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EMISSIONS TESTING REPORT 23033  
Text and Appendices

AIR QUALITY DIVISION

PERFORMED FOR:

VICINITY ENERGY  
Grand Rapids, Michigan

at the

Kent County Waste to Energy Facility  
Grand Rapids, Michigan  
Units 1 and 2 SDA Inlets and Stacks  
June 2023

by

TESTAR Engineering, PC  
5100 Unicon Drive, Suite 102  
Wake Forest, North Carolina 27587  
License Number C-3896  
919/957-9500

**PE CERTIFICATION  
REPORT 23033**

I hereby certify that I have personally examined and am familiar with the information submitted herein. Based upon my own knowledge and my inquiry of those individuals responsible for obtaining the information presented, the foregoing information is true, accurate and complete. I am aware that this information is being requested for the purpose of determining compliance with local, state, and federal laws and may be submitted to appropriate governmental regulatory agencies for those purposes. I am aware that there are significant penalties for submitting false information to such agencies, including the possibility of fine and imprisonment.

Signature



Date:

7/31/23

Gary L. Williams, PE  
Director

Professional Engineer, State of North Carolina

Seal Number 025432



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## 1.0 INTRODUCTION

### 1.1 General

Vicinity Energy (Vicinity Energy) operates the Kent County Waste-to-Energy Facility in Grand Rapids, Michigan. Vicinity Energy contracted TESTAR Engineering, PC to conduct an air emissions testing program to quantify specific emissions from Units 1 and 2 for determining compliance status. The testing program was conducted between June 20 and 22, 2023 by TESTAR Engineering, PC under the supervision of Ms. Rachael Underwood of Vicinity Energy

### 1.2 Test Personnel

Table 1-1 presents the personnel that were involved in the testing program.

**Table 1-1  
 Test Personnel**

Affiliation	Personnel Responsibility
Vicinity Energy	Rachael Underwood Test Coordinator
Michigan EGLE; Air Quality Division	Jeremy Howe Test Observer
	Trevor Drost Test Observer
TESTAR Engineering, PC	Herbert T. Dixon, Jr., PE Project Director
	Jeff Aims Field Laboratory Manager
	Forrest Peed Field Laboratory Technician
	Joe Daley Test Engineer
	Matt Warner Test Engineer
	Jorge Vazquez Test Engineer
	Raul Benetti Test Engineer
	Charles Nahrebecki CEM Test Engineer

### 1.3 Test Parameters and Run Numbers

Tables 1-2 and 1-3 present the sampling locations, sampling methods, flue gas parameters, test dates, test times, and run numbers for Units 1 and 2, respectively. Table 1-4 presents the sampling locations, sampling methods, flue gas parameters, test dates, test times, and run numbers for the Ash Handling System. Table 1-5 presents the Utilization of EPA Methods 2 and 3 Data.

**Table 1-2  
Unit 1 Test Sequence**

Test Location	Sampling Method	Flue Gas Parameter	Test Date	Test Time	Run Number
Unit 1 SDA Inlet	EPA MM26	Hydrogen Chloride	06/20/23	0837-0937	1-I-MM26-1
			06/20/23	1011-1111	1-I-MM26-2
			06/20/23	1140-1240	1-I-MM26-3
Unit 1 Stack	EPA M23	Dioxins/Furans	06/21/23	0810-1230	1-S-M23-1
			06/21/23	1254-1711	1-S-M23-2
			06/22/23	0809-1224	1-S-M23-3
	SW846 M0061	Hexavalent Chromium	06/20/23	0836-1047	1-S-M0061-1
			06/20/23	1139-1349	1-S-M0061-2
			06/20/23	1421-1641	1-S-M0061-3
	EPA MM26	Hydrogen Chloride	06/20/23	0837-0937	1-S-MM26-1
			06/20/23	1011-1111	1-S-MM26-2
			06/20/23	1140-1240	1-S-MM26-3
	EPA M29	Particulate and Metals	06/20/23	0836-1047	1-S-M29-1
			06/20/23	1139-1349	1-S-M29-2
			06/20/23	1421-1641	1-S-M29-3
	EPA M8	Sulfuric Acid Mist	06/21/23	1048-1201	1-S-M8-1
			06/21/23	1534-1642	1-S-M8-2
			06/22/23	1048-1155	1-S-M8-3
EPA M13B	Total Fluorides and Hexavalent Chromium	06/21/23	0811-1018	1-S-M13B/425-1	
		06/21/23	1255-1503	1-S-M13B/425-2	
		06/22/23	0810-1018	1-S-M13B/425-3	
EPA M25A	Total Hydrocarbons	06/21/23	0817-0945	1-S-M25A-1	
		06/21/23	0955-1119	1-S-M25A-2	
		06/21/23	1129-1317	1-S-M25A-3	
Facility CEMS	SO <sub>2</sub> , NO <sub>x</sub> , and CO	06/20/23	various	1-S-CEM-1	
Facility COMS	Opacity	06/20/23	0900-1000	1-S-COM-1	
		06/20/23	1200-1300	1-S-COM-2	
		06/20/23	1500-1600	1-S-COM-3	

Table 1-3  
 Unit 2 Test Sequence

Test Location	Sampling Method	Flue Gas Parameter	Test Date	Test Time	Run Number
Unit 2 SDA Inlet	EPA MM26	Hydrogen Chloride	06/21/23	0827-0943	2-I-MM26-1
			06/21/23	1012-1112	2-I-MM26-2
			06/21/23	1158-1258	2-I-MM26-3
Unit 2 Stack	EPA MM26	Hydrogen Chloride	06/21/23	0827-0943	2-S-MM26-1
			06/21/23	1012-1112	2-S-MM26-2
			06/21/23	1158-1258	2-S-MM26-3
	EPA M29	Particulate and Metals	06/21/23	0826-1055	2-S-M29-1
			06/21/23	1157-1423	2-S-M29-2
			06/21/23	1442-1733	2-S-M29-3
	Facility CEMS	SO2, NOx, and CO	06/21/23	various	2-S-CEM-1
	Facility COMS	Opacity	06/21/23	0900-1000	2-S-COM-1
			06/21/23	1200-1300	2-S-COM-2
		06/21/23	1500-1600	2-S-COM-3	

Table 1-4  
Ash System Test Sequence

Test Location	Sampling Method	Flue Gas Parameter	Test Date	Test Time	Run Number
Ash System	EPA M22	Fugitive Emissions	06/21/23	0903-1014	M22-1
			06/21/23	1400-1511	M22-2
			06/22/23	0820-0930	M22-3
			06/22/23	1305-1415	M22-4

Table 1-5  
Utilization of EPA Method 2 and 3 Data

Runs Requiring Additional Information	Runs Providing Air Flow Rate Data	Runs Providing Flue Gas Composition Data
1-S-MM26-1	1-S-M29-1	1-S-M29-1
1-S-MM26-2	1-S-M29-1	1-S-M29-1
1-S-MM26-3	1-S-M29-2	1-S-M29-2
1-S-M0061-1	NA	1-S-M29-1
1-S-M0061-2	NA	1-S-M29-2
1-S-M0061-3	NA	1-S-M29-3
1-S-M13B/425-1	NA	1-S-M23-1
1-S-M13B/425-2	NA	1-S-M23-2
1-S-M13B/425-3	NA	1-S-M23-3
1-S-M8-1	NA	1-S-M23-1
1-S-M8-2	NA	1-S-M23-2
1-S-M8-3	NA	1-S-M23-3
1-S-M25A-1,2,3	1-S-M23-1	NA
1-S-M25A-4,5,6	1-S-M23-1	NA
1-S-M25A-7,8,9	1-S-M23-1,2	NA
2-S-MM26-1	2-S-M29-1	2-S-M29-1
2-S-MM26-2	2-S-M29-1	2-S-M29-1
2-S-MM26-3	2-S-M29-2	2-S-M29-2

## 2.0 SUMMARY OF RESULTS

### 2.1 Report Organization

The results of the testing project are summarized in Section 2. The process tested is discussed in Section 3. The sampling and analytical methods utilized are discussed in Section 4 while the Quality Assurance/Quality Control results are presented in Section 5. Appendix A contains detailed results of the testing program. Appendix B contains the field data that was collected and Appendix C contains the analytical results. Appendix D contains all pertinent testing equipment calibration data. Refer to the Table of Contents and the List of Tables and Figures for a complete reference with appropriate page numbers.

### 2.2 Presentation of Results

Table 2-1 presents the results of the emissions testing project for Unit 1. Table 2-2 presents the results of the emissions testing project for Unit 2. A more detailed summary of the sampling gas parameters is presented in Appendix A.

### 2.3 Fugitive Emissions Results

Fugitive emissions testing was conducted on the ash handling system that transports bottom and flyash from units 1 and 2. No visible fugitive emissions were observed during any test runs. No results are presented in this section or in Appendix A because all values were zero. The field data sheets are located in Appendix B.

### 2.4 Facility COM Data

Continuous Opacity Monitoring (COM) data for opacity was provided by the facility as per 40CFR 60.11 (e) (5). This data is contained in Appendix B.

### 2.5 Dioxins/Furans Results and EMPC Values

In accordance with EPA Method 23, Section 9.9, all dioxins/furans results that were below the minimum detection limit (ND) were treated as zero when averaging or totaling the results. All dioxins/furans results that were an estimated maximum possible concentration (EMPC) are presented using the EMPC value as a positive catch when calculating the results.

Table 2-1  
Summary of Emissions, Unit 1 Annual Compliance Testing

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit
<b>SDA Inlet Concentrations @ 7% O<sub>2</sub></b>					
Hydrogen Chloride, ppmvd	564	629	475	556	NA
<b>Stack Emissions Rates, lb/hr</b>					
Carbon Monoxide – 1 hour	1.41	1.41	1.41	1.41	26.05
Carbon Monoxide – 8 hour	0.71	0.71	0.00	0.47	6.51
Dioxins/Furans, '85 USEPA TEF	1.14E-09	1.11E-08	1.02E-09	4.43E-09	3.38E-07
Hexavalent Chromium (M0061)	<8.48E-06	<8.81E-06	<7.48E-06	<8.26E-06	4.69E-04
Hexavalent Chromium (M425)	7.07E-05	6.58E-05	7.20E-05	6.95E-05	4.69E-04
Hydrogen Chloride	1.43	1.54	1.10	1.36	8.55
<b>Metals</b>					
Arsenic	3.13E-05	3.99E-05	6.64E-05	4.59E-05	7.0E-04
Beryllium	<3.58E-06	<4.70E-06	<4.61E-06	<4.30E-06	1.83E-05
Cadmium	9.03E-05	1.32E-04	9.41E-05	1.05E-04	4.17E-03
Chromium	3.11E-04	2.41E-04	3.77E-04	3.10E-04	NA
Lead	0.00104	0.00166	0.00188	0.00153	0.10
Mercury	0.0000683	0.0000769	0.0000603	0.0000685	0.07
Nitrogen Oxides – 1 hour	38.0	35.2	38.3	37.2	86
Nitrogen Oxides – 3 hour	36.8	36.7	38.8	37.4	75.25
Particulate	0.9317	1.776	1.671	1.459	2.6
Sulfur Dioxide – 8 hour	1.62	1.62	2.16	1.80	15
Sulfuric Acid Mist (IC)	0.00923	< 0.00244	< 0.00532	< 0.00566	4.4
Total Fluorides as HF	<0.00999	<0.01020	<0.01009	<0.01009	0.28
Total Hydrocarbons as CH <sub>4</sub>	0.243	0.209	0.202	0.218	0.94
<b>Stack Concentrations @ 7% O<sub>2</sub></b>					
Dioxins/Furans, ng/DSCM, 85TEF	0.00820	0.0853	0.00839	0.0340	3.0
Hexavalent Chromium, ug/DSCM	<0.0682	<0.0680	<0.0625	<0.0662	4.2
Hydrogen Chloride, ppmvd	7.46	8.01	5.79	7.08	29
<b>Metals</b>					
Arsenic, ug/DSCM	0.247	0.319	0.541	0.369	6.2
Beryllium, ug/DSCM	< 0.0283	< 0.0376	< 0.0376	< 0.0345	0.16
Cadmium, ug/DSCM	0.712	1.056	0.767	0.845	37
Chromium, ug/DSCM	2.45	1.93	3.07	2.48	NA
Lead, mg/DSCM	0.00818	0.0133	0.0153	0.0123	0.87
Mercury, mg/DSCM	0.000539	0.000615	0.000492	0.000549	0.61
Opacity by Facility COMS, %	0	0	0	0	10
Particulate, gr/DSCF	0.00321	0.00621	0.00595	0.00512	0.010
Sulfuric Acid Mist, mg/DSCM (IC)	0.0676	< 0.0197	< 0.0468	< 0.0447	39
Total Fluorides as HF, mg/DSCM	<0.0712	<0.0791	<0.0851	<0.0785	2.5
THC as CH <sub>4</sub> , mg/DSCM	1.92	1.71	1.60	1.74	8.3
<b>Stack Concentrations, ppmvd @ 7% O<sub>2</sub></b>					
Carbon Monoxide – 1 hour	10	10	10	10	200
Carbon Monoxide – 4 hour	9	2	0	4	100
Carbon Monoxide – 8 hour	6	6	1	4	50
Nitrogen Oxides – 1 hour	170	158	170	166	400
Nitrogen Oxides – 3 hour	166	164	170	167	350
Nitrogen Oxides – 24 hour	167	---	---	167	205
Sulfur Dioxide – 8 hour	5	5	7	6	50
Sulfur Dioxide – 24 hour	5	---	---	5	29
<b>Removal Efficiency, %</b>					
HCl Removal Efficiency, ppmvd	98.7	98.7	98.8	98.7	≥ 95%
Sulfur Dioxide – 8 hour, ppmvd	92.3	87.0	80.9	86.7	≥ 75%

**Table 2-2  
 Summary of Emissions  
 Unit 1 Subpart Cb Testing**

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit Limit
<b>SDA Inlet Concentrations @ 7% O<sub>2</sub></b>					
Hydrogen Chloride, ppmvd	564	629	475	556	NA
<b>Stack Concentrations @ 7% O<sub>2</sub></b>					
Cadmium, ug/DSCM	0.712	1.056	0.767	0.845	35
Dioxins/Furans, ng/DSCM	0.473	4.77	0.561	1.93	30
Hydrogen Chloride, ppmvd	7.46	8.01	5.79	7.08	29
Lead, mg/DSCM	0.00818	0.0133	0.0153	0.0123	0.40
Mercury, mg/DSCM	0.000539	0.000615	0.000492	0.000549	0.050
Particulate, mg/DSCM	7.35	14.2	13.6	11.7	25
<b>Removal Efficiency%, @ 7% O<sub>2</sub></b>					
HCl Removal Efficiency, ppmvd	98.7	98.7	98.8	98.7	≥ 95%

Table 2-3  
Summary of Emissions, Unit 2 Annual Compliance Testing

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit
<b>SDA Inlet Concentrations @ 7% O<sub>2</sub></b>					
Hydrogen Chloride, ppmvd	805	856	776	812	NA
<b>Stack Emissions Rates, lb/hr</b>					
Carbon Monoxide – 1 hour	1.35	1.16	0.19	0.90	26.05
Carbon Monoxide – 8 hour	1.34	0.77	0.56	0.89	6.51
Hydrogen Chloride	1.98	3.96	2.20	2.72	8.55
<b>Metals</b>					
Cadmium	4.10E-05	3.89E-05	3.06E-05	3.68E-05	4.17E-03
Lead	0.000615	0.000778	0.000506	0.000633	0.10
Mercury	0.000103	0.000127	0.000194	0.000141	0.07
Nitrogen Oxides – 1 hour	35.2	38.7	39.0	37.7	86
Nitrogen Oxides – 3 hour	39.7	41.1	40.9	40.6	75.25
Particulate	0.4217	0.4171	0.0819	0.3069	2.6
Sulfur Dioxide – 8 hour	0.00	0.44	0.86	0.43	15
<b>Stack Concentrations @ 7% O<sub>2</sub></b>					
Hydrogen Chloride, ppmvd	11.4	22.8	13.1	15.8	29
<b>Metals</b>					
Cadmium, ug/DSCM	0.358	0.350	0.277	0.328	37
Lead, mg/DSCM	0.00536	0.00701	0.00458	0.00565	0.87
Mercury, mg/DSCM	0.000895	0.00114	0.00175	0.00126	0.61
Opacity by Facility COMS, %	1	1	1	1	10
Particulate, gr/DSCF	0.00161	0.00164	0.000324	0.00119	0.010
<b>Stack Concentrations, ppmvd @ 7% O<sub>2</sub></b>					
Carbon Monoxide – 1 hour	10	8	1	6	200
Carbon Monoxide – 4 hour	5	5	4	5	100
Carbon Monoxide – 8 hour	10	5	4	6	50
Nitrogen Oxides – 1 hour	159	170	174	168	400
Nitrogen Oxides – 3 hour	176	177	175	176	350
Nitrogen Oxides – 24 hour	178	---	---	178	205
Sulfur Dioxide – 8 hour	0	1	2	1	50
Sulfur Dioxide – 24 hour	1	---	---	1	29
<b>Removal Efficiency, %</b>					
HCl Removal Efficiency, ppmvd	98.6	97.3	98.3	98.1	≥ 95%
Sulfur Dioxide – 8 hour, ppmvd	98.7	97.7	92.4	96.3	≥ 75%

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Table 2-4  
 Summary of Emissions  
 Unit 2 Subpart Cb Testing

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit Limit
<b>SDA Inlet Concentrations @ 7% O<sub>2</sub></b>					
Hydrogen Chloride, ppmvd	805	856	776	812	NA
<b>Stack Concentrations @ 7% O<sub>2</sub></b>					
Cadmium, ug/DSCM	0.358	0.350	0.277	0.328	35
Hydrogen Chloride, ppmvd	11.4	22.8	13.1	15.8	29
Lead, mg/DSCM	0.00536	0.00701	0.00458	0.00565	0.40
Mercury, mg/DSCM	0.000895	0.00114	0.00175	0.00126	0.050
Particulate, mg/DSCM	3.68	3.76	0.742	2.73	25
<b>Removal Efficiency%, @ 7% O<sub>2</sub></b>					
HCl Removal Efficiency, ppmvd	98.6	97.3	98.3	98.1	≥ 95%

Table 2-5  
Ash System Summary

Parameter	Rep. 1	Rep. 2	Rep. 3	Rep. 4	Average	Permit Limit
Ash System, Fugitive Emissions						
Fugitive Emissions, %	0	0	0	0	0	5 <sup>1</sup>

<sup>1</sup> Permit limit is 5% (12 minutes during a 240 minute test). Results presented as 'Average' is cumulative for four 60 minute test runs.

## **2.6 Total Hydrocarbon Results**

Methane samples were not collected and analyzed because the onsite real-time total hydrocarbon results were significantly below the permitted limit for total non-methane hydrocarbons. This procedure was approved by Ms. Rachael Underwood of Vicinity Energy and Michigan Department of Environment, Great Lakes and Energy (Mr. Terry Madden formerly with MDEQ) for previous testing programs. This report presents total hydrocarbons as carbon for comparison to the total non-methane hydrocarbons permit limit.

## **2.7 CEM Parameters**

The facility CEMS were utilized for the sulfur dioxide, nitrogen oxides, and carbon monoxide ppmvd concentrations. The facility data was provided in 1, 3, 4, 8, and 24 hour averages as necessary.

The facility CEMS were utilized for sulfur dioxide, nitrogen oxides, and carbon monoxide along with the air flow rate results from the three EPA Method 29 test runs to calculate 1, 3, and 8 hour emission rates averages in pounds per hour (lb/hr). This data is contained in Appendix B.

## **2.8 Metals Reagent Blank Corrections**

Chromium and lead were detected at low levels in the reagent blank. In accordance with EPA Method 29, Sections 12.6 and 12.7, the test run catch weights were corrected for the blank values.

## **2.9 Sulfuric Acid Mist Results**

The EPA Method 8 samples for sulfuric acid mist were analyzed using Ion Chromatography techniques rather than the Thorin titration as specified in EPA Method 8. This modification was approved by Mr. Matthew Karl of Michigan EGLE in an email dated June 23, 2020 for all future test programs. Ion chromatography is more accurate because it avoids interferences that are inherent in the titration procedure. Mr. Gary McAlister of the USEPA has stated his "technical opinion that analyzing EPA Method 8 samples for sulfuric acid mist by IC is as accurate as analyzing the samples by the Thorin titrations as specified in EPA Method 8".

## **2.10 Non-detected Values**

The results are presented using a worst-case scenario. All non-detected results were used as values for calculation purposes and the result is preceded by a "<" symbol. All non-detected results were used as a zero when calculating total catch weights for samples that had both a positive catch weight for one or more fractions and also non-detected fraction(s). When averaging across a

set of three test runs, non-detected results were treated as values. Any average result that includes a non-detected value includes a "<" symbol in front of the result.

### **2.11 Duplicate Analyses**

Run 2 for each unit was analyzed in duplicate for the metals of interest. All runs for mercury were analyzed in duplicate. All runs for HCl were analyzed in duplicate. The average of the duplicate analyses were used for reporting purposes.

### **3.0 PROCESS DESCRIPTION AND OPERATION**

The Kent County Waste-to-Energy Facility processes up to 625 tons of solid waste each day, generating up to 18 megawatts of electricity or up to 116,000 lbs per hour exported steam. The facility is operated by Vicinity Energy. Each of the two (2) Martin GmbH waterwall furnaces processes up to 312.5 tons of waste per day. Waste is combusted at furnace temperatures exceeding 1,800 degrees Fahrenheit and reduced to an inert ash residue. Before leaving the facility, combustion air is directed through technologically advanced air pollution control equipment consisting of spray dryer absorbers (SDA) and fabric filter baghouses. The effluent entering the equipment is treated by the carbon and ammonia injection systems.

## 4.0 SAMPLING AND ANALYTICAL METHODS

This section briefly describes the sampling and analytical procedures that were used and any deviations from the methods. Figure 4-1 depicts a cross-section of the SDA Inlet test locations. Figure 4-2 depicts a cross-section of the Stack test locations.

### 4.1 EPA Methods 1-4 – Air Flow Rate and Moisture

EPA Methods 1 through 4 were utilized in conjunction with each isokinetic test method. EPA Method 1 was used to determine the location of the sampling points. EPA Method 2 was used to measure the flue gas flow rate. EPA Method 3 was used to determine the flue gas molecular weight. EPA Method 4 was used to determine the flue gas moisture content. The information provided by these methods was used in determining isokinetics, parameter concentrations, and parameter emission rates.

### 4.2 EPA Method 8 – Sulfuric Acid Mist

Sulfuric acid mist concentrations and emission rates were determined utilizing EPA Method 8. The EPA Method 8 sampling train consisted of a glass nozzle, a heated glass probe, a heated glass mat filter, one chilled impinger with 100mL of 80% IPA, an unheated glass mat filter, two chilled impingers each with 100mL of 3% H<sub>2</sub>O<sub>2</sub>, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 8 with no exceptions. By placing the heated filter prior to the first (IPA) impinger, the sulfuric acid mist can be separated from the sulfur trioxide in accordance with the permit which is for sulfuric acid mist only.

At the end of each test run, the contents of the IPA impinger were poured back into the original IPA reagent jar. The contents of the H<sub>2</sub>O<sub>2</sub> impingers were poured back into the original H<sub>2</sub>O<sub>2</sub> reagent jar. The silica gel was returned to its original container. The moisture catch in the components was then determined gravimetrically. The nozzle, probe, and filter fronthalf were rinsed with IPA into a sample jar. The heated filter was placed into this sample jar. The filter backhalf, IPA impinger, fronthalf of the second filter, connecting glassware, and the second filter itself were rinsed with DI water into the IPA reagent jar. The backhalf of the second filter, the H<sub>2</sub>O<sub>2</sub> impingers, and connecting glassware were rinsed with DI water into the H<sub>2</sub>O<sub>2</sub> reagent jar.

The fronthalf portion (nozzle, probe, and filter fronthalf rinse and the heated filter) of the samples was analyzed in accordance with EPA Method 8 for sulfate as sulfuric acid mist using Ion Chromatography techniques.

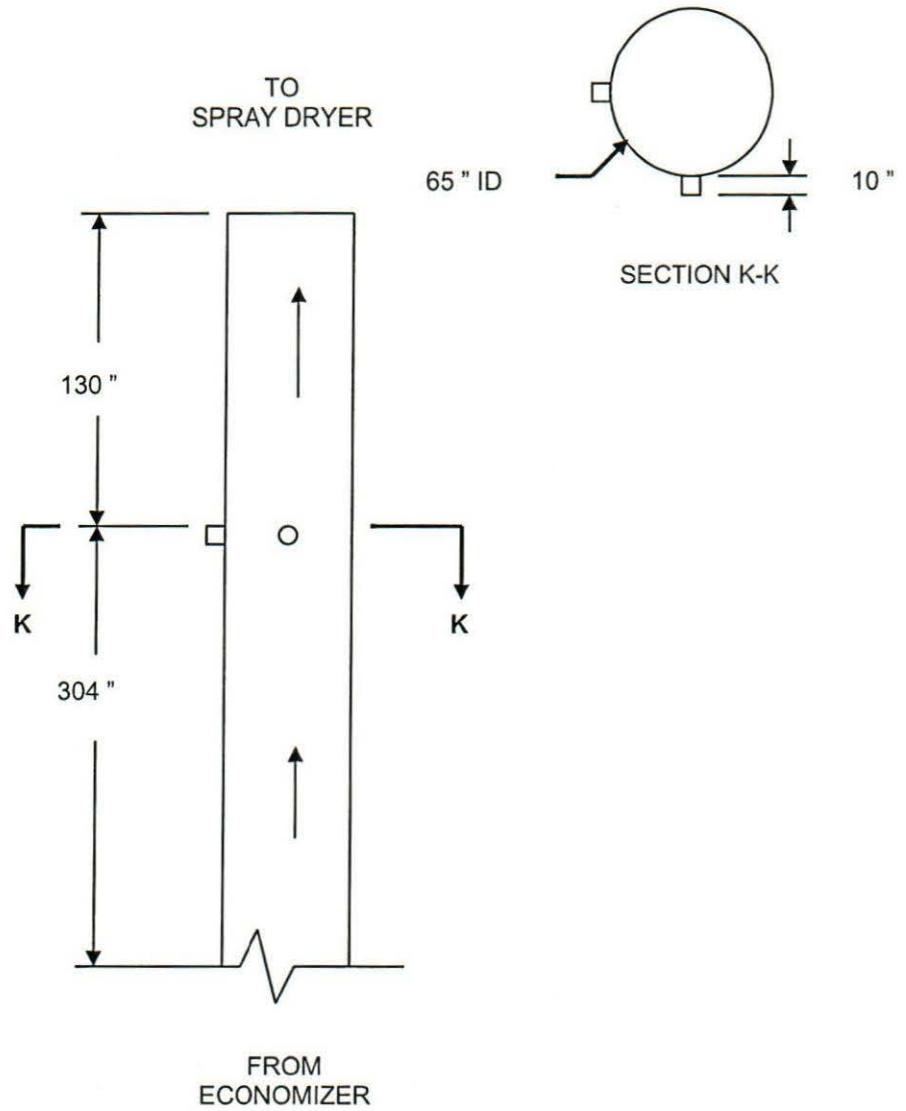


Figure 4-1. SDA Inlet Sampling Location  
(Units 1 & 2 are identical)

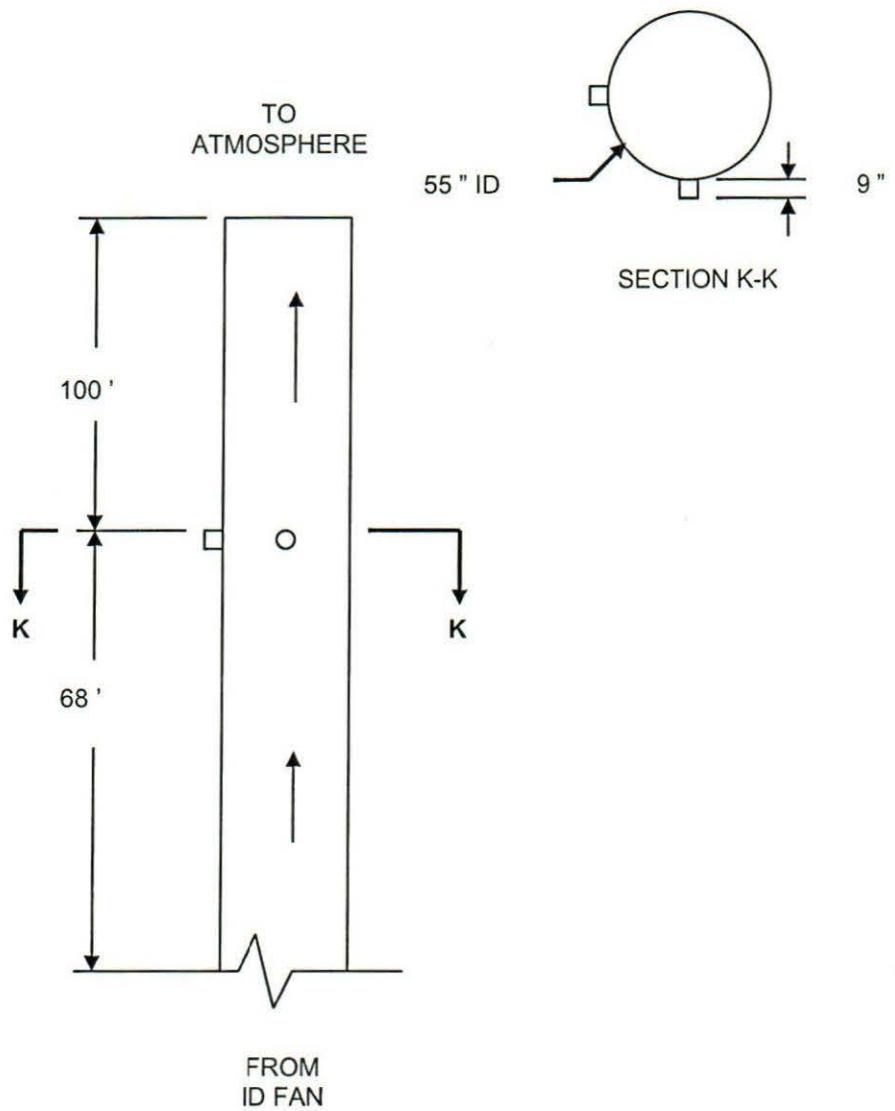


Figure 4-2. Stack Sampling Location  
(Units 1 & 2 are identical)

#### **4.3 EPA Method 13B/CARB Method 425 – Total Fluorides/Hexavalent Chromium**

Total fluorides as hydrogen fluoride and hexavalent chromium concentrations and emission rates were determined utilizing a combined EPA Method 13B and CARB Method 425 sampling train. The sampling train consisted of a glass nozzle, a heated glass probe, a heated Whatman 541 filter, two chilled impingers each with 100mL of 0.5N NaOH, an empty impinger, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 13B and CARB Method 425 with no exceptions.

At the end of each test run, the contents of the first three impingers were poured back into the original reagent jar. The moisture catch was then determined gravimetrically. The nozzle, probe, filter holder, impingers, and connecting glassware were rinsed with DI into the sample jar. The filter was placed into the sample jar.

The samples were analyzed in accordance with EPA Method 13B for total fluorides as hydrogen fluoride. The samples were analyzed in accordance with CARB Method 425 for hexavalent chromium.

#### **4.4 EPA Method 22 – Fugitive Emissions**

The accumulated emissions time of fugitive emissions was determined by observing the process area(s) during normal operations for a pre-determined observation period (one hour). This method does not require that the opacity of emissions be determined, but rather the length of time that any fugitive emissions are visible. Fugitive emissions include emissions that escape capture by exhaust hoods, that are emitted during material transfer, that are emitted from buildings housing material processing or handling equipment, or that are emitted directly from process equipment. If any fugitive emissions are observed during the observation period, the length of time that the emissions are visible is quantified using a stopwatch. This total accumulated time of fugitive emissions is then used to determine compliance with the subpart or permit.

#### **4.5 EPA Method 23/Alternate Method 052 – Dioxins/Furans**

The concentrations and emissions rates of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDD/PCDF or dioxins/furans) were determined utilizing EPA 23. The EPA Method 23 sampling train consisted of a glass nozzle, a heated glass probe, a heated glassmat filter, a condenser, an XAD resin trap, an empty impinger, two chilled impingers each with 100mL of DI water, an empty impinger, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 23 with no exceptions except that methylene chloride was not used during sample recovery.

At the end of each test run, the nozzle, probe, and filter fronthalf were rinsed with acetone into a sample jar. The filter was recovered dry into a glass petri dish. The filter backhalf, and condenser were rinsed with acetone into a sample jar. All of the components listed above up to the XAD resin trap were rinsed again with toluene into a sample jar. The XAD resin trap was sealed and placed into a chilled ice chest. The contents of the first three impingers were poured back into the original reagent jar. The silica gel was poured back into its original container. The moisture catch was then determined gravimetrically.

The samples were analyzed in accordance with EPA Method 23 for dioxins/furans.

#### **4.6 EPA Methods 3A and 25A – Total Hydrocarbons**

Oxygen and total hydrocarbon concentrations were determined utilizing a continuous emissions monitoring (CEM) system as per EPA Methods 3A and 25A. This section presents the sample system description and operation. No deviations from EPA Methods were performed.

The CEM system consisted of an in stack probe, heated out of stack filter, heated transfer lines, condenser, unheated Teflon sample lines, sample pump, distribution manifold board, analyzers, and calibration gases. All components of the sampling system that are in contact with the sample are constructed of Teflon, glass, or stainless steel (316). Flue gas was extracted from the source through a three-point stainless steel probe. Flue gas was then passed through a heated Teflon sample line to a tee where the sample was split. Part of the sample remained heated to the hydrocarbon analyzer while the remainder of the sample was diverted into a condenser. This filtering system removes interferences such as particulate and moisture. Conditioned flue gas was then transported via Teflon tubing to a Teflon lined sample pump, through a distribution manifold, and on to various analyzers. The heated out of stack filter, heated transfer lines, and heated Teflon sample lines were maintained above 250°F in accordance with EPA Method 25A, Sections 6.1 and 6.1.3. The Hydrocarbon Analyzer was maintained above 250°F per EPA Method 25A, Section 6.1.1.

The integrity of this sampling system was verified (as per EPA Methods) using EPA Protocol 1 calibration gases. The design of this sampling system allows the operator to introduce calibration gases at the outlet of the probe, prior to the heated out of stack filter (for the system bias check and calibration drift check), and directly into the analyzers (for linearity checks). The Hydrocarbon Analyzer calibration range was be 0 – 30 ppm propane and was calibrated with propane calibration gas values of approximately 10, 15, and 25 ppm. This range exceeded any peaks in emissions so that the peaks were accurately quantified.

For oxygen, a Servomex 1420B oxygen analyzer was utilized to measure the paramagnetic susceptibility of the sample gas by means of a magneto-dynamic type measuring cell. Oxygen is virtually unique in being a paramagnetic gas, this means that it is attracted into a magnetic field. In the Servomex measuring cell the oxygen concentration is detected by means of a dumb-bell mounted on a torque suspension in a strong, non-linear magnetic field. The higher the concentration of oxygen

the greater this dumb-bell is deflected from its rest position. This deflection is detected by an optical system and twin photo-cells connected to an amplifier. Around the dumb-bell is a coil of wire through which a current is passed to return the dumb-bell to its original position. The current is measured and is proportional to the oxygen concentration.

A CAI (California Analytical Instruments, Inc.) Model 300 HFID Heated Hydrocarbon Analyzer was utilized for Total Hydrocarbons. This model analyzer uses Flame Ionization Detection (FID) to determine the total hydrocarbon concentration (on a wet basis) within a gaseous sample. The analyzer has an adjustable heated oven which contains a heated pump and a burner in which a small flame is elevated and sustained by regulated flows of air and a mixture of hydrogen and helium. The burner jet is used as an electrode and is connected to the negative side of a precision power supply. An additional electrode, known as the 'collector', is connected to a high impedance, low noise electronic amplifier. The two electrodes establish an electrostatic field. When a gaseous sample is introduced to the burner, it is ionized in the flame and the electrostatic field causes the charged particles (ions) to migrate to their respective electrodes. The migration creates a small current between the electrodes. This current is measured by the precision electrometer amplified and is directly proportional to the hydrocarbon concentration of the sample.

#### **4.7 EPA Method 26 (Modified) –Hydrogen Chloride**

Hydrogen chloride concentrations and emission rates were determined utilizing EPA Method 26 modified to use large impingers. The EPA Method 26 sampling train consisted of a heated glass probe, a heated quartz filter, two chilled impingers each with 100mL of 0.1N H<sub>2</sub>SO<sub>4</sub>, one empty impinger, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 26 except that large impingers were used for sample collection.

At the end of each test run, the contents of the impingers were poured back into the original H<sub>2</sub>SO<sub>4</sub> reagent jar. The silica gel was returned to its original container. The moisture catch in the components was determined gravimetrically. The filter backhalf and impingers were rinsed with DI water into the H<sub>2</sub>SO<sub>4</sub> reagent jar.

The H<sub>2</sub>SO<sub>4</sub> portion of the samples were analyzed in accordance with EPA Method 26 for hydrogen chloride.

#### **4.8 EPA Method 29 – Particulate and Metals**

Particulate, mercury, and metals concentrations and emission rates were determined utilizing EPA Method 29. The EPA Method 29 sampling train consisted of a glass nozzle, a heated glass probe, a heated tared quartz filter, an empty impinger, two chilled impingers each with 100mL of 5%HNO<sub>3</sub>/10%H<sub>2</sub>O<sub>2</sub>, an empty impinger, two chilled impingers each with 100mL of

4%KMnO<sub>4</sub>/10%H<sub>2</sub>SO<sub>4</sub>, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 29 with no exceptions.

At the end of each test run, the nozzle, probe, and filter fronthalf were rinsed with 100 mL of acetone into a sample jar. The nozzle, probe, and filter fronthalf were rinsed again with 100 mL of 0.1N nitric acid into a sample jar. The filter was recovered dry into another sample jar. The contents of the 5%HNO<sub>3</sub>/10%H<sub>2</sub>O<sub>2</sub> impingers were poured back into the original reagent jar. Any condensate in the empty impinger was poured into a sample jar. The 4%KMnO<sub>4</sub>/10%H<sub>2</sub>SO<sub>4</sub> impingers were recovered into another sample jar. The moisture catch was then determined gravimetrically.

The filter backhalf and 5%HNO<sub>3</sub>/10%H<sub>2</sub>O<sub>2</sub> impingers were rinsed with 100 mL of 0.1N nitric acid into the reagent jar. The empty impinger was rinsed with 100 mL of 0.1N nitric acid into a sample jar. The 4%KMnO<sub>4</sub>/10%H<sub>2</sub>SO<sub>4</sub> impingers were rinsed with 100 mL of 4%KMnO<sub>4</sub>/10%H<sub>2</sub>SO<sub>4</sub> and 100 mL of DI water into the jar containing the 4%KMnO<sub>4</sub>/10%H<sub>2</sub>SO<sub>4</sub> reagent. The 4%KMnO<sub>4</sub>/10%H<sub>2</sub>SO<sub>4</sub> impingers and connecting glassware were rinsed with 25mL of 8N HCl if any brown residue remained. This HCl rinse was added to a jar containing 200mL of DI water.

The acetone rinse and filter were analyzed in accordance with EPA Method 29 for particulate. The samples were then analyzed for metals in accordance with EPA Method 29 with the fronthalf and backhalf combined for one analysis per test run. Analytical method SW846 6020 (ICP-MS) was used for all metals except mercury and SW846 Method 7470A was utilized for mercury analyses. In accordance with EPA Method 29, Sections 12.6 and 12.7, the test run catch weights were corrected for the blank values.

#### **4.9 SW846 Method 0061 – Hexavalent Chromium**

Hexavalent chromium concentrations and emission rates were determined utilizing SW846 Method 0061. The sampling train consisted of a glass nozzle, an aspirating union, a Teflon probe, a chilled Teflon impinger with 150 mL of 0.5N KOH, a recirculating pump, two chilled Teflon impingers each with 75 mL of 0.5N KOH, an empty Teflon impinger, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with SW846 Method 0061 with no exceptions. Impinger reagent from the first impinger was continuously recirculated to the aspirating union during the test run.

After the test run, the impinger contents were purged for thirty minutes with nitrogen. The contents of the impingers were then poured back into the original reagent jar. The silica gel was poured back into its container. The moisture catch was then determined gravimetrically. The nozzle, probe, recirculation lines, and impingers were rinsed with DI water into the KOH reagent jar. The pH of the sample was measured and was above 8.5 for all runs. The sample was then pressure filtrated through a 0.45 micron acetate filter to remove insoluble matter. The entire sample train was rinsed three times with 0.1M HNO<sub>3</sub> into another sample bottle. The acetate filter from the filtration step was placed into a VOA vial.

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The sample will be analyzed using IC/PCR techniques within 14 days in accordance with the method. Hexavalent chromium catch weights will be corrected for the reagent blank concentration in accordance with SW846 Method 0061, Section 7.6.4.

## **5.0 QA/QC RESULTS**

### **5.1 QA/QC Policy Procedures**

TESTAR Engineering, PC is committed to adhering to Quality Assurance/Quality Control (QA/QC) procedures and objectives that meet or exceed the relevant EPA guidance. Our procedures include calibration of equipment as appropriate, proper glassware pre-cleaning to prevent contamination of samples, proper sample recovery, documented sample custody, blank samples, duplicate analyses, matrix spike recovery, and validated computer generated results. We also adhere to other method specific criteria such as maintaining isokinetic conditions during particulate type testing and posttest leak checks.

TESTAR Engineering uses oil manometers to determine velocity differential pressures thus eliminating potential errors from magnehelic gauges. The manometers are leveled and zeroed prior to taking any measurements. All equipment used onsite undergoes a pretest audit and operational check for accuracy. Dry gas meters are checked by using an orifice to determine the meter gamma. The audit gamma must be within 3% of the full test gamma for the meter to be acceptable. Likewise, all thermocouples are checked at ambient temperature versus an ASTM reference thermometer or a thermometer that has been checked against an ASTM reference thermometer. The reading must agree within 2°F. Additionally, the barometer is checked against a reference barometer prior to each project and must agree within 0.1" Hg.

After each testing project, the dry gas meter undergoes a posttest audit following the guidelines of Alternate Method 009. Alternate Method 009 utilizes a mathematical calculation to check the dry gas meter calibration factor (gamma) versus the full test calibration factor. The gamma must agree within  $\pm 5\%$  of the full test gamma.

### **5.2 Sample Custody and Preservation**

Proper sample custody and preservation techniques ensure that the samples collected and analyzed are the same, that the sample did not change in concentration prior to analysis, and that the sample was not tampered with prior to analysis. To ensure accurate results, TESTAR Engineering collects and transports samples in clean containers that are inert to the matrix enclosed, that will not contaminate the sample, and that prevent photochemical reactions when appropriate. All samples contain unique identifiers that include the client name, facility name, project number, collection date, unique run number, sample fraction, and matrix. Liquid levels are marked in order to determine if any leakage occurred during transport. Samples are accompanied by sample custody forms identifying the client, facility, project number, sample, fractions, collection date, etc. When custody is relinquished to the laboratory, the receiving sample custodian signs the form.

### **5.3 Sample Blanks, Duplicates, and Matrix Spikes**

Several types of blanks are utilized depending upon the project QA objectives. Typical blanks include field blanks, reagent blanks, and trip blanks. Blanks help to identify the source of contamination if contamination is suspected based upon the result validation procedure. Trip blanks are typically not analyzed unless the field blank shows significant contamination. Field blanks and reagent blanks are analyzed during most testing programs involving metals unless requested not to do so by the client. Field blanks are analyzed during most programs involving organics such as dioxins/furans.

Duplicates and matrix spikes are analyzed for projects involving metals testing. At least 10% of the samples are analyzed in duplicate for metals and at least one matrix spike is performed. All mercury analyses are performed in duplicate.

Breakthrough analyses are performed for projects involving organics utilizing adsorbent tubes. Adsorbent tubes are desorbed and analyzed separately to determine if any breakthrough occurred. Breakthrough is said to have occurred if the organic catch weight on the last fraction (generally the backhalf of the last adsorbent tube) is more than 10% of the total train organic catch.

### **5.4 Data Validation and Presentation**

The field test engineer is responsible for reviewing and validating data as it is obtained. Additionally the onsite project manager reviews data for consistency, completeness, and accuracy prior to leaving the site. This validation procedure is based upon their knowledge of the process being tested and/or similar sources as well as checks built into the software being utilized. This allows for error correction or for the testing to be repeated immediately rather than at a later undetermined date. The data undergoes another review by a Project Director upon return to headquarters. Analytical data is reviewed by the QA Director upon submittal by the analytical laboratory to resolve any conflicts or concerns as soon as possible rather than after the results have been calculated.

Data is collected using computerized spreadsheets in the field and the results are calculated using validated computer programs to prevent erroneous calculations.

### **5.5 QA/QC Results**

This section presents QA/QC results from measures taken during the testing program. The results are summarized in the following tables for easy reference.

Table 5-1  
Summary of QA/QC Procedures

Test Method	QA/QC Procedure	QA/QC Objective	QA/QC Results	Status of QA/QC
EPA M8 - IC	Reagent Blank	NA	0.028 mg	Acceptable
	H2SO4 In-House Audit	≤ 10 %	2.27 %	Acceptable
	H2SO4 Matrix Spike	90 – 110 %	98.5 %	Acceptable
EPA M13B	Filter in DI Blank – HF	ND	< 0.105 ug	Acceptable
	Duplicate RPD	≤ 10 %	NA (all ND)	Acceptable
	Spike Recovery	90 – 110 %	92 %	Acceptable
CARB M425	NaOH Blank – Cr+6	ND	0.775 ug	Acceptable
	DI Blank – Cr+6	ND	< 0.020 ug	Acceptable
	Duplicate RPD	≤ 10 %	0.5 %	Acceptable
	Spike Recovery	90 – 110 %	105 %	Acceptable
EPA M23	Internal Standard Recoveries (4-6)	40 – 130 %	79.4 – 102 %	Acceptable
	Internal Standard Recoveries (7-8)	25 – 130 %	62.3 – 104 %	Acceptable
	Surrogate Standard Recoveries	70 – 130 %	78.5 – 111 %	Acceptable
EPA MM26	HCl Reagent Blank	ND	< 0.080 mg	Acceptable
	HCl In-House Audit	< 10%	2.37 %	Acceptable
	HCl Matrix Spike	90 – 110 %	100.1 %	Acceptable
EPA M29	Acetone Blank	< 1.0E-05 mg/mg	2.11E-06 mg/mg	Acceptable
EPA M29	Duplicate RPD	≤ 10 %	0 – 2.4 %	Acceptable
Arsenic	Reagent Blank	NA	< 0.2 ug	Acceptable
Beryllium	Reagent Blank	NA	< 0.05 ug	Acceptable
Cadmium	Reagent Blank	NA	< 0.2 ug	Acceptable
Chromium	Reagent Blank	NA	1.70 ug	Acceptable, blank correction
Lead	Reagent Blank	NA	0.231 ug	Acceptable, blank correction
Metals	Spike Recoveries	75 – 125 %	62 – 106 %	Acceptable <sup>1</sup>
Mercury	Reagent Blank	NA	< 0.5 ug	Acceptable
Mercury	Duplicate Injection RPD	≤ 10 %	0 – 4.6 %	Acceptable
Mercury	Duplicate Analysis RPD	≤ 20 %	0 – 18.8 %	Acceptable
Mercury	Spike Recoveries	75 – 125 %	69 – 112 %	Acceptable <sup>1</sup>
SW846 M0061	KOH Reagent Blank	NA	0.912 ug	Acceptable
	DI Reagent Blank	NA	< 0.015 ug	Acceptable
	Field Blank	NA	0.997 ug	Acceptable
	Duplicate RPD	< 10 %	< 2.7 %	Acceptable
	Spike Recovery	90 – 110 %	100 – 106 %	Acceptable

<sup>1</sup> The arsenic and beryllium spike recoveries were outside the laboratory guidelines of ±25% recovery at 62% and 69%. As per Reference Method 29, the sample was re-analyzed at a five-fold dilution resulting in an acceptable spike recoveries of 85% and 89%, indicating a matrix interference. Therefore, the arsenic and beryllium results are valid. The mercury spike recoveries were outside the laboratory guidelines of ±25% recovery at 72% and 69%. As per Reference Method 29, the sample was re-analyzed at a two-fold dilution resulting in an acceptable spike recoveries of 86%, indicating a matrix interference. Therefore, the mercury results are valid. Please refer to Appendix C.4 for further discussion.