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BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

SOLID WASTE PROCESSING AND RECYCLING FACILITY
HAMPDEN, MAINE

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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 if 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 PM, VOCs, SO_2, CO, NO_X, HAPs, 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.

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 approximately 48 MMBtu/hr. Each boiler will fire approximately 5.62 tons per hour (tph) PHS at 41% 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 2**. 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 standard cubic feet per hour (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 approximately 8,322 hours per year (95% of the available annual hours). The PTE calculations and the boiler operational parameters spec sheet are attached in **Appendix B** of the license application.

TABLE 5-1
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	43.59	24.90			**78.3**
Oxides of Nitrogen (NOx)	1.52	1.45	19.82	11.32			**34.1**
Sulfur Dioxide (SO2)	2.67	25.21	13.88	7.92			**49.7**
Particulate Matter (PM)	0.54	1.55	5.94	3.39			**11.4**
Particulate Matter < 10 µm (PM 10)	0.54	1.55	4.36	2.49			**8.9**
Particulate Matter < 2.5 µm (PM 2.5)	0.54	1.55	3.96	2.26			**8.3**
Volatile Organic Compounds	0.17	0.50	2.58	1.47	2.89	2.89	**10.5**
Ammonia	0.10	0.29	0.00	0.00	0	0	**0.4**
Lead	0	0	0.85	0.85	0.00	0.00	**1.71**
hydrochloric acid	0	0	1.16	1.16	0.02	0.02	**2.36**
Mercury* (lb/yr)	0	0	0.82	0.82	0.00	0.00	**1.64**
Total HAPS	0.06	0.18	5.56	3.18	0.15	0.15	**9.3**

As has been previously discussed with the MDEP Air Bureau, the PHS as a fuel source is unique and no emission factors currently exist. The boiler manufacturer (Hurst) was able to guarantee emissions factors for criteria pollutants based on the ultimate fuel analysis but not for HAPS. In order to generate the PTE calculations for HAPs emissions, appropriate emission factors needed to be selected. Fiberight compared the PHS to traditional fuels in order to determine which was most similar. The preliminary evaluation determined that biomass emission factors (AP-42 Section 1.6) were the most representative emission factors to use for calculation of HAPS emissions. The following discussion summarizes the justification for the use of biomass emission and where applicable, the use of fuel specific emission factors.

PTE calculations for organic HAPs were based on AP-42 emission factors. Volatile HAPs were calculated based on AP-42 Section 1.6. Laboratory data is not available for these components and volatile HAPs would be expected to be destroyed during combustion in the boilers.

Table 5-2 presents the results of the PHS sampling and analysis. The average value of the dataset for each analyte was compared to the upper limit of the published EPA data. The two referenced EPA databases, both compiled by EPA's Office of Air Quality Planning and Standards (OAQPS), include approximately 12,000 contaminant analyses performed on wood/biomass samples prior to combustion. The results of the comparison demonstrate that the PHS is generally within the upper limits of the published wood/biomass contaminant levels. The PHS data set consists of multiple sets of analysis that were conducted on limited production runs of PHS from the Lawrenceville Facility. The analysis was performed on "loose" PHS and on PHS that was shipped to an outside third party to be briquetted. In some instances, the results of testing were not consistent with biomass constituents.

While the PHS is generally consistent with the ranges of contaminants in wood/biomass published by the EPA, the heavy metal contaminant concentrations in the PHS varied sufficiently from biomass to warrant using contaminant concentrations from laboratory data rather than the AP-42 emission factors. The results of metals (including mercury), chloride (precursor to hydrogen chloride), and potential SO_2 were calculated from PHS fuel analysis results. The average of the contaminant concentration values from each dataset was used to calculate the annual PTE for each constituent. The use of average actual contaminant concentration and 100% emission rate from the combustion chamber of the boiler results in PTE calculations that are conservatively high and protective of human health and the environment.

The sulfur concentrations exhibited one outlier which was significantly larger than the remainder of the test results. The tests conducted for the presence of sulfur ranged from 700 ppm to 7,200 ppm. The test yielding 7,200 ppm was considered an outlier and was not included in the dataset.

TABLE 5-2
FIBERIGHT, LLC
PHS ANALYSIS SUMMARY

	PHS[1]		EPA Sources[2]	
			Literature Sources	OAQPS Databases Data for Wood and Biomass
	Upper limit (PPM)	Average (PPM)	Upper Limit (PPM)	Upper Limit (PPM)
Antimony	43.6	11.9	26	6
Arsenic	3.5	1.35	6.8	298
Beryllium	2	0.53	n/a	10
Cadmium	5.83	2.17	3	17
Chlorine	1380	968	2600	5400
Chromium	94.7	39.3	130	340
Cobalt	13	4.63	24	213
Lead	1090	375	340	229
Manganese	214	96.2	840	15800
Mercury	0.767	0.351	0.2	1.1
Nickel	73.8	31.6	540	175
Selenium	3.95	1.38	2	9
Sulfur (dry basis)	2870	1980	8700	6100
BTU/lb (dry)	8923	8100	8000[3]	

[1] Results of five PHS sampling events.
[2] Upper limit for Wood & Biomass Materials from a combination of EPA data and literature sources, as presented in the EPA document *Contaminant Concentrations in Traditional Fuels: Tables for Comparison, November 29.2011*, available at http://www.epa.gov/rcra/contaminant-concentrations-traditional-fuels-tables-comparison.
[3] AP-42 Section 1.6.1 btu/pound for dry wood

Metals: The metals testing results were shown to be in a wide range, and it is suspected that the main reason was for this is that the material sampled was limited and depending on the actual small fraction of the sample testing, as well as the volatility of the material, yielded varied results. It is anticipated that in a full scale production facility such as in Hampden, Maine, the results will on average be consistently lower.

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, PHS is 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 100 MMBtu/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 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, 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 particulates. 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 maintenance 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 1.43 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)

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 (SO_2)

The PHS fuel contained sulfur in concentrations exceeding typical biomass sulfur content. The potential emissions of SO_2 resulting from the combustion of PHS warranted the installation of additional control devices to maintain emissions below the Minor Source threshold. Based on current fuel analysis data, anticipated average sulfur content of the fuel is expected to be approximately 0.2%. As there are limited acid gas controls available, Fiberight evaluated the feasibility of installation of a dry lime injection system. The boiler configuration allows for injection of hydrated lime (sorbent alkaline agent) directly into the flue following the cyclone and prior to the baghouse. Sorbent injection is technically feasible.

Proposed SO_2 BACT

Fiberight is proposing the installation of hydrated lime and fuel limitations as BACT for SO_2. According to the equipment vendor, Fiberight can expect a SO_2 reduction of approximately 85%. See Figure 5 for relative injection location relative to other control devices. This reduction is sufficient to maintain SO_2 emissions less than the Major Source threshold. In order to further reduce SO_2 emissions, Fiberight is proposing a maximum PHS combustion of 73,483 tons/year. The combination of these two control measures will limit SO_2 emissions to less than 50 ton/year.

The sorbent injection system has the additional benefit of simultaneously providing a reduction in the potential hydrogen chloride emissions.

6.6 Hazardous Air Pollutants (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. Subsequent to the original application submittal, additional PHS data has been collected. The heating value and concentrations of metals are presented in Table 5-2.

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 are expected to reduce the concentrations of HAPS/Metals present in the PHS to levels similar to those found in biomass. The current data demonstrates variations in heavy metals, chlorine, and mercury concentrations that if left uncontrolled could potentially cause the facility to emit HAPS at rates that may exceed the 10 ton/yr single HAP or 25 ton/year total HAPS emission threshold.

Mercury

Activated Carbon Injection: Activated carbon injection (ACI) is 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 flue gas. However, the Fiberight boiler system has been designed with the ability to provide suitable locations for injection of ACI into the flue gas. The currently proposed baghouse has adequate capacity to handle the PM increase without a corresponding increase in PM emissions. The vendor supplied mercury control efficiency is approximately 95%. This control efficiency is sufficient to meet the Mercury emission rate of 25 pounds per year (ppy) as stated in 38 MRSA § 585-B. This control technology is technically feasible.

The carbon will be injected in the duct upstream of the baghouse approximately 10 feet from the lime injection point. The exact location of the injection point will provide for the appropriate retention time to achieve the design removal rates. See Figure 5 for relative carbon injection location relative to other control devices. There will be one bulk carbon storage silo used for both boilers.

Proposed Mercury BACT

Fiberight is proposing to install an activated carbon injection system as BACT for control of mercury emissions from the combustion of PHS in the proposed boilers. The installation of carbon injection is anticipated to limit total mercury emissions to approximately 3.6 lb/year.

Heavy Metals

As discussed above, HAP metals were calculated based on the quantity of individual metals in the fuel source. With the exception of antimony, all metals were within the range of contaminant concentrations provided by the EPA. However, enough variation was present within the samples to warrant calculating the PTE of each HAP based on actual concentrations. These results are presented in the PTE calculations. PTE calculation used the average observed concentration of each component and assumed 100% of the pollutant was exhausted from the combustion chamber.

Cyclone/Baghouse: In addition to controlling PM, the multiclone/baghouse combination will collect metals that are bound to particulates which will reduce the amount of metals emitted to the atmosphere. PTE was calculated using a control efficiency of 90%. A baghouse has been previously determined to be technically feasible a part of the PM BACT analysis.

Proposed Metals BACT

Fiberight is proposing to utilize the PM collection system of cyclone/baghouse combination as BACT for metals. This will limit total metal emissions to approximately 6.92 ton/year, excluding mercury.

Hydrogen Chloride

As discussed above, hydrogen chloride (HCl) emissions were calculated based on the quantity of chloride present in the fuel source. The results of fuel analysis put Cl^- concentrations within the range of contaminant concentration provided by the EPA. However, enough variation was present within the samples to warrant calculating the PTE of HCl based on concentrations of Cl^-. These results are presented in the potential to emit calculations. PTE calculations used the highest observed concentration of Cl^- and assumed 100% conversion of Cl^- to HCl.

Proposed HCl BACT

Fiberight is proposing the installation of hydrated lime as BACT for HCl. According to the equipment vendor, Fiberight can expect an HCl reduction of approximately 95%. This reduction is sufficient to maintain HCl emissions less than the Major Source threshold. The sorbent injection system has the additional benefit of simultaneously providing a reduction in the potential SO^2 emissions.

FIGURE 1

GENERAL ARRANGEMENT PROCESS DIAGRAM

General Arrangement Process Diagram

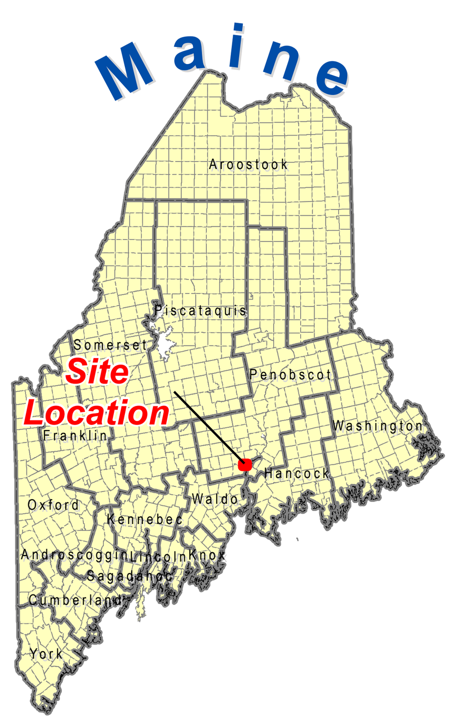
30 15 0 30 60

Feet

1 inch = 30 feet

Legend

- Pit
- Scrubber Intake
- MSW Processing Flow
- Drain
- Duct
- Wall (MSW/Processing Area)
- Stormwater Line
- Sewer Line
- Gas Line
- Water Line
- Drip Edge Outlet
- Drip Strip
- Operational Features
- Building
- Pond
- Scales
- Tank
- Road
- Anaerobic Digestion Area
- Hydrolysis Area
- Materials Recovery Facility Area
- Pulp Area
- Wash Area
- 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).

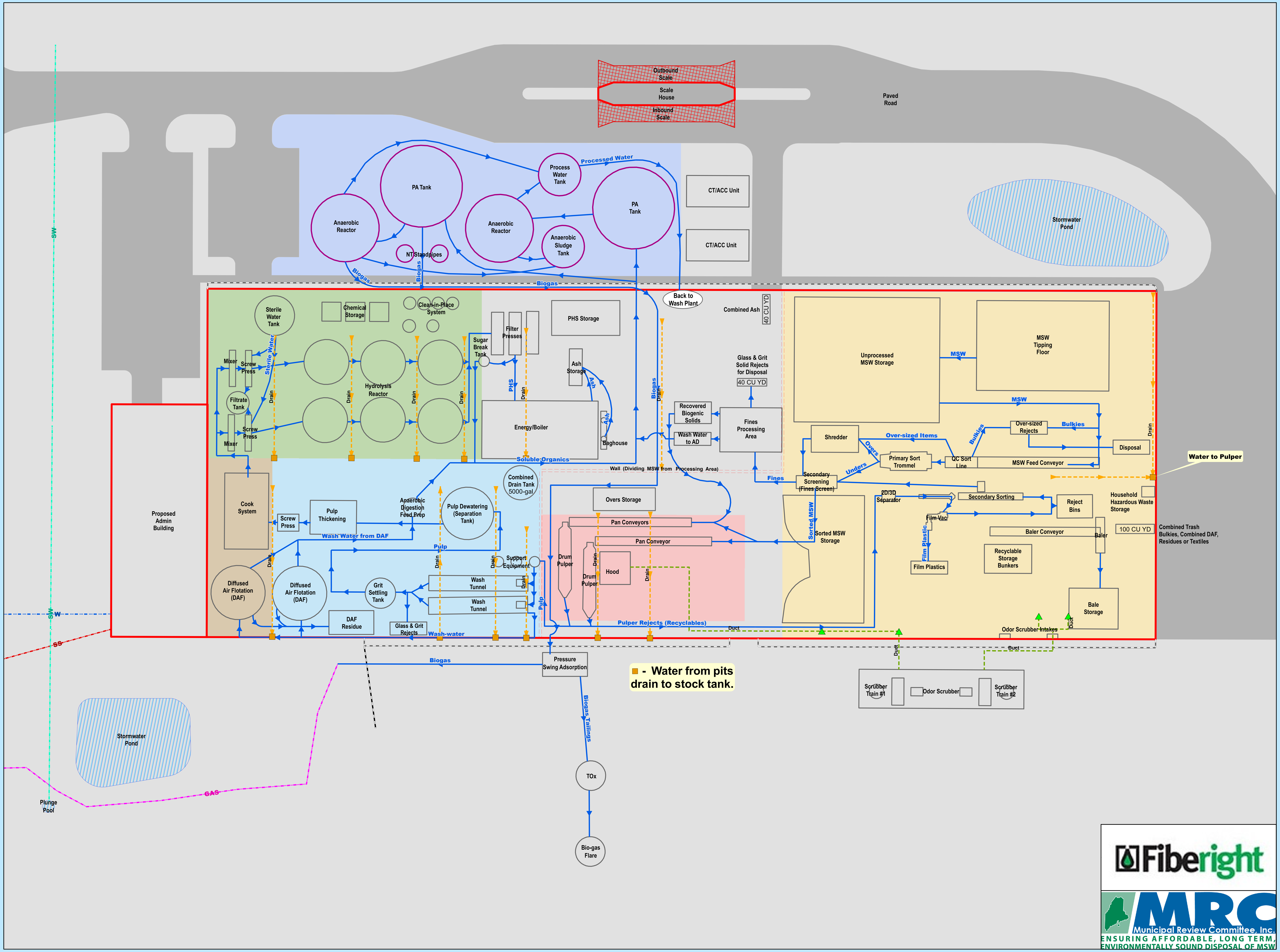
4: NORTH ARROW IS REFERENCED TO GRID NORTH.

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: 3/30/2016 [lladd]

CES INC
Engineers • Environmental Scientists • Surveyors

MXD: P:\11293-Fiberight\001-Solid Waste Facility-DSP\07-GIS_Data\MXD\General Arrangement Process Diagram 2016.mxd



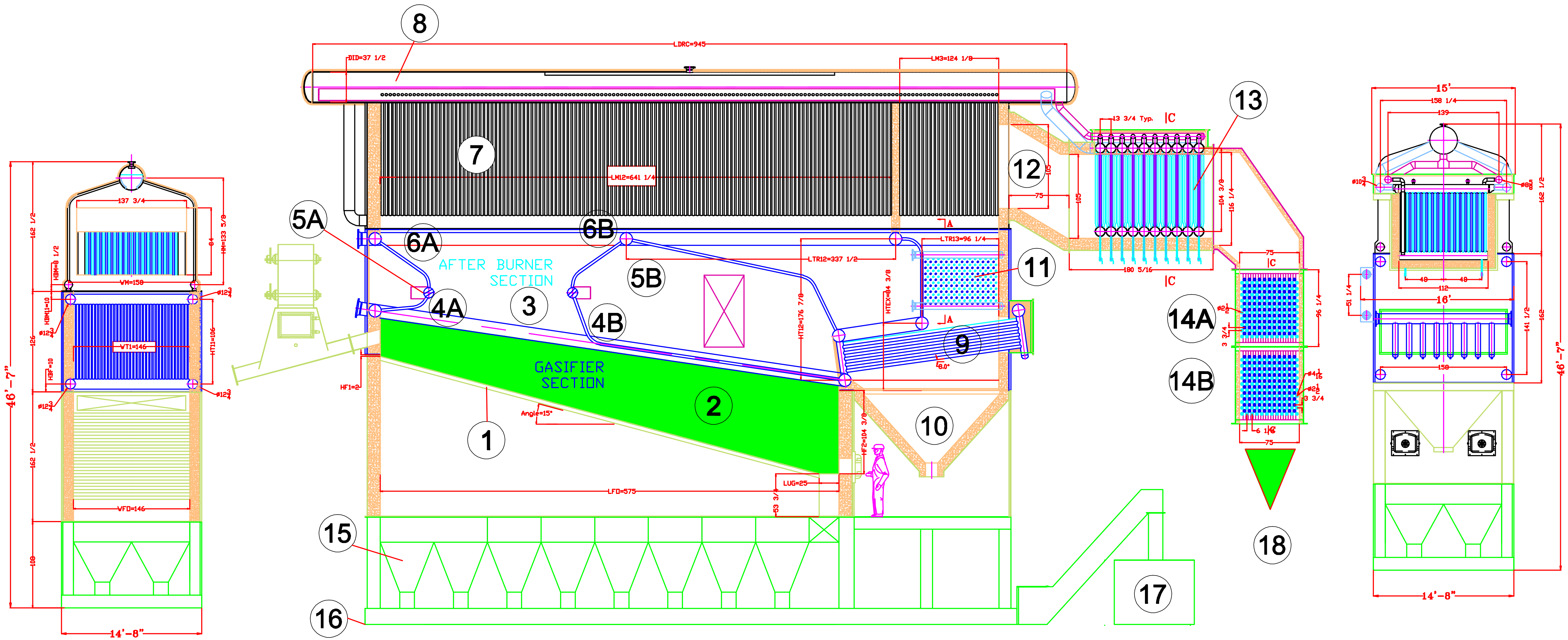
Fiberight

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	10		U-Hopper
2		Gasifier Section	11		Super Heater Section (Turbine Re-heater)
3		After Burner Section	12		Transition
4	AB	Refractory Arch	13	AB	Convective Section (Cassette Style)
5	AB	Overfire Air	14		2-Stage Economizer (2nd Stage for DA)
6	AB	Water Walls	15		Sifting Hoppers
7		Membrane Wall Section	16		Wet Ash Conveyor
8		Main Stream Drum	17		Ash Bin
9		Screener Tube Bank (Cooler)	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

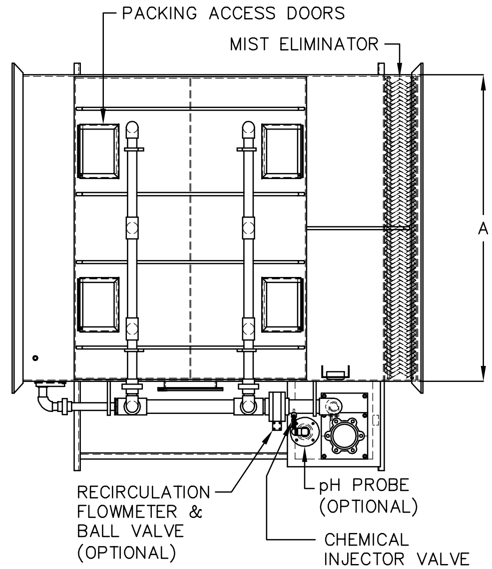
CES INC

FIGURE 3

SCRUBBER CONFIGURATION AND SPECIFICATIONS

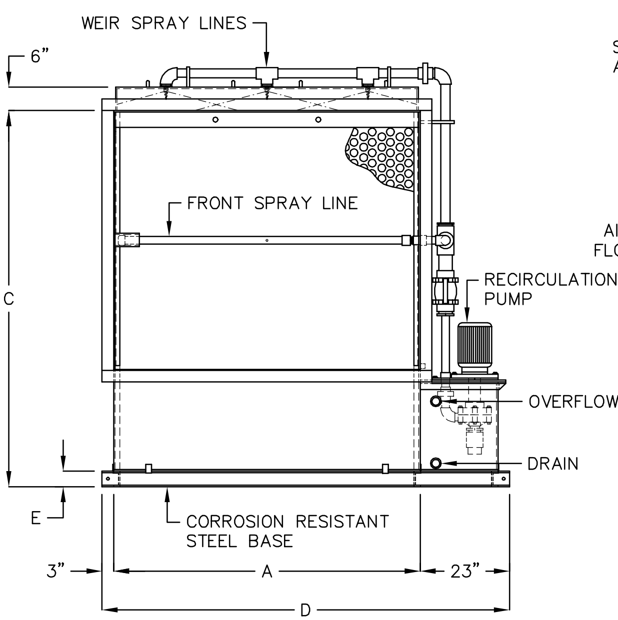
NOTES:

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.

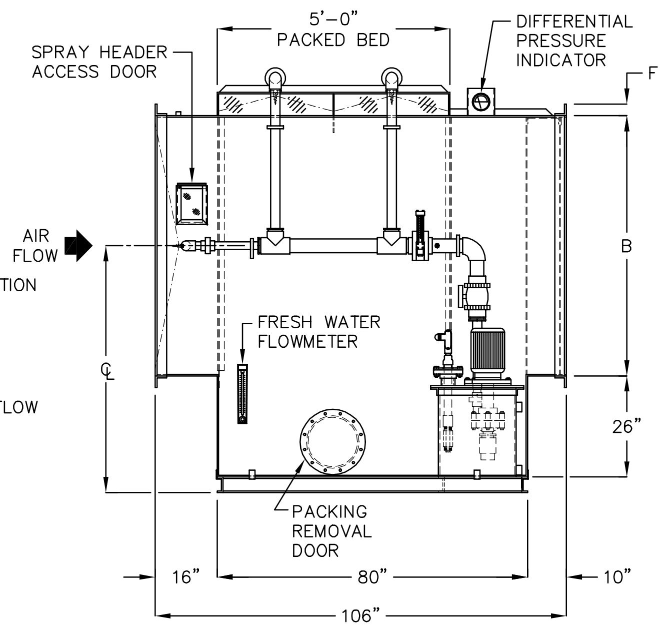


PLAN VIEW

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	43 1/2	1,237	(1) 2 HP
F105–41S	4,700	41	33	62	67	3	2	45 1/2	1,398	(1) 2 HP
F105–45S	6,000	45	37	66	71	3	2	47 1/2	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	53 1/2	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	58 1/2	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	63 1/2	2,561	(1) 7 1/2 HP
F105–84S	21,000	84	71	101	110	4	3	65 1/2	2,746	(1) 7 1/2 HP
F105–90S	23,000	90	73	103	116	4	3	66 1/2	2,990	(1) 7 1/2 HP
F105–96S	25,000	96	73	103	122	4	3	66 1/2	3,173	(1) 7 1/2 HP
F105–104S	27,000	104	73	103	130	4	3	66 1/2	3,524	(1) 7 1/2 HP
F105–112S	30,000	112	73	103	138	4	3	66 1/2	3,918	(1) 7 1/2 HP
F105–123S	32,500	123	73	103	149	4	3	66 1/2	4,081	(1) 7 1/2 HP
F105–135S	35,000	135	73	103	161	4	3	66 1/2	4,473	(1) 7 1/2 HP
F105–157S	40,000	157	73	103	183	4	3	66 1/2	5,137	(2) 7 1/2 HP
F105–179S	45,000	179	73	103	205	4	3	66 1/2	5,635	(2) 7 1/2 HP
F105–202S	52,000	202	73	103	228	4	3	66 1/2	6,233	(2) 7 1/2 HP
F105–224S	57,000	224	73	103	250	4	3	66 1/2	6,794	(2) 7 1/2 HP
F105–247S	63,000	247	73	103	273	4	3	66 1/2	7,329	(2) 7 1/2 HP



LEFT ELEVATION



FRONT ELEVATION

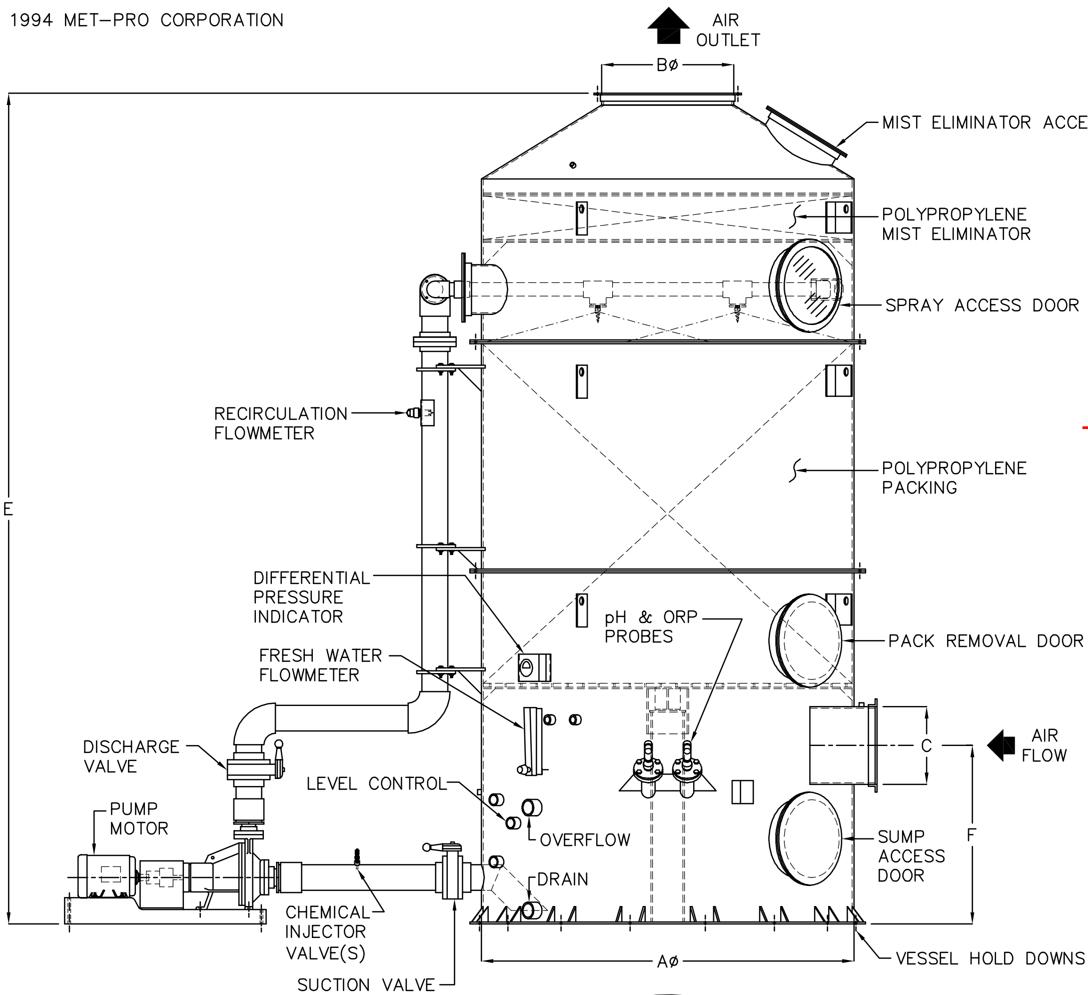
MODEL F105 SCRUBBER (SELF CONTAINED RECIRCULATION)

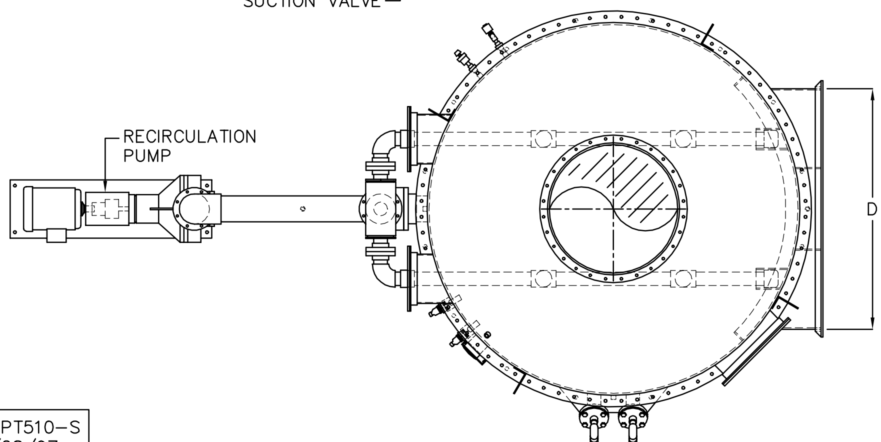
MET PRO CORPORATION

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.

CAD NO. F105SS
DATE: 7/28/97





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:

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 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.

CAD NO. PT510–S
DATE: 7/28/97

FIGURE 4

FLARE AND HYBRID THERMAL OXIDIZER SPECIFICATIONS

December 1, 2015

Via Email: aiantosca@fiberight.com

Fiberight LLC
PO Box 21171
Catonsville, MD 21228

Attention: Mr. Alan Iantosca

Subject: Budget Proposal for Low BTU Enclosed Flare and Elevated Flare
Fiberight – Hampden, ME
John Zink Proposal BF-201511-59410, r1

Dear Alan,

Thank you for your recent interest in John Zink Company services and products. We appreciate the opportunity to assist you with the flare portion of your project. To satisfy your gas flare requirements per your recent request, John Zink Company is pleased to offer a budget quote for our **Enclosed ZBRID System for Low BTU Gases and Elevated ZEF® Flare System.**

For over 80 years, the John Zink brand has provided quality, innovative technology, and worldwide service in the combustion industry. John Zink has supplied over 700 flare systems for the biogas industry and we possess the expertise and resources to ensure a successful flare project and reliable flare performance.

John Zink offers a range of features and options as listed in the following "Equipment Description" section. Our intent is to supply the safest, most reliable and economical system available that will also allow you to customize your system to meet your specific needs. After reviewing the proposal, please let us know if there are any additional options you would like to pursue.

We look forward to working with you on this project, and if you require any additional information please do not hesitate to contact me at 918.234.4760, or our local sales representative, David Ryan, at 610.517.2400.

Sincerely,
JOHN ZINK COMPANY, LLC

Ryan Talley
Applications Engineer
Biogas Flare Division

DESIGN CRITERIA

ZBRID Waste Gas Stream – Design Conditions

Type:	Biogas
Composition:	10.89% CH4 Remainder CO2, air, inerts *1,600 ppmv H_2S*
Flow Rate:	193-386 SCFM (maximum)
Temperature:	150 ^oF
Waste Heat Release:	**2.3 MM BTU/hr (maximum)**
Inlet Pressure:	20" H_2O (required at flare inlet)

ZBRID Supplemental Fuel Gas Stream

Type:	Digester Gas
Composition:	70% CH4 (maximum) Remainder CO2, air, inerts
Max Digester Gas Flow Rate:	209 SCFM (maximum)
Fuel Heat Release:	***8.0 MM BTU/hr (maximum during startup)**
Inlet Pressure:	20" H_2O (required upstream of TCV)
Maximum Heat Release for Stack:	***10.8 MM BTU/hr (maximum)**

*The initial fuel needed to pre-heat the combustion chamber to a minimum 1500 F prior to injecting the waste gas stream is 8.0 MM Btu/hr. After temperature is reached, this flowrate will continue to decrease as needed to maintain a specific operating temperature. During normal operations, we expect that **0.7-1.0 MM BTU/hr (18 – 26 SCFM of Digester Gas)** of supplemental fuel gas will be needed to maintain operating temperature.

Elevated Flare Digester Gas Stream – Design Conditions

Type:	Digester Gas
Composition:	70% CH4 (maximum) Remainder CO2, air, inerts
Flow Rate:	1200 SCFM (maximum)
Temperature:	100 ^oF
Waste Heat Release:	**45.9 MM BTU/hr (maximum)**
Inlet Pressure:	10" H_2O (required at flare inlet)

Mechanical

Design Wind Speed:	110 mph
Ambient Temperature:	32 °F to 120 °F
Electrical Area Classification:	non-hazardous
Elevation:	108 feet above MSL

Process

Smokeless Capacity:	100%
Operating Temperature:	1400 °F to 1800 °F (2000 °F shutdown)
Retention Time:	0.7 seconds at 1800 °F (minimum)
Required Flame Arrester Inlet Pressure:	10” H_2O (maximum)
Ambient Pressure:	14.7 psia

Utilities

Pilot Gas (intermittent):	22 SCFH of propane at 7-10 psig (or) 50 SCFH of natural gas at 10-15 psig
Compressed Air:	None
Electricity:	120 V, 1 ph, 60 Hz
Auxiliary Fuel:	Digester Gas

Expected Flue Gas (ZBRID Low Btu Flare)

Operating Temperature	1600ºF	1800ºF
CO_2 Volume %	7.0	8.1
H_2O Volume %	8.2	9.2
N_2 Volume %	72.6	71.8
O_2 Volume %	12.2	10.9

Estimated Emission Range (Design Flow With Digester Gas Supplemental Fuel)[(1)]

Operating Temperature	1400 – 1800 ºF
Overall Destruction Efficiency[(2)]	98%
NOx, lb / MMBTU[(3)]	0.08 – 0.10
CO, lb / MMBTU[(4)]	0.20

[(1)] Expected emission rates at lower operating temperatures are available upon request.
[(2)] Typical sulphur containing compounds are expected to have greater than 98% oxidation efficiency.
[(3)] Excludes NOx from fixed nitrogen.
[(4)] Excludes CO contribution present in landfill gas.

Expected Emission Range for Elevated ZEF Digester Flare[(1)]

Overall Destruction Efficiency[(2)]	98%
NOx, lb / MMBTU[(3)]	0.068
CO, lb / MMBTU[(4)]	0.37

[(1)].Emissions and destruction efficiency stated are based on EPA 40 CFR 60.18 and AP-42 Supplement D
[(2)] Typical sulphur containing compounds are expected to have greater than 98% oxidation efficiency.
[(3)] Excludes NOx from fixed nitrogen.
[(4)] Excludes CO contribution present in landfill gas.

NOTE: Expected emissions are based on field tests of operating units and the higher heating value (HHV) of the gas. Destruction efficiency, NOx, and CO emissions shown are valid for combustion of digester gas only. Expected emissions are not guaranteed unless expressly stated in this proposal.

SCOPE OF SUPPLY

Item 1, Enclosed Flare (ZBRID)

- One (1) 5'-0" diameter x 40'-0" overall height, A-36 carbon steel flare stack enclosure.
- Two (2) 1" layers of *A.P. Green* (or equal) ceramic fiber refractory on Inconel pins and keepers for the top portion of the stack. The bottom portion of the combustion chamber will be lined with castable refractory to create a heat zone for superior combustion.
- One (1) stainless steel manifold assembly with 4" flanged inlet connection for the waste gas stream.
- One (1) carbon steel burner manifold assembly with 4" diameter flanged inlet connection for the fuel gas stream.
- One (1) Tru-Lite™ igniter assembly for use during start-up cycles. This externally mounted pilot provides simple operation and can be removed for maintenance without entering the stack.
- One (1) bolted blade combustion air damper with opposed blade design, providing air turndown control. Galvanized finish and stainless steel press-fit bearings ensure smooth, long term operation. A special, proprietary lower burner chamber design minimizes direct radiation on the damper for maximum service life.

  NOTE: *Removal of the damper allows access to the lower flare burner chamber and eliminates the need for a separate manway.*

- Two (2) 4" diameter NPT couplings with plug provided as sample ports at 90° apart located one-half stack diameter from the flare top for accurate emission testing.
  NOTE: *These ports can be accessed by use of a temporary device such as power-lift vehicle or permanent ladder and platform equipment (refer to the recommended optional equipment section for ladder and platform selection).*
- One (1) stainless steel rain cap consisting of overlapping tabs to provide weather protection at the refractory and flare shell interface.
- Four (4) thermocouple connections at various elevations for temperature monitoring.
- Exterior protection using SSPC-SP-6 sandblast, *Sherwin Williams* Zinc Clad II primer coating system, 4 mils DFT for superior corrosion protection at shell temperatures to 750 °F**.**
- One (1) AISC designed continuous base plate for high wind stability.
- Two (2) lifting lugs to assist in erection.
- Thermocouple conduit mounting brackets.

Miscellaneous Accessories

- Four (4) operating manuals (one (1) hard copy, three (3) electronic copies on CD) with essential operating instructions, appropriate vendor literature on instrumentation, and drawings.
- 400 ft of thermocouple extension wire.

Item 2, Zink Elevated Flare (ZEF®)

- One (1) integral, stainless steel Biogas Flare Tip with stainless steel windshield.
- One (1) main flame monitoring thermocouple with 100' of extension thermocouple wire per thermocouple. This thermocouple design incorporates adjustable positioning and allows removal from grade.

- One (1) KE-1B Electronic Ignition Flare Pilot Assembly with stack mounted, weatherproof (NEMA 4) Ignition Transformer Panel and 25' of extension ignition wire.
- One (1) pilot flame monitoring thermocouple with 100' of extension thermocouple wire.
- One (1) 8" diameter, 25' high steel flare stack with 8" diameter inlet, 1" diameter drain connection, AISC designed continuous baseplate, and lifting lugs.
- Exterior protection (carbon steel) using SSPC-SP-6 surface preparation and a single coat of inorganic zinc primer, 4 mils DFT.
- One (1) temperature switch mounted to flare inlet for flame flashback indication.

Item 3, <u>Automatic Ignition and Control Station</u>

Control Station Assembly

- One (1) self-supporting steel rack with electrical panels attached to the front side and pilot gas piping and instrumentation attached to the rear side.
- One (1) weatherproof Flare Control Panel with the following 120V items:
  - One (1) Allen Bradley Compact Logix programmable logic controller for safe, overall system operation and control.
  - One (1) operator interface touch screen display for all set point changes, status, alarms, and shut down indications.
  - One (1) temperature switch for high temperature shutdown on the ZBRID.
  - One (1) flame scanner relay for the ZBRID.
  - One (1) purge air blower motor starter for the ZBRID.
- Two (2) Pilot Gas Control Systems including a pressure regulator, fail-closed shutdown valve, manual block valve, and pressure indicator, one for the Elevated Flare and one for the ZBRID.
- The control station assembly is completely piped and wired in a *UL* approved shop and functionally tested simulating actual operations.

Stack Mounted Controls for ZBRID (shipped loose for field installation by others)

- One (1) combustion air damper to control the operating temperature. As part of the automatic temperature control feature, the damper is equipped with automatically controlled louvers.
- One (1) Ignition Panel Assembly including a transformer, pilot spark electrode, and ignition wire. The enclosure is stack mounted for easy access to the pilot assembly.
- One (1) purge air blower.
- One (1) high temperature shutdown thermocouple.
- Three (3) temperature monitoring dual element thermocouples with location dependent on specific flow conditions. The operating thermocouple can be selected either automatically based on the flow rate or manually from the touch screen display.

Item 4, <u>Inlet Flame Arresters</u>

- One (1) 4" diameter, eccentric *Enardo* Flame Arrester with aluminum housing, housing drain, and removable aluminum internals mounted at the flare inlet on the ZBRID auxiliary fuel line. Internal elements can be cleaned without removing the flame arrester body from the pipe.
- One (1) 4" diameter, eccentric *Enardo* Flame Arrester with aluminum housing, housing drain, thermocouple at the inlet, and removable stainless steel internals mounted at the

flare inlet on the ZBRID waste gas line. Internal elements can be cleaned without removing the flame arrester body from the pipe.

- One (1) 8" diameter, eccentric *Enardo* Flame Arrester with aluminum housing, housing drain, and removable aluminum internals mounted at the elevated flare inlet. Internal elements can be cleaned without removing the flame arrester body from the pipe.

Item 5, Three (3) Automatic Block Valves

- Two (2) 4" automatic block valve assembles consisting of a butterfly valve and fail-closed pneumatic actuator. The valve has a carbon steel wafer body, 316 SS disk and shaft, and PTFE seal. The pneumatic actuator can be operated with either compressed air or compressed nitrogen from a cylinder. One 4" valve is for the ZBRID fuel gas stream, and the other is for the ZBRID waste gas stream.
- One (1) 8" automatic block valve assembles consisting of a butterfly valve and fail-closed pneumatic actuator. The valve has a carbon steel wafer body, 316 SS disk and shaft, and PTFE seal. The pneumatic actuator can be operated with either compressed air or compressed nitrogen from a cylinder. The 8" valve is for the digester gas line for the elevated flare.

Item 6, Flow Meter

- Three (3) thermal mass flow meter assemblies with 316 stainless steel probe for 1" NPT mounting. One for the waste gas line, one for the fuel gas line, and one for the digester gas line for the elevated flare.

Item 7, Fuel Control Valve

- One (1) temperature control valve assembly consisting of a v-port valve with electric actuator. The valve has a 316 SS body, 316 SS disk and shaft, and PTFE seal. The fuel control valve controls the fuel flow rate based off the stack temperature, and is tuned to minimize the amount of fuel gas needed for adequate combustion.

RECOMMENDED OPTIONAL EQUIPMENT

Item 8, ZBRID Access Ladder

- One (1) galvanized, safety ladder providing access to thermocouples. Equipment includes a ladder, safety rails, a safety harness, and personnel protection screening behind the ladder and around the thermocouple ports. A lockable gate is available for an additional price.

Item 9, ZBRID Service Platform

- One (1) galvanized, 150° service platform, designed per *OSHA* requirements, providing access to the stack sample ports. A continuous band of personnel protection screening around the sample ports is included with this option. A 360° service platform is available for an additional price.

Item 10, Control Panel Weather Hood

- One (1) fabricated steel hood designed to limit control panel exposure to the elements. It provides approximately 4' of overhang to the front and 2' to the rear. The hood is painted to match the rest of the control panel rack and comes with a fluorescent light assembly for enhanced visibility of the panel components at night.

Item 11, *Underwriters Laboratories* Classification

- John Zink Company is dedicated to ensuring the highest level of quality and safety standards in its products. This performance level is reflected in all products and provides the opportunity to apply the *UL* listing symbol for Industrial Control Panels on motor starters and a *UL* classification symbol on Flare Control Panels. This option is provided for applications requiring *Underwriters Laboratories* Certification.

BUDGET PRICE ITEMS 1 THRU 7 $207,000
(does not include shipping, taxes, or field services)

Recommended Optional Equipment Pricing

8. One (1) Access Ladder (ZBRID only) $7,000

9. One (1) Service Platform (ZBRID only) $10,000

10. One (1) Control Panel Weather Hood $2,500

11. *Underwriters Laboratories* Classification $2,500

John Zink Field Service for start-up, training, or testing assistance is available per the attached rate sheet.

PAYMENT AND TERMS SUMMARY

This is a budgetary proposal and is intended only as an estimate to facilitate your planning processes and does not constitute a commitment or offer to sell goods or services at the prices and terms referenced herein. Any firm offer or binding quotation will be the subject of a formal proposal at a future date.

The shipping terms are Ex Works Tulsa, OK. The price does not include any shipping and handling, or any taxes other than John Zink's contributions for unemployment insurance, old age retirement benefits, pensions, and annuities.

The price is based on the following terms of payment:
- 15% of order price due upon issuance of the order
- 50% of order price due upon issuance of general arrangement drawings
- 35% of order price due upon notification of availability for shipment*

*This payment is required in full prior to shipment or secure with a bank letter of credit. Payment is required in United States currency. A guaranteed form of payment acceptable to John Zink, such as, corporate or personal guarantees, payment by a confirmed, irrevocable letter of credit, or by three-party check may be required by John Zink.

DELIVERY SCHEDULE

Based on a release to purchase major materials at the time an order is accepted, John Zink offers the following delivery schedule:

- Initial general arrangement drawing submittal: 6-8 weeks after acceptance of the order
- Completion of fabrication: 14-16 weeks after drawing approval, or Equipment PO

An improved schedule may be arranged based on specific project requirements. Waiving drawing approval will improve the schedule by 2 – 3 weeks.

Shipping will be via common carrier. Portions of the unit will be shipped loose to reduce shipping costs and damage to the unit.

OTHER CONDITIONS

Title of Goods

Title to the goods and services subject of this order shall pass to the Buyer only when John Zink Company receives payment in full therefor. The Buyer shall cooperate, if requested, in proper filings and other procedures necessary to assure that John Zink Company shall retain perfected security interest in the goods and services.

Changes to the Scope of Work

Price is based on the inquiry design information. In the event of a process change, John Zink reserves the right to alter the equipment design in order to maintain safe engineering practices. If additions or deletions to the scope of work are required after an order is received, John Zink will submit a price summary to the customer for approval. Equipment dimensions, sizes, and sub-venders offered in this quotation shall be subject to change after the design is finalized.

Field Service

Start-up and training services are not included unless specifically noted above. If field service is requested, it shall be performed according to the terms of the attached John Zink Technical Assistance Agreement.

GENERAL SCOPE OF WORK

John Zink will furnish the labor, materials, and equipment necessary to fabricate the system offered.

For the purpose of clarification, the supplies to be delivered will include general bolts, nuts, washers, gaskets, and similar fasteners associated with the assembly of the system supplied by John Zink.

The following items are not included in the supplies to be delivered:

- Detailed fabrication drawing. Customer approval drawings include the necessary dimensions, nozzle placements, structural details, and other data required to assemble the system.
- All civil works. John Zink will supply the data necessary to design such civil works by providing loading information for the system.
- Erection of system or installation of piping or instruments. John Zink, if requested, can supply turnkey installations.
- The supply or installation of fireproofing materials, personnel protection, heat tracing, external insulation, electrical/thermocouple wire, conduit, piping, finish paint, and other miscellaneous hardware unless specifically noted.
- Permits, licenses, and approval by and from authorities to install, test, and operate the system.
- Preparation of drawings, forms and/or data for approval by state or local agencies of the design of the system, unless otherwise noted.
- Compliance with state, local, or municipal codes, except as specifically identified. The system will be designed to applicable national codes and standards. However, John Zink has numerous similar systems operating in many of the states and is knowledgeable in coordinating with the respective regulatory authorities and, if requested, can comply with the agreed upon local requirement.

CLARIFICATIONS

- A minimum undisturbed distance is required for the proper installation and performance of the flow meter. A distance of approximately ten pipe diameters of straight pipe is required before the flow meter and approximately five pipe diameters of straight pipe after the flow meter. Flow meter provided by purchaser.

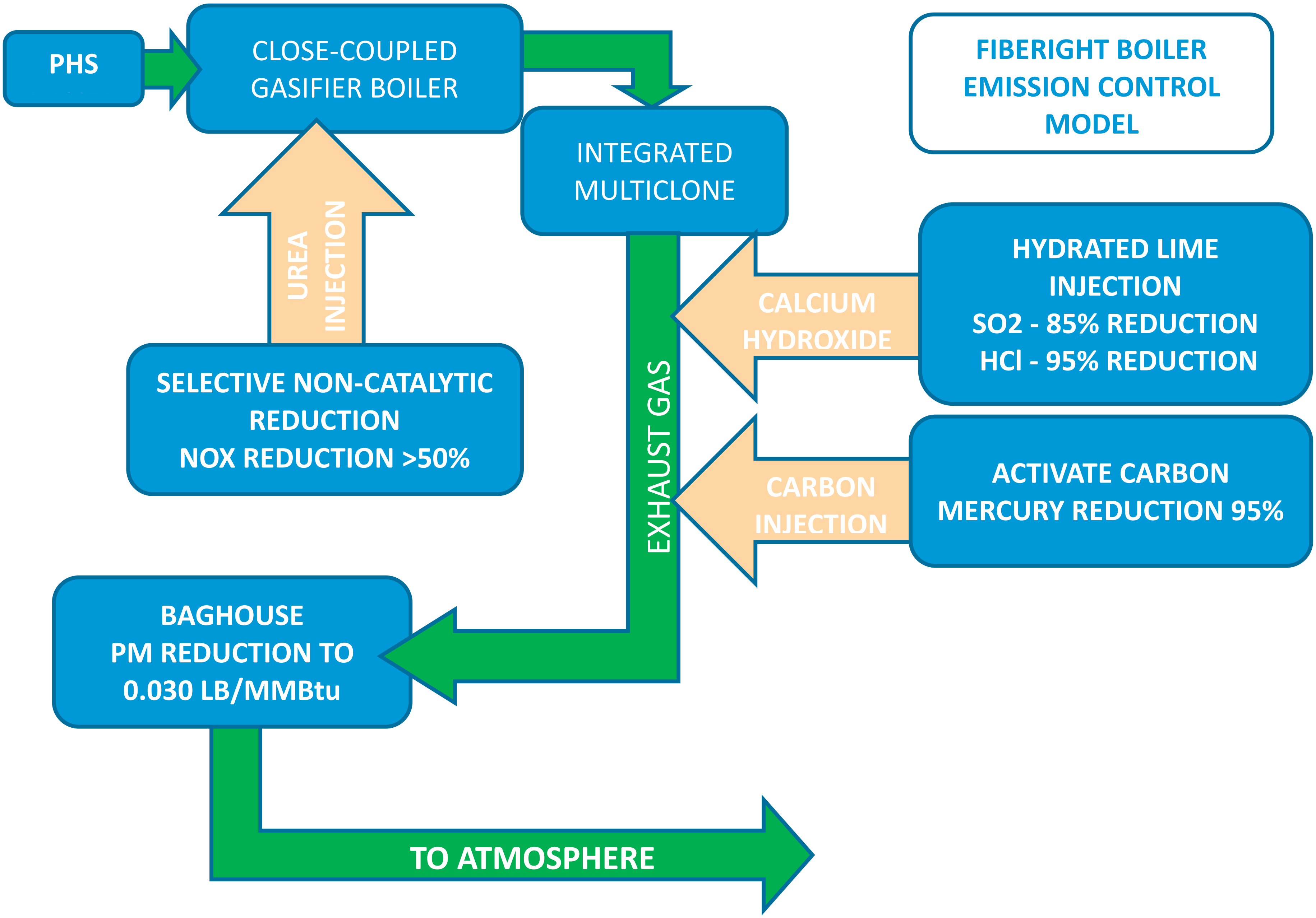
ATTACHMENTS

- John Zink Standard Terms and Conditions
- Technical Service Agreement

FIGURE 5

FIBERIGHT BOILER EMISSION CONTROL MODEL

CES INC


FIBERIGHT BOILER EMISSION CONTROL MODEL
PHS
CLOSE-COUPLED GASIFIER BOILER
INTEGRATED MULTICLONE
UREA INJECTION
SELECTIVE NON-CATALYTIC REDUCTION
NOX REDUCTION >50%
EXHAUST GAS
CALCIUM HYDROXIDE
HYDRATED LIME INJECTION
SO2 - 85% REDUCTION
HCl - 95% REDUCTION
CARBON INJECTION
ACTIVATE CARBON
MERCURY REDUCTION 95%
BAGHOUSE
PM REDUCTION TO
0.030 LB/MMBtu
TO ATMOSPHERE