FINAL REPORT

DETROIT RENEWABLE POWER

DETROIT, MICHIGAN

SHREDDER STACKS & ASH HANDLING BUILDING
2018 SOURCE TESTING PROGRAM

RWDI #1804672

November 30, 2018

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI AIR Inc. (RWDI) was retained by Detroit Renewable Power to conduct emission sampling on the Primary and Secondary Shredder (200 Line) exhaust stacks and the Ash Handling Building at their facility located at 5700 Russell Street, Detroit, Michigan. The test program was conducted in order to fulfill the requirements of the Michigan Department of Environmental Quality (MDEQ) Title V Renewable Operating Permit (ROP) # MI-ROP-M4148-2011a dated August 19, 2011.

The Sampling plan for this testing program was submitted August 2nd, 2018 to the Michigan Department of Environmental Quality (MDEQ). Approval for the testing program was granted by the MDEQ on September 13th, 2017. Testing was conducted on the 200L Primary and Secondary Shredder exhaust stacks October 2nd, 2018 and on the Ash Handling Building October 11, 2018. A copy of the MDEQ approval letter can be found in **Appendix B.**

The following table represents a summary of the stack testing results and compares the testing results to the limits set out in Detroit Renewable Power's Renewable Operating Permit.

Parameter	Stack Testing Results [1]			ROP Limit [1][3]
Limits from ROP: MI-ROP-M4148-2011a	**Primary Shredder**	**Secondary Shredder**	**Ash Handling Building**	
Particulate Matter (PM)	0.0024	0.0024	-	0.0028 lb/1000lb flue gas
Visible Emissions	0	0	➢ **Test 1:** 0 events ➢ **Test 2:** 0 events ➢ **Test 3:** 0 events	0

Notes:
[1] Concentration values are expressed at 101.3 kPa, 68 °F, and actual oxygen
[2] Refer to **Appendix A** for Renewable Operating Permit: MI-ROP-M4148-2011a

The results of the testing indicate that all parameters are in compliance with respect to the ROP limits. A summary of all testing results can be found in the **Tables** section of the report with detailed sampling results in the Appendices.

1 INTRODUCTION

RWDI AIR Inc. (RWDI) was retained by Detroit Renewable Power to conduct emission sampling on the 200L Primary and Secondary Shredder (EUMSWPPROC-LINE200) exhaust stacks and the Ash Handling Building (EUASH-HANDLING) at their facility located at 5700 Russell Street, Detroit, Michigan. The test program was conducted in order to fulfill the requirements of the Michigan Department of Environmental Quality (MDEQ) Title V Renewable Operating Permit (ROP) # MI-ROP-M4148-2011a dated August 19, 2011.

The Sampling Plan for this testing program was submitted August 2nd, 2018 to the Michigan Department of Environmental Quality (MDEQ). Approval for the testing program was granted by the MDEQ on September 13th, 2018. Testing was conducted on the 200L Primary and Secondary Shredder exhaust stack on October 2nd, 2018 and on the Ash Handling Building October 11th, 2018. A copy of the MDEQ approval letter can be found in **Appendix B.**

This stack testing study consisted of the following parameters:

- Total particulate matter (TPM);
- Velocity, flow rate and temperature; and
- Visible Emissions.

2 SOURCE DESCRIPTION

2.1 Facility Description

Detroit Renewable Power is a refuse-derived fuel (RDF) plant that began commercial operation in October 1991. The facility is permitted to receive up to 20,000 tons of municipal solid waste (MSW) per week. The MSW is processed into RDF, which is then combusted in the furnaces, producing a maximum 362,800 pounds of steam per hour per unit. The steam is used to generate up to 68 megawatts of electricity and supply export steam at a rate of up to 550,000 pounds per hour. The energy products are sold to DTE Corporation and Detroit Thermal.

2.2 Process Description- Shredder Building

The Waste processing lines (FGMSWPROC-Lines) have identical sampling ports located in 17-inch diameter stacks for the Primary Shredder baghouse and 45-inch diameter stacks for the Secondary Shredder baghouse. There are three (3) separate lines associated with this process equipment (EUMSWPROC-LINE1, EUMSWPROC-LINE2, and EUMSWPROC-LINE3). 200 Line (EUMSWPROC-LINE2) was tested for the primary and secondary exhaust system.

FGMSWPROC-LINES includes all activities from receipt of MSW in the facility, weighing, delivery of MSW into the MSW Process Building, unloading in the tipping floor area, MSW loading into RDF process conveyor lines, RDF processing, storage, loading into 2 boiler feed conveyor lines, and conveying RDF into the Power Block Building. Refuse Derived Fuel (RDF) processing starts from the loaders feeding MSW into 3 lines each consisting of a feed conveyor, magnetic separator, primary shredder (controlled by a baghouse fabric filter system), screens, secondary shredder (controlled by a cyclone and a baghouse fabric filter system) and conveyor feed into RDF storage room. Fugitive particulate in MSW Process Building are controlled by ventilation exhaust fans with vent filters.

2.3 Process Description- Ash Handling Building

EU-ASHSYSTEM refers to the ash handling system including removal grate siftings, bottom ash and fly ash from the boilers and air pollution control systems. Grate siftings and bottom ash from each boiler are discharged to a quench trough and then removed by submerged scrap conveyors (SSC). Fly ash from the tubular air heater hoppers, economizer hoppers and fabric filter hoppers, is discharged to drag-flight conveyors (DFC). The flyash is transported via the DFCs to a surge bin and from there to a flyash conditioning system (i.e., pugmill where only water is added to wet dry material). Wetted flyash from this system is discharged onto the bottom ash conveyors and transported to the ash/loadout storage building prior to off-site disposal. Fugitive particulate emissions from the ash/loadout building are controlled by a ventilation exhaust filter system.

3 SAMPLING LOCATION

3.1 Compliance Source Sample Location Description

The primary stack is 17 inch in diameter and has two sampling ports, 90 degrees apart and 6 inches in diameter. The sampling ports were located 14 duct diameters downstream from the ID fan and 42 duct diameters upstream before the stack outlet. The secondary stack is 45 inch in diameter and has two sampling ports, 90 degrees apart and 6 inches in diameter. The sampling ports were located 11 duct diameters downstream from the ID fan and 16 duct diameters upstream before the stack outlet.

Figure 3.1a: Diagram of Flow Disturbance Distance and Stack Diameters for EUMSWPROC-LINE2 (Primary Shredder Baghouse)

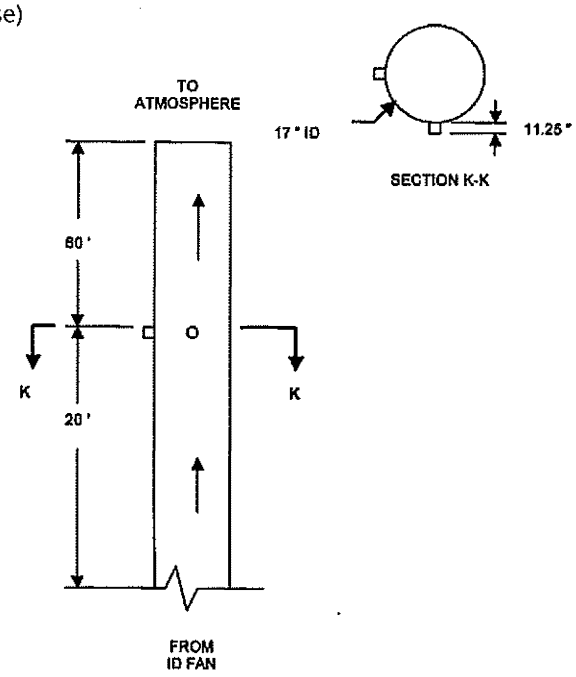
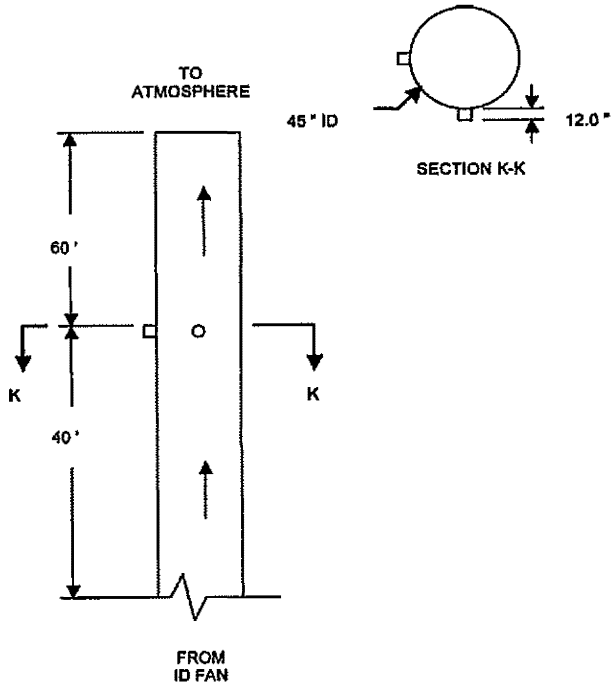


Figure 3.1b: Diagram of Flow Disturbance Distance and Stack Diameters for EUMSWPROC-LINE2 (Secondary Shredder Baghouse)



4 SAMPLING METHODOLOGY

The following section provides an overview of the sampling methodologies used in this program. **Table 1**, located in the **Tables** section, summarizes the testing parameters and corresponding methodologies.

4.1 Stack Velocity, Temperature, and Volumetric Flow Rate Determination

The exhaust velocities and flow rates were determined following the US EPA Method 2, "Determination of Stack Gas Velocity and Flow Rate (Type S Pitot Tube)". Velocity measurements were taken with a pre-calibrated S-Type pitot tube and incline manometer. Volumetric flow rates were determined following the equal area method as outlined in US EPA Method 2. Temperature measurements were made simultaneously with the velocity measurements and were conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in US EPA Method 3, "Determination of Molecular Weight of Dry Stack Gas". Stack moisture content was determined through direct condensation and according to US EPA Method 4, "Determination of Moisture Content of Stack Gas".

4.2 Sampling for Total Particulate Matter (TPM)

Particulate concentrations and emission rates were determined utilizing EPA Method 5. The EPA Method 5 sampling train consists of a nozzle, a heated glass probe, a heated, tared quartz filter, and two chilled impingers each with 100 mL 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 5 with the following exceptions:

- Due to the potential safety hazards involved in testing an RDF processing shredder stack (potentially explosive area); it was not possible to conduct testing isokinetically at all sampling points as per EPA Method 1.
- As completed in previous years, isokinetic sampling was conducted at one (1) sampling point which represents the average stack velocity measured prior to the start of the first sample run.

In order to complete this, the process line was turned off to allow testing personnel to enter the stack area; the sampling train was assembled (the sampling console (meterbox) and testing personnel were kept a safe distance from the sampling location; an umbilical was utilized to connect the console to the sampling train); a pre-selected nozzle (based on measured velocity data prior to the start of the first run) was attached to the sampling probe; a pre-test leak check was performed; the sampling probe as inserted into the point that represents the average velocity of the stack. Testing personnel then evacuated the stack area. Then the process line was turned back on. The stack velocity (ft/sec) at this selected single point, was checked to ensure it was within 20% of the average of the previous test, then sampling commenced (confirming that isokinetic sampling can be maintained). If the stack velocity was not within 20% of the average of the previous test, the process line would have been turned off and another sampling point selected.

At the conclusion of the test, the process line was turned off and a final leak check performed. Three (3) sampling runs were conducted in this manner. Collected sample volumes were greater than 40 cubic feet for the 200L Primary (EUMSWPROC-LINE2) and greater than 55 cubic feet for the 200L Secondary (EUMSWPROC-LINE2). The temperature of the filter and probe were monitored and controlled to 248°F +/- 25°F.

At the end of each test run, the nozzle, probe, and filter front half were rinsed with acetone into a sample jar. The filter was recovered dry into a sample jar. The moisture catch was then determined gravimetrically. The moisture catch in the silica gel was also determined gravimetrically. The samples were analyzed in accordance with EPA Method 5.

Method 5 notes that: *"In no case shall a blank value of greater than 0.001 percent of the weight of acetone used be subtracted from the sample weight."* Therefore, for the Primary and Secondary lines, the lowest acetone weight was used to determine the blank subtraction allowance for each of the set of samples. For the Primary Line, the lowest weight of acetone collected from the three (3) samples was 38.7grams (or 38,700 mg) as such, 0.387mg was subtracted from each of the three (3) sample weights as blank correction. For the Secondary Line, the lowest weight of acetone collected from the three (3) samples was 48.3grams (or 48,300 mg) as such, 0.483mg was subtracted from each of the three (3) sample weights as blank correction. Note that the blank correction values were well below the actual acetone blank value reported by the laboratory.

Samples were then packaged for transport to ALS Global Laboratories in Burlington, Ontario for analysis.

4.3 Sampling for Opacity

Visible emissions were determined in accordance with U.S. EPA Reference Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources". One (1) opacity test was taken during each particulate. For the opacity tests, readings were observed every 15 seconds for 30 continuous minutes. The opacity of emissions from stationary sources was determined by a certified observer.

4.4 Sampling for Visible Emissions- Ash Handling Building

The accumulated emissions time of fugitive emissions was determined by observing the process area(s) during normal operations for three, 1-hour time periods. The times included periods when ash is being transferred from the MWC unit to the storage area, and when ash is being loaded for disposal. 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 building 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 permit and Subpart Cb.

4.5 Quality Assurance/ Quality Control Activities

Applicable quality assurance measures were implemented during the sampling program to ensure the integrity of the results. These measures included detailed documentation of field data, equipment calibrations for all measured parameters, completion of Chain of Custody forms when submitting laboratory samples, and submission of field blank samples to the laboratories. **Table 2** presents a sample log and summarizes the sampling times, sample ID's, filter ID's.

Leak checks were performed on the Method 5 sampling train by plugging the sample inlet and pulling a representative vacuum. This check was done before and after each test. Similar leak check procedures for pitot tube and pressure lines were also conducted. Daily temperature sensor audits were completed by noting the ambient temperature, as measured by a reference thermometer, and comparing these values to those obtained from the stack sensor. Leak checks for each test were documented on the field data sheets presented in the applicable appendices for each sample parameter.

5 RESULTS

The average emission results for this study are presented in the **Tables** section of this report. **Table 2** presents a summary of test dates and times. A minimum of three (3) tests on the stack was performed for all of the parameters tested in the study. Detailed information regarding each test run can be found in the corresponding Appendix. Below is a summary of the applicable Table and Appendix ID with corresponding test parameter.

Parameter	Table	Appendix
Stack Gas Characteristics	3	C
Total Particulate Matter	4	C
Opacity	5	D
Visible Emissions- Ash Handling Building	6	H
ROP Limit Comparison	7	-

All calibration information for the equipment used for this study is included in **Appendix F**. All laboratory results are included in **Appendix G**.

5.1 Discussion of Results

Particulate measurement results for both the 200L Primary and Secondary (EUMSWPPROC-LINE200) indicate that the sources are in compliance with respect to the ROP limits.

There was no visible emission observed during any of the tests for the Ash Handling Building (EUASH-HANDLING).

When the laboratory reported values less than their method detection limit for a specific component, the respective concentration and emission rates were calculated using this reportable detection limit (RDL). This method is a conservative approach when calculating the emissions.

6 OPERATING CONDITIONS

Operating conditions during the sampling were monitored by Detroit Renewable Power personnel. All equipment was operated under normal maximum operating conditions.

Primary Processing:

Run 1 – Start: 10:12 | End: 11:12

Data	Unit	Run Start (0)	Stop (1)
Fabric Filter Differential Pressure	psig	2.3	2.28
Municipal Solid Waste Process Rate	ton/hr	40	40
Fabric Filter Exit Velocity	ft/sec	59.1	

Run 2 – Start: 13:12 | End: 14:12

Data	Unit	Run Start (0)	Stop (1)
Fabric Filter Differential Pressure	psig	2.28	2.30
Municipal Solid Waste Process Rate	ton/hr	40	40
Fabric Filter Exit Velocity	ft/sec	60.2	

Run 3 – Start: 15:15 | End: 16:15

Data	Unit	Run Start (0)	Stop (1)
Fabric Filter Differential Pressure	psig	2.30	2.30
Municipal Solid Waste Process Rate	ton/hr	40	40
Fabric Filter Exit Velocity	ft/sec	60.0	

Secondary Processing:

Run 1 – Start: 10:12 | End: 11:12

Data	Unit	Run Start (0)	Stop (1)
Fabric Filter Differential Pressure	psig	3.09	2.75
Municipal Solid Waste Process Rate	ton/hr	40	40
Fabric Filter Exit Velocity	ft/sec	47.9	

Run 2 – Start: 13:12 | End: 14:12

Data	Unit	Run Start (0)	Stop (1)
Fabric Filter Differential Pressure	psig	2.75	2.04
Municipal Solid Waste Process Rate	ton/hr	40	40
Fabric Filter Exit Velocity	ft/sec	46.9	

Run 3 – Start: 15:15 | End: 16:15

Data	Unit	Run Start (0)	Stop (1)
Fabric Filter Differential Pressure	psig	2.04	2.78
Municipal Solid Waste Process Rate	ton/hr	40	40
Fabric Filter Exit Velocity	ft/sec	46.6	

Radio contact was kept between the process operators and the sampling team. A member of the RWDI sampling team contacted the operator before each test, to ensure that the process was at normal operating conditions.

7 CONCLUSIONS

Testing was conducted on the 200L Primary and Secondary Shredder exhaust stacks (EUMSWPPROC-LINE200) October 2nd, 2018 and on the Ash Handling Building (EUASH-HANDLING) October 11, 2018. All sources were tested in accordance with referenced methodologies following the MDEQ approved Sampling Plan submitted August 2nd, 2018.

Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
Primary Shredder - 200L	3	Velocity, Temperature and Flow Rate	U.S. EPA [1] Methods 1-4
	3	Total Particulate Matter	U.S. EPA [1] Method 5
Secondary Shredder - 200L	3	Velocity, Temperature and Flow Rate	U.S. EPA [1] Methods 1-4
	3	Total Particulate Matter	U.S. EPA [1] Method 5
Ash Handling Building	3 - 1 hour periods	Visbile Emissions	U.S. EPA [1] Method 22

Notes:

[1] U.S. EPA - United States Environmental Protection Agency

Table 2: Sampling Summary and Sample Log

Source and Test #	Sampling Date	Start Time	End Time	Filter ID / Trap ID	Lab Sample ID
Primary Shredder - 200L	**Velocity / Total Particulate**				
Blank	2-Oct-18	-	-	-	L2184089-13/14
Test #1	2-Oct-18	10:12 AM	11:12 AM	QZ5717	L2184089-1/2
Test #2	2-Oct-18	1:12 PM	2:12 PM	QZ5722	L2184089-3/4
Test #3	2-Oct-18	3:15 PM	4:15 PM	QZ5719	L2184089-5/6
	Opacity				
Test #1	2-Oct-18			-	-
Test #2	2-Oct-18			-	-
Test #3	2-Oct-18			-	-
Secondary Shredder - 200L	**Velocity / Total Particulate**				
Blank	2-Oct-18	-	-	-	L2184089-13/14
Test #1	2-Oct-18	10:12 AM	11:12 AM	QZ5716	L2184089-7/8
Test #2	2-Oct-18	1:12 PM	2:12 PM	QZ5723	L2184089-9/10
Test #3	2-Oct-18	3:15 PM	4:15 PM	QZ5721	L2184089-11/13
	Opacity				
Test #1	2-Oct-18	10:20 AM	10:50 AM	-	-
Test #2	2-Oct-18	1:20 PM	1:50 PM	-	-
Test #3	2-Oct-18	3:30 PM	4:00 PM	-	-
Ash Handling Building	**Visible Emissions**				
Test #1	11-Oct-18	1:20 PM	2:20 PM	-	-
Test #2	11-Oct-18	2:20 PM	3:20 PM	-	-
Test #3	11-Oct-18	3:20 PM	4:20 PM	-	-

Table 3: Sampling Summary - Flow Characteristics

Stack Gas Parameter		Primary Shredder - 200L			Secondary Shredder - 200L		
		Test No. 1	Test No. 2	Test No. 3	Test No. 1	Test No. 2	Test No. 3
		TPM [1]	TPM [1]	TPM [1]	TPM [1]	TPM [1]	TPM [1]
Testing Date		**2-Oct-18**	**2-Oct-18**	**2-Oct-18**	**2-Oct-18**	**2-Oct-18**	**2-Oct-18**
Stack Temperature	°F	68	68	68	68	68	68
	°C	20	20	20	20	20	20
Moisture	%	2.2%	1.6%	2.2%	3.0%	2.1%	2.7%
Velocity	ft/s	57.02	55.67	54.84	46.17	46.41	47.36
	m/s	17.38	16.97	16.72	14.07	14.15	14.44
Actual Flow Rate	CFM	5,406	5,265	5,188	30,597	30,754	31,386
Referenced Flow Rate[2]	CFM	5,108	5,207	5,107	28,028	28,342	28,709
Sampling Isokinetic Rate	%	100	102	102	101	101	101

Notes:

[1] TPM = Sampling for total particulate matter and metals

[2] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

Detailed sampling results including individual test results can be found in Appendix C1 and C2

Table 4: Total Particulate Matter – Averaged Results

	Primary Shredder - 200L			Secondary Shredder - 200L		
	Concentration @ Actual O_2	Concentraion	Emission Rate	Concentration @ Actual O_2	Concentraion	Emission Rate
Parameter	**(gr/dscf)**	**(lbs/^{1000}lbs$_{flue\ gas}$)**	**(lbs/hr)**	**(gr/dscf)**	**(lbs/^{1000}lbs$_{flue\ gas}$)**	**(lbs/hr)**
Total Particulate Matter	< 0.0015	< 0.00273	< 0.06	< 0.0013	< 0.00238	< 0.30

Notes:

[1] Sampling followed U.S. EPA Method 5 (TPM)

[2] "<" When laboratory analysis was below the reportable detection limit, this detection limit was used to calculate the concentration and emission rate

Detailed sampling results including individual test results can be found in Appendix C1 and C2

Table 5: Opacity - Averaged Results

	Primary Shredder - 200L			Secondary Shredder - 200L		
Parameter	T1	T2	T3	T1	T2	T3
Opacity	0	0	0	0	0	0

Notes:

[1] Sampling followed Modified U.S. EPA Method 9 (Visual Opacity); Average of three tests

[2] Sampling results represent the max 6 minute average (% Opacity) during the observation period

Detailed sampling results including individual test results can be found in Appendix D

Table 6: Ash Handling Building – Visible Emissions Results

	Ash Handling Building		
	Test 1	Test 2	Test 3
Parameter	# of Observations	# of Observations	# of Observations
Observations of Visible Emisions	0	0	0

Detailed sampling results including individual test results can be found in Appendix G

Table 7: Permit Limit Comparisons

Parameter	Stack Testing Results [1]	Stack Testing Results [1]	Stack Testing Results [1]	ROP Limit [1]
Limits from ROP: MI-ROP-M4148-2011a	**Primary Shredder - 200L**	**Secondary Shredder - 200L**	**Ash Handling**	
Particulate Matter (PM)	<0.0024	<0.0024	-	0.0028 lbs/1000 $lbs_{flue\ gas}$
Observations of Visible Emissions	-	-	0	0

Notes:
[1] Refer to Appendix A for Renewable Operating Permit: MI-ROP-M4148-2011a