45.0	0.1799	5.0	0.0115
	0.5000	84.0	0.3368	44.0	0.1758		
	0.4959	83.0	0.3328	43.0	0.1717		
	0.4918	82.0	0.3287	42.0	0.1676		
	0.4878	81.0	0.3247	41.0	0.1634		
	0.4837	80.0	0.3206	40.0	0.1592		
	0.4796	79.0	0.3165	39.0	0.1551		
	0.4754	78.0	0.3125	38.0	0.1509		
	0.4713	77.0	0.3084	37.0	0.1467		
	0.4671	76.0	0.3043	36.0	0.1425		
	0.4630	75.0	0.3002	35.0	0.1383		
	0.4589	74.0	0.2960	34.0	0.1341		
	0.4547	73.0	0.2919	33.0	0.1299		
	0.4506	72.0	0.2877	32.0	0.1257		
	0.4464	71.0	0.2835	31.0	0.1216		

).4965 0.0082 STD.L/MIN. O2 10-05-1992

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00139 GMS/CC
3.98000 GMS/CC
0.00133 GMS/CC
0.02014 cP

R-215-D
Spherical
SAPPHIRE
1 ATMOS. & 70'F
3.

).0	0.4965	110.0	0.3395	70.0	0.1662	30.0	0.0390
9.0	0.4925	109.0	0.3355	69.0	0.1625	29.0	0.0373
8.0	0.4886	108.0	0.3315	68.0	0.1588	28.0	0.0356
7.0	0.4847	107.0	0.3274	67.0	0.1550	27.0	0.0339
6.0	0.4807	106.0	0.3232	66.0	0.1513	26.0	0.0324
5.0	0.4768	105.0	0.3188	65.0	0.1476	25.0	0.0308
4.0	0.4728	104.0	0.3143	64.0	0.1439	24.0	0.0293
3.0	0.4688	103.0	0.3096	63.0	0.1402	23.0	0.0278
2.0	0.4649	102.0	0.3049	62.0	0.1364	22.0	0.0264
1.0	0.4609	101.0	0.3002	61.0	0.1327	21.0	0.0250
0.0	0.4569	100.0	0.2955	60.0	0.1290	20.0	0.0236
9.0	0.4529	99.0	0.2907	59.0	0.1253	19.0	0.0223
8.0	0.4489	98.0	0.2860	58.0	0.1217	18.0	0.0210
7.0	0.4449	97.0	0.2812	57.0	0.1181	17.0	0.0197
6.0	0.4409	96.0	0.2764	56.0	0.1144	16.0	0.0184
5.0	0.4368	95.0	0.2717	55.0	0.1109	15.0	0.0172
4.0	0.4328	94.0	0.2671	54.0	0.1073	14.0	0.0162
3.0	0.4287	93.0	0.2624	53.0	0.1037	13.0	0.0153
2.0	0.4246	92.0	0.2579	52.0	0.1002	12.0	0.0144
1.0	0.4205	91.0	0.2534	51.0	0.0968	11.0	0.0135
0.0	0.4164	90.0	0.2490	50.0	0.0933	10.0	0.0126
9.0	0.4123	89.0	0.2445	49.0	0.0900	9.0	0.0117
8.0	0.4083	88.0	0.2401	48.0	0.0866	8.0	0.0108
7.0	0.4043	87.0	0.2357	47.0	0.0834	7.0	0.0099
6.0	0.4002	86.0	0.2313	46.0	0.0802	6.0	0.0091
5.0	0.3962	85.0	0.2270	45.0	0.0770	5.0	0.0082
4.0	0.3923	84.0	0.2227	44.0	0.0741		
3.0	0.3884	83.0	0.2184	43.0	0.0713		
2.0	0.3845	82.0	0.2142	42.0	0.0685		
1.0	0.3806	81.0	0.2100	41.0	0.0658		
0.0	0.3768	80.0	0.2058	40.0	0.0631		
9.0	0.3731	79.0	0.2016	39.0	0.0604		
8.0	0.3694	78.0	0.1975	38.0	0.0578		
7.0	0.3658	77.0	0.1934	37.0	0.0553		
6.0	0.3621	76.0	0.1893	36.0	0.0528		
5.0	0.3584	75.0	0.1852	35.0	0.0504		
4.0	0.3547	74.0	0.1813	34.0	0.0480		
3.0	0.3510	73.0	0.1775	33.0	0.0457		
2.0	0.3472	72.0	0.1738	32.0	0.0434		
1.0	0.3434	71.0	0.1700	31.0	0.0412		

EER1

.5652 0.0103 STD.CU.FT./MIN. O2

09-28-1992

R-615-A
Spherical
316 SS
1 ATMOS. & 70'F
7.

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00139 GMS/CC
8.04000 GMS/CC
0.00133 GMS/CC
0.02014 cP

0	0.5652	110.0	0.4161	70.0	0.2626	30.0	0.1094
0	0.5618	109.0	0.4122	69.0	0.2586	29.0	0.1054
0	0.5584	108.0	0.4083	68.0	0.2547	28.0	0.1014
0	0.5550	107.0	0.4044	67.0	0.2508	27.0	0.0974
0	0.5516	106.0	0.4005	66.0	0.2470	26.0	0.0934
0	0.5481	105.0	0.3966	65.0	0.2431	25.0	0.0894
0	0.5447	104.0	0.3928	64.0	0.2393	24.0	0.0854
0	0.5412	103.0	0.3889	63.0	0.2354	23.0	0.0814
0	0.5378	102.0	0.3851	62.0	0.2316	22.0	0.0774
0	0.5343	101.0	0.3813	61.0	0.2279	21.0	0.0734
0	0.5308	100.0	0.3775	60.0	0.2241	20.0	0.0694
0	0.5272	99.0	0.3736	59.0	0.2204	19.0	0.0655
0	0.5237	98.0	0.3698	58.0	0.2168	18.0	0.0615
0	0.5201	97.0	0.3660	57.0	0.2131	17.0	0.0575
0	0.5165	96.0	0.3622	56.0	0.2095	16.0	0.0536
0	0.5129	95.0	0.3584	55.0	0.2058	15.0	0.0496
0	0.5091	94.0	0.3546	54.0	0.2022	14.0	0.0457
0	0.5054	93.0	0.3508	53.0	0.1985	13.0	0.0417
0	0.5016	92.0	0.3470	52.0	0.1949	12.0	0.0378
0	0.4978	91.0	0.3432	51.0	0.1912	11.0	0.0338
0	0.4940	90.0	0.3394	50.0	0.1875	10.0	0.0299
0	0.4901	89.0	0.3356	49.0	0.1838	9.0	0.0260
0	0.4863	88.0	0.3318	48.0	0.1800	8.0	0.0221
0	0.4824	87.0	0.3280	47.0	0.1763	7.0	0.0181
0	0.4786	86.0	0.3242	46.0	0.1725	6.0	0.0142
0	0.4747	85.0	0.3204	45.0	0.1686	5.0	0.0103
0	0.4709	84.0	0.3166	44.0	0.1647		
0	0.4670	83.0	0.3128	43.0	0.1608		
0	0.4632	82.0	0.3090	42.0	0.1569		
0	0.4593	81.0	0.3052	41.0	0.1530		
0	0.4555	80.0	0.3014	40.0	0.1490		
0	0.4515	79.0	0.2976	39.0	0.1451		
0	0.4476	78.0	0.2937	38.0	0.1411		
0	0.4436	77.0	0.2899	37.0	0.1371		
0	0.4397	76.0	0.2860	36.0	0.1331		
0	0.4357	75.0	0.2821	35.0	0.1292		
0	0.4318	74.0	0.2782	34.0	0.1252		
0	0.4279	73.0	0.2743	33.0	0.1212		
0	0.4239	72.0	0.2704	32.0	0.1173		
0	0.4200	71.0	0.2665	31.0	0.1133		

5232 0.0366 STD.L/MIN. H2 EER7

R-215-AAA
Spherical
CARBOLOY
1 ATMOS. & 70'F
1.

09-28-1992

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00009 GMS/CC
14.95000 GMS/CC
0.00008 GMS/CC
0.00875 CP

0.6232	110.0	0.4038	70.0	0.2168	30.0	0.0878	
0.6187	109.0	0.3985	69.0	0.2123	29.0	0.0857	
0.6143	108.0	0.3931	68.0	0.2079	28.0	0.0837	
0.6099	107.0	0.3875	67.0	0.2035	27.0	0.0817	
0.6054	106.0	0.3818	66.0	0.1991	26.0	0.0798	
0.6009	105.0	0.3759	65.0	0.1949	25.0	0.0779	
0.5963	104.0	0.3699	64.0	0.1907	24.0	0.0760	
0.5916	103.0	0.3639	63.0	0.1867	23.0	0.0741	
0.5868	102.0	0.3578	62.0	0.1829	22.0	0.0723	
0.5820	101.0	0.3517	61.0	0.1793	21.0	0.0704	
0.5770	100.0	0.3456	60.0	0.1758	20.0	0.0685	
0.5719	99.0	0.3396	59.0	0.1726	19.0	0.0665	
0.5667	98.0	0.3337	58.0	0.1694	18.0	0.0645	
0.5613	97.0	0.3278	57.0	0.1663	17.0	0.0625	
0.5557	96.0	0.3221	56.0	0.1633	16.0	0.0603	
0.5500	95.0	0.3166	55.0	0.1604	15.0	0.0581	
0.5436	94.0	0.3112	54.0	0.1574	14.0	0.0560	
0.5371	93.0	0.3061	53.0	0.1545	13.0	0.0539	
0.5306	92.0	0.3011	52.0	0.1517	12.0	0.0518	
0.5240	91.0	0.2965	51.0	0.1488	11.0	0.0496	
0.5174	90.0	0.2922	50.0	0.1459	10.0	0.0475	
0.5108	89.0	0.2884	49.0	0.1429	9.0	0.0453	
0.5042	88.0	0.2849	48.0	0.1399	8.0	0.0431	
0.4976	87.0	0.2814	47.0	0.1369	7.0	0.0409	
0.4911	86.0	0.2781	46.0	0.1337	6.0	0.0387	
0.4848	85.0	0.2748	45.0	0.1305	5.0	0.0366	
0.4785	84.0	0.2715	44.0	0.1275			
0.4724	83.0	0.2682	43.0	0.1244			
0.4665	82.0	0.2650	42.0	0.1214			
0.4608	81.0	0.2616	41.0	0.1184			
0.4552	80.0	0.2582	40.0	0.1153			
0.4499	79.0	0.2547	39.0	0.1123			
0.4447	78.0	0.2510	38.0	0.1093			
0.4395	77.0	0.2471	37.0	0.1064			
0.4344	76.0	0.2430	36.0	0.1035			
0.4294	75.0	0.2387	35.0	0.1006			
0.4243	74.0	0.2345	34.0	0.0979			
0.4193	73.0	0.2301	33.0	0.0952			
0.4142	72.0	0.2257	32.0	0.0926			
0.4090	71.0	0.2213	31.0	0.0902			

EER4

.5756 0.0108 STD.CU.FT./MIN. H2

09-28-1992

R-215-B
Spherical
316 SS
1 ATMOS. & 70'F
5.

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00009 GMS/CC
8.04000 GMS/CC
0.00008 GMS/CC
0.00875 cP

.0	0.5756	110.0	0.4611	70.0	0.3169	30.0	0.1376
.0	0.5732	109.0	0.4579	69.0	0.3131	29.0	0.1328
0	0.5708	108.0	0.4547	68.0	0.3093	28.0	0.1279
0	0.5683	107.0	0.4514	67.0	0.3055	27.0	0.1230
0	0.5658	106.0	0.4481	66.0	0.3016	26.0	0.1181
0	0.5633	105.0	0.4446	65.0	0.2977	25.0	0.1132
0	0.5608	104.0	0.4410	64.0	0.2937	24.0	0.1083
0	0.5583	103.0	0.4373	63.0	0.2897	23.0	0.1034
0	0.5558	102.0	0.4336	62.0	0.2857	22.0	0.0985
0	0.5532	101.0	0.4298	61.0	0.2817	21.0	0.0935
0	0.5506	100.0	0.4260	60.0	0.2776	20.0	0.0886
0	0.5479	99.0	0.4222	59.0	0.2733	19.0	0.0836
0	0.5452	98.0	0.4184	58.0	0.2689	18.0	0.0786
0	0.5424	97.0	0.4146	57.0	0.2646	17.0	0.0735
0	0.5396	96.0	0.4108	56.0	0.2602	16.0	0.0684
0	0.5368	95.0	0.4070	55.0	0.2557	15.0	0.0633
0	0.5337	94.0	0.4033	54.0	0.2513	14.0	0.0581
0	0.5307	93.0	0.3996	53.0	0.2468	13.0	0.0529
0	0.5276	92.0	0.3959	52.0	0.2423	12.0	0.0477
0	0.5244	91.0	0.3923	51.0	0.2378	11.0	0.0424
0	0.5213	90.0	0.3888	50.0	0.2333	10.0	0.0372
0	0.5182	89.0	0.3852	49.0	0.2287	9.0	0.0319
0	0.5150	88.0	0.3817	48.0	0.2241	8.0	0.0266
0	0.5119	87.0	0.3782	47.0	0.2196	7.0	0.0214
0	0.5087	86.0	0.3746	46.0	0.2150	6.0	0.0161
0	0.5056	85.0	0.3711	45.0	0.2104	5.0	0.0108
0	0.5026	84.0	0.3676	44.0	0.2056		
0	0.4995	83.0	0.3641	43.0	0.2007		
0	0.4965	82.0	0.3606	42.0	0.1959		
0	0.4935	81.0	0.3571	41.0	0.1911		
0	0.4906	80.0	0.3536	40.0	0.1862		
0	0.4877	79.0	0.3500	39.0	0.1813		
0	0.4848	78.0	0.3465	38.0	0.1765		
0	0.4819	77.0	0.3429	37.0	0.1716		
0	0.4790	76.0	0.3392	36.0	0.1667		
0	0.4760	75.0	0.3355	35.0	0.1619		
0	0.4731	74.0	0.3319	34.0	0.1570		
0	0.4702	73.0	0.3282	33.0	0.1521		
0	0.4672	72.0	0.3244	32.0	0.1473		
0	0.4641	71.0	0.3207	31.0	0.1425		

EER2

0.5206 0.0194 STD.CU.FT./MIN. C3H8

09-28-1992

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00194 GMS/CC
8.04000 GMS/CC
0.00187 GMS/CC
0.00794 cP

R-615-A
Spherical
316 SS
1 ATMOS. & 70'F
7.

0.0	0.5206	110.0	0.3928	70.0	0.2519	30.0	0.1179
9.0	0.5176	109.0	0.3894	69.0	0.2484	29.0	0.1144
8.0	0.5145	108.0	0.3860	68.0	0.2450	28.0	0.1109
7.0	0.5114	107.0	0.3826	67.0	0.2415	27.0	0.1074
6.0	0.5083	106.0	0.3792	66.0	0.2380	26.0	0.1039
5.0	0.5052	105.0	0.3757	65.0	0.2346	25.0	0.1004
4.0	0.5021	104.0	0.3721	64.0	0.2312	24.0	0.0968
3.0	0.4990	103.0	0.3686	63.0	0.2278	23.0	0.0932
2.0	0.4959	102.0	0.3650	62.0	0.2244	22.0	0.0896
1.0	0.4928	101.0	0.3614	61.0	0.2211	21.0	0.0859
0.0	0.4897	100.0	0.3578	60.0	0.2177	20.0	0.0822
9.0	0.4866	99.0	0.3542	59.0	0.2145	19.0	0.0785
8.0	0.4835	98.0	0.3506	58.0	0.2113	18.0	0.0746
7.0	0.4803	97.0	0.3470	57.0	0.2080	17.0	0.0707
6.0	0.4772	96.0	0.3434	56.0	0.2048	16.0	0.0668
5.0	0.4740	95.0	0.3398	55.0	0.2016	15.0	0.0628
4.0	0.4709	94.0	0.3362	54.0	0.1984	14.0	0.0585
3.0	0.4677	93.0	0.3327	53.0	0.1952	13.0	0.0543
2.0	0.4645	92.0	0.3291	52.0	0.1920	12.0	0.0499
1.0	0.4613	91.0	0.3256	51.0	0.1888	11.0	0.0456
0.0	0.4581	90.0	0.3221	50.0	0.1855	10.0	0.0412
9.0	0.4549	89.0	0.3185	49.0	0.1823	9.0	0.0369
8.0	0.4517	88.0	0.3150	48.0	0.1790	8.0	0.0325
7.0	0.4485	87.0	0.3115	47.0	0.1757	7.0	0.0281
6.0	0.4452	86.0	0.3080	46.0	0.1724	6.0	0.0238
5.0	0.4420	85.0	0.3045	45.0	0.1691	5.0	0.0194
.0	0.4388	84.0	0.3010	44.0	0.1657		
.0	0.4356	83.0	0.2975	43.0	0.1623		
.0	0.4323	82.0	0.2940	42.0	0.1590		
.0	0.4291	81.0	0.2905	41.0	0.1556		
.0	0.4259	80.0	0.2870	40.0	0.1522		
.0	0.4226	79.0	0.2835	39.0	0.1487		
.0	0.4193	78.0	0.2800	38.0	0.1453		
.0	0.4160	77.0	0.2765	37.0	0.1419		
.0	0.4128	76.0	0.2730	36.0	0.1385		
.0	0.4095	75.0	0.2694	35.0	0.1350		
.0	0.4062	74.0	0.2659	34.0	0.1316		
.0	0.4028	73.0	0.2624	33.0	0.1282		
.0	0.3995	72.0	0.2589	32.0	0.1247		
.0	0.3962	71.0	0.2554	31.0	0.1213		

EER6

4374 0.0138 STD.L/MIN. C3H8 09-28-1992

14.7 PSI
60.0 DEG.F
10.0 IN.WCG
0.00194 GMS/CC
2.54000 GMS/CC
0.00187 GMS/CC
0.00794 cP

R-215-D
Spherical
GLASS
1 ATMOS. & 70'F
3.

0	0.4374	110.0	0.3168	70.0	0.1836	30.0	0.0581
0	0.4344	109.0	0.3138	69.0	0.1805	29.0	0.0559
0	0.4314	108.0	0.3107	68.0	0.1773	28.0	0.0537
0	0.4284	107.0	0.3075	67.0	0.1741	27.0	0.0516
0	0.4254	106.0	0.3042	66.0	0.1710	26.0	0.0495
0	0.4224	105.0	0.3009	65.0	0.1677	25.0	0.0474
0	0.4194	104.0	0.2973	64.0	0.1645	24.0	0.0454
0	0.4163	103.0	0.2937	63.0	0.1612	23.0	0.0434
0	0.4133	102.0	0.2901	62.0	0.1580	22.0	0.0414
0	0.4103	101.0	0.2864	61.0	0.1546	21.0	0.0395
0	0.4072	100.0	0.2828	60.0	0.1513	20.0	0.0375
0	0.4041	99.0	0.2791	59.0	0.1478	19.0	0.0357
0	0.4011	98.0	0.2754	58.0	0.1443	18.0	0.0338
0	0.3980	97.0	0.2717	57.0	0.1408	17.0	0.0320
0	0.3949	96.0	0.2681	56.0	0.1373	16.0	0.0302
0	0.3918	95.0	0.2645	55.0	0.1338	15.0	0.0284
0	0.3886	94.0	0.2609	54.0	0.1302	14.0	0.0269
0	0.3855	93.0	0.2574	53.0	0.1268	13.0	0.0254
0	0.3823	92.0	0.2539	52.0	0.1233	12.0	0.0239
0	0.3792	91.0	0.2505	51.0	0.1198	11.0	0.0225
0	0.3760	90.0	0.2472	50.0	0.1164	10.0	0.0210
0	0.3729	89.0	0.2438	49.0	0.1130	9.0	0.0196
0	0.3697	88.0	0.2405	48.0	0.1097	8.0	0.0182
0	0.3666	87.0	0.2373	47.0	0.1064	7.0	0.0167
0	0.3635	86.0	0.2341	46.0	0.1032	6.0	0.0153
0	0.3604	85.0	0.2309	45.0	0.1000	5.0	0.0138
0	0.3574	84.0	0.2277	44.0	0.0970		
0	0.3543	83.0	0.2245	43.0	0.0939		
0	0.3513	82.0	0.2213	42.0	0.0910		
0	0.3484	81.0	0.2182	41.0	0.0880		
0	0.3454	80.0	0.2150	40.0	0.0851		
0	0.3426	79.0	0.2119	39.0	0.0823		
0	0.3398	78.0	0.2087	38.0	0.0794		
0	0.3370	77.0	0.2055	37.0	0.0766		
0	0.3341	76.0	0.2023	36.0	0.0739		
0	0.3313	75.0	0.1991	35.0	0.0712		
0	0.3285	74.0	0.1960	34.0	0.0685		
0	0.3256	73.0	0.1929	33.0	0.0658		
0	0.3227	72.0	0.1898	32.0	0.0632		
0	0.3198	71.0	0.1867	31.0	0.0607		

EQUIPMENT CALIBRATIONS - MISCELLANEOUS

ISOTRAIN: VOST #1

DATE: SEPTEMBER 23, 1992

ROTAMETER READING	GAS METER READING			GASOMETER		SAMPLE TIME	TEMPERATURE		BAROMETER PRESSURE	VOLUME		SAMPLING RATE	Yds
	START (L)	STOP (L)	NET (L)	READING (mm)	VOLUME (L)	(sec)	GAS METER (F)	GASO-METER (F)	(inH2O)	Vstd,m METER (Std.L)	Vstd,std STANDARD (Std.L)	(Std.L/M)	
10.00	193.000	202.000	9.00	27.000	8.796	1631	90	70	29.7	8.723	8.846	0.321	1.014
20.00	213.000	223.200	10.20	30.000	9.773	1158	95	69	29.7	9.797	9.848	0.508	1.005
30.00	245.000	256.000	11.00	32.500	10.588	912	96	71	29.7	10.546	10.628	0.694	1.008
40.00	282.000	295.000	13.00	38.000	12.379	804	99	71	29.7	12.397	12.427	0.925	1.002

Y,AVG = 1.007