Supplemental BACT Analysis for NCRP-Lumberton PSD Application (revised 1/2/2019)

As requested by the North Carolina Division of Air Quality (DAQ), North Carolina Renewable Power (NCRP) is submitting this BACT analysis to supplement the PSD permit application that was submitted to DAQ in March 2017. More specifically, DAQ requested that NCRP submit a BACT analysis for the Poultry Litter Storage Warehouse and three Belt Dryers that were part of the original project for which the PSD application was submitted.

Poultry Litter Storage Warehouse (ES-16)

The Poultry Litter Storage Warehouse is a large enclosed building that houses poultry litter on site prior to combustion in one of the two boilers (ES-1A and ES-1B).

Emissions

The PSD pollutant emissions from the warehouse are expected to be minimal and will consist of particulate matter (PM, PM_{10}, and $PM_{2.5}$), volatile organic compounds (VOC), and nitrous oxide (N_2O). Calculations of the potential emissions are attached. As shown in the attachment, particulate matter emissions have been estimated using AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles, Table 13.2.4-1 (Crushed limestone), and Chapter 11.9 Western Surface Coal Mining, Table 11.9-1 (bulldozing - overburden). The N_2O emissions were estimated using emission factors presented in a document published in 2006 by Iowa State University entitled "Air Quality and Emissions from Livestock and Poultry Production/Waste Management Systems." There is no available data for VOC emissions and they are expected to be negligible. Below is a table summarizing the estimated emissions.

Summary of Emissions from Poultry Litter Storage Warehouse

Pollutant	Annual Emission Rate (ton/yr)
PM	0.080
PM_{10}	0.012
$PM_{2.5}$	0.008
VOC	Negligible
N_2O	0.14

BACT Analysis

Particulate Matter

As shown in the table above, the particulate emissions from the warehouse are expected to be very low. This is primarily due to the existence of the warehouse, as it shields the material handling from wind. Based on our emissions estimates, the warehouse will reduce PM emissions that would have occurred had the litter been stored outdoors by more than 90%. The remaining PM emissions are too low to warrant the cost of add-on controls. Therefore, NCRP proposes, as a work practice standard, that the storage and handling of the litter in the warehouse be deemed as BACT for particulate emissions from the Poultry Litter Storage Warehouse.

Volatile Organic Compounds

As mentioned in the previous section, VOC emissions are expected to be negligible. Add-on controls would be cost prohibitive and there are no known work practice standards for reducing VOC emissions from poultry litter storage. Therefore, NCRP proposes that "no controls" be deemed as BACT for VOC emissions from the Poultry Litter Warehouse.

Nitrous Oxide

Nitrous oxide is regulated as a greenhouse gas (GHG). Because the project was subject to PSD for GHG emissions, a BACT analysis of nitrous oxide is required. As shown in the table above, the N_2O emissions are expected to be only 0.13 ton/yr. Due to the low emission rate, it can be assumed that add-on controls would not be feasible. Therefore, NCRP proposes "no controls" as BACT for the N_2O emissions from the Poultry Litter Storage Warehouse.

Belt Dryers (ES-17, ES-18, ES-19)

The Belt Dryers consist of three tunnel dryers that remove some of the moisture in the wood chips prior to combustion in one of the boilers or, alternatively, shipment to other sites as a fuel product. Heat is provided by hot water from the boilers after the water has been through the turbine generator. This provides waste heat recovery and improves the combustion characteristics of the wood chips.

Emissions

The only PSD-related pollutant emitted from the belt dryers is VOC. VOC stack tests were performed on one of the belt dryers in August 2018. According to the results of the test, the potential VOC emissions would be 84.7 ton/yr if the dryer were operated at a feed rate (wet wood chips) of 30 ton/hr for 8760 hours per year. This corresponds to a product rate (dried wood chips) of approximately 20 ton/hr. NCRP does not anticipate operating the belt dryers at a rate higher than this. Additionally, the total air flow for all 8 of the stacks is 1,200,000 acfm. Also, as shown in the test report excerpt (attached), the VOC concentrations in the stacks were very low, ranging from 8.25 to 9.60 ppm by weight (about 2 – 3 ppm, by volume). An excerpt from the test report along with calculations supporting the above potential emission rate are attached.

BACT Analysis

The control technologies available for use on VOC sources consist of thermal oxidizers, regenerative thermal oxidizers (RTOs), and catalytic oxidizers. Based on USEPA's Air Pollution Control Technology Fact Sheet for thermal incinerators (EPA-452/F-03-022), "thermal incinerators (oxidizers) perform best at concentrations around 1500 to 3000 ppmv. Therefore, a thermal oxidizer would not be an appropriate control technology for the belt dryer exhaust, which is typically on 2 to 3 ppmv. Similarly, according to USEPA's Air Pollution Control Technology Fact Sheet for regenerative incinerators (EPA-452/F-03-021), RTOs "have been used effectively at inlet loadings as low as 100 ppmv or less." Therefore, an RTO would not be appropriate as a control technology for the belt dryers. Finally, according to USEPA's Air Pollution Control Technology Fact Sheet for catalytic incinerators (EPA-452/F-03-018), "typical gas flow rates for packaged catalytic incinerators are 0.33 to 24 sm^3/sec (700 to 50,000 scfm). The air flow from the belt dryer is approximately 1,200,000 acfm, so a catalytic oxidizer would not be appropriate for the belt dryer exhaust.

In addition to the considerations stated above, the belt dryer exhaust is typically only about 100 degrees F. Therefore, considerable fuel combustion would be required to raise the temperature to a level required to incinerate the VOCs (1400 to 1500 degrees F for thermal oxidizers and RTOs and 600 to 800 degrees F for catalytic oxidizers). The fuel combustion would produce additional pollutants, such as CO and NOx that are not currently present in the belt dryer exhaust.

Based on these considerations, add-on controls would not be technically feasible on the belt dryers. Additionally, there are no work practice standards that would have any appreciable effect on the emissions from the belt dryers. Therefore, NCRP proposes that “no controls” be deemed as BACT for these emission units. NCRP will operate the belt dryers in accordance with the manufacturer’s specifications.

EPS

ATTACHMENT 1
Poultry Litter Warehouse Potential Emissions

North Carolina Renewable Power - Lumberton, LLC
Poultry Litter Warehouse PM Emissions

PM Emissions Summary

	PM Emissions			PM10 Emissions			PM2.5 Emissions		
	PM Emissions without Warehouse (tpy)	PM Emissions with Warehouse (tpy)	Reduction in PM Emissions due to Warehouse (tpy)	PM10 Emissions without Warehouse (tpy)	PM10 Emissions with Warehouse (tpy)	Reduction in PM10 Emissions due to Warehouse (tpy)	PM2.5 Emissions without Warehouse (tpy)	PM2.5 Emissions with Warehouse (tpy)	Reduction in PM2.5 Emissions due to Warehouse (tpy)
PM emissions from material handling	0.12	0.01	0.11	0.06	0.004	0.05	0.01	0.001	0.01
PM emissions from wind erosion	1.32	0.00	1.32	0.66	0.000	0.66	0.10	0.000	0.10
PM emissions from front-end loader	0.71	0.07	0.64	0.08	0.008	0.07	0.07	0.007	0.07
Totals	2.16	0.08	2.08	0.80	0.012	0.79	0.18	0.008	0.17

North Carolina Renewable Power - Lumberton, LLC
Poultry Litter Material Handling Potential Emissions - without Warehouse

Poultry Litter Material Handling without Warehouse - Potential Emissions

0.74	PM K Value	AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles (January 1995)
0.35	PM_{10} K Value	AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles (January 1995)
0.053	$PM_{2.5}$ K Value	AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles (January 1995)
7.5	U - Average Wind Speed (mph)	National Climatic Data Center - average wind speed for Raleigh, NC
23.85	M - Poultry Litter Moisture Content (%)	Lowest estimated poultry litter moisture content
44.76	Maximum Hourly Production Rate (tons/hr)	Taken from poultry litter sampling data from 2012
392,087	Maximum Annual Production Rate (TPY)	

Emission Source ID No.	Source Description	Max Hourly Throughput (tons/hr)	Max Annual Throughput (TPY)	PM Emission Factor (lb/ton)[1]	PM_{10} Emission Factor (lb/ton)[1]	$PM_{2.5}$ Emission Factor (lb/ton)[1,4]	Hourly PM Emissions (lb/hr)[2]	Annual PM Emissions (TPY)[3]	Hourly PM_{10} Emissions (lb/hr)[2]	Annual PM_{10} Emissions (TPY)[3]	Hourly $PM_{2.5}$ Emissions (lb/hr)[2]	Annual $PM_{2.5}$ Emissions (TPY)[3]
IES-16	Transfer Point - Truck Dumps on Ground	44.8	392,087	1.25E-04	5.90E-05	8.74E-06	5.59E-03	2.45E-02	2.64E-03	1.16E-02	3.91E-04	1.71E-03
IES-16	Transfer Point - Existing Cogar Reclaimer moves litter from ground to Belt Conveyor C-1D	44.8	392,087	1.25E-04	5.90E-05	8.74E-06	5.59E-03	2.45E-02	2.64E-03	1.16E-02	3.91E-04	1.71E-03
IES-16	Transfer Point - Belt Conveyor to Disc Screen	44.8	392,087	1.25E-04	5.90E-05	8.74E-06	5.59E-03	2.45E-02	2.64E-03	1.16E-02	3.91E-04	1.71E-03
IES-16	Transfer Point - Disc Screen to Conveyor	44.8	392,087	1.25E-04	5.90E-05	8.74E-06	5.59E-03	2.45E-02	2.64E-03	1.16E-02	3.91E-04	1.71E-03
	Transfer Point - Conveyor to Boiler House Fuel Bin	44.8	392,087	1.25E-04	5.90E-05	8.74E-06	5.59E-03	2.45E-02	2.64E-03	1.16E-02	3.91E-04	1.71E-03
						Total	0.028	0.122	0.013	0.058	0.002	0.009

[1] Emission factors calculated utilizing AP-42 Section 13.2.4 calculation: $EF = K*0.0032*(U/5)^{1.3}/(M/2)^{1.4}$

[2] Hourly emissions calculated utilizing maximum hourly throughput

[3] Annual emissions calculated utilizing maximum annual throughput

[4] $PM_{2.5}$ calculation uses particle size multiplier from AP-42 Section 13.2.4 (approximately 7% of PM is $PM_{2.5}$)

Average Poultry litter HHV as fired = 4083 Btu/lb

Maximum Hourly Production Rate (tons/hr) = (430 MMBtu/hr*10^6 Btu/MMBtu*85%) /(4083 Btu/lb*2000 lb/ton) = 44.76 tons/hr

Conservatively estimated poultry litter burning capacity to be 85% of boiler capacity

Fuel Material Handling - Emission Estimates

Source ID No: IES-16

Material Silt Content (s) [1]	1.6	%
Material Moisture Content (M)	23.85	%
Number of Dozers	1	
Annual Operating Hours	8760	
Particle size scaling factor, PM_{10}	0.75	
Particle size scaling factor, $PM_{2.5}$	0.105	

Emission Factor Equations[2]

PM (TSP $\leq$ 30 um) [3]

EF_{PM} (lb/hr/dozer) = $(5.7*(s)^{1.2})/(M)^{1.3}$

$\leq$ 15 um[4]

EF_{PM15} (lb/hr/dozer) = $(1.0*(s)^{1.5})/(M)^{1.4}$

Emission Source ID No.	Source Description	Emission Factor, EF (lb/hr/dozer) PM	PM_{10}	$PM_{2.5}$	PM (lb/hr)	PM_{10} (lb/hr)	$PM_{2.5}$ (lb/hr)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
IES-16	Front-End Loader/Dozer Operations	0.16	0.02	0.02	0.16	0.02	0.02	0.71	0.08	0.07

[1]Source: AP-42, Chapter 13.2.4 Aggregate Handling and Storage Piles, Table 13.2.4-1 (Crushed limestone)

[2]Source: AP-42, Chapter 11.9 Western Surface Coal Mining, Table 11.9-1 (bulldozing - overburden)

[3]Multiply the TSP predictive equation by the $PM_{2.5}$ scaling factor to determine the $PM_{2.5}$ emission factor

[4]Multiply the PM_{15} predictive equation by the PM_{10} scaling factor to determine the PM_{10} emission factor

North Carolina Renewable Power - Lumberton, LLC
Poultry Litter Material Handling Potential Emissions - with Warehouse

Poultry Litter (IES-16) Material Handling with Warehouse - Potential Emissions

0.74	PM K Value	AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles (January 1995)
0.35	PM_{10} K Value	AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles (January 1995)
0.053	$PM_{2.5}$ K Value	AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles (January 1995)
1	U - Average Wind Speed (mph)	Estimated wind speed inside warehouse
23.85	M - Poultry Litter Moisture Content (%)	Lowest estimated poultry litter moisture content
44.76	Maximum Hourly Production Rate (tons/hr)	Taken from poultry litter sampling data from 2012
392,087	Maximum Annual Production Rate (TPY)	Taken from poultry litter sampling data from 2012

Emission Source ID No.	Source Description	Max Hourly Throughput (tons/hr)	Max Annual Throughput (TPY)	PM Emission Factor (lb/ton)[1]	PM_{10} Emission Factor (lb/ton)[1]	$PM_{2.5}$ Emission Factor (lb/ton)[1,4]	Hourly PM Emissions (lb/hr)[2]	Controlled Annual PM Emissions (TPY)[3]	Hourly PM_{10} Emissions (lb/hr)[2]	Controlled Annual PM_{10} Emissions (TPY)[3]	Hourly $PM_{2.5}$ Emissions (lb/hr)[2]	Controlled Annual $PM_{2.5}$ Emissions (TPY)[3]
IES-16	Transfer Point - Truck Dumps on Ground	44.8	392,087	9.09E-06	4.30E-06	6.36E-07	4.07E-04	1.78E-03	1.92E-04	8.43E-04	2.85E-05	1.25E-04
IES-16	Transfer Point - Existing Cogar Reclaimer moves litter from ground to Belt Conveyor C-1D	44.8	392,087	9.09E-06	4.30E-06	6.36E-07	4.07E-04	1.78E-03	1.92E-04	8.43E-04	2.85E-05	1.25E-04
IES-16	Transfer Point - Belt Conveyor to Disc Screen	44.8	392,087	9.09E-06	4.30E-06	6.36E-07	4.07E-04	1.78E-03	1.92E-04	8.43E-04	2.85E-05	1.25E-04
IES-16	Transfer Point - Disc Screen to Conveyor	44.8	392,087	9.09E-06	4.30E-06	6.36E-07	4.07E-04	1.78E-03	1.92E-04	8.43E-04	2.85E-05	1.25E-04
	Transfer Point - Conveyor to Boiler House Fuel Bin	44.8	392,087	9.09E-06	4.30E-06	6.36E-07	4.07E-04	1.78E-03	1.92E-04	8.43E-04	2.85E-05	1.25E-04
						Total	0.002	0.009	0.001	0.004	0.000	0.001

[1] Emission factors calculated utilizing AP-42 Section 13.2.4 calculation: $EF = K*0.0032*(U/5)^{1.3}/(M/2)^{1.4}$

[2] Hourly emissions calculated utilizing maximum hourly throughput

[3] Annual emissions calculated utilizing maximum annual throughput

[4] $PM_{2.5}$ calculation uses particle size multiplier from AP-42 Section 13.2.4 (approximately 7% of PM is $PM_{2.5}$)

Maximum Hourly Production Rate (tons/hr) = (430 MMBtu/hr*10^6 Btu/MMBtu*85%) /(4083 Btu/lb*2000 lb/ton) = 44.76 tons/hr

Conservatively estimated poultry litter burning capacity to be 85% of boiler capacity

Fuel Material Handling - Emission Estimates

Source ID No: IES-16

Material Silt Content (s) [1]	1.6 %
Material Moisture Content (M)	23.85 %
Number of Dozers	1
Annual Operating Hours	8760
Particle size scaling factor, PM_{10}	0.75
Particle size scaling factor, $PM_{2.5}$	0.105

Emission Factor Equations[2]

PM (TSP $\leq$ 30 um) [3]

EF_{PM} (lb/hr/dozer) = $(5.7*(s)^{1.2})/(M)^{1.3}$

$\leq$ 15 um[4]

EF_{PM15} (lb/hr/dozer) = $(1.0*(s)^{1.5})/(M)^{1.4}$

Emission Source ID No.	Source Description	Emission Factor, EF (lb/hr/dozer) PM	PM_{10}	$PM_{2.5}$	PM (lb/hr)	PM_{10} (lb/hr)	$PM_{2.5}$ (lb/hr)	Controlled PM (tpy)[5]	Controlled PM_{10} (tpy)[5]	Controlled $PM_{2.5}$ (tpy)[5]
IES-16	Front-End Loader/Dozer Operations	0.16	0.02	0.02	0.16	0.02	0.02	0.07	0.01	0.01

[1]Source: AP-42, Chapter 13.2.4 Aggregate Handling and Storage Piles, Table 13.2.4-1 (Crushed limestone)

[2]Source: AP-42, Chapter 11.9 Western Surface Coal Mining, Table 11.9-1 (bulldozing - overburden)

[3]Multiply the TSP predictive equation by the $PM_{2.5}$ scaling factor to determine the $PM_{2.5}$ emission factor

[4]Multiply the PM_{15} predictive equation by the PM_{10} scaling factor to determine the PM_{10} emission factor

[5]Control of 90% taken to calculate PM, PM10 and PM2.5 emissions for the dozer being in the warehouse.

North Carolina Renewable Power - Lumberton, LLC
Poultry Litter Potential Emissions from Wind Erosion - without Warehouse

Poultry Litter without Warehouse - Potential Emissions from Wind Erosion

Emission Source ID No.	Emission Source Description	Pile Area (acres)	Pile Length (ft)	Pile Width (ft)	Height of Storage Pile (ft)	Pile Surface Area[1] (m^2)	PM (lb/hr)	PM (tpy)	PM_{10} (lb/hr)	PM_{10} (tpy)	$PM_{2.5}$ (lb/hr)	$PM_{2.5}$ (tpy)
IES-16	Poultry Litter Storage Pile	0.75	200	100	25	2394.19	0.302	1.32	0.151	0.66	0.023	0.10
						Total	**0.30**	**1.32**	**0.15**	**0.66**	**0.02**	**0.10**

Calculated Emission Factors[2,3]

PM (g/m2-day)	PM10 (g/m2-day)	PM2.5 (g/m2-day)
1.37	0.69	0.10

1. Surface area of piles calculated as half cylinders $S = 0.5 * 2\pi hL+2\pi h^2$

Where:

h = the average of the pile height and 1/2 of the width

b = 1/2 width

c = height

As the two piles are connected at the center, the surface area of one half circle (the end of the half cylinder) has been subtracted from each.

2. EPA Report 451/R-93-001, "Models for Estimating Air Emissions Rates from Superfund Remedial Actions"

EF = 1.9 x (s/15) x ((365-p)/235) x (f/15) (Equation 7-9)

Where:

EF = emission factor (g/m^2-day)

p = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

p = 110 days per AP-42 Figure 13.2.2-1

s = surface material silt content (%)

s = 7.5 % per AP-42 Table 13.2.4-1; value for overburden

f = fraction of time wind >5.4 m/s at mean pile height

f = 20 per Table 7-3, Default Values for Estimating PM Emissions from Other Area Sources

3. PM Fractions (AP-42, Section 13.2.5-3)

Particle Size	k
PM30	1
PM10	0.5
PM2.5	0.075

North Carolina Renewable Power - Lumberton, LLC
Poultry Litter Potential Emissions from Wind Erosion - with Warehouse

Poultry Litter with Warehouse - Potential Emissions from Wind Erosion

Emission Source ID No.	Emission Source Description	Pile Area (acres)	Pile Length (ft)	Pile Width (ft)	Height of Storage Pile (ft)	Pile Surface Area[1] (m^2)	Controlled Emissions PM (lb/hr)	PM (tpy)	PM_{10} (lb/hr)	PM_{10} (tpy)	$PM_{2.5}$ (lb/hr)	$PM_{2.5}$ (tpy)
IES-16	Poultry Litter Storage Pile	0.75	200	100	25	2394.19	0.000	0.00	0.000	0.00	0.000	0.00
						Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Calculated Emission Factors[2,3]

PM (g/m2-day)	PM10 (g/m2-day)	PM2.5 (g/m2-day)
0.00	0.00	0.00

1. Surface area of piles calculated as half cylinders $S = 0.5 * 2\pi hL+2\pi h^2$

Where:

h = the average of the pile height and 1/2 of the width

b = 1/2 width

c = height

As the two piles are connected at the center, the surface area of one half circle (the end of the half cylinder) has been subtracted from each.

2. EPA Report 451/R-93-001, "Models for Estimating Air Emissions Rates from Superfund Remedial Actions"

EF = 1.9 x (s/15) x ((365-p)/235) x (f/15) (Equation 7-9)

Where:

EF = emission factor (g/m^2-day)

p = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

p = 110 days per AP-42 Figure 13.2.2-1

s = surface material silt content (%)

s = 7.5 % per AP-42 Table 13.2.4-1; value for overburden

f = fraction of time wind >5.4 m/s at mean pile height

The default value for f in Table 7-3= 20. However, since the litter will be inside the warehouse, emissions from wind erosion is considered to be negligible.

f = 00

3. PM Fractions (AP-42, Section 13.2.5-3)

Particle Size	k
PM30	1
PM10	0.5
PM2.5	0.075

N2O and NH3 Emissions from Poultry Litter Warehouse

Emissions of N2O			
N2O flux rates for land application of poultry and swine manure	61.3 to 184	mg NOx/m2-d	The range is for the entire year. The highest end of the range was used as a conservative estimate.
	3.78E-05	lb NOx/ft2-d	Iowa State University (2006)[1]
Area of poultry litter warehouse	100 ft by 200 ft		Conservative estimate of size of warehouse/poultry litter shed.
	20,000	ft2	
Hours of operation	365	days/yr	--
N2O emissions	E = 3.8E-5 lb NO_x/ft^2-d * 20,000 ft^2 * 365 days		
	276.17	lb/yr NOx	
	0.14	tons/yr NOx	
	0.03	lb/hr	
Emissions of NH3			
NH3 flux rates from storage of poultry litter	4.2 to 9.1	g NH/m2-d	Typically, the higher end of the range would be used to provide a conservative estimate. However, the poultry litter delivered to the site has been dried and screened. It has been observed to be similar to wood chips and has very little detectible odor. For this reason, the lower end of the range is a better representation of expected ammonia emissions.
	8.40E-04	lb NH3/ft2-d	Iowa State University (2006)
Area of poultry litter warehouse	100 ft by 200 ft		Conservative estimate of size of warehouse/poultry litter shed.
	20,000	ft2	
Hours of operation	24	hrs/day	--
NH3 emissions	E = 8.4E-4 lb NH3/ft^2-d * 20,000 ft^2 / 24 hr/day		
	0.70	lb/hr	
	3.07	tpy	

[1] Air Quality and Emissions from Livestock and Poultry Production / Waste Management Systems.
(2006) Retrieved from http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1624&context=abe_eng_pubs

EPS

ATTACHMENT 2
Belt Dryers Test Report Excerpt
& Potential Emissions

COMPLIANCE AIR EMISSIONS TEST REPORT

North Carolina Renewable Power – Lumberton, LLC
(Georgia Renewable Power, LLC)
Lumberton, North Carolina
Project ID: 0618-12
Version: 1
Date Prepared: October 10, 2018
Air Permit No.: 05543T25
Test Date(s): August 22-23, 2018

Prepared by:

Environmental Source Samplers, Inc.
436 Raleigh Street
Wilmington, North Carolina

Prepared for:

IMI Industrial Services Group
PO Box 537
Watkinsville, Georgia

CERTIFICATION

This test report is submitted to IMI Industrial Services Group by Environmental Source Samplers, Inc., covering air emissions sampling conducted at the North Carolina Renewable Power facility in Lumberton, North Carolina on August 22-23, 2018. ESS operated within the requirements of ASTM D7036-04 during this test project. The data and results presented in this report are believed to be representative of the actual operating and test parameters.

Analytical reports are reviewed for completeness, accuracy, adherence to method protocol, and compliance with quality assurance guidelines and NELAC 2009 standards. The results relate only to the laboratory samples listed. Neither this certification nor report shall be reproduced except in full, without written approval of ESS. ESS laboratory (VELAP ID: 460039) is accredited through the Virginia Environmental Laboratory Accreditation Program (VELAP) for methods pertaining to filterable particulate matter. ESS only subcontracts to laboratories with NELAP accreditation. All test results provided meet all requirements of NELAP unless labeled otherwise. Justification will be provided in Appendix D for all results that do not meet NELAP requirements. Certificates of Accreditation are available upon request.

Results Reviewed By:

Matt Gatian, Director of US Operations
October 10, 2018

Report Reviewed and Finalized By:

Mark Looney, President
October 10, 2018

NELAP ACCREDITED TNI LABORATORY

TABLE OF CONTENTS

<u>TABLES</u>

<u>FIGURES</u>

Environmental Source Samplers, Inc. (ESS) conducted compliance air emissions sampling at the North Carolina Renewable Power (Georgia Renewable Power, LLC) facility in Lumberton, North Carolina. Sampling was conducted on four of the outlet stacks associated with biomass belt dryer ES-17 on August 22-23, 2018.

A series of three (3) test runs was conducted on each stack for specific criteria including: Oxygen (O_2), Carbon Dioxide (CO_2), Volatile Organic Compounds (VOC), Formaldehyde (CH_2O), and Methanol (CH_3OH).

U.S. EPA methods 3a and 25a were used to conduct the O_2, CO_2, and VOC sampling. EPA method 323 was utilized for sampling formaldehyde. EPA Method 308 was used to conduct sampling for methanol.

All aforementioned methodologies were supported by EPA Methods 1 – 4, as required.

The sampling was conducted for initial compliance, to establish emission rates per NCGS 143-215.108, and to determine if the emissions source may be considered an "insignificant activity" as defined under 15A NCAC 02Q .0503(8).

Personnel present included:

- Mr. Greg Reeves, NC DEQ
- Mr. Gregg Martin, IMI Industrial Services Group
- Mr. Frank Burbach, EPS
- Mr. Rick Houser, Georgia Renewable Power, LLC
- Mr. Tiberiu Munteanu, QSTI, Environmental Source Samplers, Inc.
- Mr. Iulian Duma, QSTI, Environmental Source Samplers, Inc.
- Mr. Josh Girt, QSTI, Environmental Source Samplers, Inc.
- Mr. Richard Sitter, QSTI, Environmental Source Samplers, Inc.
- Mr. Eric Clark, Environmental Source Samplers, Inc.

The test results are detailed below and detailed more completely in Appendix B of this report. Field data sheets are included in Appendix A; calculations in Appendix B; operational data in Appendix C; laboratory data in Appendix D; and calibration data in Appendix E.

Table 2-1: Emission Summary – Three Run Average

Emission Test Parameter	Stack 1	Stack 3	Stack 6	Stack 8	Total Emissions	Insignificant Activity Limit
Production Rate (ton/hr)	21.8	32.3	32.3	32.3	N/A	N/A
VOC (ppmw-C)	8.25	8.51	9.60	8.82	70.36	N/A
VOC (lb/hr)	2.20	2.27	2.54	2.31	18.64	N/A
VOC (ton/yr)	9.63	9.92	11.13	10.10	81.56	5
Formaldehyde (ppmvd)	< 0.05	< 0.05	< 0.06	< 0.05	< 0.42	N/A
Formaldehyde (lb/hr)	< 0.03	< 0.03	< 0.04	< 0.03	< 0.26	N/A
Formaldehyde (lb/yr)	< 292.4	< 257.6	< 343.5	< 274.6	< 2336.2	1000
Methanol (ppmvd)	< 0.05	< 0.04	< 0.03	< 0.04	< 0.32	N/A
Methanol (lb/hr)	< 0.04	< 0.03	< 0.02	< 0.03	< 0.24	N/A
Methanol (lb/yr)	< 320.6	< 221.4	< 200.8	< 224.6	< 1934.8	1000

< Below detection limit

Table 2-2: Adjusted Emission Summary – Three Run Average

Emission Test Parameter	Stack 1	Stack 3	Stack 6	Stack 8	Total Emissions	Insignificant Activity Limit
Production Rate (ton/hr)	6	6	6	6	N/A	N/A
VOC (ton/yr)	2.68	1.84	2.07	1.88	16.94	5
Formaldehyde (lb/yr)	81.2	47.9	63.8	51.0	487.8	1000
Methanol (lb/yr)	89.1	41.1	37.3	41.7	418.4	1000

Per facility guidance, ESS summed the emissions for all four stacks and multiplied this value by two to represent total emissions from all eight stacks associated with the biomass belt dryer.

Additionally, ESS has calculated all results in Table 2-2 as a percentage of the total test result value based off the belt capacity limit of six (6) tons per hour.

Belt Dryer Stack Test - Operating Data

	Lbs.	Cu/Ft	Feet	Lbs. / Hr.	Tons / Hr.
Dryer Bed width			21		
A. Dryer Bed Depth stack 1			0.25		
B. Dryer Bed Depth stacks 2,3,4			0.375		
800 RPM belt speed @ min			4.72		
A. Wood Chips	718.6	24.78		43,117.2	21.6
B. Wood Chips	1,077.9	37.17		64,675.8	32.3
Wet Wood Chip weight / cu/ft	29				

Test Results

Stack Number	1	3	6	8	Total (for 8 stacks)
VOC Emission Rates (lb/hr)	2.20	2.27	2.54	2.31	
Feed Rate (ton/hr)	21.6	32.3	32.3	32.3	
VOC Emission Factor (lb/ton)	0.102	0.070	0.079	0.072	
Estimated VOC Emission Rate (lb/hr) @ 30 ton/hr Feed Rate	3.056	2.108	2.359	2.146	19.3
				Potential Annual Emissions (ton/yr) =	**84.7**