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APPENDIX

Appendix 1 – NHSM Non-Waste Application

SECTION 1.0 | INTRODUCTION

Chapter 115 of the Maine Department of Environmental Protection (MDEP) regulations requires a new or modified facility to include, with the Air Emission License Application, a demonstration that the emission source in question will receive Best Available Control Technology (BACT) to control emissions from applicable sources. BACT is defined by MDEP as a process where an emission limitation based on the maximum degree of reduction for each pollutant emitted from, or which results from, the new or modified emissions unit which MDEP reviews on a case by case basis taking into account energy, environmental and economic impacts, and other costs, determines is achievable for such emissions unit through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combination techniques for control of each pollutant. In no event shall application of BACT result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Part 60 and 61 or any applicable emission standard established by MDEP. If MDEP determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emission standard infeasible, a design, equipment, work practice, operational standard or combination thereof may be prescribed instead to satisfy the requirement for the application of BACT. Such a standard shall, to the degree possible, set forth the emission reduction achievable by implementation of such design, equipment, work practice, or operation and shall provide for compliance by means which achieve equivalent results.

The Criteria Pollutants that will be emitted from the boilers and control devices at the proposed facility are particulate matter (PM_{total}/PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) including metals. These pollutants have been evaluated in this analysis.

SECTION 2.0 | PURPOSE

The purpose of this document is to provide an analysis of control technologies by using a "top-down" approach to identify the best technology solution, allowing for environmental, energy, and economic considerations. This analysis has been performed for the two boilers associated with the facility's municipal solid waste processing operations anticipated to run approximately 7,920 hours per year.

Fiberight, LLC (Fiberight) and the Municipal Review Committee (MRC) have followed the "top-down" methodology for determining BACT for the operation of the close-coupled gasifier boilers. As described in EPA's draft New Source Review Workshop Manual (October 1990), the five steps of a top-down BACT analysis are:

1. Identify all available control technologies applicable to the proposed source.
2. Eliminate technically infeasible options.
3. Rank remaining control technologies by control effectiveness.

4. Evaluate the most effective controls and document results, including a case-by-case consideration of energy, environmental, and economic impacts.
5. Select BACT.

Steps 1 through 5 have been completed for particulate matter (PM), volatile organic compounds (VOC), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_X), and heavy metals emissions associated with the boiler operations at the Facility.

SECTION 3.0 | APPLICABILITY

Chapter 115 of MDEP regulations requires a new or modified facility to include with the Air Emission License Application, a demonstration that the emission source in question will receive BACT to control emissions. Officials at MDEP's Bureau of Air Quality have been consulted regarding this project and have indicated that a BACT analysis is required.

SECTION 4.0 | FACILITY DESCRIPTION

The proposed Fiberight facility will consist of a 144,000 square foot building constructed on a 90+/- acre undeveloped parcel located on the east side of Coldbrook Road in Hampden, Maine (see Site Location Map attached to the Application). Proposed operations for the facility will include receipt and processing of municipal solid waste (MSW). Received MSW will initially be sorted to remove oversized items (i.e., masonry, furniture, domestic appliances, carpets, etc.) that have little to no recycling value and would occupy volume further along the process. MSW will then be conveyed to the Primary Sort Trommel where the oversized material is separated from MSW which will be screened and processed. The portion of the MSW not screened out by the Primary Sort Trommel will continue forward to Secondary Screening where the "fines" (food waste, glass, some paper, and plastic) will be separated from the "overs" (plastic containers, cardboard, and larger papers). The overs will be fed forward to the pulper feed tipping floor, while the unders are conveyed to the Fines Processing System. From that stage forward, the various portions of the waste stream will be sorted for recyclables including: aluminum, ferrous and other metals, plastic containers, film plastics, and glass and processed to create bio-methane and biomass fuel. Sugars may be used for conversion into biofuels or for production of bio-methane. Bio-methane will be piped into the Bangor Gas natural gas pipeline located adjacent and to the east of the facility. Sugars, or some portion thereof, may be sold in the future as feedstock for manufacturing process facilities. The solids remaining following the hydrolysis process are transferred to the boilers for fuel. Fiberight anticipates approximately 80 percent of all incoming waste to the facility will be converted into renewable fuels and recyclables which will be sold on the commodities market and the remaining 20 percent will be oversize items, process residues, glass, and grit to be disposed off-site at a secure landfill. The general site and process configuration is presented in **Attachment A** of the license application.

Fiberight has submitted a Non-waste Determination Application for Non-Hazardous Secondary Material (NHSM) to the United States Environmental Protection Agency (EPA) in reference to the Post-Hydrolysis Solids (PHS) fuel. The application was submitted in accordance with 40 CFR Section 241.3(c) to demonstrate the PHS fuel meets the legitimacy criteria and is not a solid waste. Based on the self-determination that the fuel is a non-waste NHSM, Fiberight does not anticipate operating under the CISWI regulations. The NHSM non-waste application and subsequent EPA correspondence is included in this BACT analysis as **Appendix 1**.

Two close-coupled gasifier/boilers and turbines will be used to meet the heat and power needs of the facility. The boilers will be used to produce steam for process and building heat and for power generation by steam turbines. The boilers will be supplied by Hurst Boilers, Inc. The boiler fuel will consist of primarily PHS generated during processing of the MSW. Each boiler is rated for a heat input of 48.86 mmBtu/hr. Each boiler will fire approximately 5.62 tons per hour (tph) PHS at 42.5% moisture. The boiler system is equipped with an integral gasifier. The system is equipped with a fuel feed that introduces the fuel to the gasifier and is exposed to heated under-fire air. The gas containing the combustible organics is generated in an oxygen deficient environment that allows combustible organics to be released from the fuel without combustion occurring. The released gases are conveyed to the combustion area of the unit which is in close proximity to the boiler tubes. Over fire air is introduced to the gases with sufficient oxygen to cause combustion to occur. The combustion releases heat that is transferred to the boiler tubes. This system is different from a typical gasification unit as the released combustible gases remain in a closed system rather than being transferred to a separate boiler unit for combustion. Natural gas or bio-methane will be used at startup of the units. A schematic of the close-coupled gasifier boiler is attached as **Figure 1**. A summary of expected emissions is included in **Attachment B** of the license application.

The receiving, pulping, and materials recovery facility (MRF) portion will be maintained under negative pressure by two fans rated at approximately 50,000 ACFM. The fans will draw ambient air from the processing area where the exhaust from each fan will be treated by one of two VOC/odor scrubber trains. The scrubber train will consist of one Duall Model F105-202s Cross Flow scrubber which will precede a Duall Model PT510-132 Packed Tower Scrubber. The scrubber's primary purpose will be to treat the fan exhaust and prevent odor from entering the atmosphere, but will also collect nuisance dust in the ambient air stream. The scrubbers are the odor and VOC emission control for the receiving area and the processing area prior to the wash stage. A schematic of the scrubbers system is attached as **Figure 3**. A summary of expected emissions is included in **Attachment B** of the license application.

Tail gas generated during the generation and treatment of biogas for sales and distribution will be thermally treated. The anaerobic digestion plant will generate approximately 1,200 standard cubic feet per minute (scfm) of bio-gas. This feed gas will be approximately 70% methane (CH_4) and contain 500 ppm hydrogen sulfide (H_2S). The feed gas is piped to the Pressure Swing Absorption (PSA) that is used to condition the bio–methane to Bangor Gas' specifications prior to introduction into the pipeline. During normal operations, the tail gas generated during gas clean-up will be piped to a John Zink ZBRID system for Low Btu Gases. Fiberight anticipates a maximum of 386 scfm of tail gas will be generated from feed gas treatment. The tail gases will consist of approximately 11% CH_4 and contain 1,000 ppm H_2S. In order to maintain combustion of the tail gas, additional Btu's will be added by introducing feed gas as supplemental fuel in the ZBRID unit.

During process upset conditions, feed gas will be thermally oxidized in an enclosed flare. Process upsets may include inadequate gas quality or downtime of the PSA. The facility's proposed flare is expected to operate less than 36 days per year.

The enclosed flare and ZBRID will emit CO, NOx, SO_2, PM, VOCs, and HAPs.

The flare/ZBRID system is the emission control device for the PSA gas clean-up and during biogas generation process upset conditions. The flare is designed with sufficient capacity to combust 100% of the potential maximum biogas generation of 72,000 SCFH. A summary of expected emissions is included in **Attachment B** of the license application.

SECTION 5.0 | ANNUAL EMISSION ESTIMATES

Emissions from the Fiberight processing facility are primarily the result of the two boilers. The boilers generate CO, NO_X, SO_2, PM, VOCs, and HAPs. The Maximum Potential to Emit (PTE) estimates have been calculated using information provided by Fiberight, assuming the facility will be actively processing waste 330 days per year or 7,920 hours per year. The PTE calculations and the boiler operational parameters spec sheet are attached in **Appendix B** of the license application.

TABLE 1-1
FIBERIGHT, LLC
MAXIMUM POTENTIAL TO EMIT

Criteria Pollutants (Ton/Year)							
	Flare	Thermal Oxidizer Hybrid	Boiler #1	Boiler #2	Scrubber #1	Scrubber #2	Total
Carbon Monoxide (CO)	6.91	2.90	44.78	44.78			99.4
Oxides of Nitrogen (NOx)	1.52	1.45	20.36	20.36			43.7
Sulfur Dioxide (SO2)	2.90	4.78	5.08	5.08			17.8
Particulate Matter (PM)	0.54	1.55	6.10	6.10			14.3
Particulate Matter < 10 µm (PM10)	0.54	1.55	4.48	4.48			11.0
Particulate Matter < 2.5 µm (PM2.5)	0.54	1.55	4.07	4.07			10.2
Volatile Organic Compounds	0.17	0.50	2.65	2.65	2.89	2.89	11.7
Ammonia	0.10	0.29	0.00	0.00			0.4
HAPS	0.06	0.18	3.29	3.29	0.15	0.15	7.1

SECTION 6.0 | IDENTIFICATION OF CONTROL ALTERNATIVES

Proposed control measures are primarily directed at limiting NOx, VOC, and PM emissions as these constituents are the pollutants of concern associated with these types of operational units.

6.1 Nitrogen Oxides (NOx)

The production of NOx in a combustion system is primarily the result of nitrogen present in the fuel or it is generated due to high operation temperature (thermal NOx) during combustion. The manufacturer of the drying system assumed nitrogen content of 0.45% in the fuel for their emissions estimates. Thermal NOx is typically formed at a temperatures greater than 2,370ºF and is not expected to be a significant contributor to the overall NOx emissions from this project.

The following are available NOx control mechanisms:

Combustion Controls: It may be possible to set operational parameters (excess air, recycled air, burner inlet temp, etc.) to minimize NOx emissions from the unit. In addition, wood fuel is inherently low in bound nitrogen. There is little to no financial impact from using combustion controls and no additional environmental impacts. This is a technically feasible method for reduction of NOx.

Selective Catalytic Reduction (SCR): SCR is an add-on NOx control device placed in the exhaust stream following the boiler and involves injecting ammonia (NH_3) or urea into the flue gas in the presence of a catalyst. The NH_3/urea reacts with NOx in the presence of a catalyst to form water and nitrogen. The presence of condensable organics and/or high concentrations of particulates may have a masking effect on the catalyst surface causing a reduction or cessation of catalyst activity. The SCR also functions better on systems with steady operational loads. Load fluctuations can cause variations in exhaust temperature and NOx concentration which can create problems with the effectiveness of the SCR system. SCR systems will also require reheating of the exhaust stream. The gas exiting the boiler system is anticipated to be approximately 275ºF. The gas will need to be reheated to between 400ºF and 800ºF to effectively control NO_x by SCR. This will require additional combustion which will increase both operational cost and emissions. A typical SCR system will provide control between 70% and 90%. SCR systems are typically found in boilers exceeding 100mmBtu/hr heat input. Due to lack of space for placement of a catalyst and insufficient boiler size to effectively operate SCR, this option is technically infeasible.

Selective Non-Catalytic Reduction (SNCR): SNCR relies on the injection of ammonia or urea into the flue gas but unlike SCR, does not use a catalyst. The injection site and temperature affect the control efficiency of this system. The reagent must be injected at a point in the system that operates at an optimum temperature between 1600°F and 2100°F, and provides sufficient residence time for the injected ammonia to react with the NO_x. The Hurst Boiler system is designed with an injection point following the afterburner in order to allow for SNCR. SNCR application has proven effective in NO_X reduction in biomass boilers of similar size. Cost of the SNCR is an operating expense that will be driven by the variation of NO_X reduction requirements and reagent use. Through operational controls, the system can be optimized to reduce operation cost associated with an SNCR. Hurst provided a controlled emission rate estimate of 0.10 mmBtu/hr. This system is technically feasible.

Proposed NOx BACT

Fiberight is proposing to utilize SNCR for both boilers and will represent BACT for NO_X emissions. Use of this control system will allow the facility to attain emission levels below the Minor Source Threshold of 100 tons per year.

6.2 Particulate Matter (PM):

Particulate Emissions will be generated by the boilers from combustion of shredded wood fines and post hydrolysis solids (PHS). The raw material feed rate and combustion of residues will be the primary contributor to PM emissions from the facility. The following is a discussion of the available PM control devices:

Cyclone/Multiclone: A cyclone or multiclone is a dry mechanical collector utilizing centrifugal and inertial forces for particulate/dust collection. Cyclones use the velocity differential across the cyclone to separate particles of various sizes. A multiclone uses several smaller diameter cyclones to improve collection efficiency for smaller particles. Cyclone collectors may be used in series with each other, as a pre-filtration system in front of higher efficiency systems, or for product separation and reclamation.

Cyclones are simple and inexpensive to operate and, dependent on design criteria, can provide control efficiencies adequate to meet certain emission goals. Typically, cyclones provide a reduced efficiency as particulate size decreases. Correctly designed cyclones can potentially provide control efficiency up to 95% on PM <10µm but efficiency reduces for particles below PM10.

Fabric Filters/Baghouses: Fabric filters in various configurations are capable of control efficiencies exceeding 99% for particulate matter varying in aerodynamic diameter. In the application of the boilers proposed for the Fiberight facility, the relatively low moisture content of the emissions (approximately 13%) would not be expected to result in condensable particulates and subsequent overloading of associated fabric filters. Operation of these units, when compared to other controls, is relatively simple and offers a large number of fabrics and configurations that can be customized to better suit the specific process. The use of a baghouse also allows the collected material to be easily removed from the hopper for disposal.

Electric Static Precipitator (ESP): ESPs are widely used for the control of particulates from a variety of combustion sources including wood combustion. An ESP is a particle control device that employs electric fields to charge the particulates and remove them from the gas stream onto oppositely charged collector plates. There are a number of different designs that achieve very high overall control efficiencies. Control efficiencies typically average over 98% with control efficiencies almost as high for particle sizes of one micrometer or less. ESPs are available as a dry electrostatic precipitator or a wet electrostatic precipitator (WESP). The method of collection is the same in both systems with the primary difference being the use of water to remove the PM from the collection media in the WESP system. The advantage of dry systems is that they may have a lower capital cost and reduced waste disposal problems. Wet systems may be less expensive to operate and are slightly more efficient at capturing very small particles but would add an additional wet waste stream.

As discussed in EPA's *Wet Electro Static Precipitator* and *Dry Electro Static Precipitator* fact sheets, ESPs are physically large units which will not provide the control over large particle size distribution variations. The units require a large volume of flue gas to achieve the residency time required to reach the unit's maximum efficiency. ESPs function optimally in steady state conditions. The proposed boiler units will be prone to load and flow fluctuations and wide variation in particulate size. These fluctuations would affect the efficiency of either a dry or wet ESP. This control device is technically feasible for the proposed facility but has been removed from consideration of BACT as it is not anticipated to achieve higher control efficiencies than the controls previously discussed. ESPs typically have higher capital and operating costs than baghouses but do not provide significantly improved particulate controls on smaller systems.

Exhaust Gas Recycle: Exhaust Gas Recycling (EGR) is a potential pollutant control mechanism for biomass combustion units. EGR is typically used to recover heat and reduce the emission from the final exhaust point of the system. The recycling of gas will bring the pollutants present in the exhaust gas back into contact with the heat source (flame) resulting in the destruction of some of the condensables, VOCs, and particulates. Gas recycling is limited by the ability to provide make-up air and necessary gas condition for drying. EGR is technically feasible but will not provide sufficient control to be considered BACT without add-on control devices.

Proposed Particulate Matter BACT

Based on the varying size of anticipated particulate matter and ability to collect and recirculate filtered material back into the processing stream, Fiberight is proposing to operate a multiclone system in conjunction with a filter fabric/baghouse control system. The multiclone will serve to collect the larger particulates exiting the boiler. This will allow the baghouse filters to be designed to control smaller particulate. The proposed baghouse system will consist of a BETH USA BETHPULS bag filter single-line baghouse. Each boiler will exhaust to an individual baghouse for control of PM. Fiberight will use good housekeeping practices and manufacturer's guidance for maintainance intervals and fabric filters replacement. Collected materials from the hopper will be conveyed to a roll-off container within the processing building. The proposed baghouse configuration will have a PM emission rate of approximately 6.1 lbs/hr for each boiler.

6.3 Volatile Organic Compounds (VOC)

VOC generation in regards to industrial boilers typically results from vaporization of fuels or leaks in oil or gas piping. In the case of a biomass fired boiler, VOCs would primarily occur during combustion while operating in process upset conditions or failing to maintain the equipment.

Good Combustion Practices: Good combustion practices include operating the system based on the design and recommendation provided by the manufacturer and by maintaining proper air-to-fuel ratios with periodic maintenance checks. A well operated system utilizing good combustion practices is the most prevalent and cost effective measure for reducing VOC emissions from the proposed boilers.

Proposed VOC BACT

Proposed good combustion practices to be implemented by Fiberight will maintain VOC emissions below the threshold for a minor source. Good combustion practices will be considered BACT for this project.

6.4 Carbon Monoxide

CO emissions are generally a product of incomplete combustion. The most effective methods for reduction of CO emissions are designed to complete the combustion process. Control devices can include add-on controls and good combustion practices.

Good Combustion Practices: Good combustion practices include operating the system based on the design and recommendation provided by the manufacturer. A well operated combustion system will be balanced to limit both CO and NOx. A system that maximizes the combustion of the fuel will emit the least amount of CO possible. Combustion parameters may include temperature, excess air, fuel feed rate, and gas recirculation. Good combustion practices are the most prevalent and cost effective measure for reduction of CO emissions.

Proposed CO BACT

Fiberight is proposing to use good combustion practices for control of CO emissions.

6.5 Sulfur Dioxide

The PHS and wood fuel is inherently low in sulfur content. The low projected emissions for SO_2 do not warrant the installation of additional control devices. The anticipated fuel sulfur content is approximately 0.05% as received. The use of this low sulfur fuel will be considered BACT for SO_2 for this project.

Proposed CO BACT

Fiberight is proposing to use low sulfur content fuel and good combustion practices for control of SO_2 emissions.

6.6 HAPs/Heavy Metals

Fiberight has submitted a Self-Determination to the EPA stating that PHS is a NHSM and not a waste. As part of this determination Fiberight submitted analytical data to the EPA summarizing the contaminants present in the fuel. The heating value and concentrations of metals, specifically mercury, are expected to be similar to biomass. The PHS fuel and boiler system differs from the sources that typically install controls for metals and other HAPs. The typical add-on control for mercury is carbon injection and is usually found on large coal-burning power generation facilities and waste to energy facilities that burn MSW or waste derived fuels. The Fiberight processing and enzymatic hydrolysis process contains separation, washing and processing steps designed to limit the inorganic contaminants in the pulp that enters the hydrolysis reactors. These steps reduce the concentrations of Metals/HAPS present in the PHS to levels similar to those found in biomass.

Activated Carbon Injection: Activated carbon injection (ACI) is a typically installed on larger boiler systems that combust MSW, waste derived fuels or coal. Smaller boiler systems generally do not have the size or suitable locations for carbon injection in order to provide the necessary residence time for ACI to have effective mixing of the carbon and flu gas. In addition the injected carbon increases the amount of particulates in the gas stream and consequently the amount of PM captured in the baghouse that must be disposed of. Fiberight will be using fuel with low levels of metals in the fuel and the addition of carbon to the flue gas will provide limited control on the target pollutants entrained in the gas stream. ACI is determined to be technically infeasible.

Proposed Metals/HAPs BACT

Fiberight is proposing to use a fuel that has inherently low concentration of heavy metals. In addition the PM control system (multiclone/baghouse) will collect metals that are bound to particulates which will further reduce the amount of metals emitted to the atmosphere. In addition the emission control system is designed to provide sufficient control and collection efficiencies to meet the requirements for New Sources as specified in 40 CFR Part 63, Subpart JJJJJJ *National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers Area Sources*.

FIGURE 1

GENERAL ARRANGEMENT PROCESS DIAGRAM

General Arrangement Process Diagram

30 15 0 30 60
Feet
1 inch = 30 feet

Legend

🟧 Pit	▢ Operational Features
▲ Scrubber Intake	▢ Building
➤ MSW Processing Flow	▨ Pond
➤ Drain	☒ Scales
- - Duct	▢ Tank
Wall (MSW/Processing Area)	■ Road
Stormwater Line	■ Anaerobic Digestion Area
Sewer Line	■ Hydrolysis Area
Gas Line	■ Materials Recovery Facility Area
Water Line	■ Pulp Area
Drip Edge Outlet	■ Wash Area
Drip Strip	■ Waste Water Treatment Area

MAP NOTES:

1: SITE DATA DEVELOPED BY CES, INC., DECEMBER, 2015.

2: OPERATIONAL FEATURES AND INFRASTRUCTURE PROVIDED BY FIBERIGHT, 2015. LOCATIONS ARE APPROXIMATE AND ARE SUBJECT TO CHANGES.

3: MAP IS PROJECTED USING STATE PLANE COORDINATES, US SURVEY FEET, EAST ZONE AND AND REFERENCES THE NORTH AMERICAN DATUM OF 1983 (NAD83).

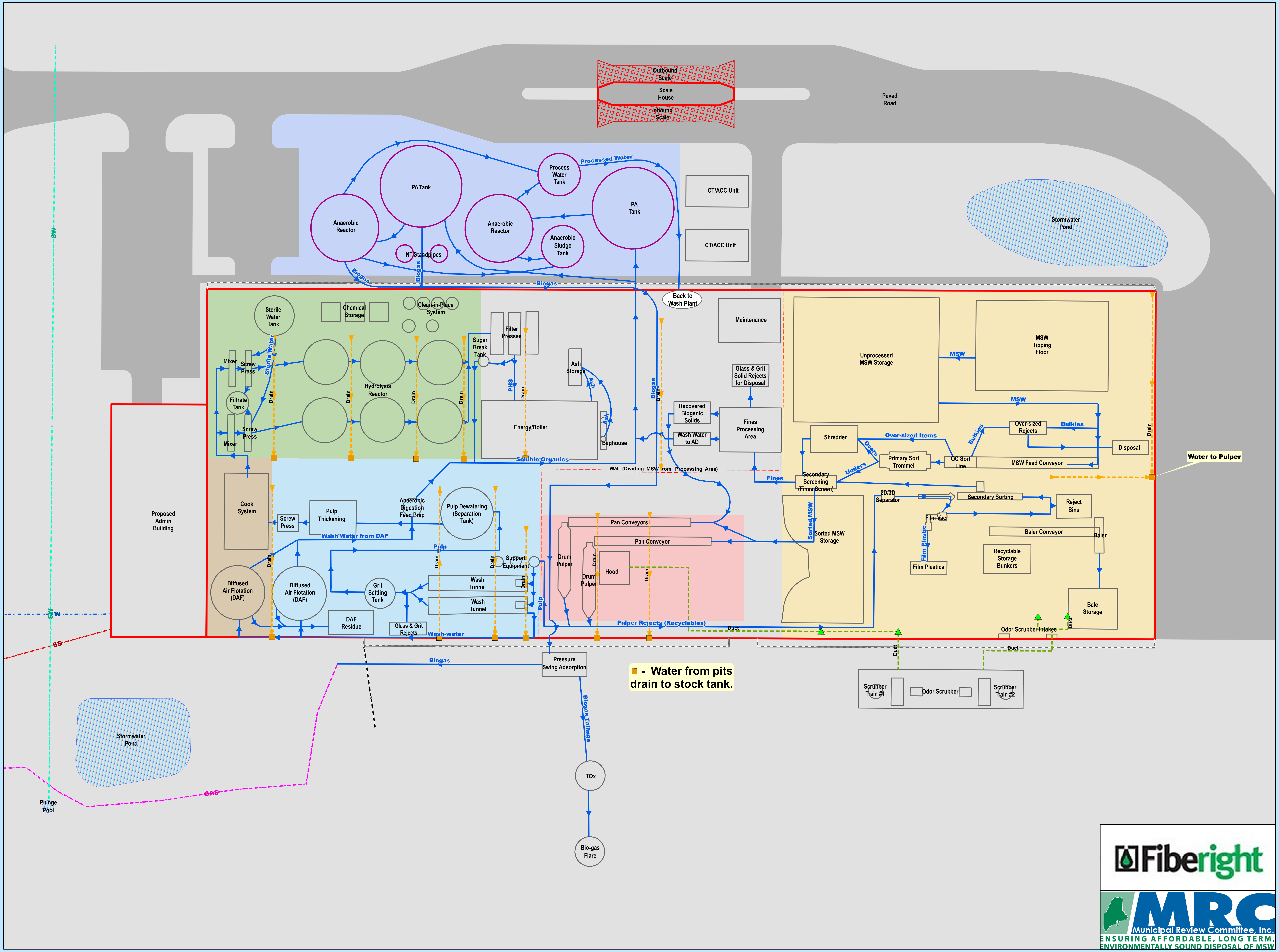
4: NORTH ARROW IS REFERENCED TO GRID NORTH.

5: INTENDED FOR REFERENCE PURPOSES ONLY. THE MRC & CES, INC. AND THEIR AFFILIATES ARE NOT RESPONSIBLE FOR THE MISUSE OF THIS MAP OR DATA DEPICTED HEREIN.

Fiberight, LLC. & Municipal Review Committee
Project No.: 11293.001
Updated: 12/8/2015 [lladd]

CES INC
Engineers • Environmental Scientists • Surveyors

MXD: P:\11293-Fiberight\001-Solid Waste Facility-DSP\07-GIS_Data\MXD\General Arrangement Process Diagram 110415.mxd



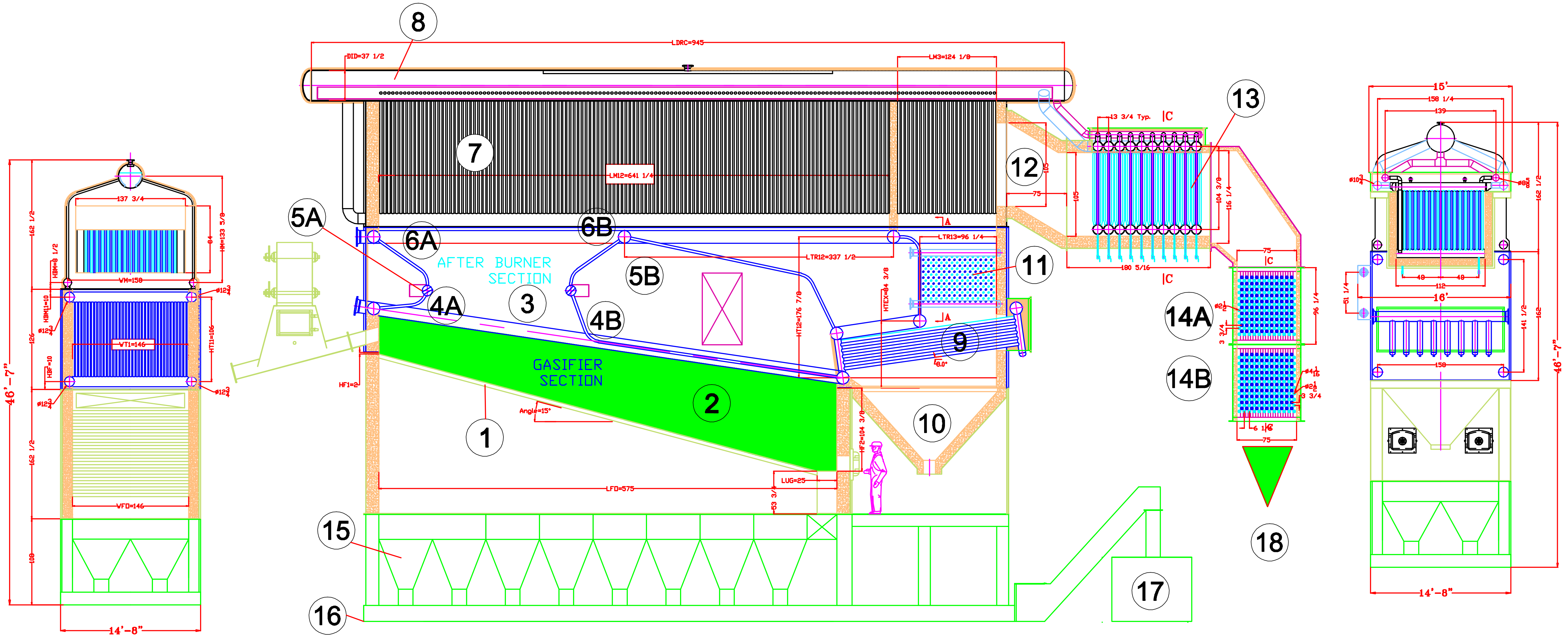
Fiberight

MRC
Municipal Review Committee, Inc.
ENSURING AFFORDABLE, LONG TERM, ENVIRONMENTALLY SOUND DISPOSAL OF MSW

FIGURE 2

BOILER CONFIGURATION

CLOSE–COUPLED GASIFIER



Close Coupled Gasifier Drawing Key

1 Reciprocating Grate
2 Gasifier Section
3 After Burner Section
4 AB Refractory Arch
5 AB Overfire Air
6 AB Water Walls
7 Membrane Wall Section
8 Main Stream Drum
9 Screener Tube Bank (Cooler)

10 U-Hopper
11 Super Heater Section (Turbine Re-heater)
12 Transition
13 AB Convective Section (Cassette Style)
14 2-Stage Economizer (2nd Stage for DA)
15 Sifting Hoppers
16 Wet Ash Conveyor
17 Ash Bin
18 Flue Gas to Emissions Control

Hurst BOILER

HURST BOILER
& WELDING CO., INC.
COOLIDGE, GEORGIA 31738
PH: 229-346-3545 FAX. 229-346-3874

3500 CLOSE COUPLE GASIFIER
RECIPROCATING GRATE STOKER

for: GLOBAL ENERGY

SCALE:	DRAWN BY:	DATE:	CHECKED BY:	DRAWING NUMBER:	R
	VK	10/01/2014	VK	003	1

FIGURE 3

SCRUBBER CONFIGURATION

Proposal Number: 174-3733- 010-T-010

SCOPE OF SUPPLY
For
AMEC Power and Process

Attention: Matthew De Kam

Rep: Great Northern Environmental

Matt Fritze

Phone: (651) 289-9100

Date:	November 18, 2013
Validity	60 days
Expiration date:	January 18, 2014

Haluk M. Bafrali *Nov. 18, 2013*

Approved by Date

Terms and Delivery

BUDGET Price:	**US$ 850,000.00**
Options:	
Service	**Not included**

Term of Sale:	**F.O.B. Shipping Point, Freight Allowed**
Payment Terms:	**Net 30 days**
Submittals:	**4 – 6 weeks after receipt of order with complete details**
Shipment:	**12 – 14 weeks after approval with release for fabrication**

Validity

Pricing is valid for 60 days from the date given on the cover page of this document. Pricing and Payment Terms are subject to credit approval.

Escalation

Due to market volatility in key raw materials including, but not limited to, steel, nickel, chrome, copper, precious, and other metals, thermoplastic and FRP resins, pricing provided may be subject to escalation at time of Met-Pro issuance of purchase orders to its suppliers.

Offer Acceptance

ACCEPTANCE OF THIS OFFER IS LIMITED TO ITS TERMS INCLUDING ALL OF THE TERMS AND CONDITIONS ATTACHED, WHICH ARE PART OF THE OFFER.

To insure proper processing, a purchase order resulting from this proposal should **reference proposal number # 263-3693-010-T-010**, and be issued to: Duall, Met-Pro Technologies.

Contact information:
Haluk M. Bafrali
Regional Sales Manager – Municipal Systems
Phone: 412-220-9713
e-mail: hbafrali@met-pro.com

Accepted by:

Title:

BASIS OF DESIGN

Service Conditions: **100,000 CFM Total Flow**
Two (2) trains each with a flow of 50,000 CFM
Location of Equipment: Indoors
Free-Standing: Yes

Process Requiring Controls:
No. of Control Stages: Two (2) Stages each train
Stage 1 & 2:

Gas Conditions:	Inlet	Outlet
Flow Rate, ACFM	50,000	50,000
Temperature, F	70	70
Relative Humidity, %	75%	75%
Bulk Gas Composition	Air	Air

Contaminant	Inlet	Outlet	Overall Removal Efficiency
Ammonia	**15,000 ppb**	**750 ppb**	**95%**
H_2S	**1,000 ppb**	**100 ppb**	**99% or 100 ppb whichever is greater**
VOCs (as H_2S)	**6,000 ppb**	**600 ppb**	**99%**

Operating Parameters:

Stage	1	2
Differential Pressure Drop, iwg	2”	3”
Flow Direction	Cross flow	Counter current

Chemical Usage:	**Per 50,000 cfm train.**
H_2SO_4 (93%)	**0.40 gph**
NaOH (20%)	**1.6 gph**
NaOCl (12%)	**9.5 gph**

Equipment Scope of Supply: Two (2) 50,000 CFM Trains:

Each Train to consist of:

A. Cross-Flow Scrubber – Duall Model F105-202S complete with:

- Material of Construction: Heavy Duty Corrosion Resistant PVC
- Spray Liquid Distributor: PVC Nozzle(s)
- Plumbing: Schedule 80 PVC
- Scrubbing Bed: High Efficiency Polypropylene Spherical Packing
- Mist Eliminator Bed: High Efficiency Polypropylene Spherical Packing
- Differential Pressure Gauge: Magnehelic
- Transitions: Inlet and Outlet
- Recirculation Pump: Vertical Seal-less/Horizontal with TEFC Motor

B. Packed Tower Scrubber – Duall Model PT510-132 Complete with:

- Material of Construction: Heavy Duty Corrosion Resistant PVC
- Spray Liquid Distributor: PVC Nozzle(s)
- Plumbing: Schedule 80 PVC
- Scrubbing Bed: High Efficiency Polypropylene Spherical Packing
- Mist Eliminator Bed: High Efficiency Polypropylene Spherical Packing
- Differential Pressure Gauge: Magnehelic
- Transitions: Inlet and Outlet
- Recirculation Pump: Vertical Seal-less/Horizontal
- Recirculation Sump: Self Contained/Remote with TEFC Motor

C. FRP Fan – Duall Model NH-98 Fan

Complete 125 HP, TEFC, 1800 RPM, 3 ph., 60 Hz. 460 V. motor.

D. Inter-Connecting Duct Work

Duct work between cross flow scrubber and packed tower scrubber.
Duct work between packed tower scrubber and fan.

E. Control Panel

NEMA 4X Control panel with motor starters for fan and pumps.
pH and ORP controllers.

F. Chemical Metering Pumps

Three (3) metering pumps.
One H_2SO_4 pump.
One NaOH pump.
One NaOCl pump.

ITEMS NOT SUPPLIED BY Met-Pro Environmental Air Solutions: Unless specifically listed in our scope of supply, these items are not part of this proposal. Please contact MPEAS for optional pricing.

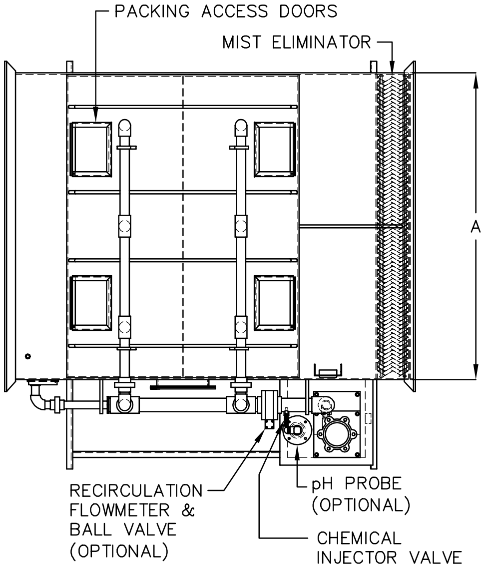
- All permits, taxes, duties, brokerage, local fees and licensing fees are the responsibility of others.
- Freight driver detention expenses.
- Off loading and storage.
- All piping, valves, and accessories required to complete installation.
- All electrical wiring, conduit, motor control centers, local disconnects, and instrumentation connection accessories.
- Inlet ducting, pipe and collection hoods
- Supports/Hangers.
- Hardware.
- Gas detectors and or sensors.
- Dampers/Actuators
- Flexible Connectors
- Pre-wiring or skid mounting of panel.
- Fan sound acoustical cladding.
- Installation (basic).
- System airflow balancing.
- Annual or biannual system inspection and balancing (site visits).
- Installation supervision.

Notice

All material contained in this Quote is proprietary and shall be treated confidentially by all recipients. Your acceptance of this material constitutes acknowledgment of the confidential relationship under which disclosure and delivery are made. This Quote represents our interpretation of your requirements based on the specific information provided at time of inquiry, and should discrepancies arise, modifications be made, or understandings differ, we reserve the right to modify the Quote. This Quote is for this inquiry only and does not eliminate or supersede any other agreements or obligations (financial or otherwise), between the parties.

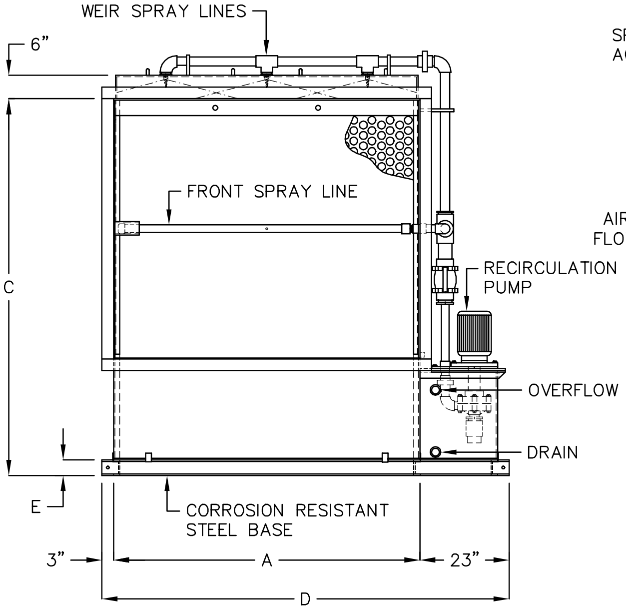
NOTES:

1. DIMENSIONS IN INCHES, WEIGHTS IN POUNDS.
2. DIMENSIONS ARE APPROXIMATE ONLY, DO NOT USE FOR FABRICATION.
3. STANDARD MATERIALS ARE PVC, CPVC, PP, & PVC/FRP.
4. MAXIMUM PRESSURE DROP ACROSS THE SCRUBBER AT DESIGN CONDITIONS IS 2 1/2" W.C.

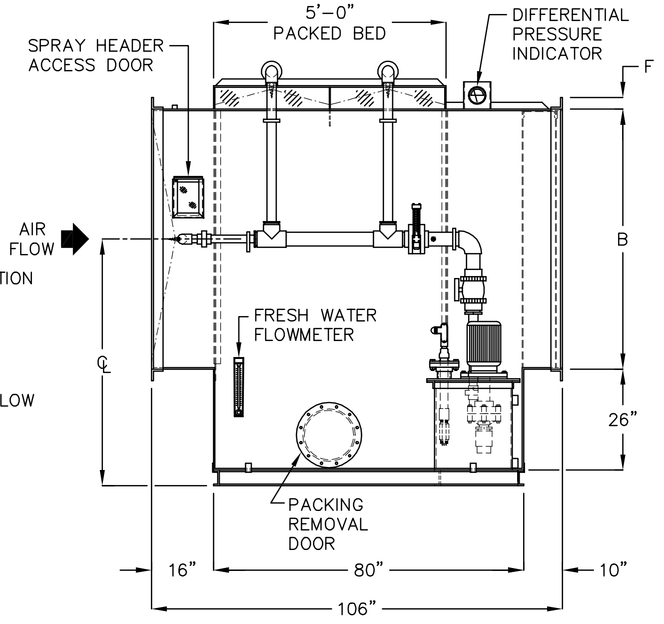


PLAN VIEW

MODEL NUMBER	MAX. CFM	A	B	C	D	E	F	℄	DRY WEIGHT	PUMP QTY. AND H.P.
F105–18S	500	18	10	39	44	3	2	34	784	(1) 2 HP
F105–22S	1,000	22	14	43	48	3	2	36	942	(1) 2 HP
F105–28S	2,000	28	20	49	54	3	2	39	1,094	(1) 2 HP
F105–32S	2,700	32	24	53	58	3	2	41	1,148	(1) 2 HP
F105–37S	3,700	37	29	58	63	3	2	43½	1,237	(1) 2 HP
F105–41S	4,700	41	33	62	67	3	2	45½	1,398	(1) 2 HP
F105–45S	6,000	45	37	66	71	3	2	47½	1,491	(1) 5 HP
F105–52S	8,000	52	44	73	78	3	2	51	1,654	(1) 5 HP
F105–58S	10,000	58	49	78	84	3	3	53½	1,849	(1) 5 HP
F105–64S	12,000	64	54	83	90	3	3	56	1,997	(1) 5 HP
F105–69S	14,000	69	59	88	95	3	3	58½	2,437	(1) 5 HP
F105–74S	16,000	74	64	93	100	3	3	61	2,468	(1) 5 HP
F105–79S	18,000	79	67	97	105	4	3	63½	2,561	(1) 7½ HP
F105–84S	21,000	84	71	101	110	4	3	65½	2,746	(1) 7½ HP
F105–90S	23,000	90	73	103	116	4	3	66½	2,990	(1) 7½ HP
F105–96S	25,000	96	73	103	122	4	3	66½	3,173	(1) 7½ HP
F105–104S	27,000	104	73	103	130	4	3	66½	3,524	(1) 7½ HP
F105–112S	30,000	112	73	103	138	4	3	66½	3,918	(1) 7½ HP
F105–123S	32,500	123	73	103	149	4	3	66½	4,081	(1) 7½ HP
F105–135S	35,000	135	73	103	161	4	3	66½	4,473	(1) 7½ HP
F105–157S	40,000	157	73	103	183	4	3	66½	5,137	(2) 7½ HP
F105–179S	45,000	179	73	103	205	4	3	66½	5,635	(2) 7½ HP
F105–202S	52,000	202	73	103	228	4	3	66½	6,233	(2) 7½ HP
F105–224S	57,000	224	73	103	250	4	3	66½	6,794	(2) 7½ HP
F105–247S	63,000	247	73	103	273	4	3	66½	7,329	(2) 7½ HP



LEFT ELEVATION



FRONT ELEVATION

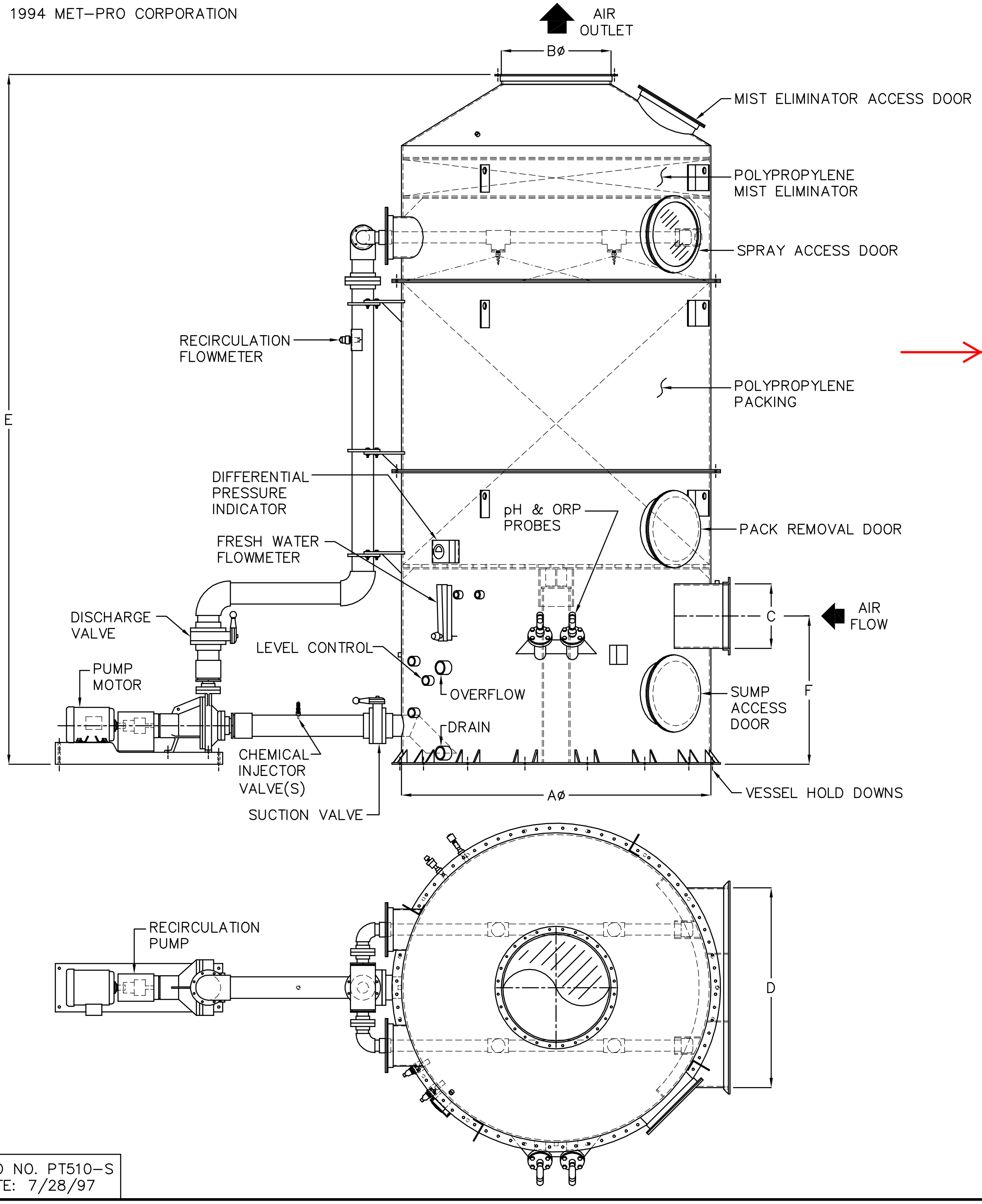
CAD NO. F105SS
DATE: 7/28/97

MODEL F105 SCRUBBER (SELF CONTAINED RECIRCULATION)

MET PRO CORPORATION

DUALL DIVISION
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

DATE	DUALL JOB NO.
AIR FLOW RATE	C.F.M.
PRESSURE DROP	W.C.
RECYCLE RATE	G.P.M.
MAKE–UP RATE	G.P.H.



MODEL NUMBER	MAX. CFM	AØ	BØ	C	D	E	F	RECYCLE RATE	PUMP HP	DRY WEIGHT
PT510–24	1,500	24	12 3/4	12 3/4"Ø		232	42	20	1 1/2	900
PT510–36	3,500	36	16	16"Ø		236	44	46	3	1,600
PT510–48	6,500	48	20	20"Ø		242	46	82	3	2,300
PT510–60	10,500	60	26	26"Ø		246	49	126	5	2,700
PT510–72	15,500	72	30	30"Ø		250	51	185	5	4,300
PT510–84	21,000	84	36	19	53	255	45	250	7 1/2	5,700
PT510–96	27,500	96	42	20	62	250	46	326	7 1/2	6,900
PT510–108	34,500	108	46	24	69	256	48	415	15	8,300
PT510–120	43,000	120	52	26	76	262	49	510	15	10,900
PT510–132	52,000	132	56	29	84	268	51	620	20	11,400
PT510–144	62,000	144	62	32	92	274	52	735	20	12,900

NOTES:

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2. DIMENSIONS ARE APPROXIMATE ONLY, DO NOT USE FOR FABRICATION.
3. STANDARD MATERIALS ARE PVC, CPVC, PP, & PVC/FRP.
4. MAXIMUM PRESSURE DROP ACROSS THE SCRUBBER AT DESIGN CONDITIONS IS 4 1/2" W.C.
5. LIFTING LUGS ARE SUPPLIED BY DUALL AS REQUIRED.

MODEL PT510
ODOR CONTROL SCRUBBER

MET PRO
CORPORATION

DUALL DIVISION
1550 INDUSTRIAL DRIVE
OWOSSO, MI 48867

DATE	DUALL JOB NO.	
AIR FLOW RATE		C.F.M.
PRESSURE DROP		W.C.
RECYCLE RATE		G.P.M.
MAKE–UP RATE		G.P.H.

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CAD NO. PT510–S
DATE: 7/28/97

APPENDIX 1

NHSM NON-WASTE APPLICATION

Non-Waste Determination Application for
Non-hazardous Secondary Material -
Fermentate from a Cellulosic Ethanol Plant
Pursuant to 40 CFR Section 241.3, Standards and Procedures for Identification of Non-Hazardous Secondary Materials
6/7/2013

Submitted to U.S. EPA Region 7
Administrator Bob Perciasepe
11201 Renner Blvd.
Lenexa, KS 66219

Submitted by:
Fiberight LLC
PO Box 21171
Catonsville, MD 21228
Craig Stuart Paul, CEO
410-340-9387

Summary:

This document is an application submitted pursuant to 40 CFR Section 241.3(c). That regulation allows for certain types of non-hazardous secondary materials (NHSM) to be determined by the U.S. EPA to be non-wastes when they are used for combustion. Fiberight proposes herein that the material it wishes to produce for sale at its cellulosic ethanol plant to various customers for use in combustion units meets the criteria spelled out in the above referenced regulation; and as such is not a solid waste.

The material is similar in content to more widely used fuels, and emissions from its burning should be similar as well. Tables are included in this document that compare both constituents with other fuels, and likely air emissions.

Emission factors for criteria pollutants are likely to be similar to the burning of wood or bagasse. Metals emissions were calculated directly from analyses of the NHSM for metals content. Neither the criteria nor hazardous waste pollutants are much different from those emitted from wood, bagasse, coal, TDF, and so on. The material has a significant heating value, similar to bagasse and wood and as such, should be harvested to produce renewable energy. With its fuel made from what would otherwise be waste, Fiberight is at the forefront of the cellulosic ethanol production technology.

Introduction:

<u>The Process:</u> Fiberight is a privately held company founded in 2007 with current operations in Virginia, Maryland and Iowa. As a leading edge clean technology company, our team focuses on transforming post-recycled municipal solid wastes and other organic feed stocks into next generation renewable biofuels, with cellulosic ethanol as the core product. Pilot plant facilities have been on-going during 2008-2009. In November 2009, Fiberight purchased a former dry-mill corn ethanol plant in Blairstown, IA with the intent to cost efficiently retrofit this plant for commercial level operations. Initial stage investment for the company's $30 million Iowa plant will enable the company to commence production of its demonstration scale facility in early 2015 to convert industrial and municipal solid wastes into cellulosic ethanol and biogas using proprietary sorting, pulping, enzymatic hydrolysis and recycling technology. Following the demonstration phase at our Virginia plant from 3rd Qtr 2012 – 1st Qtr, 2013 the Iowa plant will be scaled to commercial production capacity of 6 MMgy by early 2016 Fiberight is targeting rapid expansion of its proto-type commercial plants in markets with 100,000 or more population within a five mile radius, with special focus on municipalities with high-stranded trash costs or landfill limitations.

Fiberight's Targeted Fuel Extraction (TFE) process recognizes that solid waste is neither homogeneous nor fully convertible to energy. Fiberight has developed a remarkably innovative system that bifurcates organic and inorganic wastes and converts them according to type. Fiberight's TFE process separates, cleans and processes organic and hydrocarbon fractions then converts the organic fraction into cellulosic biofuel, the hydrocarbon fraction into plant energy and electricity, and the inert fraction into recyclables or other beneficial products. It is the residue from the fermentation of the organic (biomass such as paper and cardboard) contained in the waste that Fiberight is targeting for sale for the use of replacing other fuels at the end use facilities.

Novel technologies such as enzyme recycling and cellulosic sugar concentration are being developed to control costs and the company has tested these processes on a commercial scale. During 2012, Fiberight achieved high yield conversion factors at its Lawrenceville, VA pilot plant due to recent evolution of the robust enzyme catalysts used in strategic partnership with technical partner, Novozymes. Fiberight is now able to forecast, with extensive data back-up, its ability to produce cellulosic ethanol in a commercially viable process.

It is the understanding of the different compositions of materials contained in the nation's MSW, and the ability to focus optimized processes for their conversion without creating dangerous emissions or effluents, that differentiates Fiberight's technology from other less efficient thermal or chemical waste to energy projects. Most importantly, the technology platform has been tested at an industrial scale, all the way through finished transportation grade fuel; making Fiberight one of the first companies in the US to achieve this important milestone.

By applying a combination of expertise in the waste industry with specialty biotech knowledge, Fiberight has created a means to efficiently sort, pulp, process, digest and refine the abundant cellulosic content in organic waste materials. Our processes produce high yields of glucose which is converted into alcohol and then into the end product – fuel grade cellulosic ethanol. What differentiates Fiberight from other biofuel approaches is that we have applied our practical materials handling expertise in the recycling and waste management industries to develop the concept into a commercially viable business. Our team has taken its knowledge about production plant design, waste processing methodologies, and our expertise regarding enzymatic hydrolysis to build a profitable and solution-driven business.

Fiberight's Key Process:

- Pre-sort & primary pulping removes possibly useable materials to optimize process
- Separates Biogenic from hydrocarbon based components for efficient conversion to biofuel and credit qualification
- Creates clean plastics stream for recycling
- Wash stage for quality fractionation & ash removal
- Continuous fed batch – high solids loading for cellulosic sugar concentration
- Cellular disruption for yield maximization combined with sterilization stage
- Sterility management in enzymatic digestion & fermentation
- Secondary wash to overcome glucose inhibition & glucose losses

- Enzyme recovery enables high enzyme dosing and yield improvement while controlling cost
- Glucose concentration step improves ethanol yield & energy balance while obviating “stuck” fermentations
- By products for beneficial sale or energy production –including residual organic biomass and waste plastic fraction which is unsuitable for recycling but ideal for energy

Definition of Biomass output -The fermentation process is designed around a clean biomass pulp. It is optimized for enzymatic conversion. The Hydrolysis of the biomass fraction of the community's waste produces liquid sugars for conversion to biofuels, and a byproduct that we refer to as fermentate or NHSM. These are the materials left after the extractable sugars have been removed from the organic fraction of the carefully targeted separated waste.

This document is intended to meet the requirements of 40 CFR 241.3(c) and (d)(2) which allow that certain materials meeting the rule specified legitimacy criteria are not wastes when combusted for energy recovery.

These provisions are codified into regulations at 40 CFR part 241.3. According to the regulation at 241.3(c) The Regional Administrator may grant a non-waste determination that a non-hazardous secondary material that is used as a fuel, which is not managed within the control of the generator, is not discarded and is not a solid waste when combusted. The Fiberight facility is located within Region 7. This application is submitted to the Region 7 Administrator. The criteria and process for making such non-waste determinations includes the following:

(1) Submittal of an application to the Regional Administrator for the EPA Region where the facility or facilities are located or the Assistant Administrator for the Office of Solid Waste and Emergency Response for a determination that the non-hazardous secondary material, even though it has been transferred to a third party, has not been discarded and is indistinguishable in all relevant aspects from a fuel product. The determination will be based on whether the non-hazardous secondary material that has been discarded is a legitimate fuel as specified in paragraph (d)(1) of this section and on the following criteria:

(i) Whether market participants treat the non-hazardous secondary material as a product rather than as a solid waste;

(ii) Whether the chemical and physical identity of the non-hazardous secondary material is comparable to commercial fuels;

(iii) Whether the non-hazardous secondary material will be used in a reasonable time frame given the state of the market;

(iv) Whether the constituents in the non-hazardous secondary material are released to the air, water or land from the point of generation to the point just prior to combustion of the secondary material at levels comparable to what would otherwise be released from traditional fuels; and

(v) Other relevant factors.

Section (d)(1) establishes the legitimacy of the material as a fuel product. Each of these criteria above and the legitimacy criteria are addressed separately below.

40 CFR 241.3(c)(1)(i): Do market participants treat the material as a product rather than a solid waste?

The Fiberight process is innovative, and there are no competitors to compare this material to. We believe that in the future the market will treat this newly developed material as a valuable product, based on its significant heating value, and its similarity to other fuels, including fossil fuels. Using the fermentate for energy recovery is an opportunity to reduce greenhouse gas emissions (GHG) by replacing fossil fuels with material derived from what is essentially biomass; mostly paper and cardboard.

40 CFR 241.3(c)(1)(ii): Is the chemical and physical identity of the NHSM comparable to commercial fuels?

Table 1 is a comparison of the constituents of the material and several other fuel types.

Table 1
Comparison of Fermentate to Common Fuels

% by wt.	Spr Crk Coal[c]	Ill. Coal[c,m]	Oil[b]	Wood[a,m]	Bagasse [p]
Ash	5.7	10.80	0.09	5.30	0.80
Carbon	79.3	69.00	85.71	49.70	19.20
Chlorine		0.04	-	-	-
Hydrogen	5.9	4.90	10.14	5.40	2.60
Nitrogen	0.96	1.00	0.51	0.20	0.15
Oxygen	17.89	10.00	0.92	39.30	77.10
Sulfur	0.35	4.30	2.63	0.10	trace
HHV (Btu/lb)	9,190	10,300	18,192	8,370 (dry)	3,280
Moisture	24.1	17.6	0	5 - 75	58.7
Mercury (lb/mmBtu)[s]	8.30E-05			3.50E-06	

% by wt.	MSW[l]	RDF[l]	TDF[q]	Poult.Litter	NHSM.[o]
Ash	16.00	6.00	4.78	15.7	**4.30**
Carbon	27.90	36.10	83.87	27.2	**56.30**
Chlorine	0.10	0.10	0.09	0.71	**0.20**
Hydrogen	3.70	5.10	7.09	3.7	**7.92**
Nitrogen	0.20	0.80	0.24	2.7	**0.49**
Oxygen	20.70	31.60	2.17	23.1	**21.40**
Sulfur	0.10	0.10	1.2	0.29	**0.05**
HHV (Btu/lb)	5,100	6,200	15,500	4,637	**3,787**
Moisture	31.3	20.2	0.62	27.4	**65.1**
Mercury (lb/mmBtu)[s]		5.50E-06		5.43E-06	**3.96E-05**

As the table shows, the fermentate has a similar composition to the other commonly used fuels. Moisture is comparable with wood or bagasse, and the carbon and hydrogen components are similar to wood. In fact, the composition of the residuals is most similar to wood. Green wood is generally accepted to have an average moisture content of 40 to 50%, with as-received heating values of around 4500 Btu/lb..

Therefore, to estimate emissions from burning the material we have used EPA's AP42 criteria pollutant emission factors for wood. There is robust data for the emission factors for wood, which is not the case for biomass or paper mill sludge. For metals, we have conservatively assumed that metals in the washed pulp would not participate in the fermentation process, and would be 100% contained in the residual material. The volatility of each of the metals was then determined, and the destination (fly ash, bottom ash) was determined from research paper authored by Leslie Sloss titled, *Volatility of Trace Elements Found in Coals and Solid Fuels* (Clarke and Sloss). The metals that were assumed to be in the fly ash would be controlled by the existing bag house on Boiler No. 5. A conservative control efficiency of 93% was used to develop final emission factors. Ninety three percent is the collection efficiency given in Minnesota Rules for particles smaller than 10 microns. We, again conservatively, assumed that the emitted particles would all be smaller than 10 microns.

The emission rate of these elements was compared to emissions from coal, wood, oil bagasse, RDF, and MSW. EPA presents factors for coal, oil and wood as both controlled and uncontrolled. We assumed that most of the measurements would be controlled because boilers burning these types of fuels do have particulate emission controls; typically ESPs or bag house filters.

Table 2, shows the estimated emission rates of criteria pollutants of various fuel, and we have assumed that the most similar emissions would result from wood burning, with its similar moisture content and material makeup. Also, the NHSM discussed here is primarily derived from wood (paper and cardboard). Table 3 shows the estimated element emission rates of NHSM and other fuels. The emissions of elements are compared in Table 4.by dividing the NHSM emission rate by those factors from coal, or from wood when no factor for coal was available for a given pollutant. Table 4 shows that many of the metals are emitted in quantities equal to those from other fuels, and some of them are emitted at lower rates. There is a higher level of emissions predicted for some of the metals as compared to coal. Many of the metals listed are not considered hazardous, and they will not be discussed further herein. Those metals that are classified as hazardous air pollutants by 40 CFR Part 63, (HAPs), and that do show predicted emissions at higher values than other fuels are manganese and nickel.

Manganese is considered hazardous at air concentrations that are much higher than that found in ambient air. . The danger from manganese over exposure is in the work place; most commonly from those working as welders. The metal causes neurological damage at chronic exposures greater than 0.2 ug/m3 on an annual basis. There is no danger quantified by the Minnesota Department of Health for short term exposures. For illustrative purposes, a 25 MW coal power plant would produce approximately 0.0092 ug/m3 at maximum; approximately one percent of the health benchmark in the air surrounding the facility. This is according to an exercise performed for a utility boiler using Minnesota's Risk Assessment Screening Spreadsheet, also referred to as an AERA (See New Ulm Public Utilities Major Amendment to a Part 70 Permit application, 2009). Computer dispersion models used in the analysis are generally believed to predict results that are higher than that that will actually occur; they are a conservative estimation tool.

Nickel is a respiratory irritant, and has an acute health benchmark of 11 ug/m3, and a chronic health benchmark of 0.05 ug/m3. Nickel is also thought to cause cancer at high chronic exposures. Nickel has not been identified in Minnesota as a pollutant of concern in the ambient air. Again, likely over exposures are due to workplace contamination. Using the AERA, the maximum ambient concentration that a 25 MW coal power plant would produce is 0.11 ug/m3 on a 1-hour basis, and 0.00061 ug/m3 on an annual basis. Both estimated values are approximately one percent of the health benchmark.

All three tables are shown below.

Table 2
Emission Factors for Criteria Pollutants for Coal and Wood

Emission Factors lb/mmBtu	Coal[d,e,f]	Oil[g]	Wood[h]	Bagasse[p]	MSW[u]	RDF	Poult. Litter[t]	NHSM[o]
NOx	0.35	0.37	0.22	0.16		0.46	0.03 to 0.20	**0.22**
SOx	0.49	1.57	0.03		0.35	0.35		**0.03**
PM	0.68	0.11	0.56	2.06	2.52	0.63	0.02	**2.06**
PM2.5	0.18	0.06	0.43					**0.43**
PM10	0.50	0.10	0.50	0.18				**0.50**
CO	0.20	0.03	0.60		0.05	0.17	0.20	**0.60**
CO2	205.48	165.22	206.36	205.97	198.44	243.64		**206.36**

Criteria Pollutants are assumed to be very similar to those emitted by wood. The higher emission factor between wood and bagasse is used due to the similarity of moisture and heating value.

Table 3
Emission Factors for Coal and Wood
Metals Concentration of Fermentate

	Coal	Oil	Wood	MSW	RDF	NHSM			NHSM
	lb/mmBtu (emission)	lb/mmBtu (emission)	lb/mmBtu (emission)	lb/mmBtu (emission)	lb/mmBtu (emission)	lb/mmBtu	Percent (n) Volatile	Control	lb/mmBtu (emission)
Pollutant - lb/mmBtu	controlled and uncontrolled mixed			uncontr.	uncontr.	concentration			controlled
Antimony	7.22E-07	3.50E-05	7.90E-06				10%	90%	0.00E+00
Arsenic	5.42E-04	1.32E-03	2.20E-05	4.39E-04	5.40E-04	6.87E-04	50%	90%	3.43E-05
Barium		1.71E-05	1.70E-04				10%	90%	0.00E+00
Beryllium	8.42E-07	1.85E-05	1.10E-06				10%	90%	0.00E+00
Cadmium	4.30E-05	2.65E-06	4.10E-06	1.10E-03	7.94E-04	1.85E-04	50%	90%	9.24E-06
Chromium, total	1.57E-03	5.63E-06	2.10E-05	9.02E-04	1.27E-03	1.03E-02	10%	90%	1.03E-04
Chromium, hexavalent	3.17E-06	1.65E-06	3.50E-06				10%	90%	0.00E+00
Cobalt		4.01E-05	6.50E-06			5.81E-04	10%	90%	5.81E-06
Copper		1.17E-05	4.90E-05			1.85E-02	10%	90%	1.85E-04
Iron			9.90E-04			8.19E-01	10%	90%	8.19E-03
Lead	5.07E-04	1.01E-05	4.80E-05	2.14E-02	1.83E-02	5.81E-03	50%	90%	2.90E-04
Manganese	1.97E-05	2.00E-05	1.60E-03			1.56E-02	10%	90%	1.56E-04
Mercury	1.60E-05	7.53E-07	3.50E-06	5.63E-04	5.09E-04	7.92E-05	100%	90%	7.92E-06
Molybdenum	0.00E+00	5.25E-06	2.10E-06			5.28E-04	10%	90%	5.28E-06
Nickel	1.12E-05	5.63E-04	3.30E-05	7.89E-04	7.14E-04	5.28E-03	10%	90%	5.28E-05
Phosphorus		6.31E-05	2.70E-05			4.75E-01	10%	90%	4.75E-03
Potassium	0.00E+00		3.90E-02			1.24E-01	10%	90%	1.24E-03
Selenium	5.21E-05	4.55E-06	2.80E-06			0.00E+00	100%	90%	0.00E+00
Silver			1.70E-03			0.00E+00	10%	90%	0.00E+00
Socium			3.60E-04			0.00E+00	50%	90%	0.00E+00

Strontium		1.00E-05	1.14E-02	50%	90%	5.68E-04
Tin		2.30E-05	1.19E-02	50%	90%	5.94E-04
Titanium		2.00E-05	2.22E-02	50%	90%	1.11E-03
Vanadium	2.12E-04	9.80E-07	1.03E-02	10%	90%	1.03E-04
Yittrium		3.00E-07	0.00E+00	10%	90%	0.00E+00
Zinc	1.94E-04	4.20E-04	6.87E-02	50%	90%	3.43E-03

.

To more easily quantify the metals predicted emission rates with that of another fuel, in this case coal, with wood factors used when there existed no factor for coal for a given pollutant, we produced a ratio of predicted NHSM emissions to that of the other fuels. A value greater than one in the table below indicates that the NHSM will produce higher emissions of that pollutant. A value less than one shows that the NHSM emits less than the other fuels. The elements that are considered hazardous are highlighted

Table 4

Ratio of Element Emissions from NHSM and coal and wood

	NHSM emissions/ coal or wood emissions				
		HAP?			HAP?
Antimony	0.00	yes	**Molybdenum**	1.76	no
Arsenic	0.04	yes	**Nickel**	3.29	yes
Barium	0.00	no	**Phosphorus**	123.23	no
Beryllium	0.00	yes	**Potassium**	0.02	no
Cadmium	0.15	yes	**Selenium**	0.00	yes
Chromium, total	0.05	yes	**Silver**	0.00	no
Chromium, hex	0.00	yes	**Socium**	0.00	no
Cobalt	0.63	yes	**Strontium**	39.74	no
Copper	2.64	no	**Tin**	18.08	no
Iron	5.79	no	**Titanium**	38.82	no
Lead	0.40	yes	**Vanadium**	73.56	no
Manganese	5.55	yes	**Yittrium**	0.00	no
Mercury	0.35	yes	**Zinc**	5.72	no

40 CFR 241.3(c)(1)(iii) Will the the non-hazardous secondary material will be used in a reasonable time frame given the state of the market?

Fiberight will transfer the fuel in pellet form in covered trucks as generated. Once it reaches the customer, it will likely be dumped into underground hoppers. From the hoppers the material is conveyed via covered conveyor to silos used for fuel and/or biomass. The silo prevents exposure of the material to rain and the elements.

Section 241.3(d)(1) Legitimacy Criteria:

The rule reads:

"(d) Legitimacy criteria for non-hazardous secondary materials.

(1) Legitimacy criteria for non-hazardous secondary materials used as a fuel in combustion units include the following:

(i) The non-hazardous secondary material must be managed as a valuable commodity based on the following factors:

(A) The storage of the non-hazardous secondary material prior to use must not exceed reasonable time frames;

(B) Where there is an analogous fuel, the non-hazardous secondary material must be managed in a manner consistent with the analogous fuel or otherwise be adequately contained to prevent releases to the environment;

(C) If there is no analogous fuel, the non-hazardous secondary material must be adequately contained so as to prevent releases to the environment;

(ii) The non-hazardous secondary material must have a meaningful heating value and be used as a fuel in a combustion unit that recovers energy.

(iii) The non-hazardous secondary material must contain contaminants or groups of contaminants at levels comparable in concentration to or lower than those in traditional fuel(s) which the combustion unit is designed to burn. In determining which traditional fuel(s) a unit is designed to burn, persons may choose a traditional fuel that can be or is burned in the particular type of boiler, whether or not the combustion unit is permitted to burn that traditional fuel. In comparing contaminants between traditional fuel(s) and a non-hazardous secondary material, persons can use data for traditional fuel contaminant levels compiled from national surveys, as well as contaminant level data from the specific traditional fuel being replaced. To account for natural variability in contaminant levels, persons can use the full range of traditional fuel contaminant levels, provided such comparisons also consider variability in non-hazardous secondary material contaminant levels. Such comparisons are to be based on a direct comparison of the contaminant levels in both the non-hazardous secondary material and traditional fuel(s) prior to combustion."

Each of the legitimacy criteria requirements are discussed separately:

40 CFR Section 241.3(d)(i) Is the non-hazardous secondary material managed as a valuable commodity based on the following factors?

(A) The storage of the non-hazardous secondary material prior to use must not exceed reasonable time frames;

As discussed earlier in this document, the NHSM will be generated on a daily basis as a pellet, and will normally be transferred directly to a trailer and transported to the customer. There will be a facility to store material for a short time (maximum 5 days) to allow for transport disruption.

(B) Where there is an analogous fuel, the non-hazardous secondary material must be managed in a manner consistent with the analogous fuel or otherwise be adequately contained to prevent releases to the environment;

The material will not be exposed to the environment in any stage of the process. This meets or exceeds the containment of most similar fuels.

(C) If there is no analogous fuel, the non-hazardous secondary material must be adequately contained so as to prevent releases to the environment;

As above, there will be no exposure to the environment

40 CFR Section 241.3(d)(ii) Does the non-hazardous secondary material have a meaningful heating value and will it be used as a fuel in a combustion unit that recovers energy?

The heating value of the fuel is 3787 Btu/lb. This is higher than the heating value of Bagasse, which is recognized as a valuable fuel. The stoker boiler that will be used for the material's combustion recovers heat in its water walled boiler for providing comfort heat to the buildings on campus.

40 CFR Section 241.3(d)(iii) .Does the non-hazardous secondary material contain contaminants or groups of contaminants at levels comparable in concentration to or lower than those in traditional fuel(s) which the combustion unit is designed to burn? In determining which traditional fuel(s) a unit is designed to burn, persons may choose a traditional fuel that can be or is burned in the particular type of boiler, whether or not the combustion unit is permitted to burn that traditional fuel. In comparing contaminants between traditional fuel(s) and a non-hazardous secondary material, persons can use data for traditional fuel contaminant levels compiled from national surveys, as well as contaminant level data from the specific traditional fuel being replaced. To account for natural variability in contaminant levels, persons can use the full range of traditional fuel contaminant levels, provided such comparisons also consider variability in non-hazardous secondary material contaminant levels. Such comparisons are to be based on a direct comparison of the contaminant levels in both the non-hazardous secondary material and traditional fuel(s) prior to combustion."

We refer the reader to the detailed tables, Tables 1, 2, and 3, that present comparisons of material composition to widely used fuels, and that compare projected emissions of criteria and hazardous air pollutants with other fuels.

Conclusion: On July 5, 2012 Fiberight after obtaining public comments, received the first EPA approved pathway for municipal solid waste (MSW) to biofuel under 40 CFR 80.1450. This application demonstrates additional legitimate fuels that can be derived from the MSW. The analysis presented in this document shows that the material that Fiberight proposes to sell as fuel meets the requirements for a legitimate fuel under 40 CFR Section 241.3(d)(1). This document is an application submitted pursuant to 40 CFR Section 241.3(c). That regulation allows for certain types of non-hazardous secondary materials (NHSM) to be determined by the U.S. EPA to be non-wastes when they are used for combustion. Fiberight proposes herein that the material it wishes to produce for sale at its cellulosic ethanol plant to various customers for use in combustion units meets the criteria spelled out in the above referenced regulation; and as such is not a solid waste.

The material is similar in content to more widely used fuels, and emissions from its burning should be similar as well. Tables are included in this document that compare both constituents with other fuels, and likely air emissions.

Emission factors for criteria pollutants are likely to be similar to the burning of wood or bagasse. Metals emissions were calculated directly from analyses of the NHSM for metals content. Neither the criteria nor hazardous waste pollutants are much different from those emitted from wood, bagasse, coal, TDF, and so on. The material has a significant heating value, similar to bagasse and wood and as such, should be harvested to produce renewable energy.

9/25/13 & 10/7/13 E-mail Exchange with EPA re: Non-Waste Determination Application____

From: Bredehoft, Deborah [mailto:bredehoft.deborah@epa.gov]
Sent: Wednesday, September 25, 2013 3:19 PM
To: Jenny Reinertsen - Reinertsen Environmental Services (jreiner@frontiernet.net)
Cc: Toensing, Don
Subject: Additionally Requested Information on Fiberight

Ms. Reinertsen –

Thank you for taking a few minutes to speak with me this morning about Fiberight. As I mentioned during the call, I have outlined EPA's questions below. After you have received and reviewed these questions, could you provide me with an approximately date by which you believe you will respond?

EPA's questions:

1. Is the 8/12/2013 table in ppm of lb/MMBtu? Both units are indicated on the table.
2. Chlorine is on a dry basis, but it does not appear that any of the other pollutants are. What is the % moisture used for the other pollutants?
3. On the same table, footnote "aa" says "residual solids." Is this the NHSM material as-burned, or something else? Also, can they provide the "Summary of Chemical Analysis" spreadsheet referenced in this footnote?
4. Could you provide the moisture content in fuel product?
5. Could you provide the nitrogen and sulfur values for the finished product.
6. Could you provide the general composition of fermentate (paper, cardboard, enzyme used, tannins, etc.)? We are not looking for the chemical composition, but for more general information on what composes the fermentate.
7. How much paper stock is in the skimmings from the DAF? Are the skimmings high in plastic? Are the skimmings similar to what comes off in a recycling process?
8. Could you please indicate if there is a buyer currently lined up and interested in purchasing the fuel generated from this process?

Thanks!
Deborah Bredehoft
Environmental Engineer
RCRA Compliance Officer
USEPA/AWMD/WEMM
Phone: 913-551-7164+
Fax: 913-551-9164
E-mail: Bredehoft.Deborah@epa.gov

RESPONSE: From: Jenny Reinertsen [mailto:jreiner@frontiernet.net]
Sent: Monday, October 07, 2013 1:26 PM
To: 'bredehoft.deborah@epa.gov'
Cc: 'Tlnayes'; 'Brian Ryerson'
Subject: FW: FW: Additionally Requested Information on Fiberight

Deborah: Please see my answers to your questions below. Let me know if you have further questions, or require any additional information.

EPA Questions:

1. Is the 8/12/2013 table in ppm of lb/MMBtu? Both units are indicated on the table.

   The values given for concentration are % by weight (see cell C8 and I8) unless otherwise noted. For instance, mercury is given in lb/mmBtu units.

   The second and third tables are in lb/mmBtu units so that emissions can be compared between the fuels on a standardized basis.

   The fourth table gives elements in units of concentration, either ppm or ppmw depending on the data available. I would assume that the data given in ppm is equivalent to ppmw.

2. Chlorine is on a dry basis, but it does not appear that any of the other pollutants are. What is the % moisture used for the other pollutants?

   The numbers provided in this table are retrieved from EPA data. No % moisture is provided in those documents. For more information, see corresponding footnotes.

3. On the same table, footnote "aa" says "residual solids." Is this the NHSM material as-burned, or something else? Also, can they provide the "Summary of Chemical Analysis" spreadsheet referenced in this footnote?

   This Summary of Chemical Analysis" spreadsheet was provided in original correspondence. The spreadsheet is attached for your convenience. 'Residual solids' refers to the form of the NHSM as tested by the lab. (Washed pulp, composite, residual solids, etc…) It is the residual solids that will be burned.

4. Could you provide the moisture content in fuel product?

   Please see Summary of Chemical Analysis spreadsheet with total moisture listed.
   It is 65.1% moisture.

5. Could you provide the nitrogen and sulfur values for the finished product.

   Please see Chemical Composition and Emissions Comparison Sheet. The NHSM is:
   N-0.49% by wt.
   S-0.05% by wt.

6. Could you provide the general composition of fermentate (paper, cardboard, enzyme used, tannins, etc.)? We are not looking for the chemical composition, but for more general information on what composes the fermentate.

   The fermentate tested in 2010 was the same as Fiberight is processing now – MSW source biomass. Therefore the biomass composition would include some quantity of each of the following: cardboard, newspaper, card stock or chip board, cellulosic based packaging materials. Our enzymes used were provided by Novozymes and would have been C-Tech.

7. How much paper stock is in the skimmings from the DAF? Are the skimmings high in plastic? Are the skimmings similar to what comes off in a recycling process?

Plastics are not in the skimmings from the DAF, as most are separated from the pulp in the washing process and exit separately. The composition is approximately 60% fine cellulosic fibers and 40% ash (primarily calcium carbonate and bentonite or clay).

8. Could you please indicate if there is a buyer currently lined up and interested in purchasing the fuel generated from this process?

There is a buyer, but that entity would prefer to remain anonymous at this time. This entity uses solid fuel fired boilers for comfort heating for a large number of buildings.

Please let me know if you need additional information.

We appreciate your efforts in this matter.

Thank you,

Jenny L. Reinertsen, P.E.
Environmental Engineer
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August 12, 2013

Don Toensing, Chief, Waste Enforcement and Materials
Management Branch
EPA-Region 7
11201 Renner Boulevard
Lenexa, Kansas 66219

Subject: Additional Information For The Fiberight Request For Feedback as To The Applicability Of 40 CFR Section 241.3 Which Allows That Some NHSM Are Non-wastes

Dear Mr. Toensing;

This letter is in response to your email dated August 5th, 2013. In it, you requested a comparison of the actual contaminant concentrations between other fuels and the fermentate produced in the Fiberight process. You also requested a more detailed description of the Fiberight processing of the "fermentate" that occurs after it is separated from the ethanol process.

First, Table 1 shows a comparison of the actual contaminant concentrations in the NHSM compared to coal and other relevant fuels. The elements in bold are considered hazardous air pollutants.

Table 1

Element Concentrations						
Pollutant [cc]- lb/mmBtu	**Coal** ppm	**Oil [v]** ppm	**Wood [w]** ppm	**MSW [x]** ppm dry	**RDF [bb]** ppm	**NHSM [aa]** ppm
Antimony[cc]	**nd**	**nd**	**26.00**	**13.30**	**<5.0**	**22.00**
Arsenic[cc]	**7.60**	**0.306**	**6.80**	**6.90**	**~3.0**	**2.60**
Barium	150.00	nd	nd	nd	nd	150.00
Beryllium[cc]	**0.99**	**0.027**	**nd**	**nd**	**~1.0**	**<0.2**
Cadmium[cc]	**0.06**	**0.02**	**3.00**	**13.60**	**1.0-10.0**	**0.70**
Chlorine	nd	131	2600.00	0.716 [y]	nd	0.58 [z]
Chromium, total[cc]	**22.00**	**0.31**	**130.00**	**94.60**	**50.0-250.0**	**39.00**
Cobalt	3.90	1.63	24.00	46.70	nd	2.20
Copper	12.00	nd	nd	325.00	<1000.0	70.00
Fluorine	nd	17.5	300.00	0.014 [y]	nd	nd
Iron	140.00	nd	nd	752.70	nd	3100.00
Lead[cc]	**4.80**	**1.41**	**340.00**	**226.00**	**100.0-500.0**	**96.00**
Manganese[cc]	**35.00**	**0.35**	**840.00**	**156.80**	**~250.0**	**59.00**
Mercury[cc]	**0.22**	**0.0092**	**0.20**	**0.60**	**1.0-10.0**	**<0.3**
Molybdenum	0.19	nd	nd	29.00	nd	2.00

Nickel[cc]	**9.40**	**26**	**540.00**	**59.60**	**10.0-100.0**	**20.00**
Phosphorus	900.00	nd	nd	546.70	nd	1800.00
Potassium	0.00	nd	nd	nd	nd	470.00
Selenium[cc]	**1.50**	**0.095**	**2.00**	**nd**	**3.0-6.0**	**<0.5**
Silver	nd	nd	nd	nd	nd	nd
Sodium	nd	nd	nd	nd	nd	370.00
Strontium	nd	nd	nd	nd	nd	nd
Tin	nd	nd	nd	0.10	~500.0	45.00
Titanium	nd	nd	nd	145.00	nd	84.00
Vanadium	nd	nd	nd	37.30	nd	39.00
Yttrium	5.90	nd	nd	nd	nd	nd
Zinc	11.00	nd	nd	306.30	300.0-800.0	260.00

v: Oil; Table d-8b. trace element concentrations in fuel oil (for 1994 estimates). (1994). Retrieved from http://www.epa.gov/ttn/atw/combust/utiltox/addendum.pdf
w: Numbers are highest in range given, from: Contaminant concentrations in traditional fuels: Tables for comparison. (2011, November 29). Retrieved from http://www.epa.gov/wastes/nonhaz/define/pdfs/nhsm_cont_tf.pdf
x: Table 3.1 Elemental Composition of Bulk MSW, #'s mean of references. Municipal Solid Waste (MSW) to Liquid Fuel Synthesis, Volume 1: Availability of Feedstock and Technology. December, 2008. http://www.pnl.gov/main/publications/external/technical_reports/PNNL-18144.pdf
y: wt% daf
z: Chlorine content as a dry basis
aa: residual solids. Summary of Chemical Analysis spreadsheet.
bb: Zevenhoven. , & Kilpinen (2001, June 19). Chapter 8 trace elements, alkali metals. Retrieved from http://users.abo.fi/rzevenho/tracalk.PDF
cc: Pollutants noted (or compounds of) listed as Hazardous Air Pollutants (HAPs) in Section 112 of the U.S. Clean air Act (1970). (In Bold)

Secondly, a more detailed description of the processing of the “fermentate” that occurs after it is separated from the ethanol process follows;

Anaerobic digestion (AD) Feed Preparation System;

1. Hydrolysis solids removed in the Hydrolysis Centrifuge and Hydrolysis Filter, sludge from the wash system dissolved air flotation (DAF) sludge tank, stillage from the bottom of the beer stripper and sludge from AD plant are collected in the Dilution Tank (TK-9100).

2. This stillage is then centrifuged to remove the bulk of the solids. The concentrate, is sent to the high flow DAF Feed Tank (TK-9500) where it will be combined with the wash water system purges from the Regenex Filtrate Tank, White Water Tank and the filtrate from the Wet Cake Re-slurry Tank Belt Press (FB-9300).

3. The water from the high flow DAF feed tank is first passed through a DAF unit to reduce the suspended solids and then is sent through the Clarified Waste Water Filter Press (FP-9600) to further clarify the waste water prior to being sent to the AD plant.

4. Sludge from the DAF along with the wet cake from the stillage centrifuge is discharged to the Wet Cake Re-slurry Tank (TK-9300) to re-suspend the solids in a liquor that is low in COD. These re-slurried solids are directed to the Belt Press (FB-9300) to remove approximately 50% of the moisture.

5. The filtrate from the belt press is directed back to the high flow DAF feed tank to be reprocessed. The pressed cake from the belt press as well as filter cake from the clarified waste-water filter press is sent to a designated storage area.

6. The cake material will then be routed to a pellet mill where biomass fuel pellets will be made and subsequently dried and sold for biomass combustion. (Ref. “Scope Definition for Blairstown Renewable Energy Project at page 30 of 42, #3. AD Feed Preparation System”, Fiberight, 4-2-2013.)

We hope that this answers your questions. If this description is confusing, or you would like any other information, please do not hesitate to contact me at jreiner@frontiernet.net or (218) 834 5872.

Regards,

Jenny L. Reinertsen, P.E.