Table 6-13. Results of the NMU NO_x SIL Modeling Analysis (01-05 SAW MET)

Averaging Period	NMU Maximum Impact [1] ($\mu g/m^3$)	Year of Maximum Impact	Impact UTM Easting (meters)	Impact UTM Northing (meters)	Significant Impact Level ($\mu g/m^3$)	NMU Impact As % Of SIL
Annual	0.974	2005	468,960.8	5,157,154.0	1	97.40%

[1] Consistent with how the standards are applied, the maximum annual impact is based upon the highest of the 1st high impacts determined using five discrete years of meteorological data (2001 through 2005).

6.6 TAC MODELING ANALYSIS RESULTS

In addition to the criteria pollutant modeling analyses, a TAC modeling analysis has been conducted to demonstrate that the emissions of TACs from the new CFB boiler (Unit #10) will be in compliance with the Michigan AQD's air toxics regulations. Refined modeling for TACs was performed to determine the ambient, off-property impact from trace metals and organic compounds emitted from the new boiler.

Modeling was performed in accordance with the same methodology used for the criteria pollutant modeling and followed all regulations, guidelines and policies established by U.S. EPA and MDEQ, and again utilized the ISC-AERMOD (PRIME) model Version 04300. Michigan Rule 225 states that emissions from the new or modified source shall not cause a violation of the Initial Threshold Screening Level (ITSL) for non-carcinogens or Initial Risk Screening Level (IRSL) for carcinogenic compounds.

The results were determined by scaling the emission rate for each TAC by model predicted impacts based on a 1.0 gram/second model run for the averaging period associated with each TAC's applicable screening. Using this methodology, it is possible to determine the ambient impacts for multiple pollutants based on one model run instead of running a model for each TAC individually.

The emission rate of each TAC was determined by taking the maximum short term emission rate of each compound for the various fuel types that could potentially be used in the proposed CFB boiler. Table B-2 of Appendix B shows the maximum short term emission rates on a compound-

by-compound basis, which were then converted into gram/second emission rates for scaling purposes. The emission rates and calculated ambient impacts for all TACs (which includes HAPs) are presented in Table C-1 of Appendix C.

The following is a brief description of the procedure for using the gram per second modeled impacts to determine a specific pollutant's maximum ground level concentration.

Worst Case Acetaldehyde Impact, 24-Hour Averaging Period

CFB Boiler Stack Acetaldehyde Emission Rate = 2.47E-02 gram/sec

Gram/Second Modeled Impact for 24-hour averaging period = 1.589 ($\mu g/m^3$)/(g/sec)

$$Acetaldehyde\ Impact = \frac{1.589\ (\mu g/m^3)}{(1\ gram/second)} \times \frac{2.47E\text{-}02\ grams}{second}$$

$$Acetaldehyde\ Impact = \frac{0.0392\ \mu g\ Acetaldehyde}{m^3}$$

As shown in the preceding calculations, the acetaldehyde emissions from the new CFB boiler exhaust stack results in a 24-hour impact of 0.0392 $\mu g/m^3$, which is approximately 0.44% of the acetaldehyde screening level of 9 $\mu g/m^3$ on a 24-hour basis.

The modeled impacts associated with the annual, 1-hour, 8-hour, and 24-hour modeled averaging periods for the new CFB boiler exhaust stack are presented in Table 6-14.

Table 6-14. 1.0 Gram Per Second Modeled Impacts for the New CFB Boiler

Averaging Period	Modeled Impact ($\mu g/m^3$)/(g/sec)	X (East) Impact Location [1] (meters)	Y (North) Impact Location [1] (meters)	Receptor Elevation (meters)
Annual	0.211	468,960.8	5,157,204.0	193.79
24-Hour	1.589	468,760.8	5,156,254.0	201.88
8-Hour	2.712	466,860.8	5,151,904.0	283.74
1-Hour	15.779	466,860.8	5,151,904.0	283.74

[1] These distances are referenced from the site ordinate (UTM coordinate Easting = 468,874.0 meters, and Northing = 5,156,608.0 meters).

Table C-1 of Appendix C presents the results of applying the modeled impacts of Table 6-14 to the maximum TAC emission rates. Table C-1 shows that the TAC emitted at the highest hourly rate, hydrochloric acid (HCl), results in an ambient impact of 0.24 $\mu g/m^3$ when scaled by the 24-hour modeled impact. This impact is approximately 1.2% of the allowable screening level (SL) of 20 $\mu g/m^3$ on a 24-hour averaging period basis. Similarly, the TAC that is expected to have the highest ambient impacts versus its screening level is formaldehyde, which has been predicted to result in a maximum annual ambient impact of 0.028 $\mu g/m^3$ - approximately 34% of the allowable screening level (SL) of 0.08 $\mu g/m^3$ on an annual averaging period basis. (Note that although the impact for chromium VI is predicted to be approximately 26% of its screening level, the emission rate quantified for Cr VI is uncontrolled and is expected to be much less than the rate presented in Table C-1, and thus result in a much lower impact after considering control efficiency of the baghouse).

Overall, the results presented in Table C-1 show that all TACs will comply with the applicable screening levels at the maximum predicted emission rates and thus comply with the Michigan AQD air toxics rules.

It should be noted that although the Michigan AQD ITSL for lead (Pb) has a 3-month averaging period, a 24-hour ambient impact has been determined and compared to the ITSL of 1.5 $\mu g/m^3$ on a 3-month basis. This represents a conservative approach because it over predicts the ambient impact that would occur on a 3-month basis.

In conclusion, the proposed operation of the NMU facility expansion will be in compliance with all applicable federal and state ambient air quality standards for both criteria pollutants and TAC emissions.

6.7 DISPERSION MODELING FILES

Table 6-15 lists the ISC AERMOD files that have been included in Appendix C on compact disc. These include the complete Lakes Environmental project files for all modeling runs. The Marquette OE East and Marquette 7.5-minute DEM files utilized in determining elevated terrain through AERMAP are also included electronically.

Table 6-18. Summary of the NMU Modeling Files

ISC AERMOD View Files	File Description	Meteorological Data
NMU01_CO through NMU05_CO	CO SIL Models	2001-2005
NMUPM_P1 through NMUPM_P5	PM_{10} SIL Models	2001-2005
NMU01SO2 through NMU05SO2	SO_2 PSD and NAAQS Models	2001-2005
NMU_NOx1 through NMU_NOx5	NO_x SIL Models	2001-2005
NMU_GPS2	TAC modeling Gram/Second Model	2005

7.0 SECONDARY IMPACT ANALYSIS

An additional impact analysis is required for major new sources or major modifications at existing major sources pursuant to 40 CFR Part 52.21(o). In addition, Section 7(a) of the Endangered Species Act (ESA) requires review of threatened and endangered species in the area surrounding the proposed projects. Therefore, the additional impact analysis is necessary to evaluate the impacts from the proposed project on:

- Associated growth
- Soils, vegetation, and wildlife
- Visibility impairment
- Threatened and Endangered Species

The proposed project is considered a major modification and will result in emissions of particulate matter ($PM_{10}/PM_{2.5}$), nitrogen oxides (NO_x), sulfur dioxide (SO_2) and carbon monoxide (CO) greater than the major source significant level. Consequently, an additional impact analysis addressing the effects of PM, NO_x, SO_2, and CO in these areas is required.

Additionally, MDEQ has requested a quantitative analysis regarding the impact of the 7 MW cooling tower on fogging and icing. Fogging occurs as a result of evaporative moisture from the cooling tower and result in reduced visibility and increased humidity directly adjacent to the cooling tower. Icing when the ambient temperature is below freezing the cooling tower fog freezes on road surfaces.

7.1 ASSOCIATED GROWTH

The purpose of the growth impact analysis is to quantify the impact from growth resulting from the construction and operation of the proposed project and to assess air quality impacts that would result from that growth. Impacts on the ambient air and surrounding community resulting from the installation of the new CFB will be minor.

Northern Michigan University will be receiving solid fuels for the new boiler via 40 ton trucks delivered approximately once per day, Monday through Friday. While an increase in vehicle traffic as a result of fuel truck delivery will increase, both Sugarloaf and Wright Avenues are

currently major transportation routes. Specifically, Sugarloaf Avenue is currently heavily traveled by logging trucks delivering fibers to facilities from processing plants north and west of Marquette. Consequently, the increase in truck traffic as a result of the new solid fuel boiler will be relatively insignificant.

NMU is proposing to construct and install a new CFB boiler and steam turbine in response to increased demand for power and steam at the Marquette campus. The proposed project also includes construction of a new boiler building. Due to abundant supplies of solid fuel, including coal and wood waste, the project is not expected to affect the fuel supply or impact the fuel markets within the upper peninsula of Michigan or the Midwest.

7.2 SOILS, VEGETATION, AND WILDLIFE

Additional increases in pollutant levels resulting from a specific emission source can have an impact on air quality-related values (AQRVs). However, it is important to evaluate the level of the expected increase. AQRVs can include visibility, odor, flora, fauna, and geographic resources; archeological, historical, and other cultural resources; and soil and water resources.

NMU has performed a modeling demonstration for $PM_{10}/PM_{2.5}$, NO_x, SO_2, and CO emissions resulting from the installation of the new CFB boiler. This ambient impact analysis addressed emissions from the all units at NMU, including the three (3) existing natural gas/oil-fired boilers, and compared the model results with both the primary and secondary National Ambient Air Quality Standards. Note that the primary and secondary standards for PM_{10}, NO_x, SO_2, and CO have the same NAAQS and that the impacts associated with the proposed project will be minor.

The highest predicted NO_x concentration increases resulting from the proposed project at NMU are less than the ambient health standards allowed in the NAAQS. Specifically, AERMOD predicted the following PM_{10} impacts from the facility as a result of future potential emissions:

- Annual concentration of 0.97 $\mu g/m^3$ (primary NAAQS is 100 $\mu g/m^3$)

The highest predicted SO_2 concentration increases resulting from the proposed project at NMU are less than the ambient health standards allowed in the NAAQS. Specifically, AERMOD predicted the following PM_{10} impacts from the facility as a result of future potential emissions:

- 3-hour concentration of 520.24 $^{\mu g}/_{m}{}^{3}$ (primary NAAQS is 1,300 $^{\mu g}/_{m}{}^{3}$)
- 24-hour concentration of 217.39 $^{\mu g}/_{m}{}^{3}$ (primary NAAQS is 365 $^{\mu g}/_{m}{}^{3}$)
- Annual concentration of 30.56 $^{\mu g}/_{m}{}^{3}$ (primary NAAQS is 80 $^{\mu g}/_{m}{}^{3}$)

Modeling was also performed for PM_{10} and CO emissions. This modeling showed that the impacts from both PM_{10} and CO as a result of the proposed project are less than the federal significant impact levels of 1 and 5 $^{\mu g}/_{m}{}^{3}$, and 500 and 2,000 $^{\mu g}/_{m}{}^{3}$, respectively.

Based on the modeling results presented above, no impact on soils, vegetation, or wildlife can be expected. Further, these small concentration increases are not likely to have an adverse effect on AQRVs within the vicinity of the facility.

7.3 VISIBILITY

NMU is located within 50 km from the Seney National Wildlife Refuge (Seney) Class I area. As such, a visibility analysis using the CALPUFF model was performed to determine whether the emissions from the new CFB will cause a degradation of visibility due to increased relative humidity within Seney.

The visibility modeling demonstration was performed according the modeling protocol submitted to MDEQ on August 18, 2006 and approved via e-mail on August 21, 2006. The results confirm that the potential emissions from the new CFB will not result in visibility impairment at Seney.

While sulfates are a subset of the $PM_{2.5}$ and known to contribute to regional haze problems, the small incremental increase in sulfates from the proposed project are considered to be negligible in comparison to the region's current quality index and have not been quantified. Therefore, no adverse effect on regional haze is expected from the proposed new boiler.

7.4 THREATENED AND ENDANGERED SPECIES

A request for review of threatened and endangered species in the area surrounding the NMU facility was submitted to the Michigan Department of Natural Resources (MDNR) was submitted by NTH Consultants, Ltd. A review by the MDNR – Wildlife Division determined that "the project should have no impact on rare or unique natural features ..." and a copy of the letter from Ms. Lori Sargent, Endangered Species Specialist, is included in Appendix E.

Additionally, a request for review for threatened and endangered species by the U.S. Fish and Wildlife Service was requested as well. Per the letter included in Appendix E, the U.S. Fish and Wildlife Service confirms that no threatened and endangered species are present in the area impacted by the project and no additional review is necessary.

7.5 COOLING TOWER IMPACTS

As requested by MDEQ, a quantitative analysis for impacts of fogging and icing from the proposed 7 MW cooling tower was performed using the Seasonal/Annual Cooling Tower Impact (SACTI) model. This analysis confirmed that impairments to the surrounding community as a result of fogging and icing is not expected. The electronic input and output files from this analysis is included in Appendix C on compact disc, with hardcopy output in Appendix F.

APPENDIX A

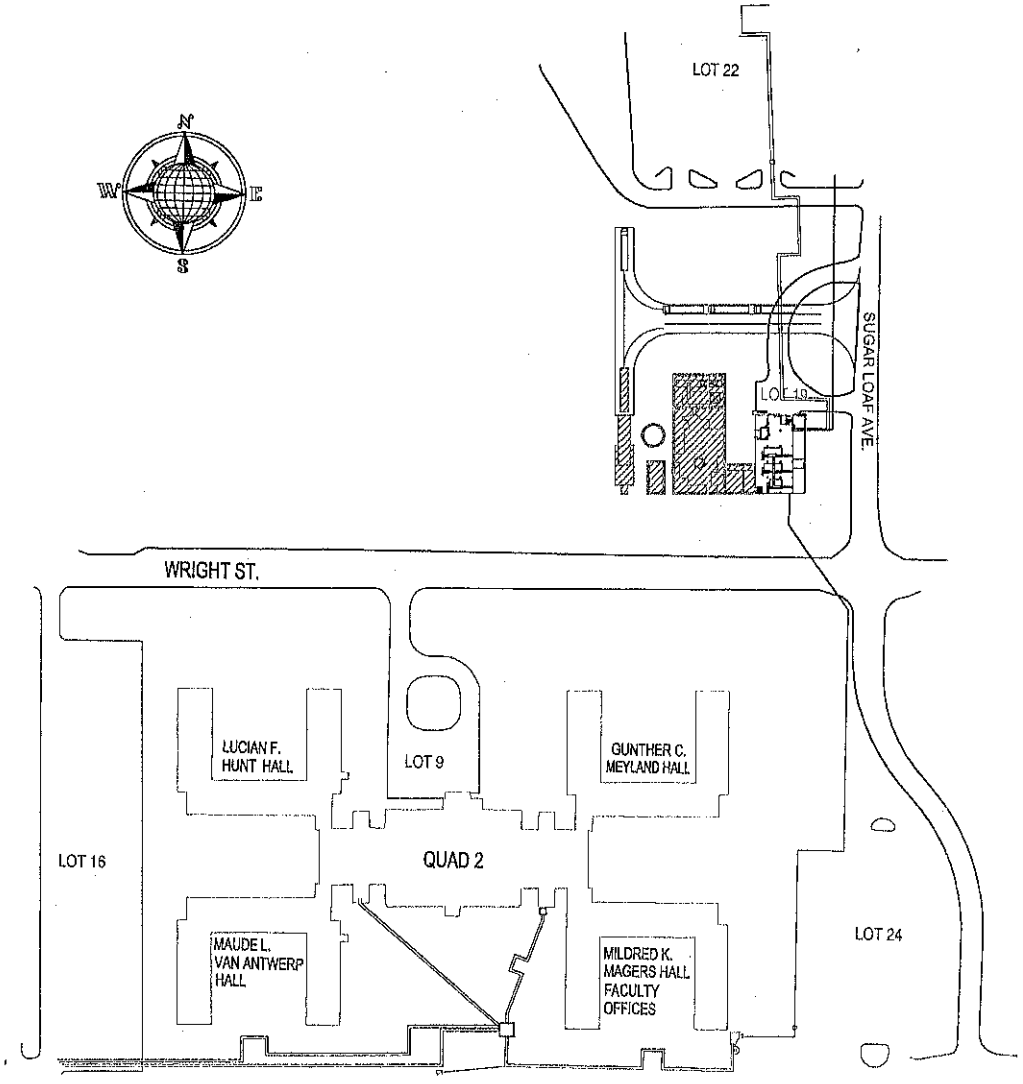
Site Drawings

CAMPUS MAP - NORTHERN SECTION

NORTHERN MICHIGAN UNIVERSITY

MARQUETTE, MICHIGAN

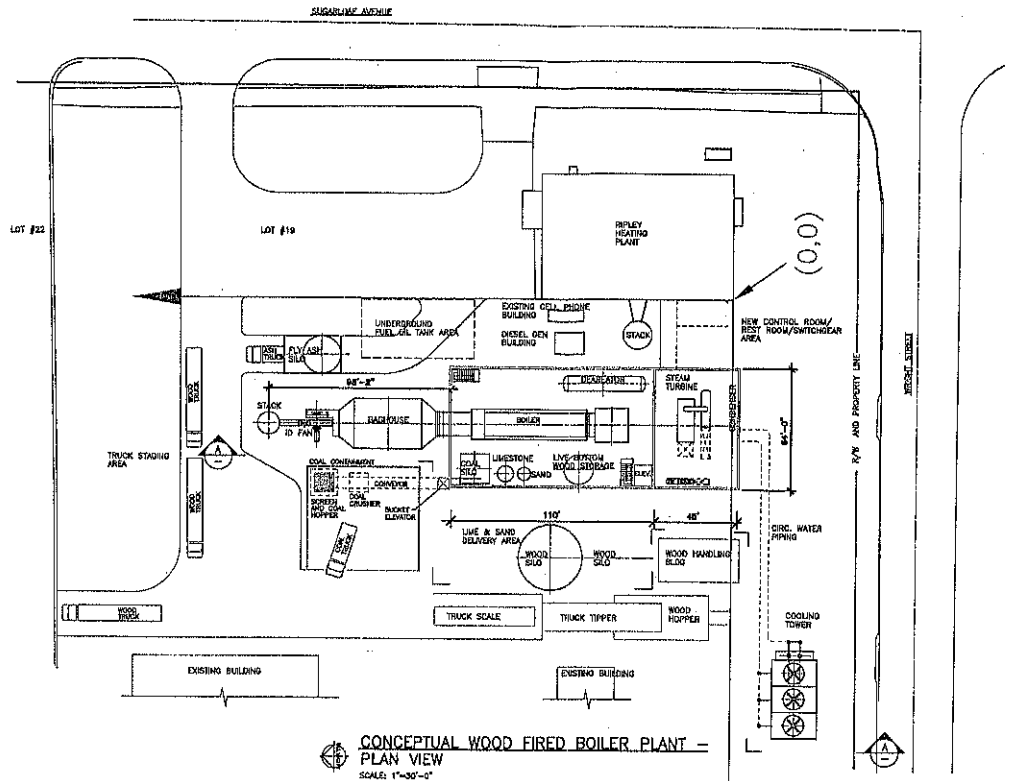
DATE: SEPTEMBER 4, 2003



ELECTRICAL LEGEND	
SYMBOL	UTILITY
	ELECTRIC
	HIGH MAST LIGHTPOLE
	SINGLE SHOEBOX LIGHTPOLE
	DOUBLE SHOEBOX LIGHTPOLE
	QUAD SHOEBOX LIGHTPOLE
	LIGHTPOLE
	CODE BLUE STATION
	MANHOLE
	LIGHTED BUILDING SIGNS

STEAM LEGEND	
SYMBOL	UTILITY
	STEAM
	ABANDONED STEAM
	MANHOLE
	STEAM VAULT (SV)

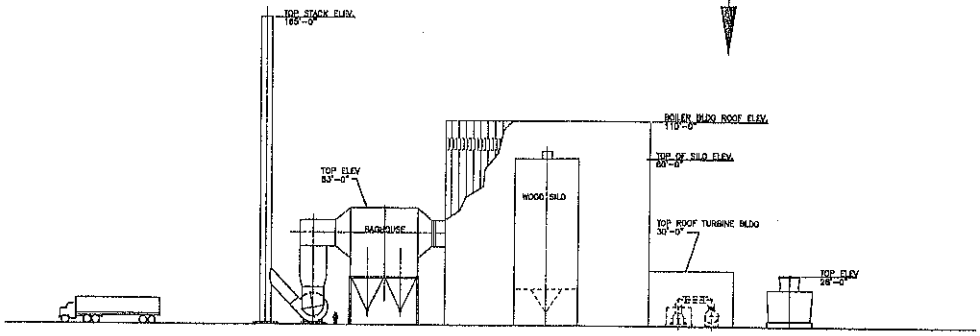
DWG. NO. 5049-C0A-M1001A



CONCEPTUAL WOOD FIRED BOILER PLANT – PLAN VIEW

SCALE: 1"=30'-0"

30 15 0 30 60 90



A SECTION PLANT ELEVATION

NOT TO BE USED FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DWN	ENGR	CHK	APPV

CUMMINS & BARNARD, INC.
CONSULTING ENGINEERS SINCE 1881
5403 DATA COURT
ANN ARBOR, MICHIGAN 48108
(734) 761-9130 Fax (734) 761-9881
www.Cummins-Barnard.com

NORTHERN MICHIGAN UNIVERSITY
WOOD/COAL FIRED BOILER

EQUIPMENT ARRANGEMENT

SCALE: 20'=1'-0" | PROJECT NO. 5049.01

DWG. NO. 5049-C0A-M1001A | REV. A

APPENDIX B

Emission Summary Tables

Northern Michigan University
New CFB Boiler
Toxic Air Contaminant Modeling Results

1.0 Gram/Sec Modeled Impacts

Averaging Period	Impact (ug/m^3 / 1 g/s)
Annual	0.211
24 Hour	1.589
8 Hour	2.712
1 Hour	15.779

Table C-1. TAC Emission Rates and Modeling Impact Results

Compound	CAS No.	Maximum Emission Rates (lb/hr)	Maximum Emission Rates (tpy)	Modeled Rate (gram/sec)	ITSL (ug/m3)	IRSL (ug/m3)	Averaging Period	Ambient Impact (ug/m3)	% of SL
Lead	7439-92-1	2.48E-03	1.09E-02	3.12E-04	1.5		24 hour	4.96E-04	0.03%
HCl	7647-01-0	1.20	5.26	1.51E-01	20		24 hour	2.41E-01	1.20%
HF	7664-39-3	0.15	0.66	1.89E-02	26		1 hour	2.99E-01	1.15%
H_2SO_4	7664-93-9	1.13	4.94	1.42E-01	10		8 hour	3.86E-01	3.86%
Total Dioxin/Furan	1746-01-6	4.33E-10	1.90E-09	5.45E-11		2.30E-07	Annual	1.15E-11	0.00%
Metals									
Antimony	7440-36-0	1.68E-03	7.36E-03	2.12E-04	0.2		24 hour	3.37E-04	0.168%
Arsenic	7440-38-2	1.42E-04	6.22E-04	1.79E-05		0.0002	Annual	3.77E-06	1.88%
Barium	7440-39-3	9.18E-04	4.02E-03	1.16E-04	5		8 hour	3.14E-04	0.006%
Beryllium	7440-41-7	3.70E-06	1.62E-05	4.66E-07	0.02		24 hour	7.41E-07	0.004%
Beryllium	7440-41-7	3.70E-06	1.62E-05	4.66E-07		0.0004	Annual	9.83E-08	0.025%
Cadmium	7440-43-9	2.29E-04	1.00E-03	2.89E-05		0.0006	Annual	6.09E-06	1.02%
Chromium, total	7440-47-3	4.95E-03	2.17E-02	6.24E-04	0.1		Annual	1.31E-04	0.131%
Chromium, hexavalent	18540-29-9	8.25E-04	3.61E-03	1.04E-04	0.1		24 hour	1.65E-04	0.17%
Chromium, hexavalent	18540-29-9	8.25E-04	3.61E-03	1.04E-04		8.30E-05	Annual	2.19E-05	26.40%
Chromium, trivalent	16065-83-1	1.55E-04	6.78E-04	1.95E-05	5		8 hour	5.29E-05	0.001%
Cobalt	7440-48-4	1.25E-03	5.48E-03	1.58E-04	0.2		8 hour	4.28E-04	0.214%
Copper	7440-50-8	1.16E-04	5.06E-04	1.46E-05	2		8 hour	3.95E-05	0.002%
Iron		2.33E-03	1.02E-02	2.94E-04	0.1		Annual	6.20E-05	0.06%
Magnesium	7439-95-4	1.38E-01	6.03E-01	1.73E-02	100		8 hour	4.70E-02	0.047%
Manganese	7439-96-5	3.77E-03	1.65E-02	4.75E-04	0.05		24 hour	7.55E-04	1.51%
Molybdenum		2.29E-04	1.00E-03	2.89E-05	0.1		Annual	6.09E-06	0.006%
Nickel	7440-02-0	3.09E-04	1.35E-03	3.89E-05		0.0042	Annual	8.21E-06	0.20%
Phosphorus	7723-14-0	6.37E-05	2.79E-04	8.02E-06	1		8 hour	2.17E-05	0.002%
Potassium		9.19E-02	4.03E-01	1.16E-02	0.1		Annual	2.44E-03	2.44%
Selenium	7782-49-2	1.63E-02	7.15E-02	2.06E-03	2		8 hour	5.58E-03	0.279%
Silver	7440-22-4	4.01E-03	1.76E-02	5.05E-04	0.1		8 hour	1.37E-03	1.37%
Sodium		8.49E-04	3.72E-03	1.07E-04	0.1		Annual	2.25E-05	0.02%
Strontium		2.36E-05	1.03E-04	2.97E-06	0.1		Annual	6.26E-07	0.001%
Tin	7440-31-5	5.42E-05	2.37E-04	6.83E-06	20		8 hour	1.85E-05	0.000%
Titanium		4.72E-05	2.07E-04	5.94E-06	0.1		Annual	1.25E-06	0.001%
Vanadium		4.80E-04	2.10E-03	6.04E-05	0.1		Annual	1.27E-05	0.013%
Yttrium		7.07E-07	3.10E-06	8.91E-08	0.1		Annual	1.88E-08	0.000%
Zinc (as ZnO)	1314-13-2	5.23E-02	2.29E-01	6.59E-03	50		8 hour	1.79E-02	0.036%
Organic Toxic Air Contaminants (TACs)									
Acetaldehyde	75-07-0	1.96E-01	8.57E-01	2.47E-02	9		24 hour	3.92E-02	0.435%
Acetaldehyde	75-07-0	1.96E-01	8.57E-01	2.47E-02		0.5	Annual	5.20E-03	1.04%
Acetophenone	98-86-2	1.88E-04	8.22E-04	2.37E-05	490		8 hour	6.41E-05	0.000%
Acrolein	107-02-8	2.39E-02	1.05E-01	3.01E-03	0.02		Annual	6.34E-04	3.17%
Acrolein	107-02-8	2.39E-02	1.05E-01	3.01E-03	0.5		1 hour	4.75E-02	9.50%
Benzene	71-43-2	9.90E-01	4.34E+00	1.25E-01	30		24 hour	1.98E-01	0.66%
Benzene	71-43-2	9.90E-01	4.34E+00	1.25E-01		0.1	Annual	2.63E-02	26.30%
Benzyl chloride	100-44-7	8.76E-03	3.84E-02	1.10E-03		0.02	Annual	2.33E-04	1.16%
Benzoic acid	65-85-0	1.11E-05	4.85E-05	1.40E-06	0.1		Annual	2.94E-07	0.000%
Biphenyl	92-52-4	2.13E-05	9.32E-05	2.68E-06	15		8 hour	7.27E-06	0.000%
Bis(2-Ethylhexyl)phthalate	117-81-7	9.14E-04	4.00E-03	1.15E-04		0.2	Annual	2.43E-05	0.012%
Bromoform	75-25-2	4.88E-04	2.14E-03	6.15E-05		0.9	Annual	1.30E-05	0.001%
Carbon disulfide	75-15-0	1.63E-03	7.13E-03	2.05E-04	700		24 hour	3.26E-04	0.000%
Carbazole	86-74-8	4.24E-04	1.86E-03	5.35E-05	0.1		Annual	1.13E-05	0.011%
Carbon tetrachloride	56-23-5	1.06E-02	4.65E-02	1.34E-03		0.07	Annual	2.82E-04	0.40%
Chlorine	7782-50-5	1.86E-01	8.16E-01	2.35E-02	15		8 hour	6.36E-02	0.42%
2-Chloroacetophenone	532-27-4	8.76E-05	3.84E-04	1.10E-05	0.03		24 hour	1.75E-05	0.058%
Chlorobenzene	108-90-7	7.78E-03	3.41E-02	9.80E-04	70		24 hour	1.56E-03	0.002%
Chloroform	67-66-3	6.60E-03	2.89E-02	8.32E-04		0.4	Annual	1.75E-04	0.044%
2-Chloronaphthalene	91-58-7	5.66E-07	2.48E-06	7.13E-08	0.1		Annual	1.50E-08	0.000%
2-Chlorophenol	95-57-8	5.66E-06	2.48E-05	7.13E-07	0.1		Annual	1.50E-07	0.000%
Cumene	98-82-8	6.63E-05	2.91E-04	8.36E-06	400		24 hour	1.33E-05	0.000%
Cyanide	57-12-5	3.13E-02	1.37E-01	3.94E-03	50		1 hour	6.22E-02	0.12%
1,4-Dichlorobenzene	106-46-7	2.50E-04	1.10E-03	3.15E-05	800		24 hour	5.01E-05	0.000%
1,4-Dichlorobenzene	106-46-7	2.50E-04	1.10E-03	3.15E-05		0.14	Annual	6.65E-06	0.005%
2,4-Dinitrophenol	51-28-5	4.24E-05	1.86E-04	5.35E-06	0.1		Annual	1.13E-06	0.001%
2,4-Dinitrotoluene	121-14-2	3.50E-06	1.53E-05	4.42E-07	2		8 hour	1.20E-06	0.000%
2,4-Dinitrotoluene	121-14-2	3.50E-06	1.53E-05	4.42E-07		0.009	Annual	9.31E-08	0.001%
Dimethyl sulfate	77-78-1	6.01E-04	2.63E-03	7.57E-05	0.5		8 hour	2.05E-04	0.041%
Ethylbenzene	100-41-4	7.31E-03	3.20E-02	9.21E-04	1000		24 hour	1.46E-03	0.000%
Ethylbenzene	100-41-4	7.31E-03	3.20E-02	9.21E-04		3	Annual	1.94E-04	0.006%
Ethylchloride	75-00-3	5.26E-04	2.30E-03	6.62E-05	10000		24 hour	1.05E-04	0.000%
Ethylene dichloride	107-06-2	5.01E-04	2.19E-03	6.31E-05		0.04	Annual	1.33E-05	0.033%
Ethylene dibromide	106-93-4	1.50E-05	6.58E-05	1.89E-06	9		24 hour	3.01E-06	0.000%
Ethylene dibromide	106-93-4	1.50E-05	6.58E-05	1.89E-06		0.002	Annual	3.99E-07	0.020%
Formaldehyde	50-00-0	1.04E+00	4.54E+00	1.31E-01		0.08	Annual	2.75E-02	34.44%

Northern Michigan University
New CFB Boiler
Toxic Air Contaminant Modeling Results

1.0 Gram/Sec Modeled Impacts

Averaging Period	Impact (ug/m^3 / 1 g/s)
Annual	0.211
24 Hour	1.589
8 Hour	2.712
1 Hour	15.779

Table C-1. TAC Emission Rates and Modeling Impact Results

Compound	CAS No.	Maximum Emission Rates (lb/hr)	Maximum Emission Rates (tpy)	Modeled Rate (gram/sec)	ITSL (ug/m3)	IRSL (ug/m3)	Averaging Period	Ambient Impact (ug/m3)	% of SL
Heptachlorobiphenyl	28655-71-2	1.56E-08	6.82E-08	1.96E-09	0.1		Annual	**4.13E-10**	0.000%
Hexachlorobiphenyl	26601-64-9	1.30E-07	5.68E-07	1.63E-08	0.1		Annual	**3.44E-09**	0.000%
Hexanal	66-25-1	1.65E-03	7.23E-03	2.08E-04	2		Annual	**4.38E-05**	0.002%
Hexane	110-54-3	3.75E-01	1.64E+00	4.73E-02	700		24 hour	**7.52E-02**	0.011%
Isobutyraldehyde	78-84-2	2.83E-03	1.24E-02	3.56E-04	160		24 hour	**5.66E-04**	0.000%
Isophorone	78-59-1	7.26E-03	3.18E-02	9.15E-04	280		1 hour	**1.44E-02**	0.005%
Isophorone	78-59-1	7.26E-03	3.18E-02	9.15E-04		3.7	Annual	**1.93E-04**	0.005%
2-Methylnaphthalene	91-57-6	3.77E-05	1.65E-04	4.75E-06	10		Annual	**1.00E-06**	0.000%
3-Methylchloranthrene		3.75E-07	1.64E-06	4.73E-08	0.1		Annual	**9.97E-09**	0.000%
Monochlorobiphenyl		5.19E-08	2.27E-07	6.53E-09	0.1		Annual	**1.38E-09**	0.000%
Methyl bromide	74-83-9	3.54E-03	1.55E-02	4.46E-04	5		24 hour	**7.08E-04**	0.014%
Methyl chloride	74-87-3	6.63E-03	2.91E-02	8.36E-04	90		24 hour	**1.33E-03**	0.001%
Methyl chloride	74-87-3	6.63E-03	2.91E-02	8.36E-04		1.6	Annual	**1.76E-04**	0.011%
Methyl ethyl ketone	78-93-3	4.88E-03	2.14E-02	6.15E-04	5000		24 hour	**9.77E-04**	0.000%
Methyl hydrazine	60-34-4	2.13E-03	9.32E-03	2.68E-04	0.1		Annual	**5.65E-05**	0.057%
Methyl methacrylate	80-62-6	2.50E-04	1.10E-03	3.15E-05	700		24 hour	**5.01E-05**	0.000%
Methyl tert butyl ether	1634-04-4	4.38E-04	1.92E-03	5.52E-05	3000		24 hour	**8.77E-05**	0.000%
Methylene chloride	75-09-2	6.84E-02	2.99E-01	8.61E-03		2	Annual	**1.82E-03**	0.091%
Naphthalene	91-20-3	2.29E-02	1.00E-01	2.88E-03	3		24 hour	**4.58E-03**	0.15%
Naphthalene	91-20-3	2.29E-02	1.00E-01	2.88E-03		0.08	Annual	**6.07E-04**	0.76%
2-Nitrophenol	88-75-5	5.66E-05	2.48E-04	7.13E-06	0.1		Annual	**1.50E-06**	0.002%
4-Nitrophenol	100-02-7	2.59E-05	1.14E-04	3.27E-06	0.1		Annual	**6.89E-07**	0.001%
Pentachlorobiphenyl		2.83E-07	1.24E-06	3.56E-08	0.1		Annual	**7.51E-09**	0.000%
Pentachlorophenol	87-86-5	1.20E-05	5.27E-05	1.51E-06	100		24 hour	**2.41E-06**	0.000%
Pentachlorophenol	87-86-5	1.20E-05	5.27E-05	1.51E-06		0.03	Annual	**3.19E-07**	0.001%
Perylene	198-55-0	1.23E-07	5.37E-07	1.54E-08	0.1		Annual	**3.26E-09**	0.000%
Phenol	108-95-2	1.20E-02	5.27E-02	1.51E-03	600		1 hour	**2.39E-02**	0.004%
Propionaldehyde	123-38-6	1.44E-02	6.30E-02	1.81E-03	4		Annual	**3.82E-04**	0.010%
Propanal	123-38-6	7.54E-04	3.30E-03	9.51E-05	4		Annual	**2.00E-05**	0.001%
Styrene	100-42-5	4.48E-01	1.96E+00	5.64E-02	1000		24 hour	**8.97E-02**	0.009%
Styrene	100-42-5	4.48E-01	1.96E+00	5.64E-02		1.7	Annual	**1.19E-02**	0.70%
Tetrachlorobiphenyl		5.89E-07	2.58E-06	7.43E-08	0.1		Annual	**1.57E-08**	0.000%
Tetrachloroethylene	127-18-4	8.96E-03	3.92E-02	1.13E-03	0.1		Annual	**2.38E-04**	0.24%
Toluene	108-88-3	2.17E-01	9.50E-01	2.73E-02	5000		24 hour	**4.34E-02**	0.001%
o-Tolualdehyde	529-20-4	1.70E-03	7.43E-03	2.14E-04	440		24 hour	**3.40E-04**	0.000%
p-Tolualdehyde	104-87-0	2.59E-03	1.14E-02	3.27E-04	0.1		Annual	**6.89E-05**	0.069%
Trichlorobiphenyl		6.13E-07	2.68E-06	7.72E-08	0.1		Annual	**1.63E-08**	0.000%
Trichlorofluoromethane	75-69-4	9.67E-03	4.23E-02	1.22E-03	56200		1 hour	**1.92E-02**	0.000%
Trichloroethene	79-01-6	7.07E-03	3.10E-02	8.91E-04		0.6	Annual	**1.88E-04**	0.031%
1,1,1-Trichloroethane	71-55-6	7.31E-03	3.20E-02	9.21E-04	1000		24 hour	**1.46E-03**	0.000%
2,4,6-Trichlorophenol	88-06-2	5.19E-06	2.27E-05	6.53E-07		0.3	Annual	**1.38E-07**	0.000%
Vinyl acetate	108-05-4	9.51E-04	4.17E-03	1.20E-04	200		24 hour	**1.90E-04**	0.000%
Vinyl Chloride	75-01-4	4.24E-03	1.86E-02	5.35E-04	100		24 hour	**8.50E-04**	0.001%
Vinyl Chloride	75-01-4	4.24E-03	1.86E-02	5.35E-04		0.11	Annual	**1.13E-04**	0.10%
Xylenes	1330-20-7	4.63E-04	2.03E-03	5.83E-05	100		24 hour	**9.27E-05**	0.000%
o-Xylene	95-47-6	5.89E-03	2.58E-02	7.43E-04	100		24 hour	**1.18E-03**	0.001%
Polynuclear Aromatic Hydrocarbons (PAH)									
Acenaphthene	83-32-9	2.15E-04	9.40E-04	2.70E-05	210		24 hour	**4.30E-05**	0.000%
Acenaphthylene	208-96-8	1.18E-03	5.16E-03	1.49E-04	35		24 hour	**2.36E-04**	0.001%
Acetone	67-64-1	4.48E-02	1.96E-01	5.64E-03	5900		8 hour	**1.53E-02**	0.000%
Anthracene	120-12-7	7.07E-04	3.10E-03	8.91E-05	1000		24 hour	**1.42E-04**	0.000%
Benzaldehyde	100-52-7	2.00E-04	8.78E-04	2.52E-05		0.4	Annual	**5.32E-06**	0.001%
Benzo(a)anthracene	56-55-3	1.53E-05	6.71E-05	1.93E-06	0.1		Annual	**4.07E-07**	0.000%
Benzo(a)pyrene	50-32-8	6.13E-04	2.68E-03	7.72E-05		0.0005	Annual	**1.63E-05**	3.26%
Benzo(e)pyrene	192-97-2	6.13E-07	2.68E-06	7.72E-08	0.1		Annual	**1.63E-08**	0.000%
Benzo(b)fluoranthene	205-99-2	2.36E-05	1.03E-04	2.97E-06	0.1		Annual	**6.26E-07**	0.001%
Benzo(j,k)fluoranthene		3.77E-05	1.65E-04	4.75E-06	0.1		Annual	**1.00E-06**	0.001%
Benzo(k)fluoranthene	205-82-3	8.49E-06	3.72E-05	1.07E-06	0.1		Annual	**2.25E-07**	0.000%
Benzo(b,j,k)fluoranthene		2.36E-05	1.03E-04	2.97E-06	0.1		Annual	**6.26E-07**	0.001%
Benzo(g,h,i)perylene	191-24-2	2.19E-05	9.60E-05	2.76E-06	12		24 hour	**4.39E-06**	0.000%
Chrysene	218-01-9	8.96E-06	3.92E-05	1.13E-06	0.1		Annual	**2.38E-07**	0.000%
Crotonaldehyde	4170-30-3	2.33E-03	1.02E-02	2.94E-04	9		1 hour	**4.64E-03**	0.052%
Decachlorobiphenyl	2051-24-3	6.37E-08	2.79E-07	8.02E-09	0.1		Annual	**1.69E-09**	0.000%
Dibenzo(a,h)anthracene	53-70-3	2.15E-06	9.40E-06	2.70E-07	0.1		Annual	**5.70E-08**	0.000%
1,2-Dibromoethene	540-49-8	1.30E-02	5.68E-02	1.63E-03	0.1		Annual	**3.44E-04**	0.34%
Dichlorobiphenyl		1.74E-07	7.64E-07	2.20E-08	0.1		Annual	**4.63E-09**	0.000%
1,2-Dichloroethane	107-06-2	6.84E-03	2.99E-02	8.61E-04		0.04	Annual	**1.82E-04**	0.45%
1,2-Dichloropropane	78-87-5	7.78E-03	3.41E-02	9.80E-04	4		24 hour	**1.56E-03**	0.039%
7,12-Dimethylbenz(a)anthracene		3.34E-06	1.46E-05	4.20E-07	0.1		Annual	**8.86E-08**	0.000%
Fluoranthene	206-44-0	3.77E-04	1.65E-03	4.75E-05	140		24 hour	**7.55E-05**	0.000%
Fluorene	86-73-7	8.02E-04	3.51E-03	1.01E-04	140		24 hour	**1.60E-04**	0.000%
Indeno(1,2,3,c,d)pyrene	193-39-5	2.05E-05	8.98E-05	2.58E-06	0.1		Annual	**5.45E-07**	0.001%
Phenanthrene	85-01-8	1.65E-03	7.23E-03	2.08E-04	0.1		Annual	**4.38E-05**	0.044%
Pyrene	129-00-0	8.72E-04	3.82E-03	1.10E-04	100		24 hour	**1.75E-04**	0.000%
5-Methyl chrysene	3697-24-3	2.75E-07	1.21E-06	3.47E-08	0.1		Annual	**7.31E-09**	0.000%

Note: An ITSL of 0.1 that is red bolded is a default screening level per AQD air toxics policy

APPENDIX C

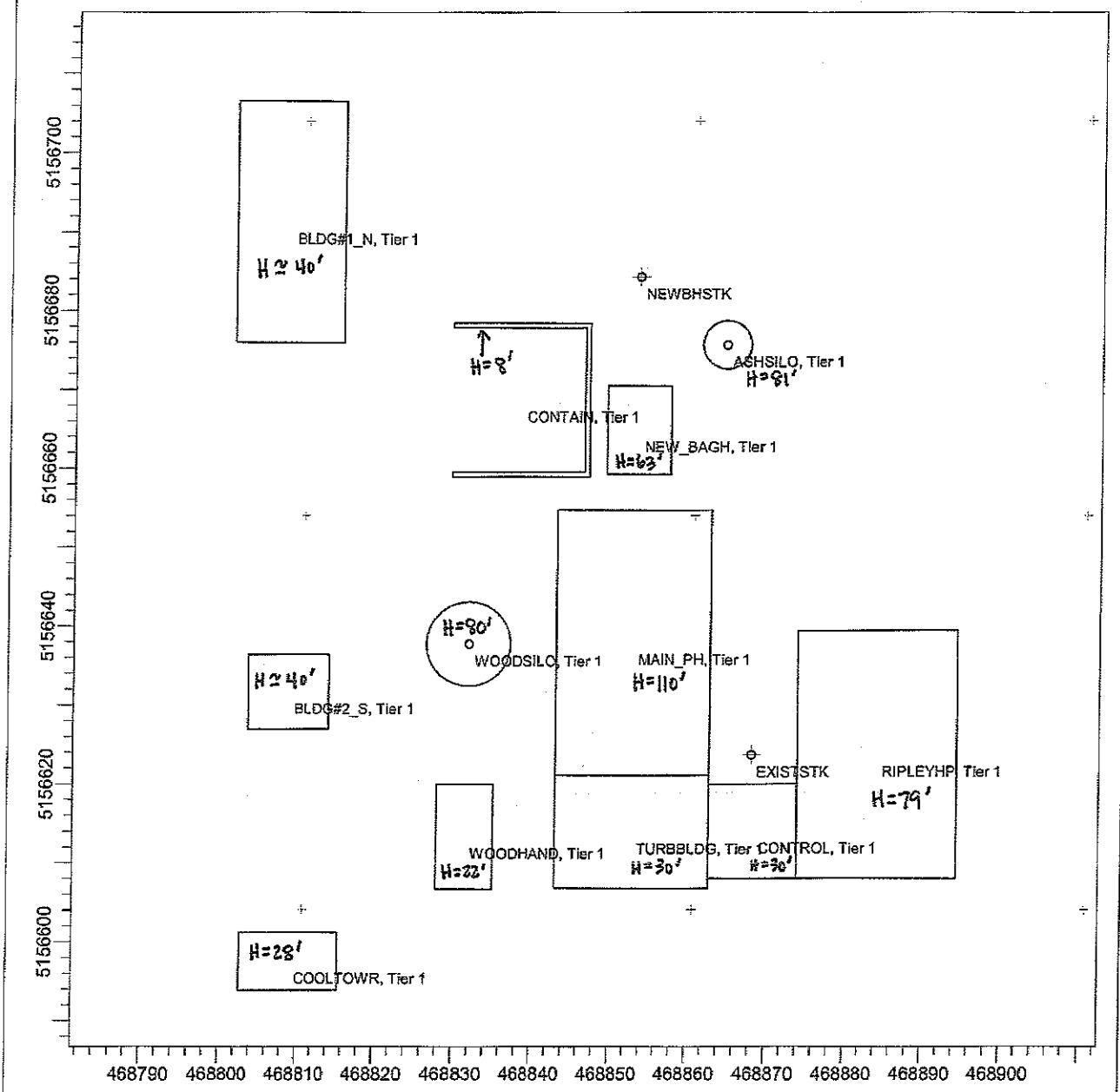
Dispersion Modeling Support Information

NMU Campus
Modeling Building Layouts

(with Building Heights)

PROJECT TITLE:

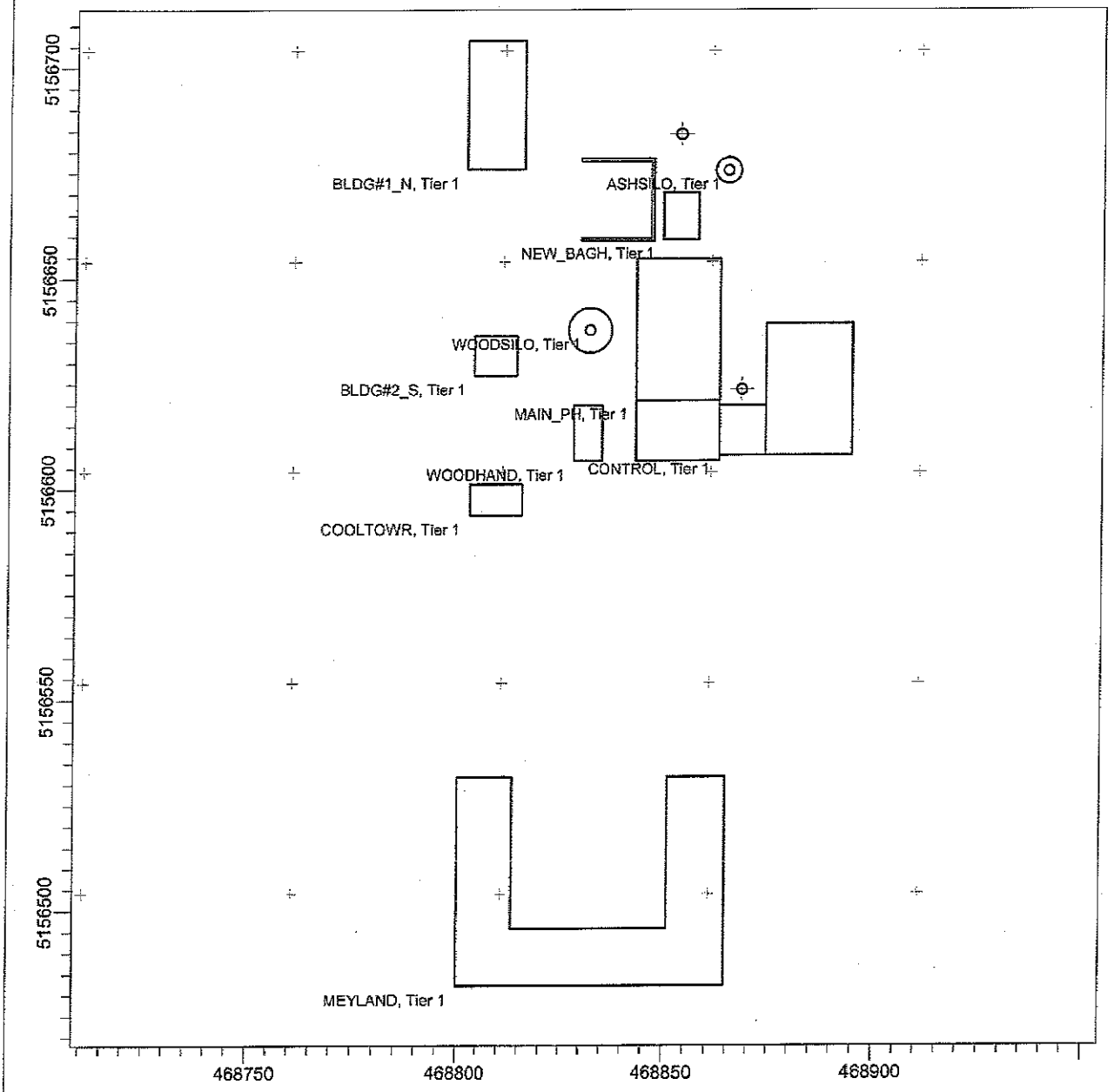
Northern Michigan University - Powerhouse Modification PTI
Building Layout



COMMENTS: NMU Power Plant Building Layout	SOURCES: **2**	COMPANY NAME: **NTH Consultants, Ltd**	
	RECEPTORS: **7537**	MODELER: **Edward Bishop, Asst Project Engineer**	
		SCALE: 1:800 0 0.02 km	
		DATE: **1/25/2007**	PROJECT NO.: **16-060504**

PROJECT TITLE:

Northern Michigan University - Powerhouse Modification PTI
Building Layout

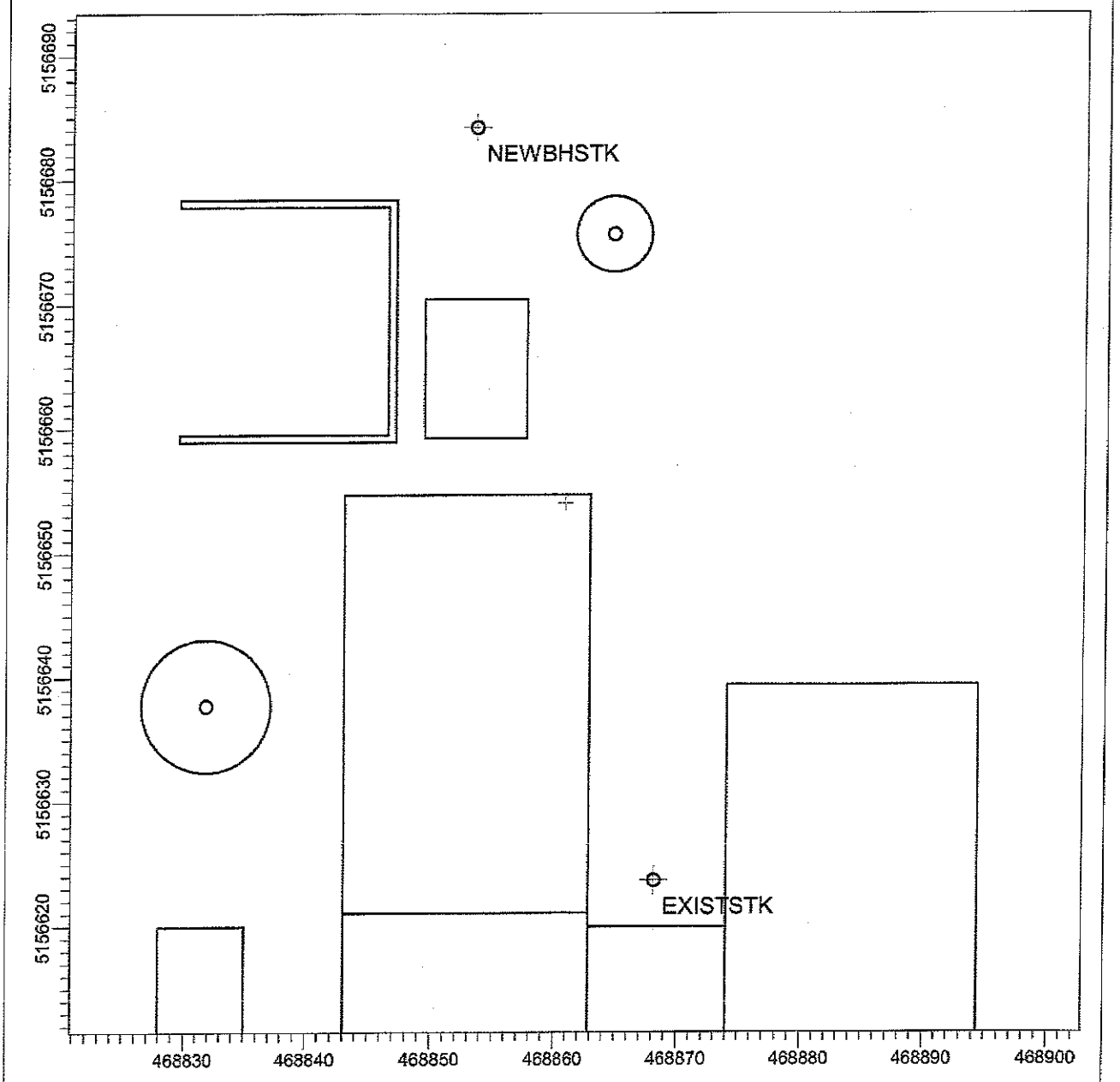


COMMENTS: NMU Power Plant Building Layout:	SOURCES: **2**	COMPANY NAME: **NTH Consultants, Ltd**	
	RECEPTORS: **7537**	MODELER: **Edward Bishop, Asst Project Engineer**	
		SCALE: 1:1,500 0 0.05 km	
		DATE: **1/25/2007**	PROJECT NO.: **16-060504**

Stack Layout

PROJECT TITLE:

Northern Michigan University - Powerhouse Modification PTI
Stack Identification Layout



COMMENTS: NMU Power Plant Building Layout:	SOURCES: **2**	COMPANY NAME: **NTH Consultants, Ltd**	
	RECEPTORS: **7537**	MODELER: **Edward Bishop, Asst Project Engineer**	
		SCALE: 1:500 0 0.01 km	
		DATE: **1/25/2007**	PROJECT NO.: **16-060504**

Existing Facility, New Structures, and Stack Coordinates

(Internal Coordinates)

Northern Michigan University - Modeling Analysis Layout for Proposed Boiler Project

Coordinate System Layout for Northern Michigan University Located in Marquette, MI
The Southwest Corner of the Existing Ripley Heating Plant Bldg Equals Site Coordinate (0,0)

Building	Corner I.D.	Coordinates (feet)		Height	Coordinates (meters)		Height
		X (E)	Y (N)	(feet)	X (E)	Y (N)	(meters)
Ripley Heating Plant	A1	0.00	0.00	79.00	0.00	0.00	24.08
	A2	0.00	102.92	79.00	0.00	31.37	24.08
	A3	66.92	102.92	79.00	20.40	31.37	24.08
	A4	66.92	0.00	79.00	20.40	0.00	24.08
	A5	0.00	0.00	79.00	0.00	0.00	24.08
New Boiler Main Building	B1	-101.53	42.82	110.00	-30.95	13.05	33.53
	B2	-101.53	153.12	110.00	-30.95	46.67	33.53
	B3	-36.53	153.12	110.00	-11.14	46.67	33.53
	B4	-36.53	42.82	110.00	-11.14	13.05	33.53
	B5	-101.53	42.82	110.00	-30.95	13.05	33.53
New Steam Turbine Bldg	C1	-101.53	-4.19	30.00	-30.95	-1.28	9.14
	C2	-101.53	42.82	30.00	-30.95	13.05	9.14
	C3	-36.53	42.82	30.00	-11.14	13.05	9.14
	C4	-36.53	-4.19	30.00	-11.14	-1.28	9.14
	C5	-101.53	-4.19	30.00	-30.95	-1.28	9.14
New Control Room	D1	-36.53	0.00	30.00	-11.14	0.00	9.14
	D2	-36.53	39.13	30.00	-11.14	11.93	9.14
	D3	0.00	39.13	30.00	0.00	11.93	9.14
	D4	0.00	0.00	30.00	0.00	0.00	9.14
	D5	-36.53	0.00	30.00	-11.14	0.00	9.14
Coal Containment Structure	E1	-145.96	167.00	8.00	-44.49	50.90	2.44
	E2	-145.96	169.00	8.00	-44.49	51.51	2.44
	E3	-90.29	169.00	8.00	-27.52	51.51	2.44
	E4	-90.29	229.00	8.00	-27.52	69.80	2.44
	E5	-145.96	229.00	8.00	-44.49	69.80	2.44
	E6	-145.96	231.00	8.00	-44.49	70.41	2.44
	E7	-88.29	231.00	8.00	-26.91	70.41	2.44
	E8	-88.29	167.00	8.00	-26.91	50.90	2.44
	E9	-145.96	167.00	8.00	-44.49	50.90	2.44
Wood Handling Building	F1	-151.12	-4.43	22.00	-46.06	-1.35	6.71
	F2	-151.12	39.14	22.00	-46.06	11.93	6.71
	F3	-127.87	39.14	22.00	-38.98	11.93	6.71
	F4	-127.87	-4.43	22.00	-38.98	-1.35	6.71
	F5	-151.12	-4.43	22.00	-46.06	-1.35	6.71
New Baghouse Structure	G1	-80.76	168.12	63.00	-24.62	51.24	19.20
	G2	-80.76	204.76	63.00	-24.62	62.41	19.20
	G3	-53.75	204.76	63.00	-16.38	62.41	19.20
	G4	-53.75	168.12	63.00	-16.38	51.24	19.20
	G5	-80.76	168.12	63.00	-24.62	51.24	19.20
Cooling Tower Structure	H1	-233.86	-46.48	28.00	-71.28	-14.17	8.53
	H2	-233.86	-22.48	28.00	-71.28	-6.85	8.53
	H3	-191.86	-22.48	28.00	-58.48	-6.85	8.53
	H4	-191.86	-46.48	28.00	-58.48	-14.17	8.53
	H5	-233.86	-46.48	28.00	-71.28	-14.17	8.53
Existing Nearby Bldg #1	I1	-237.56	222.84	40.00	-72.41	67.92	12.19
	I2	-237.56	323.23	40.00	-72.41	98.52	12.19
	I3	-191.52	323.23	40.00	-58.37	98.52	12.19
	I4	-191.52	222.84	40.00	-58.37	67.92	12.19
	I5	-237.56	222.84	40.00	-72.41	67.92	12.19
Existing Nearby Bldg #2	J1	-230.95	62.16	40.00	-70.39	18.95	12.19
	J2	-230.95	93.06	40.00	-70.39	28.37	12.19
	J3	-196.64	93.06	40.00	-59.94	28.37	12.19
	J4	-196.64	62.16	40.00	-59.94	18.95	12.19
	J5	-230.95	62.16	40.00	-70.39	18.95	12.19
Gunther C. Meyland Hall	K1	-242.84	-412.65	120.00	-74.02	-125.78	36.58
(NE Section of Quad 2)	K2	-242.84	-250.26	120.00	-74.02	-76.28	36.58
	K3	-198.80	-250.26	120.00	-60.59	-76.28	36.58
	K4	-198.80	-368.41	120.00	-60.59	-112.29	36.58
	K5	-75.38	-368.41	120.00	-22.98	-112.29	36.58
	K6	-75.38	-250.26	120.00	-22.98	-76.28	36.58
	K7	-30.78	-250.26	120.00	-9.38	-76.28	36.58
	K8	-30.78	-412.65	120.00	-9.38	-125.78	36.58
	K9	-242.84	-412.65	120.00	-74.02	-125.78	36.58

Circular Strutures	Center I.D.	Coordinates (feet)		Height	Coordinates (meters)		Diameter	Height
		X (E)	Y (N)	(feet)	X (E)	Y (N)	(meters)	(meters)
New Ash Silo	O1	-30.54	221.91	81.00	-9.31	67.64	6.10	24.69
Wood Silo	P1	-138.44	97.43	80.00	-42.19	29.70	10.65	24.38

Stacks	I.D.	Coordinates (feet)		Height	Coordinates (meters)		Diameter	Height
		X (E)	Y (N)	(feet)	X (E)	Y (N)	(meters)	(meters)
New Baghouse Stack	NewBHStk	-67.25	250.08	165.00	-20.50	76.22	1.83	50.29
Existing Boiler Stack	ExistStk	-19.02	51.28	150.00	-5.80	15.63	1.52	45.72

Existing Facility, New Structures, and Stack Coordinates

(UTM Coordinates)

Northern Michigan University - Modeling Analysis Layout for Proposed Boiler Project

Coordinate System Layout for Northern Michigan University Located in Marquette, MI
The Southwest Corner of the Ripley Heating Plant Bldg Equals UTM Coordinate (468,874 E; 5,156,608 N)

Building	Corner I.D.	Coordinates (meters)		Height	UTM Coordinates (meters)		Elevation
		X (E)	Y (N)	(feet)	Easting	Northing	(meters)
Ripley Heating Plant	A1	0.00	0.00	79.00	468874.00	5156608.00	195.38
	A2	0.00	31.37	79.00	468874.00	5156639.37	195.38
	A3	20.40	31.37	79.00	468894.40	5156639.37	195.38
	A4	20.40	0.00	79.00	468894.40	5156608.00	195.38
	A5	0.00	0.00	79.00	468874.00	5156608.00	195.38
New Boiler Main Building	B1	-30.95	13.05	110.00	468843.05	5156621.05	195.38
	B2	-30.95	46.67	110.00	468843.05	5156654.67	195.38
	B3	-11.14	46.67	110.00	468862.86	5156654.67	195.38
	B4	-11.14	13.05	110.00	468862.86	5156621.05	195.38
	B5	-30.95	13.05	110.00	468843.05	5156621.05	195.38
New Steam Turbine Bldg	C1	-30.95	-1.28	30.00	468843.05	5156606.72	195.38
	C2	-30.95	13.05	30.00	468843.05	5156621.05	195.38
	C3	-11.14	13.05	30.00	468862.86	5156621.05	195.38
	C4	-11.14	-1.28	30.00	468862.86	5156606.72	195.38
	C5	-30.95	-1.28	30.00	468843.05	5156606.72	195.38
New Control Room	D1	-11.14	0.00	30.00	468862.86	5156608.00	195.38
	D2	-11.14	11.93	30.00	468862.86	5156619.93	195.38
	D3	0.00	11.93	30.00	468874.00	5156619.93	195.38
	D4	0.00	0.00	30.00	468874.00	5156608.00	195.38
	D5	-11.14	0.00	30.00	468862.86	5156608.00	195.38
Coal Containment Structure	E1	-44.49	50.90	8.00	468829.51	5156658.90	195.38
	E2	-44.49	51.51	8.00	468829.51	5156659.51	195.38
	E3	-27.52	51.51	8.00	468846.48	5156659.51	195.38
	E4	-27.52	69.80	8.00	468846.48	5156677.80	195.38
	E5	-44.49	69.80	8.00	468829.51	5156677.80	195.38
	E6	-44.49	70.41	8.00	468829.51	5156678.41	195.38
	E7	-26.91	70.41	8.00	468847.09	5156678.41	195.38
	E8	-26.91	50.90	8.00	468847.09	5156658.90	195.38
	E9	-44.49	50.90	8.00	468829.51	5156658.90	195.38
Wood Handling Building	F1	-46.06	-1.35	22.00	468827.94	5156606.65	195.38
	F2	-46.06	11.93	22.00	468827.94	5156619.93	195.38
	F3	-38.98	11.93	22.00	468835.02	5156619.93	195.38
	F4	-38.98	-1.35	22.00	468835.02	5156606.65	195.38
	F5	-46.06	-1.35	22.00	468827.94	5156606.65	195.38
New Baghouse Structure	G1	-24.62	51.24	63.00	468849.38	5156659.24	195.38
	G2	-24.62	62.41	63.00	468849.38	5156670.41	195.38
	G3	-16.38	62.41	63.00	468857.62	5156670.41	195.38
	G4	-16.38	51.24	63.00	468857.62	5156659.24	195.38
	G5	-24.62	51.24	63.00	468849.38	5156659.24	195.38
Cooling Tower Structure	H1	-71.28	-14.17	28.00	468802.72	5156593.83	195.38
	H2	-71.28	-6.85	28.00	468802.72	5156601.15	195.38
	H3	-58.48	-6.85	28.00	468815.52	5156601.15	195.38
	H4	-58.48	-14.17	28.00	468815.52	5156593.83	195.38
	H5	-71.28	-14.17	28.00	468802.72	5156593.83	195.38
Existing Nearby Bldg #1	I1	-72.41	67.92	40.00	468801.59	5156675.92	196.90
	I2	-72.41	98.52	40.00	468801.59	5156706.52	196.90
	I3	-58.37	98.52	40.00	468815.63	5156706.52	196.90
	I4	-58.37	67.92	40.00	468815.63	5156675.92	196.90
	I5	-72.41	67.92	40.00	468801.59	5156675.92	196.90
Existing Nearby Bldg #2	J1	-70.39	18.95	40.00	468803.61	5156626.95	195.38
	J2	-70.39	28.37	40.00	468803.61	5156636.37	195.38
	J3	-59.94	28.37	40.00	468814.06	5156636.37	195.38
	J4	-59.94	18.95	40.00	468814.06	5156626.95	195.38
	J5	-70.39	18.95	40.00	468803.61	5156626.95	195.38
Gunther C. Meyland Hall	K1	-74.02	-125.78	120.00	468799.98	5156482.22	195.38
(NE Section of Quad 2)	K2	-74.02	-76.28	120.00	468799.98	5156531.72	195.38
	K3	-60.59	-76.28	120.00	468813.41	5156531.72	195.38
	K4	-60.59	-112.29	120.00	468813.41	5156495.71	195.38
	K5	-22.98	-112.29	120.00	468851.02	5156495.71	195.38
	K6	-22.98	-76.28	120.00	468851.02	5156531.72	195.38
	K7	-9.38	-76.28	120.00	468864.62	5156531.72	195.38
	K8	-9.38	-125.78	120.00	468864.62	5156482.22	195.38
	K9	-74.02	-125.78	120.00	468799.98	5156482.22	195.38

Northern Michigan University - Modeling Analysis Layout for Proposed Boiler Project

Coordinate System Layout for Northern Michigan University Located in Marquette, MI
The Southwest Corner of the Ripley Heating Plant Bldg Equals UTM Coordinate (468,874 E; 5,156,608 N)

Building	Corner I.D.	Coordinates (meters)		Height	UTM Coordinates (meters)		Elevation
		X (E)	Y (N)	(feet)	Easting	Northing	(meters)

Circular Strutures	Center I.D.	Coordinates (feet)		Height	UTM Coordinates (meters)		Diameter	Height
		X (E)	Y (N)	(feet)	UTM Easting	UTM Northing	(meters)	(meters)
New Ash Silo	O1	-9.31	67.64	81.00	468864.69	5156675.64	6.10	24.69
Wood Silo	P1	-42.19	29.70	80.00	468831.81	5156637.70	10.65	24.38

Stacks	I.D.	Coordinates (feet)		Height	UTM Coordinates (meters)		Diameter	Height
		X (E)	Y (N)	(feet)	UTM Easting	UTM Northing	(meters)	(meters)
New Baghouse Stack	NewBHStk	-20.50	76.22	165.00	468853.50	5156684.22	1.83	50.29
Existing Boiler Stack	ExistStk	-5.80	15.63	150.00	468868.20	5156623.63	1.52	45.72

160'

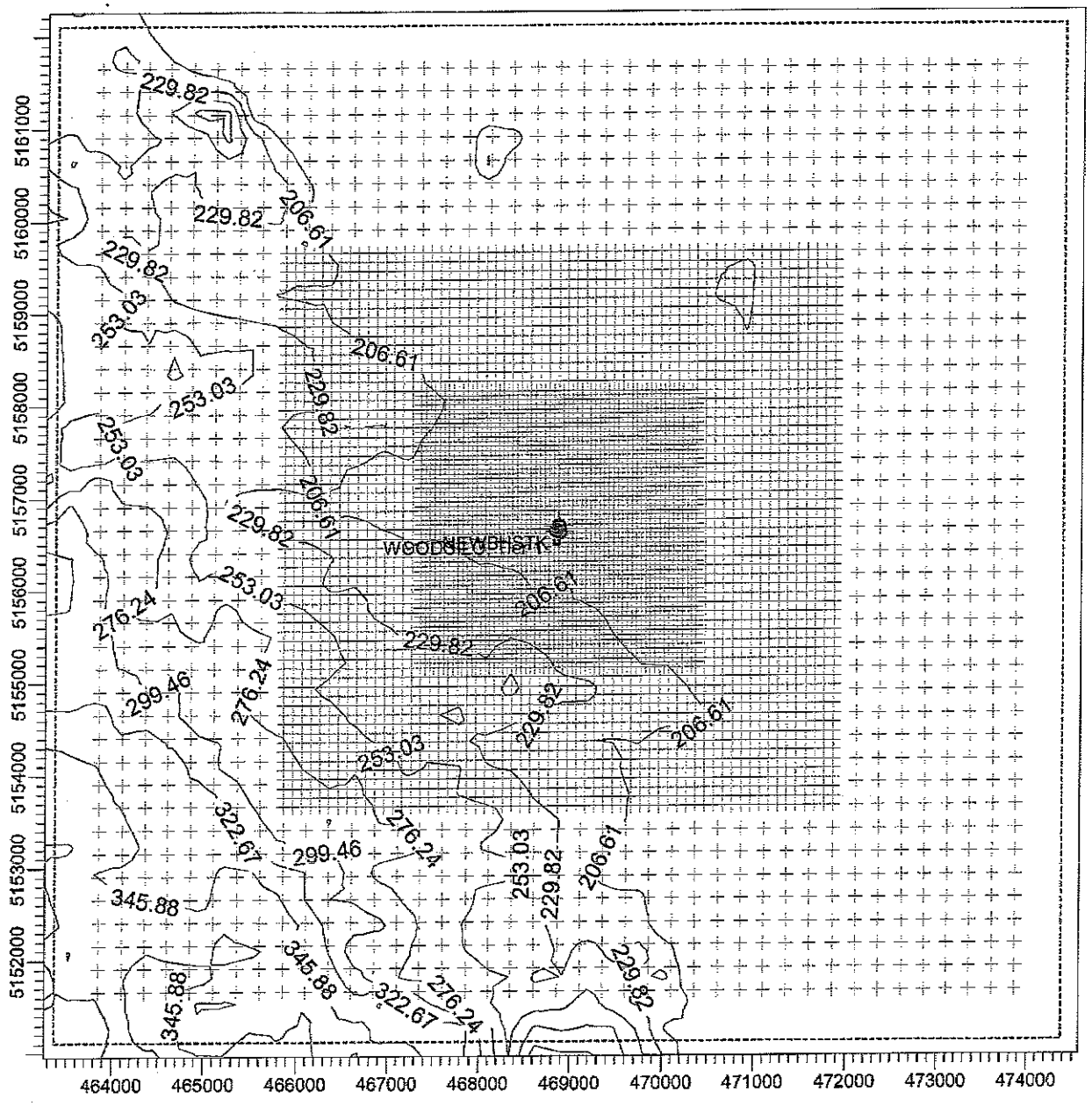
150'

Used in modeling inputs

Receptor Grid Layout Diagrams

PROJECT TITLE:

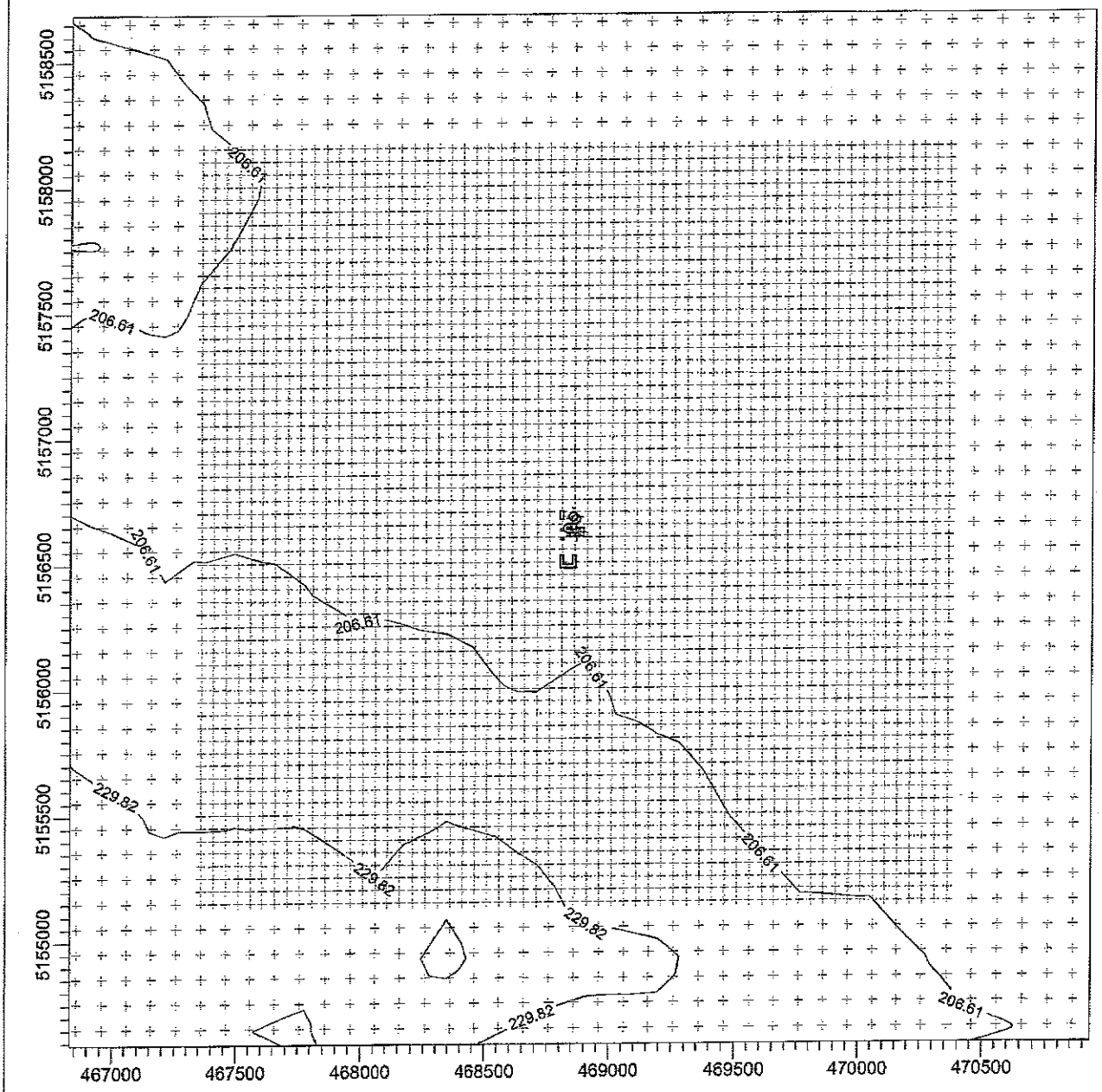
Northern Michigan University - Powerhouse Modification PTI
Receptor Grid Layout



COMMENTS: NMU Receptor Grid Layout: Inner Grid: 1 km x 1 km 50-m spacing Middle Grid: 3 km x 3 km 100-m spacing Outer Grid: 5 km x 5 km 250-m spacing	SOURCES: **2**	COMPANY NAME: **NTH Consultants, Ltd**	
	RECEPTORS: **7537**	MODELER: **Edward Bishop, Asst Project Engineer**	
		SCALE: 1:69,000 0 2 km	
		DATE: **1/25/2007**	PROJECT NO.: **16-060504**

PROJECT TITLE:

Northern Michigan University - Powerhouse Modification PTI
Receptor Grid Layout - Zoomed



COMMENTS: NMU Receptor Grid Layout: Inner Grid: 1 km x 1 km 50-m spacing Middle Grid: 3 km x 3 km 100-m spacing	SOURCES: **2** RECEPTORS: **7537**	COMPANY NAME: **NTH Consultants, Ltd** MODELER: **Edward Bishop, Asst Project Engineer** SCALE: 1:25,000 0 0.5 km	
		DATE: **1/25/2007**	PROJECT NO.: **16-060504**

Existing Source Emission Rates

NMU Boiler Project - Existing Source Emission Rates

Pre Permit 126-05 Emission Estimates

Basis: 1,020 Btu/scf nat gas
135,000 Btu/gallon fuel oil

Year	Nat Gas (MM scf)	Fuel Oil (gal)	Heat Input Nat Gas (MM Btu)	Heat Input Fuel Oil (MM Btu)	Total (MM Btu)
2000	358.057	1313	365218	177.3	365,395
2001	363.933	363	371212	49.0	371,261
2002	401.341	0	409368	0.0	409,368
2003	377.819	22471	385375	3033.6	388,409
2004	384.185	25896	391869	3496.0	395,365

Potential Fuel Oil Capacity (MM gal/year)
10,356,267

0.0025 Max Actual Capacity Factor
21.90 Equiv Hrs using Fuel Oil/year

Past Actual - Estimated Annual Emissions

Pollutant	NOx	CO	Tons/Year PM	SO2	VOC
2000	17.92	15.04	1.36	0.16	0.98
2001	18.20	15.29	1.38	0.12	1.00
2002	**20.07**	**16.86**	**1.53**	0.12	**1.10**
2003	19.12	15.92	1.48	0.93	1.04
2004	19.47	16.20	1.51	**1.06**	1.06
Maximum	**20.07**	**16.86**	**1.53**	**1.06**	**1.10**
lb/hour	**4.582**	**3.848**	**0.348**	**0.242**	**0.252**

annual average lb/hour

AP42 Factors

	Nat Gas (lb/mmscf)	Fuel Oil (lb/mmBtu)
NOx	100	0.148
CO	84	0.037
PM	7.6	0.03
SO2	0.6	0.54
VOC	5.5	0.002

Permit 126-05 Equipment - Potential Emissions (Based on Two Boilers @ Rated Capacities)

	2 Boilers Capacity (MM Btu/hr)	Nat Gas (MM scf/hr)	Nat Gas (MM scf/yr)	Fuel Oil (gal/hr)	Fuel Oil (gal/year)
Nat Gas	167.2	0.1639	1,057.14		
Fuel Oil	159.6			1,182.22	2,732,040

Annual Operation With Fuel Type (hour/year)
6449.1 Nat Gas
2310.9 Fuel Oil

Pollutant	NOx	CO	PM	SO2	VOC
Nat Gas	26.43	44.40	4.02	0.32	2.91
Fuel Oil	18.44	28.77	5.53	99.58	0.37
Maximum	n/a	n/a	n/a	n/a	n/a
Totals	44.87	73.17	9.55	99.90	3.28

Low NOx/AP42 Factors

	Nat Gas (lb/mmscf)	Fuel Oil (lb/mmBtu)
NOx	50	0.100
CO	84	0.156
PM	7.6	0.03
SO2	0.6	0.54
VOC	5.5	0.002

0.5 Wt-% Sulfur in Fuel Oil

		NOx	CO	PM	SO2	VOC
Nat Gas only	lb/hour	8.196	13.769	1.246	0.098	**0.902**
Oil Only (max hourly)	lb/hour	15.960	**24.898**	**4.788**	**86.184**	0.319
Limited Oil Use (annual ave hourly)	lb/hr (annual)	**10.244**	16.705	2.180	22.808	0.748

Note: **red bold** = maximum emission rate used for future potential modeling purposes

Modeled Emission Rates for Existing Boilers (based on two operating at maximum capacity)

	NOx	CO	PM	SO2
PSD Increment	0.714		0.559	10.829
NAAQS	1.291	3.137	0.603	10.859
	Emission rates above given in units of gram/second			

File: NMU Modeled Rates (Exist & New) Tab: Existing Equip Summary

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Summary of TAC Analysis Results

Background Concentrations

BACKGRND (Aug 21 06)

BACKGROUND CONCENTRATIONS

	CITY	ADDRESS	TYPE	YEAR	Distance	3-HR	24-HR	ANNUAL
SO2	Escanaba	County Road 414	Rural	2003	65.3 km	45.2	13.3	2.7
SO2	Escanaba	County Road 414	Rural	2004	65.3 km	34.6	10.6	2.7
SO2		Seney Nat'L Wildlife Refuge, Hcr2,	Rural	2005	158.5 km	29.3	13.3	2.7
						45.2	13.3	2.7

	CITY	ADDRESS	TYPE	YEAR	Distance	ANNUAL
NO2		Harrington Beach State Park, 531 Hw	Rural	2003	225.4 km	11.5
NO2	Two Rivers	Manitowoc/Woodlnd Dunes, 2315 Goodw	Rural	2004	176.5 km	5.7
NO2	Two Rivers	Manitowoc/Woodlnd Dunes, 2315 Goodw	Rural	2005	176.5 km	5.7
						11.5

	CITY	ADDRESS	TYPE	YEAR	Distance	24-HR	ANNUAL
PM10	Green Bay	Prangeway, 1300 N Quincy Street	Urban	2003	160.8 km	----	19.0
PM10	Green Bay	Prangeway, 1300 N Quincy Street	Urban	2004	160.8 km	----	15.0
PM10	Green Bay	Prangeway, 1300 N Quincy Street	Urban	2005	160.8 km	----	22.0
						48.0	22.0
						4th High	

	CITY	ADDRESS	TYPE	YEAR	Distance	1-HR	8-HR
CO	Milwaukee	Dnr Ser Hdqrts, 2300 N M. L. King J	Urban	2003	258.5 km	4408	3016
CO	Milwaukee	Dnr Ser Hdqrts, 2300 N M. L. King J	Urban	2004	258.5 km	4524	3480
CO		Seney Nat'L Wildlife Refuge, Hcr2,	Rural	2005	158.5 km	812	464
						4524	3480

	CITY	ADDRESS	TYPE	YEAR	Distance	QUARTER
Pb	Milwaukee	Health Center, 1337 So 16th St	Urban	2003	262.1 km	0.03
Pb		Mayville, Near N6705 Madison Rd	Rural	2004	256.2 km	0.01
Pb		1769 S Jeffs Rd	Rural	2005	316.5 km	0.01
						0.03

APPENDIX D

RACT/BACT/LAER Clearinghouse Results

Northern Michigan University
RBLC

RBLCID	FACILITY NAME	STATE	PERMIT No.	PERMIT DATE	DESCRIPTION	PROCESS NAME	FUEL	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	EMIS LIMIT	UNIT	AVG TIME	BASIS
MN-0058	VIRGINIA DEPARTMENT OF PUBLIC UTILITIES	MN	13700028-005	6/30/2005	WOOD FIRED BOILER, 230 MMBTU/H HEAT INPUT, SPREADER STOKER	BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Particulate Matter (PM)	0.025	LB/MMBTU	3-HR TEST	BACT-PSD
MN-0058	VIRGINIA DEPARTMENT OF PUBLIC UTILITIES	MN	13700028-005	6/30/2005		BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Particulate Matter < 10 µ (PM10)	0.025	LB/MMBTU	3-HR TEST	BACT-PSD
MN-0058	VIRGINIA DEPARTMENT OF PUBLIC UTILITIES	MN	13700028-005	6/30/2005		BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Carbon Monoxide	0.3	LB/MMBTU	4-HOUR BLOCK AVERAGE	BACT-PSD
MN-0058	VIRGINIA DEPARTMENT OF PUBLIC UTILITIES	MN	13700028-005	6/30/2005		BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Nitrogen Oxides (NOx)	0.15	LB/MMBTU	30 DAY AVERAGE	BACT-PSD
MN-0059	HIBBING PUBLIC UTILITIES	MN	13700027-003	6/30/2005		BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Particulate Matter < 10 µ (PM10)	0.025	LB/MMBTU	3-HR TEST	BACT-PSD
MN-0059	HIBBING PUBLIC UTILITIES	MN	13700027-003	6/30/2005		BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Particulate Matter (PM)	0.025	LB/MMBTU	3-H TEST	BACT-PSD
MN-0059	HIBBING PUBLIC UTILITIES	MN	13700027-003	6/30/2005		BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Carbon Monoxide	0.3	LB/MMBTU	4-HOUR BLOCK AVERAGE	BACT-PSD
MN-0059	HIBBING PUBLIC UTILITIES	MN	13700027-003	6/30/2005		BOILER, WOOD FIRED	WOOD	230	mmbtu/h		Nitrogen Oxides (NOx)	0.15	LB/MMBTU	30-DAY ROLING AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004	ETHANOL PRODUCTION PLANT RATED AT 65 MILLION GALLONS PER YEAR.	BOILER, COAL-FIRED	LIGNITE	250	MMBTU/H	BOILER ACTS AS A CONTROL DEVICE FOR THE DISTILLER'S GRAIN DRYERS , DISTILLATION COLUMNS AND BIOMETHANATOR (I.E. GASES FROM THESE PROCESSES ARE ROUTED TO THE BOILER FOR COMBUSTION).	Particulate Matter < 10 µ (PM10)	0.02	LB/MMBTU	3-HOUR AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		BOILER, COAL-FIRED	LIGNITE	250	MMBTU/H		Sulfur Oxides (SOx)	0.09	LB/MMBTU	30 DAY ROLLING AVG.	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		BOILER, COAL-FIRED	LIGNITE	250	MMBTU/H		Nitrogen Oxides (NOx)	0.1	LB/MMBTU	30 DAY ROLLING AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		BOILER, COAL-FIRED	LIGNITE	250	MMBTU/H		Carbon Monoxide	0.11	LB/MMBTU	3 HOUR ROLLING AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		BOILER, COAL-FIRED	LIGNITE	250	MMBTU/H		Particulate Matter (PM)	0.048	LB/MMBTU	3 HOUR AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		DDGS COOLING		22	T/H		Particulate Matter < 10 µ (PM10)	0.004	GR/DSCF	3 HOUR AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		GRAIN RECEIVING		420	T/H		Particulate Matter < 10 µ (PM10)	0.004	GR/DSCF	3 HOUR AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		HAMMERMILLING		76	T/H		Particulate Matter < 10 µ (PM10)	0.004	GR/DSCF	3 HOUR AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		DDGS LOADOUT		420	T/H		Particulate Matter < 10 µ (PM10)	0.004	GR/DSCF	3 HOUR AVERAGE	BACT-PSD
ND-0020	RICHARDTON PLANT	ND	4004	8/4/2004		COAL HANDLING		27	T/H		Particulate Matter < 10 µ (PM10)	0.004	GR/DSCF	3 HOUR AVERAGE	BACT-PSD

RBLCID	FACILITY NAME	STATE	PERMIT No.	PERMIT DATE	DESCRIPTION	PROCESS NAME	FUEL	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	EMIS LIMIT	UNIT	AVG TIME	BASIS
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004	THIS FACILITY BREWS AND PACKAGES BEER. EACH BOILER NOT TO EXCEED 160,000 LB STEAM/H OR 238 MMBTU/H. BOTH BOILERS TOGETHER NOT TO EXCEED 125,682 TONS COAL/ROLLING 12-MONTHS. THIS PTI, 14-05515, IS A MODIFICATION TO PTI #14-05143 ISSUED 11/15/01 FOR THE ADDITION OF AN 8.5 MW STEAM TURBINE GENERATOR TO AN EXISTING COAL FIRED BOILER (THERE WERE NO EMISSIONS FROM THE STEAM TURBINE ITSELF). THIS MODIFICATION WAS TO INCREASE THE HCL HOURLY AND T/YR LIMITS AND SO2/MMBTU LIMIT. THE T/YR FACILITYWIDE LIMITS HAVE NOT CHANGED, EXCEPT FOR HCL WHICH HAS INCREASE BY 46.1 T/YR IN THIS NEW PERMIT.	BOILER (2), COAL FIRED	COAL	238	MMBTU/H	TWO BOILERS, CAPABLE OF BURNING AND WITH LIMITS FOR COAL, NATURAL GAS, NUMBERS 2 AND 6 FUEL OILS. POUND PER HOUR LIMITS ARE FOR EACH BOILER; AND EXCEPT FOR VOC AND CO, ALL T/YR LIMITS ARE FOR BOTH BOILERS COMBINED. COAL USAGE FOR BOTH BOILERS TOGETHER NOT TO EXCEED 125,682 TONS/ROLLING 12 MONTHS. THESE LIMITS FOR THE COAL.	Nitrogen Oxides (NOx)	0.7	LB/MMBTU		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), COAL FIRED	COAL	238	MMBTU/H		Carbon Monoxide	5.2	LB/H	EACH BOILER	BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), COAL FIRED	COAL	238	MMBTU/H		Sulfur Dioxide (SO2)	1.6	LB/MMBTU		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), COAL FIRED	COAL	238	MMBTU/H		Particulate Matter < 10 µ (PM10)	0.01	GR/ACF		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 6 FUEL OIL	NO. 6 FUEL OIL	238	MMBTU/H		Particulate Matter < 10 µ (PM10)	0.01	GR/ACF		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 6 FUEL OIL	NO. 6 FUEL OIL	238	MMBTU/H		Nitrogen Oxides (NOx)	0.7	LB/MMBTU		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 6 FUEL OIL	NO. 6 FUEL OIL	238	MMBTU/H		Carbon Monoxide	8.15	LB/H	EACH BOILER	BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 6 FUEL OIL	NO. 6 FUEL OIL	238	MMBTU/H		Sulfur Dioxide (SO2)	1.6	LB/MMBTU		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 2 FUEL OIL	NO. 2 FUEL OIL	238	MMBTU/H		Particulate Matter < 10 µ (PM10)	0.01	GR/ACF		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 2 FUEL OIL	NO. 2 FUEL OIL	238	MMBTU/H		Nitrogen Oxides (NOx)	0.7	LB/MMBTU		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 2 FUEL OIL	NO. 2 FUEL OIL	238	MMBTU/H		Volatile Organic Compounds (VOC)	0.38	LB/H	EACH BOILER	BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 2 FUEL OIL	NO. 2 FUEL OIL	238	MMBTU/H		Carbon Monoxide	8.5	LB/H	EACH BOILER	BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NO. 2 FUEL OIL	NO. 2 FUEL OIL	238	MMBTU/H		Sulfur Dioxide (SO2)	1.6	LB/MMBTU		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NATURAL GAS	NATURAL GAS	238	MMBTU/H		Particulate Matter < 10 µ (PM10)	0.01	GR/ACF		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NATURAL GAS	NATURAL GAS	238	MMBTU/H		Nitrogen Oxides (NOx)	0.7	LB/MMBTU		BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NATURAL GAS	NATURAL GAS	238	MMBTU/H		Carbon Monoxide	20	LB/H	EACH BOILER	BACT-PSD
OH-0241	MILLER BREWING COMPANY - TRENTON	OH	14-05515	5/27/2004		BOILER (2), NATURAL GAS	NATURAL GAS	238	MMBTU/H		Sulfur Dioxide (SO2)	1.6	LB/MMBTU		BACT-PSD

RBLCID	FACILITY NAME	STATE	PERMIT No.	PERMIT DATE	DESCRIPTION	PROCESS NAME	FUEL	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	EMIS LIMIT	UNIT	AVG TIME	BASIS
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004	SEVEN BOILERS PURCHASED FROM AN ETHANOL PLANT, REBUILDING TO BURN WOOD AND TO GENERATE POWER, USING WOOD WASTE	WOOD FIRED BOILERS (7)	WOOD	175	MMBTU/H	Oxidation catalyst, selective catalytic reduction, sodium bicarbonate injection, reverse air baghouse w/98% control.	Particulate Matter < 10 µ (PM10)	3.97	LB/H		BACT-PSD
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		WOOD FIRED BOILERS (7)	WOOD	175	MMBTU/H		Nitrogen Oxides (NOx)	27.98	LB/H		N/A
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		WOOD FIRED BOILERS (7)	WOOD	175	MMBTU/H		Carbon Monoxide	31.8	LB/H		BACT-PSD
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		WOOD FIRED BOILERS (7)	WOOD	175	MMBTU/H		Sulfur Dioxide (SO2)	22.13	LB/H		N/A
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		WOOD HANDLING SYSTEM		130495	ACFM		Particulate Matter < 10 µ (PM10)	6.71	LB/H		BACT-PSD
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	FUEL OIL #2	227	MMBTU/H		Nitrogen Oxides (NOx)	43.13	LB/H	ON FUEL OIL	N/A
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	FUEL OIL #2	227	MMBTU/H		Carbon Monoxide	27.24	LB/H	WITH FUEL OIL	BACT-PSD
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	FUEL OIL #2	227	MMBTU/H		Particulate Matter < 10 µ (PM10)	9.08	LB/H	WITH FUEL OIL	BACT-PSD
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	FUEL OIL #2	227	MMBTU/H		Sulfur Dioxide (SO2)	2.84	LB/H	FOR FUEL OIL	N/A
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	NATURAL GAS	247	MMBTU/H		Nitrogen Oxides (NOx)	14.82	LB/H	WITH NATURAL GAS	N/A
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	NATURAL GAS	247	MMBTU/H		Carbon Monoxide	27.17	LB/H	WITH NATURAL GAS	BACT-PSD
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	NATURAL GAS	247	MMBTU/H		Particulate Matter < 10 µ (PM10)	1.73	LB/H	WITH NATURAL GAS	BACT-PSD

RBLCID	FACILITY NAME	STATE	PERMIT No.	PERMIT DATE	DESCRIPTION	PROCESS NAME	FUEL	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	EMIS LIMIT	UNIT	AVG TIME	BASIS
*OH-0269	BIOMASS ENERGY, LLC-SOUTH POINT POWER	OH	07-00534	1/5/2004		AUXILIARY BOILER	NATURAL GAS	247	MMBTU/H		Sulfur Dioxide (SO2)	0.15	LB/H	WITH NATURAL GAS	N/A
LA-0126	JOYCE MILL	LA	PSD-LA-679	4/24/2002	JOYCE MILL PRODUCES LUMBER AND WOOD WASTES, SUCH AS WOOD CHIPS, SHAVINGS, SAWDUST AND BARK. THE WOOD WASTE IS USED FOR FUEL IN THE BOILERS TO PRODUCE STEAM FOR THE MILL.	KIPPER BOILERS NO.1 AND NO.2 (EACH)	WOOD WASTE	58.3	MMBTU/H EACH	EMISSION POINTS 74A (NO.1) AND 74B (NO.2)	Carbon Monoxide	105.5	LB/H	EACH	Other Case-by-Case
LA-0126	JOYCE MILL	LA	PSD-LA-679	4/24/2002		MCBURNEY BOILER NO.4	WOOD WASTE	154.2	MMBTU/H	EMISSION POINT 75A.	Carbon Monoxide	279.1	LB/H		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002	STEAM PRODUCTION FACILITY	BOILER, STEAM	WOOD	120	MMBTU/H	Wood limit 70% Mixture. Wood/Bark excluding any wood which contains chemical treatments or has affixed thereto paint and/or finishing materials or paper or plastic laminates: Average annual heat content: 5,000 Btu/lb HHV	Particulate Matter (PM)	0.15	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	WOOD	120	MMBTU/H		Particulate Matter < 10 µ (PM10)	0.14	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	WOOD	120	MMBTU/H		Sulfur Dioxide (SO2)	0.47	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	WOOD	120	MMBTU/H		Nitrogen Dioxide (NO2)	0.4	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	WOOD	120	MMBTU/H		Carbon Monoxide	0.44	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	COAL	120	MMBTU/H	In order to meet the annual emission limitations included in this permit, the wood/coal mixture shall not exceed 30% coal by BTU content on an annual basis.	Particulate Matter (PM)	0.15	LB/MMBTU		Other Case-by-Case

RBLCID	FACILITY NAME	STATE	PERMIT No.	PERMIT DATE	DESCRIPTION	PROCESS NAME	FUEL	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	EMIS LIMIT	UNIT	AVG TIME	BASIS
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	COAL	120	MMBTU/H	Average annual heat content 13,000 Btu/lb HHV. Average sulfur content per shipment 0.9% and average ash content per shipment 7%.	Particulate Matter < 10 µ (PM10)	0.14	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002	STEAM PRODUCTION FACILITY	BOILER, STEAM	COAL	120	MMBTU/H	In order to meet the annual emission limitations included in this permit, the wood/coal mixture shall not exceed 30% coal by BTU content on an annual basis. Average annual heat content 13,000 Btu/lb HHV. Average sulfur content per shipment 0.9% and average ash content per shipment 7%.	Sulfur Dioxide (SO2)	0.47	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	COAL	120	MMBTU/H		Nitrogen Oxides (NOx)	0.4	LB/MMBTU		Other Case-by-Case
VA-0268	THERMAL VENTURES	VA	30529	2/15/2002		BOILER, STEAM	COAL	120	MMBTU/H		Carbon Monoxide	0.44	LB/MMBTU		Other Case-by-Case
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002	WILLAMETTE INDUSTRIES REQUESTED A PSD MODIFICATION TO INSTALL A REGENERATIVE THERMAL OXIDIZER OR CATALYTIC OXIDIZER (RTO/RCO), REMOVE THE PRODUCTION LIMIT IMPOSED BY PART 70 OPERATING PERMIT NO. 3240-00010-V2, AND MODERNIZE THE PLYWOOD MANUFACTURING PROCESS AT THE DODSON DIVISION.	WOOD FIRED BOILER	WOOD	233	MMBTU/H	EIQ NO. 017. NO PHYSICAL MODIFICATION TO THE BOILERS WILL BE NEEDED (FIRING RATES WILL BE INCREASED) SO BACT IS NOT REQUIRED FOR EMISSIONS FROM BOILERS.	Nitrogen Oxides (NOx)	47.91	LB/H		Other Case-by-Case
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002		WOOD FIRED BOILER	WOOD	233	MMBTU/H		Carbon Monoxide	191.68	LB/H		Other Case-by-Case
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002		VENNER DRYER NO.1 COOLING ZONE	NATURAL GAS			EIQ NO. 028. SCC FOR GAS VENEER DYER, PINES. NO THROUGHPUT GIVEN.	Nitrogen Oxides (NOx)	0.37	LB/H		BACT-PSD
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002		VENNER DRYER NO.1 COOLING ZONE	NATURAL GAS				Carbon Monoxide	0.09	LB/H		BACT-PSD
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002		VENNER DRYER NO.2 COOLING ZONE	NATURAL GAS			EIQ NO. 029. SCC FOR GAS VENEER DYER, PINES. NO THROUGHPUT GIVEN.	Nitrogen Oxides (NOx)	0.86	LB/H		BACT-PSD
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002		VENNER DRYER NO.2 COOLING ZONE	NATURAL GAS				Carbon Monoxide	0.22	LB/H		BACT-PSD
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002		VENEER DRYERS, HOT ZONES	NATURAL GAS			EMISSIONS INFORMATION IN THE PERMIT IS ORGANIZED UNDER THE REGENERATIVE THERMAL OXIDIZER OR	Nitrogen Oxides (NOx)	10.27	LB/H		BACT-PSD
LA-0125	WILLAMETTE INDUSTRIES, INC.	LA	PSD-LA-627 (M-1)	1/7/2002		VENEER DRYERS, HOT ZONES	NATURAL GAS				Carbon Monoxide	9.31	LB/H		BACT-PSD

RBLCID	FACILITY NAME	STATE	PERMIT No.	PERMIT DATE	DESCRIPTION	PROCESS NAME	FUEL	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	EMIS LIMIT	UNIT	AVG TIME	BASIS
VA-0267	VPI POWER STATION	VA	20124	8/30/2001	Steam generation for electricity.	BOILER, OVERFEED STOKER	COAL	146.7	MMBTU/H	No. 11 boiler. Boiler produces steam for generation of electricity.	Particulate Matter < 10 µ (PM10)	2.9	LB/H		BACT-PSD
VA-0267	VPI POWER STATION	VA	20124	8/30/2001		BOILER, OVERFEED STOKER	COAL	146.7	MMBTU/H		Sulfur Dioxide (SO2)	0.16 23.6	LB/H		BACT-PSD
VA-0267	VPI POWER STATION	VA	20124	8/30/2001		BOILER, OVERFEED STOKER	COAL	146.7	MMBTU/H		Nitrogen Dioxide (NO2)	36.1	LB/H		BACT-PSD
VA-0267	VPI POWER STATION	VA	20124	8/30/2001		BOILER, OVERFEED STOKER	COAL	146.7	MMBTU/H		Carbon Monoxide	33.2	LB/H		BACT-PSD
VA-0267	VPI POWER STATION	VA	20124	8/30/2001		BOILER, OVERFEED STOKER	COAL	146.7	MMBTU/H		Particulate Matter (PM)	2.9	LB/H		BACT-PSD
AR-0045	COLUMBIAN CHEMICALS - EL DORADO	AR	906-AOP-R1 (70-0014)	8/9/2001	This plant makes carbon black using the oil furnance process. This determination is a modification. Emission increases of SO2 and NOx will exceed the PSD significance levels. Increases of PM10 emissions are less than the PSD threshold. Other pollutants' proposed emissions are lower than the past actual emissions because of the addition of new control equipment. Pollutant Emissions (T/yr) Carbon Disulfide 87.75 Carbonyl sulfide 13.46 Hydrogen 117.76 TRS 219.04	COAL-FIRED BOILERS (2)	SUB-BITUMINOUS COAL	9700	MMBTU/H FOR EACH	CO catalyst technology used with a coal fired source was deemed technically infeasible. Due to position in ductwork, the catalyst is exposed to a substantial amount of fly ash in the flue gas stream. No physical modification was made for this process under this determination, but permitted emission rates for ppm emissions of CO change due to the use of new emission factors.	Carbon Monoxide	100	PPM	24 hr. average	Other Case-by-Case
AR-0045	COLUMBIAN CHEMICALS - EL DORADO	AR	906-AOP-R1 (70-0014)	8/9/2001		CARBON BLACK MFG, UNIT D STACK & VENT	NATURAL GAS			Throughput is confidential. This carbon black mfg process is being added. New stacks: SN-31, SN-48, SN-49. BACT determination for SO2 and NOx only.	Sulfur Dioxide (SO2)	0.2	LB/H		BACT-PSD
AR-0045	COLUMBIAN CHEMICALS - EL DORADO	AR	906-AOP-R1 (70-0014)	8/9/2001		CARBON BLACK MFG, UNIT D STACK & VENT	NATURAL GAS				Nitrogen Oxides (NOx)	7.7	LB/H		BACT-PSD
AR-0045	COLUMBIAN CHEMICALS - EL DORADO	AR	906-AOP-R1 (70-0014)	8/9/2001		CARBON BLACK MFG., UNITS A, B, & C	FEEDSTOCK OIL				Sulfur Dioxide (SO2)	2530	LB/H	combined	BACT-PSD
AR-0045	COLUMBIAN CHEMICALS - EL DORADO	AR	906-AOP-R1 (70-0014)	8/9/2001		CARBON BLACK MFG., UNITS A, B, & C	FEEDSTOCK OIL				Nitrogen Oxides (NOx)	248	LB/H	combined	BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03138R16	5/10/2001	MODIFICATION FOR INSTALLATION OF NEW EQUIPMENT TO INCREASE PRODUCTION CAPACITY.	BOILER, POWER, COAL-FIRED	COAL	249	MMBTU/H	POWER BOILER CAN FIRE COAL, NO. 6 FUEL OIL, OR BARK/WOOD FIBER SLUDGE.	Particulate Matter (PM)	0.16	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03138R16	5/10/2001		BOILER, POWER, COAL-FIRED	COAL	249	MMBTU/H		Sulfur Dioxide (SO2)	0.8	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03138R16	5/10/2001		BOILER, POWER, COAL-FIRED	COAL	249	MMBTU/H		Nitrogen Oxides (NOx)	0.4	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03138R16	5/10/2001		BOILER, POWER, COAL-FIRED	COAL	249	MMBTU/H		Carbon Monoxide	0.208	LB/MMBTU		BACT-PSD

RBLCID	FACILITY NAME	STATE	PERMIT No.	PERMIT DATE	DESCRIPTION	PROCESS NAME	FUEL	THRUPUT	UNIT	PROCESS NOTES	POLLUTANT	EMIS LIMIT	UNIT	AVG TIME	BASIS
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001	MODIFICATION FOR INSTALLATION OF NEW EQUIPMENT TO INCREASE PRODUCTION CAPACITY.	BOILER, POWER, OIL-FIRED	NO. 6 FUEL OIL	249	MMBTU/H	POWER BOILER CAN FIRE COAL, NO. 6 FUEL OIL, OR BARK/WOOD FIBER SLUDGE.	Particulate Matter (PM)	0.0562	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		BOILER, POWER, OIL-FIRED	NO. 6 FUEL OIL	249	MMBTU/H		Sulfur Dioxide (SO2)	0.8	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		BOILER, POWER, OIL-FIRED	NO. 6 FUEL OIL	249	MMBTU/H		Nitrogen Oxides (NOx)	0.367	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		BOILER, POWER, OIL-FIRED	NO. 6 FUEL OIL	249	MMBTU/H		Carbon Monoxide	0.033	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		BOILER, POWER, WOODWASTE-FIRED	WOODWASTE	600	MMBTU/H		Particulate Matter (PM)	0.25	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		BOILER, POWER, WOODWASTE-FIRED	WOODWASTE	600	MMBTU/H		Sulfur Dioxide (SO2)	0.024	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		BOILER, POWER, WOODWASTE-FIRED	WOODWASTE	600	MMBTU/H		Nitrogen Oxides (NOx)	0.35	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		BOILER, POWER, WOODWASTE-FIRED	WOODWASTE	600	MMBTU/H		Carbon Monoxide	0.5	LB/MMBTU		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		RECOVERY BOILER	NO. 6 FUEL OIL	557	MMBTU/H	BOILER FIRES AN AVERAGE OF 5.59 MILLION POUNDS OF BLACK LIQUOR SOLIDS PER DAY.	Sulfur Dioxide (SO2)	979.2	LB/H		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		RECOVERY BOILER	NO. 6 FUEL OIL	557	MMBTU/H		Nitrogen Dioxide (NO2)	586.5	LB/H		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		RECOVERY BOILER	NO. 6 FUEL OIL	557	MMBTU/H		Carbon Monoxide	357.1	LB/H		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		RECOVERY BOILER	NO. 6 FUEL OIL	557	MMBTU/H		Particulate Matter (PM)	0.044	GR/DSCF @ 8% O2		N/A
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		SMELT TANKS					Sulfur Dioxide (SO2)	6.2	LB/H		BACT-PSD
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		LIME KILN	NO.6 FUEL OIL	212	LB/MMBTU		Particulate Matter (PM)	0.13	GR/DSCF @ 10% O2		N/A
NC-0092	RIEGELWOOD MILL	NC	03136R16	5/10/2001		LIME KILN	NO.6 FUEL OIL	212	LB/MMBTU		Total Reduced Sulfur	8	PPM @ 10% O2		N/A

APPENDIX E

ESA Documentation

STATE OF MICHIGAN

JENNIFER M. GRANHOLM
GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LANSING

REBECCA A. HUMPHRIES
DIRECTOR

August 8, 2006

Mr. Jeffrey Jaros
NTH Consultants, Ltd.
608 S. Washington
Lansing, MI 48933

RE: **Two proposed air permit locations in Holland and Marquette, Michigan submitted to DNR Endangered Species Assessment web application**

Dear Mr. Jaros:

The location of the proposed projects were checked against known localities for rare species and unique natural features, which are recorded in a statewide database. This continuously updated database is a comprehensive source of existing data on Michigan's endangered, threatened, or otherwise significant plant and animal species, natural plant communities, and other natural features. Records in the database indicate that a qualified observer has documented the presence of special natural features at a site. The absence of records in the database for a particular site may mean that the site has not been surveyed. Records are not always up-to-date, and may require verification. In some cases, the only way to obtain a definitive statement on the status of natural features is to have a competent biologist perform a complete field survey.

Under Act 451 of 1994, the Natural Resources and Environmental Protection Act, Part 365, Endangered Species Protection, "a person shall not take, possess, transport, ...fish, plants, and wildlife indigenous to the state and determined to be endangered or threatened," unless first receiving an Endangered Species Permit from the Department of Natural Resources, Wildlife Division. *Responsibility to protect endangered and threatened species is not limited to the list below. Other species may be present that have not been recorded in the database.*

The presence of threatened or endangered species does not preclude activities or development, but may require alterations in the project plan. Special concern species are not protected under endangered species legislation, but recommendations regarding their protection may be provided. Protection of special concern species will help prevent them from declining to the point of being listed as threatened or endangered in the future.

The following is a summary of the results for the project in Ottawa County, City of Holland, T5N R16W section 36 **and** Marquette County, City of Marquette, T48N R25W section 11:

> The project should have no impact on rare or unique natural features at the location specified above if it proceeds according to the plans provided. Please contact me for an evaluation if the project plans are changed.

Thank you in for your coordination in addressing the protection of Michigan's natural resource heritage. Responses and correspondence can be sent to: Michigan Department of Natural Resources, Wildlife Division – Natural Heritage Program, PO Box 30180, Lansing, MI 48909. If you have further questions, please call me at 517-373-1263 or e-mail at SargenL2@michigan.gov .

Sincerely,

Lori A Sargent

Lori G. Sargent
Endangered Species Specialist
Wildlife Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE
East Lansing Field Office (ES)
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823-6316

IN REPLY REFER TO:

November 24, 2006

Mr. Jeffrey P. Jaros
NTH Consultants, Ltd.
608 S. Washington Avenue
Lansing, MI 48933

Re: Endangered Species List Request, Proposed Construction of Solid Fuel Fired Boiler, Northern Michigan University, Marquette, Marquette County, Michigan

Dear Mr. Jaros:

Thank you for your October 24, 2006 request for information regarding federally listed and proposed threatened and endangered species, candidate species, or critical habitat near your proposed project. Your request and this response are made pursuant to the Endangered Species Act of 1973, as amended (Act). Under this project, Northern Michigan University proposes to install a cogeneration of coal/wood/natural gas fired circulating fluidized bed boiler on the north end of its campus, next to the existing Ripley Heating Plant.

Our records do not indicate the presence of federally listed species or critical habitat near your proposed project. This precludes the need for further action on this project as required by the Act. If, however, more than six months pass, project plans change, or new information becomes available that indicates listed species or proposed species may be affected, you should conduct further consultation with this office.

We appreciate your concern for endangered and threatened species. Any questions can be directed to Tameka Dandridge of this office at Tameka_Dandridge@fws.gov or 517/351-8315.

Sincerely,

Craig A. Czarnecki
Field Supervisor

cc: MDNR-Wildlife Division, Lansing, MI (Attn: Lori Sargent)

s: admin/archives/nov06/se list/NTH-NMU~solidfuel.tnd.doc

APPENDIX F

Cooling Tower Modeling Output

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  EPRI PLUME AND DRIFT ANALYSIS SYSTEM PREPROCESSOR CODE, PRE-RELEASE VERSION 09-01-90
  CASE STUDY: Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)

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  INPUT INFORMATION
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  SURFACE TAPE TYPE:              CD144
  TOWER TYPE:                LINEAR MECHANICAL DRAFT
  TOWER HEIGHT (M):               12.50
  TOWER DIAMETER (M):             47.03
  TOWER HEAT (KW):              7000.00
  TOWER AIR FLOW (KG/S):         679.50
  SITE LATITUDE:                  46.60
  SITE LONGITUDE:                 87.40
  SITE TIME ZONE:                EASTERN
  ROUGHNESS HEIGHT (CM):           0.07
  REFERENCE HEIGHT (M):           10.00

  RECORD STOPPING SWITCH:          8760
  RECORD SKIPPING FACTOR:             1
  HOURLY RECORD PRINT LOG:       NOT SELECTED
  BI-DAILY MIXING HEIGHT TAPE:   SELECTED
  MIXING HEIGHT TYPE:            RURAL
  FOGGING/ICING OPTION:          SELECTED
  DRIFT OPTION:                  SELECTED



  MONTHLY CLEARNESS INDEX
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   JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC
   ---   ---   ---   ---   ---   ---   ---   ---   ---   ---   ---   ---
  .460  .490  .520  .490  .530  .550  .560  .550  .530  .500  .420  .420


  TOTAL DAILY SOLAR ENERGY DEPOSITION
     (LONG-TERM AVERAGE FOR MONTH)
  ----------------------------------

   JAN      FEB      MAR      APR      MAY      JUN      JUL      AUG      SEP      OCT      NOV      DEC
   ---      ---      ---      ---      ---      ---      ---      ---      ---      ---      ---      ---
   5.74     8.79    13.10    16.08    20.47    22.69    22.52    19.34    14.78    10.05     5.82
4.60
1              ************************************WIND SPEED FREQUENCY
TABLE**************************************
               Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
   WIND        ***********************************************WIND
FROM*********************************************
   SPEED          N     NNE     NE     ENE     E     ESE     SE     SSE     S     SSW     SW     WSW     W
WNW    NW     NNW
   RANGE       ***********************************************WIND
HEADED*******************************************
   (M/S)          S     SSW     SW     WSW     W     WNW     NW     NNW     N     NNE     NE     ENE     E
ESE    SE     SSE    SUM

   0  TO   1  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
   1  TO   2  0.009 0.003 0.003 0.003 0.004 0.002 0.003 0.004 0.008 0.009 0.008 0.005 0.007
0.003 0.004 0.005 0.081
```

prep

2	TO	3	0.017	0.009	0.011	0.007	0.009	0.004	0.007	0.010	0.022	0.017	0.012	0.015	0.022
0.011	0.009	0.010	0.192												
3	TO	4	0.016	0.015	0.012	0.006	0.007	0.003	0.006	0.012	0.026	0.021	0.015	0.007	0.019
0.013	0.015	0.009	0.202												
4	TO	5	0.014	0.019	0.015	0.005	0.002	0.002	0.007	0.010	0.031	0.016	0.013	0.008	0.011
0.012	0.011	0.008	0.183												
5	TO	6	0.012	0.012	0.010	0.002	0.001	0.001	0.006	0.008	0.030	0.016	0.007	0.007	0.006
0.006	0.007	0.008	0.139												
6	TO	7	0.012	0.006	0.004	0.001	0.000	0.001	0.002	0.005	0.017	0.007	0.004	0.003	0.004
0.004	0.006	0.005	0.083												
7	TO	8	0.008	0.006	0.001	0.000	0.000	0.000	0.001	0.003	0.013	0.006	0.002	0.002	0.002
0.003	0.005	0.002	0.056												
8	TO	9	0.005	0.003	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.003	0.002	0.001	0.001
0.001	0.002	0.002	0.025												
9	TO	10	0.006	0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.003	0.001	0.001	0.001
0.000	0.002	0.001	0.019												
10	TO	11	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.000
0.000	0.000	0.000	0.011												
11	TO	12	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000	0.000	0.000	0.005												
12	TO	13	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.003												
13	TO	14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.001												
14	TO	15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.001												
15	TO	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000												
20	TO	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000												
25	TO	30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000												
30	TO OVER		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000												

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AVERAGE	4.47699	VARIANCE	4.52228	STD DEV	2.12657
STD ERR	0.02459	SKEWNESS	1.31718	KURTOSIS	2.01213

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1 **********RELATIVE HUMIDITY FREQUENCY TABLE**********

Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)

RELATIVE **********WIND FROM**********

HUMIDITY N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW

RANGE(%) **********WIND HEADED**********

S SSW SW WSW W WNW NW NNW N NNE NE ENE E ESE SE SSE SUM

0	TO	10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	TO	20	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.003
20	TO	30	0.000	0.001	0.000	0.000	0.000	0.001	0.002	0.003	0.003	0.001	0.001	0.001	0.001	0.000	0.015
30	TO	40	0.001	0.003	0.004	0.002	0.002	0.002	0.004	0.005	0.007	0.004	0.004	0.004	0.004	0.003	0.050
40	TO	50	0.002	0.005	0.007	0.002	0.001	0.000	0.002	0.005	0.013	0.007	0.007	0.004	0.005	0.003	0.066
50	TO	60	0.008	0.008	0.008	0.004	0.001	0.001	0.001	0.005	0.020	0.011	0.008	0.006	0.008	0.005	0.103

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  60  TO  70  0.014 0.010 0.009 0.003 0.003 0.001 0.002 0.007 0.018 0.012 0.008 0.007 0.010
0.009 0.011 0.006 0.130
  70  TO  80  0.015 0.012 0.008 0.003 0.002 0.001 0.003 0.006 0.026 0.016 0.009 0.010 0.014
0.014 0.013 0.012 0.162
  80  TO  90  0.029 0.014 0.009 0.006 0.006 0.003 0.005 0.009 0.026 0.020 0.016 0.010 0.022
0.014 0.018 0.014 0.221
  90  TO 100  0.027 0.016 0.009 0.004 0.004 0.004 0.007 0.009 0.029 0.020 0.009 0.007 0.007
0.005 0.010 0.009 0.175
 100  TO OVER 0.012 0.009 0.003 0.002 0.002 0.001 0.004 0.005 0.011 0.008 0.004 0.002 0.003
0.001 0.003 0.003 0.074


********************************************************************************************************
************************************
 AVERAGE   74.66025      VARIANCE 402.23911      STD DEV   20.05590
 STD ERR    0.23196      SKEWNESS   1.08593      KURTOSIS   1.22048

********************************************************************************************************
************************************
1              **********************************DEW POINT TEMPERATURE FREQUENCY
TABLE*********************************
               Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
   DEW POINT  ***********************************************WIND
FROM*********************************************
   TEMP          N     NNE    NE     ENE     E     ESE    SE     SSE     S     SSW    SW     WSW     W
WNW    NW     NNW
   RANGE (C)  ***********************************************WIND
HEADED*******************************************
                 S     SSW    SW     WSW     W     WNW    NW     NNW     N     NNE    NE     ENE     E
ESE    SE     SSE    SUM

 -45  TO -40  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 -40  TO -35  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 -35  TO -30  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001
0.000 0.000 0.000 0.001
 -30  TO -25  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.002 0.001 0.004
0.002 0.000 0.000 0.010
 -25  TO -20  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.002 0.003
0.001 0.001 0.001 0.010
 -20  TO -15  0.001 0.000 0.001 0.000 0.001 0.001 0.000 0.000 0.003 0.004 0.004 0.005 0.009
0.006 0.008 0.004 0.047
 -15  TO -10  0.016 0.007 0.003 0.001 0.002 0.002 0.004 0.003 0.005 0.011 0.008 0.006 0.011
0.008 0.015 0.010 0.111
 -10  TO  -5  0.016 0.012 0.008 0.003 0.001 0.002 0.007 0.007 0.013 0.007 0.005 0.003 0.005
0.006 0.008 0.005 0.108
  -5  TO   0  0.021 0.015 0.009 0.004 0.005 0.005 0.005 0.007 0.025 0.014 0.011 0.006 0.009
0.006 0.008 0.007 0.158
   0  TO   5  0.018 0.014 0.008 0.004 0.003 0.001 0.004 0.007 0.019 0.012 0.004 0.003 0.009
0.007 0.010 0.012 0.138
   5  TO  10  0.021 0.015 0.013 0.004 0.004 0.002 0.004 0.010 0.024 0.013 0.007 0.007 0.008
0.006 0.006 0.007 0.150
  10  TO  15  0.014 0.010 0.012 0.004 0.003 0.001 0.004 0.012 0.030 0.014 0.011 0.008 0.012
0.009 0.004 0.003 0.151
  15  TO  20  0.003 0.004 0.003 0.003 0.002 0.001 0.002 0.007 0.033 0.021 0.012 0.007 0.003
0.002 0.002 0.001 0.106
  20  TO  25  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.003 0.002 0.001 0.001 0.001
0.001 0.000 0.000 0.010
  25  TO  30  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
  30  TO  35  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
  35  TO  40  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
  40  TO  45  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
```

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  45  TO OVER 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000


*************************************************************************************************
***********************************
 AVERAGE     1.50883      VARIANCE 120.84354      STD DEV   10.99289
 STD ERR     0.12714      SKEWNESS   0.12920      KURTOSIS   2.21745

*************************************************************************************************
***********************************
1              *********************************DRY BULB TEMPERATURE FREQUENCY
TABLE*********************************
               Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
   DRY BULB    ***********************************************WIND
FROM*********************************************
   TEMP          N     NNE    NE     ENE     E     ESE    SE     SSE     S     SSW    SW     WSW     W
WNW    NW     NNW
   RANGE (C)   ***********************************************WIND
HEADED*********************************************
                 S     SSW    SW     WSW     W     WNW    NW     NNW     N     NNE    NE     ENE     E
ESE    SE     SSE    SUM

 -45  TO -40  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 -40  TO -35  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 -35  TO -30  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 -30  TO -25  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 -25  TO -20  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.002 0.001 0.003
0.002 0.000 0.000 0.008
 -20  TO -15  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.001 0.002 0.003 0.006
0.003 0.002 0.000 0.018
 -15  TO -10  0.004 0.002 0.001 0.001 0.001 0.001 0.001 0.001 0.004 0.007 0.004 0.005 0.013
0.006 0.011 0.008 0.069
 -10  TO  -5  0.017 0.008 0.006 0.003 0.001 0.001 0.003 0.004 0.008 0.011 0.009 0.006 0.007
0.008 0.017 0.008 0.118
  -5  TO   0  0.023 0.013 0.008 0.002 0.003 0.004 0.005 0.005 0.012 0.009 0.007 0.003 0.006
0.006 0.006 0.006 0.119
   0  TO   5  0.020 0.017 0.007 0.005 0.005 0.002 0.005 0.005 0.020 0.013 0.007 0.005 0.010
0.008 0.012 0.011 0.151
   5  TO  10  0.012 0.010 0.006 0.002 0.002 0.001 0.004 0.005 0.018 0.007 0.004 0.004 0.007
0.003 0.004 0.006 0.097
  10  TO  15  0.017 0.011 0.009 0.003 0.003 0.002 0.005 0.009 0.025 0.015 0.004 0.004 0.006
0.005 0.006 0.007 0.131
  15  TO  20  0.011 0.008 0.009 0.003 0.003 0.001 0.003 0.008 0.025 0.012 0.008 0.005 0.005
0.005 0.003 0.002 0.112
  20  TO  25  0.004 0.008 0.011 0.005 0.003 0.001 0.003 0.012 0.029 0.013 0.010 0.008 0.008
0.006 0.002 0.002 0.126
  25  TO  30  0.000 0.001 0.001 0.001 0.001 0.000 0.001 0.002 0.009 0.007 0.005 0.003 0.003
0.002 0.000 0.000 0.037
  30  TO  35  0.000 0.000 0.001 0.000 0.000 0.000 0.000 0.001 0.003 0.003 0.003 0.002 0.001
0.000 0.000 0.000 0.014
  35  TO  40  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
  40  TO  45  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
  45  TO OVER 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000


*************************************************************************************************
***********************************
 AVERAGE     6.44997      VARIANCE 154.27522      STD DEV   12.42076
 STD ERR     0.14365      SKEWNESS   1.16754      KURTOSIS   2.32720
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**********************************************************************************************
**********************************
1                ***********************************STABILITY CLASS FREQUENCY
TABLE**********************************
                 Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
   STABILITY     ************************************************WIND
FROM*********************************************
   CLASS           N     NNE    NE     ENE     E     ESE    SE     SSE     S     SSW    SW     WSW     W
WNW    NW      NNW
                 ************************************************WIND
HEADED*********************************************
                   S     SSW    SW     WSW     W     WNW    NW     NNW     N     NNE    NE     ENE     E
ESE    SE      SSE    SUM

       1         0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.002
       2         0.003 0.003 0.004 0.003 0.002 0.002 0.002 0.003 0.003 0.003 0.002 0.002 0.003
0.001 0.001 0.001 0.037
       3         0.007 0.011 0.016 0.005 0.002 0.001 0.003 0.005 0.016 0.009 0.009 0.008 0.007
0.005 0.004 0.003 0.113
       4         0.072 0.053 0.028 0.010 0.010 0.006 0.017 0.029 0.085 0.049 0.029 0.024 0.032
0.030 0.041 0.030 0.545
       5         0.015 0.007 0.007 0.005 0.006 0.004 0.006 0.011 0.035 0.019 0.012 0.009 0.014
0.011 0.011 0.009 0.180
       6         0.009 0.002 0.002 0.001 0.002 0.001 0.002 0.004 0.014 0.015 0.009 0.005 0.016
0.006 0.005 0.006 0.102
       7         0.003 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.003 0.002 0.003 0.002 0.003
0.001 0.001 0.001 0.021


**********************************************************************************************
**********************************
 AVERAGE     4.25201      VARIANCE    0.99227      STD DEV     0.99613
 STD ERR     0.01152      SKEWNESS    1.07871      KURTOSIS    1.21936

**********************************************************************************************
**********************************
1                ******************************************K FREQUENCY
TABLE**********************************************
                 Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
     K           ************************************************WIND
FROM*********************************************
   (UA/VE)         N     NNE    NE     ENE     E     ESE    SE     SSE     S     SSW    SW     WSW     W
WNW    NW      NNW
    RANGE        ************************************************WIND
HEADED*********************************************
                   S     SSW    SW     WSW     W     WNW    NW     NNW     N     NNE    NE     ENE     E
ESE    SE      SSE    SUM

 0.0  TO 0.1   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.1  TO 0.2   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.2  TO 0.3   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.3  TO 0.4   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.4  TO 0.5   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.5  TO 0.6   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.6  TO 0.7   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.7  TO 0.8   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 0.8  TO 0.9   0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
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0.000 0.000 0.000 0.000
 0.9 TO 1.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 1.0 TO 1.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 1.2 TO 1.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 1.4 TO 1.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 1.6 TO 1.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 1.8 TO 2.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 2.0 TO 2.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 2.5 TO 3.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 3.0 TO OVER 0.110 0.078 0.058 0.024 0.022 0.014 0.031 0.054 0.155 0.098 0.064 0.050 0.075
0.054 0.062 0.051 1.000

****
****

AVERAGE	3.50000	VARIANCE	0.00000	STD DEV	0.00000
STD ERR	0.00000	SKEWNESS	1.00000	KURTOSIS	1.00000

****
****
1 **********VSTAR FREQUENCY
TABLE**********
Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
**********WIND
FROM**********
VSTAR N NNE NE ENE E ESE SE SSE S SSW SW WSW W
WNW NW NNW
RANGE **********WIND
HEADED**********
S SSW SW WSW W WNW NW NNW N NNE NE ENE E
ESE SE SSE SUM

0 TO 1 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1 TO 2 0.093 0.067 0.054 0.023 0.020 0.011 0.026 0.048 0.141 0.087 0.058 0.047 0.070
0.052 0.056 0.045 0.895
2 TO 3 0.003 0.002 0.001 0.000 0.000 0.001 0.001 0.000 0.002 0.002 0.001 0.001 0.001
0.001 0.001 0.002 0.020
3 TO 4 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.001 0.000 0.000
0.000 0.000 0.000 0.004
4 TO 5 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000 0.001
0.000 0.001 0.001 0.007
5 TO 6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
6 TO 7 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
7 TO 8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
8 TO 9 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
9 TO 10 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
10 TO 11 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
11 TO 12 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
12 TO 13 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
13 TO 14 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

0.000 0.000 0.000 0.000
14 TO 15 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
15 TO 20 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
20 TO 25 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
25 TO 30 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
30 TO OVER 0.012 0.009 0.003 0.002 0.002 0.001 0.004 0.005 0.011 0.008 0.004 0.002 0.003
0.001 0.003 0.003 0.074

****

AVERAGE	4.03170	VARIANCE	76.75311	STD DEV	8.76089
STD ERR	0.10132	SKEWNESS	3.54087	KURTOSIS	12.83027

****

1 PLUME LENGTH PARAMETER FREQUENCY TABLE

Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)

PLUME LENGTH RANGE (M) FROM HEADED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.0 TO 0.2	0.099	0.071	0.054	0.023	0.020	0.012	0.027	0.049	0.145	0.091	0.060	0.048	0.072	0.053	0.059	0.047
0.2 TO 0.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.4 TO 0.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.6 TO 0.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.8 TO 1.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.0 TO 1.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.2 TO 1.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.4 TO 1.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.6 TO 1.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1.8 TO 2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.0 TO 2.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.2 TO 2.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.4 TO 2.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.6 TO 2.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.8 TO 3.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.0 TO 3.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.2 TO 3.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3.4 TO 3.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

0.000 0.000 0.000 0.000
3.6 TO 3.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.8 TO 4.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
4.0 TO 4.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
4.2 TO 4.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
4.4 TO 4.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
4.6 TO 4.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
4.8 TO 5.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
5.0 TO 5.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
5.2 TO 5.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
5.4 TO 5.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
5.6 TO 5.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
5.8 TO 6.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
6.0 TO 6.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
6.2 TO 6.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
6.4 TO 6.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
6.6 TO 6.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
6.8 TO 7.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
7.0 TO 7.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
7.2 TO 7.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
7.4 TO 7.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
7.6 TO 7.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
7.8 TO 8.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
8.0 TO 8.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
8.2 TO 8.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
8.4 TO 8.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
8.6 TO 8.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
8.8 TO 9.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
9.0 TO 9.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
9.2 TO 9.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
9.4 TO 9.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
9.6 TO 9.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
9.8 TO 10.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1 **********PLUME LENGTH PARAMETER FREQUENCY
TABLE**********

PLUME ********** WIND
FROM**********
LENGTH N NNE NE ENE E ESE SE SSE S SSW SW WSW W
WNW NW NNW
RANGE (M) ********** WIND
HEADED**********
S SSW SW WSW W WNW NW NNW N NNE NE ENE E
ESE SE SSE SUM

10.0 TO 10.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
10.4 TO 10.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
10.8 TO 11.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
11.2 TO 11.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
11.6 TO 12.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
12.0 TO 12.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
12.4 TO 12.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
12.8 TO 13.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
13.2 TO 13.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
13.6 TO 14.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
14.0 TO 14.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
14.4 TO 14.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
14.8 TO 15.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
15.2 TO 15.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
15.6 TO 16.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
16.0 TO 16.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.002
16.4 TO 16.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
16.8 TO 17.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
17.2 TO 17.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
17.6 TO 18.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.001 0.000 0.003
18.0 TO 18.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
18.4 TO 18.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
18.8 TO 19.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
19.2 TO 19.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
19.6 TO 20.0 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.004
20.0 TO 21.0 0.000 0.001 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.003
21.0 TO 22.0 0.000 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.001 0.000
0.000 0.000 0.000 0.004
22.0 TO 23.0 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.001 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.004
23.0 TO 24.0 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000

```
0.000 0.000 0.000 0.003
 24.0 TO 25.0 0.002 0.001 0.000 0.000 0.000 0.000 0.001 0.000 0.001 0.000 0.000 0.000 0.000
0.000 0.000 0.001 0.006
 25.0 TO 26.0 0.001 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.001 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.005
 26.0 TO 27.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000 0.000
0.000 0.001 0.000 0.004
 27.0 TO 28.0 0.000 0.001 0.001 0.000 0.000 0.000 0.000 0.000 0.001 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.004
 28.0 TO 29.0 0.000 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.003
 29.0 TO 30.0 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.001 0.000 0.000
0.000 0.000 0.000 0.004
 30.0 TO 31.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
 31.0 TO 32.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 32.0 TO 33.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
 33.0 TO 34.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 34.0 TO 35.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 35.0 TO 36.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 36.0 TO 37.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 37.0 TO 38.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 38.0 TO 39.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 39.0 TO 40.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 40.0 TO OVER 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000

**********************************************************************************************
***********************************
 AVERAGE     1.55888      VARIANCE  31.63983      STD DEV     5.62493
 STD ERR     0.06506      SKEWNESS   4.17934      KURTOSIS   18.08287

**********************************************************************************************
***********************************
1                ********************************PLUME HEIGHT PARAMETER FREQUENCY
TABLE*********************************
                 Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
    PLUME        ***********************************************WIND
FROM*************************************************
    HEIGHT         N     NNE     NE     ENE     E     ESE     SE     SSE     S     SSW     SW     WSW     W
WNW     NW     NNW
    RANGE (M)    ************************************************WIND
HEADED***********************************************
                   S     SSW     SW     WSW     W     WNW     NW     NNW     N     NNE     NE     ENE     E
ESE     SE     SSE     SUM

  0.0  TO 0.1   0.100 0.071 0.055 0.023 0.020 0.012 0.027 0.049 0.147 0.091 0.061 0.048 0.072
0.053 0.060 0.048 0.937
  0.1  TO 0.2   0.001 0.001 0.000 0.000 0.001 0.000 0.000 0.001 0.001 0.000 0.000 0.000 0.001
0.001 0.000 0.000 0.007
  0.2  TO 0.3   0.001 0.001 0.000 0.000 0.000 0.000 0.001 0.001 0.001 0.001 0.000 0.000 0.001
0.000 0.001 0.000 0.008
  0.3  TO 0.4   0.001 0.001 0.001 0.000 0.000 0.000 0.000 0.000 0.002 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.007
  0.4  TO 0.5   0.001 0.001 0.000 0.001 0.000 0.000 0.001 0.001 0.002 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.008
  0.5  TO 0.6   0.001 0.001 0.000 0.000 0.000 0.000 0.001 0.000 0.001 0.001 0.001 0.000 0.000
```

0.000 0.000 0.000 0.007
0.6 TO 0.7 0.001 0.001 0.001 0.000 0.000 0.000 0.001 0.000 0.001 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.006
0.7 TO 0.8 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.004
0.8 TO 0.9 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000
0.000 0.000 0.001 0.005
0.9 TO 1.0 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.003
1.0 TO 1.1 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000
0.000 0.000 0.000 0.003
1.1 TO 1.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
1.2 TO 1.3 0.000 0.000 0.000 0.000 0.001 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.002
1.3 TO 1.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.001
1.4 TO 1.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1.5 TO 1.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1.6 TO 1.7 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1.7 TO 1.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1.8 TO 1.9 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1.9 TO 2.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.0 TO 2.1 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.1 TO 2.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.2 TO 2.3 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.3 TO 2.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.4 TO 2.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.5 TO 2.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.6 TO 2.7 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.7 TO 2.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.8 TO 2.9 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
2.9 TO 3.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.0 TO 3.1 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.1 TO 3.2 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.2 TO 3.3 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.3 TO 3.4 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.4 TO 3.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.5 TO 3.6 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.6 TO 3.7 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.7 TO 3.8 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
3.8 TO 3.9 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000

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 3.9  TO 4.0  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.0  TO 4.1  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.1  TO 4.2  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.2  TO 4.3  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.3  TO 4.4  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.4  TO 4.5  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.5  TO 4.6  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.6  TO 4.7  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.7  TO 4.8  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.8  TO 4.9  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 4.9  TO 5.0  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
1              **********************************PLUME HEIGHT PARAMETER FREQUENCY
TABLE**********************************
               Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)
   PLUME       ************************************************WIND
FROM**********************************************
   HEIGHT        N     NNE    NE     ENE     E     ESE    SE     SSE     S     SSW    SW     WSW     W
WNW    NW     NNW
   RANGE (M)   ************************************************WIND
HEADED**********************************************
                 S     SSW    SW     WSW     W     WNW    NW     NNW     N     NNE    NE     ENE     E
ESE    SE     SSE    SUM

 5.0  TO 5.2  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 5.2  TO 5.4  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 5.4  TO 5.6  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 5.6  TO 5.8  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 5.8  TO 6.0  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 6.0  TO 6.2  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 6.2  TO 6.4  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 6.4  TO 6.6  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 6.6  TO 6.8  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 6.8  TO 7.0  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 7.0  TO 7.2  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 7.2  TO 7.4  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 7.4  TO 7.6  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 7.6  TO 7.8  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 7.8  TO 8.0  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 8.0  TO 8.2  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 8.2  TO 8.4  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
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0.000 0.000 0.000 0.000
 8.4  TO 8.6  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 8.6  TO 8.8  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 8.8  TO 9.0  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 9.0  TO 9.2  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 9.2  TO 9.4  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 9.4  TO 9.6  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 9.6  TO 9.8  0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 9.8  TO 10.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 10.0 TO 10.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 10.5 TO 11.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 11.0 TO 11.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 11.5 TO 12.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 12.0 TO 12.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 12.5 TO 13.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 13.0 TO 13.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 13.5 TO 14.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 14.0 TO 14.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 14.5 TO 15.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 15.0 TO 15.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 15.5 TO 16.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 16.0 TO 16.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 16.5 TO 17.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 17.0 TO 17.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 17.5 TO 18.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 18.0 TO 18.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 18.5 TO 19.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 19.0 TO 19.5 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 19.5 TO 20.0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000
 20.0 TO OVER 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000

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 AVERAGE     0.08216      VARIANCE    0.02140      STD DEV     0.14628
 STD ERR     0.00169      SKEWNESS    4.76015      KURTOSIS   27.32819

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1 **********PLUME LENGTH-K-STABILITY FREQUENCY
TABLE**********
Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)

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	STABILITY CATEGORY 1			STABILITY CATEGORY 2			STABILITY
CATEGORY 3 PLUME							
LENGTH RANGE (M)	K1	K2	K3	K1	K2	K3	K1
K2 K3							
0.0 TO 0.2	0.000	0.000	0.152	0.000	0.000	0.668	0.000
0.000 0.112							
0.2 TO 0.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
0.4 TO 0.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
0.6 TO 0.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
0.8 TO 1.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
1.0 TO 1.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
1.2 TO 1.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
1.4 TO 1.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
1.6 TO 1.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
1.8 TO 2.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
2.0 TO 2.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
2.2 TO 2.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
2.4 TO 2.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
2.6 TO 2.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
2.8 TO 3.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
3.0 TO 3.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
3.2 TO 3.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
3.4 TO 3.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
3.6 TO 3.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
3.8 TO 4.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
4.0 TO 4.2	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
4.2 TO 4.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
4.4 TO 4.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
4.6 TO 4.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
4.8 TO 5.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							

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5.0 TO 5.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
5.2 TO 5.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
5.4 TO 5.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
5.6 TO 5.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
5.8 TO 6.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
6.0 TO 6.2	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
6.2 TO 6.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
6.4 TO 6.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
6.6 TO 6.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
6.8 TO 7.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
7.0 TO 7.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
7.2 TO 7.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
7.4 TO 7.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
7.6 TO 7.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
7.8 TO 8.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
8.0 TO 8.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
8.2 TO 8.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
8.4 TO 8.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
8.6 TO 8.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
8.8 TO 9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
9.0 TO 9.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
9.2 TO 9.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
9.4 TO 9.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
9.6 TO 9.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
9.8 TO 10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							

1 **********PLUME LENGTH-K-STABILITY FREQUENCY TABLE**********

Northern Michigan University - MARQUETTE - COOLING TOWER ANALYSIS (NTH)

****
****

	STABILITY CATEGORY 1			STABILITY CATEGORY 2			STABILITY CATEGORY 3
PLUME							
LENGTH RANGE (M)	K1	K2	K3	K1	K2	K3	K1
K2 K3							
10.0 TO 10.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000

0.000 0.000							
10.4 TO 10.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
10.8 TO 11.2	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
11.2 TO 11.6	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
11.6 TO 12.0	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
12.0 TO 12.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
12.4 TO 12.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
12.8 TO 13.2	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
13.2 TO 13.6	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
13.6 TO 14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
14.0 TO 14.4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
14.4 TO 14.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
14.8 TO 15.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
15.2 TO 15.6	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
15.6 TO 16.0	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
16.0 TO 16.4	0.000	0.000	0.000	0.000	0.000	0.002	0.000
0.000 0.000							
16.4 TO 16.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
16.8 TO 17.2	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
17.2 TO 17.6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.000							
17.6 TO 18.0	0.000	0.000	0.000	0.000	0.000	0.003	0.000
0.000 0.000							
18.0 TO 18.4	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
18.4 TO 18.8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000 0.001							
18.8 TO 19.2	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
19.2 TO 19.6	0.000	0.000	0.000	0.000	0.000	0.001	0.000
0.000 0.000							
19.6 TO 20.0	0.000	0.000	0.000	0.000	0.000	0.002	0.000
0.000 0.001							
20.0 TO 21.0	0.000	0.000	0.000	0.000	0.000	0.003	0.000
0.000 0.000							
21.0 TO 22.0	0.000	0.000	0.000	0.000	0.000	0.002	0.000
0.000 0.003							
22.0 TO 23.0	0.000	0.000	0.000	0.000	0.000	0.003	0.000
0.000 0.001							
23.0 TO 24.0	0.000	0.000	0.000	0.000	0.000	0.002	0.000
0.000 0.002							
24.0 TO 25.0	0.000	0.000	0.000	0.000	0.000	0.005	0.000
0.000 0.001							
25.0 TO 26.0	0.000	0.000	0.000	0.000	0.000	0.004	0.000
0.000 0.000							
26.0 TO 27.0	0.000	0.000	0.000	0.000	0.000	0.003	0.000
0.000 0.000							
27.0 TO 28.0	0.000	0.000	0.000	0.000	0.000	0.004	0.000
0.000 0.000							
28.0 TO 29.0	0.000	0.000	0.000	0.000	0.000	0.003	0.000
0.000 0.000							

29.0 TO 30.0	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
30.0 TO 31.0	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
31.0 TO 32.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32.0 TO 33.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33.0 TO 34.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34.0 TO 35.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35.0 TO 36.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36.0 TO 37.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37.0 TO 38.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38.0 TO 39.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39.0 TO 40.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40.0 TO OVER	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

1 CAT NUM TYPE UH WX DBT DTDZ DPT VE TE MXHT PLGT
FREQ REFERENCE HEIGHT= 10. M

1	FOG	10.0	0.25	263.1	-0.010	262.6	0.3	270.1	500.	6.24
0.0012										
2	FOG	15.0	0.25	263.1	-0.010	262.6	0.3	270.1	500.	0.00
0.0004										
3	FOG	12.0	0.25	263.1	-0.010	261.1	0.3	269.8	500.	0.00
0.0037										
4	FOG	17.0	0.25	263.1	-0.010	261.1	0.3	269.8	500.	0.00
0.0004										
5	FOG	15.0	0.25	263.1	-0.010	258.6	0.3	269.4	500.	0.00
0.0003										
6	FOG	12.5	0.25	273.1	-0.010	272.4	0.3	278.5	500.	0.00
0.0036										
7	FOG	16.5	0.25	273.1	-0.010	269.4	0.3	277.6	500.	0.00
0.0009										
8	FOG	15.0	0.25	283.1	-0.010	282.4	0.3	286.9	500.	0.00
0.0007										
9	FOG	16.5	0.25	283.1	-0.010	279.4	0.3	285.6	500.	0.00
0.0001										
10	FOG	15.5	0.25	293.1	-0.010	291.1	0.3	294.9	500.	0.00
0.0001										
11	PLUME	3.9	0.15	289.6	-0.018	279.4	0.3	288.1	868.	0.00
0.1517										
12	PLUME	4.9	0.25	278.5	-0.010	273.9	0.3	281.5	850.	9.48
0.6676										
13	PLUME	2.2	0.30	277.0	0.030	273.7	0.3	280.8	950.	18.88
0.1118										
14	PLUME	8.7	0.25	271.0	-0.010	270.9	0.3	276.9	632.	0.00
0.0001										
15	PLUME	7.7	0.25	275.4	-0.010	275.3	0.3	280.6	1120.	1.17
0.0001										
16	PLUME	4.6	0.25	292.1	-0.010	292.0	0.3	295.1	996.	1.73
0.0003										
17	PLUME	5.7	0.25	285.4	-0.010	285.3	0.3	289.2	730.	2.58
0.0003										
18	PLUME	7.7	0.25	274.3	-0.010	274.2	0.3	279.7	984.	3.38
0.0005										
19	PLUME	5.7	0.25	285.1	-0.010	285.0	0.3	288.9	620.	3.20

											prep
0.0004											
	20	PLUME	4.6	0.25	290.4	-0.010	290.3	0.3	293.6	426.	4.17
0.0001											
	21	PLUME	5.8	0.25	283.4	-0.010	283.3	0.3	287.4	671.	4.44
0.0004											
	22	PLUME	7.2	0.25	276.0	-0.010	275.9	0.3	281.1	689.	5.10
0.0001											
	23	PLUME	4.6	0.25	285.4	-0.010	285.3	0.3	289.2	800.	11.31
0.0001											
	24	PLUME	6.2	0.25	281.0	-0.010	280.9	0.3	285.4	782.	5.47
0.0005											
	25	PLUME	3.6	0.25	292.1	-0.010	292.0	0.3	295.1	923.	10.12
0.0001											
	26	PLUME	4.9	0.25	287.6	-0.010	287.5	0.3	291.1	836.	6.03
0.0003											
	27	PLUME	5.1	0.25	285.4	-0.010	285.3	0.3	289.2	904.	7.21
0.0003											
	28	PLUME	7.7	0.25	272.1	-0.010	272.0	0.3	277.8	766.	7.69
0.0001											
	29	PLUME	4.1	0.25	291.0	-0.010	290.9	0.3	294.1	496.	7.72
0.0001											
	30	PLUME	5.7	0.25	282.1	-0.010	282.0	0.3	286.3	1046.	8.15
0.0004											
	31	PLUME	6.2	0.25	279.3	-0.010	279.2	0.3	283.9	771.	8.39
0.0001											
	32	PLUME	4.9	0.25	285.7	-0.010	285.6	0.3	289.4	784.	8.93
0.0003											
	33	PLUME	4.1	0.25	286.0	-0.010	285.9	0.3	289.7	11.	14.07
0.0001											
	34	PLUME	5.7	0.25	281.0	-0.010	280.9	0.3	285.4	1028.	9.97
0.0001											
	35	PLUME	5.4	0.25	281.2	-0.010	281.1	0.3	285.5	726.	12.08
0.0007											
	36	PLUME	5.7	0.25	280.8	-0.010	280.7	0.3	285.2	631.	10.33
0.0007											
	37	PLUME	4.2	0.25	287.6	-0.010	287.5	0.3	291.1	830.	11.12
0.0005											
	38	PLUME	3.6	0.25	289.6	-0.010	289.5	0.3	292.8	902.	12.95
0.0003											
	39	PLUME	4.6	0.25	284.3	-0.010	284.2	0.3	288.2	767.	12.85
0.0004											
	40	PLUME	5.1	0.25	282.1	-0.010	282.0	0.3	286.3	676.	12.29
0.0005											
	41	PLUME	5.9	0.25	278.1	-0.010	278.0	0.3	282.9	610.	12.64
0.0005											
	42	PLUME	3.1	0.25	292.1	-0.010	292.0	0.3	295.1	603.	13.13
0.0003											
	43	PLUME	3.6	0.25	283.9	-0.010	283.8	0.3	287.9	701.	18.87
0.0127											
	44	PLUME	2.9	0.25	277.5	-0.010	277.4	0.3	282.4	604.	24.83
0.0298											
	45	PLUME	3.3	0.25	271.6	-0.010	271.6	0.3	277.4	605.	29.10
0.0174											

MET RECORDS READ :	8760
RECORDS DISCARDED:	0
CALM RECORDS:	1284
TOTAL TO NEW FILE:	8760

APPENDIX G

Visibility Modeling Support Information

Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input (MM Btu/hr)	165
Gross Output (MW/hr)	16 (Approximately, nominally ?)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	1.35%	100.0%	165	12,500	14,800	7.40	64,824	0.1614
Coal, PRB	0.53%	100.0%	165	8,600	41,163	10.63	46,575	
Natural Gas	0.00%	100.0%	165	23,269	7,974	3.55	31,277	
Virgin Wood	0.00%	100.0%	205	4,000	45,000	22.73	199,043	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
Carbon tetrachloride	56235													5.18E-05	lb/MMBtu	1.05E-03	4.60E-02
Chlorine	7782505													9.89E-04	lb/MMBtu	1.89E-01	8.16E-01
2-Chloroacetophenone	532274	9.05E-05	lb/ton	5.98E-05	2.91E-04	3.63E-05	lb/ton	5.78E-05	2.84E-04					2.71E-09	lb/MMBtu	5.66E-07	2.46E-06
Chlorobenzene	108907	2.53E-05	lb/ton	1.67E-01	8.22E-01	2.53E-05	lb/ton	2.70E-04	1.31E-03					3.50E-05	lb/MMBtu	7.75E-03	3.41E-02
Chloroform	67663	8.79E-05	lb/ton	5.80E-04	2.83E-03	8.79E-05	lb/ton	7.39E-04	3.23E-03					3.69E-05	lb/MMBtu	8.60E-05	3.59E-02
1-Chloro-1,1-difluoroethane	75683													2.76E-05	lb/MMBtu	5.66E-07	2.48E-06
2-Chloroethanol	107073													2.76E-05	lb/MMBtu	5.66E-07	2.48E-06
Cumene	98828	8.10E-05	lb/ton	4.51E-03	1.98E-04	8.10E-05	lb/ton	8.63E-05	2.81E-04								
Cyanide	74908	2.86E-05	lb/ton	2.11E-02	9.23E-02	2.86E-05	lb/ton	3.03E-02	1.47E-01								
1,4-Dichlorobenzene	106467									1.38E-03	lb/MMscf	2.50E-04	1.10E-03				
2,4-Dinitrotoluene	121142	3.22E-07	lb/ton	5.38E-06	1.04E-05	3.22E-07	lb/ton	3.56E-05	1.43E-05								
Dimethyl sulfate	77781	5.52E-05	lb/ton	4.05E-04	1.70E-03	5.52E-05	lb/ton	6.01E-04	2.63E-03								
2,4-Dinitrophenol	51285													2.07E-07	lb/MMBtu	4.24E-05	1.65E-04
Ethylbenzene	100414	1.08E-04	lb/ton	8.09E-04	3.80E-03	1.08E-04	lb/ton	1.19E-03	5.16E-03					3.57E-05	lb/MMBtu	7.31E-03	3.20E-02
Ethylchloride	75003	4.63E-05	lb/ton	3.57E-04	1.57E-03	4.63E-05	lb/ton	5.28E-04	2.30E-03					7.31E-07	lb/MMBtu	1.50E-04	6.57E-04
Ethylene dichloride	107062	4.00E-05	lb/ton	3.40E-04	1.49E-03	4.00E-05	lb/ton	5.01E-04	2.19E-03					5.25E-04	lb/MMBtu	1.08E-01	4.72E-01
Ethylene dibromide	106934	1.39E-05	lb/ton	1.62E-05	4.47E-05	1.39E-05	lb/ton	1.60E-05	6.54E-05					9.01E-04	lb/MMBtu	2.15E-03	PRB Coal
Formaldehyde	50000	2.76E-04	lb/ton	2.04E-03	8.95E-03	2.76E-01	lb/ton	3.07E-03	1.32E-02	8.52E-02	lb/MMscf	1.56E-02	6.85E-02	1.40E+00	lb/MMBtu	2.88E-03	PRB Coal
Heptachlorobiphenyl	28655712													7.98E-11	lb/MMBtu	1.64E-08	4.64E-08
Hexachlorobiphenyl	26601649													6.23E-10	lb/MMBtu	1.28E-07	5.62E-07
Hexanol	66251													8.05E-08	lb/MMBtu	1.66E-05	7.23E-05
Hexane	110543	7.71E-05	lb/ton	5.70E-04	2.50E-03	7.71E-05	lb/ton	8.38E-04	3.67E-03	2.07E+00	lb/MMscf	3.75E-01	1.64E+00	1.75E-01	lb/MMBtu	3.60E+01	1.58E+02
Isobutyraldehyde	78842													4.31E-06	lb/MMBtu	8.90E-04	1.24E-02
Isophorone	78591	2.97E-04	lb/ton	4.94E-03	2.16E-02	6.67E-04	lb/ton	7.26E-03	3.18E-02								
2-Methylnaphthalene	91576													2.71E-09	lb/MMBtu	5.60E-07	2.45E-06
3-Methylchloranthrene	56495													2.09E-08	lb/MMBtu	4.32E-06	1.89E-05
Pentachlorophenol	87865																
Methyl bromide (Bromomethane)	74839	1.84E-04	lb/ton	1.36E-03	5.98E-03	1.84E-04	lb/ton	2.00E-03	8.77E-03					2.53E-10	lb/MMBtu	5.15E-08	2.27E-07
Methyl chloride	74873	8.10E-04	lb/ton	4.51E-03	1.98E-02	8.10E-04	lb/ton	9.63E-03	2.81E-02					4.76E-09	lb/MMBtu	9.84E-07	4.31E-06
Methyl ethyl ketone	78933	4.46E-04	lb/ton	1.33E-01	1.45E-02	4.46E-04	lb/ton	1.66E-03	2.71E-02					2.88E-06	lb/MMBtu	5.42E-04	2.37E-03
Methyl hydrazine	60344	1.96E-04	lb/ton	1.45E-03	6.34E-03	1.96E-04	lb/ton	2.13E-03	9.32E-03					6.21E-06	lb/MMBtu	1.27E-03	PRB Coal
Methyl methacrylate	80626	8.39E-05	lb/ton	1.70E-04	7.46E-04	2.30E-05	lb/ton	2.50E-04	1.10E-03								
Methyl tert butyl ether	1634044	4.63E-05	lb/ton	2.98E-04	1.30E-03	4.63E-05	lb/ton	4.38E-04	1.92E-03								
Methylene chloride (Dichloromethane)	75092	3.34E-04	lb/ton	2.47E-03	1.08E-02	3.34E-04	lb/ton	3.63E-03	1.59E-02					3.34E-04	lb/MMBtu	6.81E-02	2.98E-01
2-Nitropropane	79469													2.76E-07	lb/MMBtu	5.66E-05	2.48E-04
4-Nitrobiphenyl	92933													1.27E-07	lb/MMBtu	2.60E-05	1.14E-04
Pentachlorobiphenyl	25429290?													1.38E-09	lb/MMBtu	2.83E-07	1.24E-06
Pentachlorophenol	87865													5.87E-08	lb/MMBtu	1.20E-05	5.27E-05
Perylene	198550													6.98E-10	lb/MMBtu	1.43E-07	6.27E-07
Phenol	108952	1.84E-04	lb/ton	1.36E-04	5.98E-04	1.84E-04	lb/ton	2.00E-04	8.77E-04					9.47E-08	lb/MMBtu	1.93E-02	8.47E-02
Propionaldehyde	123386	4.37E-04	lb/ton	3.23E-03	1.42E-02	4.37E-04	lb/ton	4.76E-03	2.08E-02					7.22E-05	lb/MMBtu	1.47E-02	6.46E-02
Propanal	123386													3.69E-08	lb/MMBtu	7.54E-06	3.30E-05
Pyrene	129000	2.68E-06	lb/ton	2.13E-04	9.33E-04	2.86E-06	lb/ton	3.13E-04	1.37E-03					2.16E-03	lb/MMBtu	4.40E-01	1.93E+00
Tetrachlorobiphenyl	26914230													2.68E-09	lb/MMBtu	5.48E-07	2.40E-06
Tetrachloroethylene	127184	4.63E-05	lb/ton	3.68E-04	1.60E-03	4.95E-05	lb/ton	5.39E-04	2.36E-03					4.37E-08	lb/MMBtu	8.90E-06	3.90E-05
Toluene	108883	2.78E-04	lb/ton	2.04E-03	8.96E-03	2.78E-04	lb/ton	3.03E-03	1.32E-02	3.94E-03	lb/MMscf	2.09E-04	3.11E-03	1.05E-03	lb/MMBtu	2.17E-01	9.50E-01
o-Tolualdehyde	529204													8.28E-06	lb/MMBtu	1.70E-03	7.42E-03
p-Tolualdehyde	104870													1.27E-05	lb/MMBtu	2.60E-03	1.14E-02
Trichlorobiphenyl														2.68E-09	lb/MMBtu	5.13E-07	2.56E-06

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
Carbon tetrachloride	1.08E-02	4.60E-02	Wood	5.18E-05
Chlorine	1.89E-01	8.16E-01	Wood	9.89E-04
2-Chloroacetophenone	5.78E-05	2.84E-04	PRB Coal	4.74E-07
Chlorobenzene	7.75E-03	3.41E-02	Wood	3.69E-05
Chloroform	8.60E-03	2.80E-02	Wood	3.22E-05
2-Chloropropylene	5.66E-07	2.48E-06	Wood	2.70E-09
2-Chloroethanol	5.66E-06	2.48E-05	Wood	2.70E-08
Cumene	8.63E-05	2.81E-04	PRB Coal	3.99E-07
Cyanide	3.03E-02	1.32E-01	PRB Coal	1.40E-04
1,4-Dichlorobenzene	2.50E-04	1.10E-03	Nat Gas	1.35E-06
2,4-Dinitrotoluene	3.56E-05	1.56E-05	PRB Coal	1.64E-08
Dimethyl sulfate	6.01E-04	2.63E-03	PRB Coal	2.78E-06
2,4-Dinitrophenol	4.24E-05	1.86E-04	Wood	2.07E-07
Ethylbenzene	1.19E-03	5.16E-03	Wood	5.57E-06
Ethylchloride	7.31E-07	3.20E-03	Wood	3.57E-09
Ethylene dichloride	5.25E-04	2.30E-03	PRB Coal	2.84E-06
Ethylene dibromide	9.01E-04	2.15E-03	PRB Coal	2.71E-06
Formaldehyde	1.56E-02	6.85E-02	PRB Coal	8.12E-06
Heptachlorobiphenyl	1.64E-08	4.64E-08	Wood	7.98E-11
Hexachlorobiphenyl	1.28E-07	5.62E-07	Wood	6.23E-10
Hexanol	1.66E-05	7.23E-05	Wood	8.05E-08
Hexane	3.75E-01	1.64E+00	Nat Gas	2.03E-04
Isobutyraldehyde	8.90E-04	1.24E-02	Wood	4.31E-06
Isophorone	7.26E-03	3.18E-02	PRB Coal	3.92E-06
2-Methylnaphthalene	5.77E-08	1.89E-04	Wood	1.84E-07
3-Methylchloranthrene	4.32E-06	1.89E-05	Nat Gas	2.09E-09
Pentachlorobiphenyl	2.83E-10	1.24E-06	Wood	1.37E-09
Pentachlorophenol	1.20E-05	5.27E-05	Wood	5.81E-08
Methyl bromide	1.36E-03	5.98E-03	Wood	1.32E-06
Methyl chloride	9.63E-03	2.81E-02	PRB Coal	3.99E-06
Methyl ethyl ketone	1.66E-03	2.71E-02	PRB Coal	2.84E-06
Methyl hydrazine	2.13E-03	9.32E-03	PRB Coal	1.15E-06
Methyl methacrylate	2.50E-04	1.10E-03	PRB Coal	1.36E-06
Methyl tert butyl ether	4.38E-04	1.92E-03	PRB Coal	2.37E-06
Methylene chloride	6.81E-02	2.98E-01	Wood	3.29E-04
2-Nitropropane	5.66E-05	2.48E-04	Wood	2.73E-07
4-Nitrobiphenyl	2.60E-05	1.14E-04	Wood	1.27E-07
Pentachlorobiphenyl	2.83E-07	1.24E-06	Wood	1.39E-09
Pentachlorophenol	1.20E-05	5.27E-05	Wood	5.87E-08
Perylene	1.43E-07	6.27E-07	Wood	6.98E-10
Phenol	1.93E-02	8.47E-02	Wood	9.47E-08
Propionaldehyde	1.47E-02	6.46E-02	Wood	7.22E-05
Propanal	7.54E-04	3.30E-03	Wood	3.69E-08
Pyrene	4.40E-01	1.93E+00	Wood	2.16E-03
Tetrachlorobiphenyl	5.48E-07	2.40E-06	Wood	2.68E-09
Tetrachloroethylene	8.90E-03	3.90E-02	Wood	4.37E-06
Toluene	2.17E-01	9.50E-01	Wood	1.06E-03
o-Tolualdehyde	1.70E-03	7.43E-03	Wood	8.28E-06
p-Tolualdehyde	2.60E-03	1.14E-02	Wood	1.27E-05
Trichlorobiphenyl	5.13E-07	2.56E-06	Wood	2.86E-09

Prepared by MTH Consultants, Ltd.

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Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input (MM Btu/hr)	185
Gross Output (MW/hr)	10

(Approximate: normally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	1.53%	100.0%	185	12,500	14,800	7.40	64,824	0.1814
Coal, PRB	0.60%	100.0%	185	8,500	21,765	10.88	95,329	
Natural Gas	0.00%	100.0%	185	23,200	7,974	3.99	34,927	
Virgin Wood	0.00%	100.0%	205	4,500	45,550	22.78	199,533	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
Trichlorofluoromethane	75694													4.72E-05	lb/MMBtu	9.87E-03	4.23E-02
Trichloroethane	79016													3.45E-05	lb/MMBtu	7.07E-03	3.10E-02
1,1,1-Trichloroethane	71556	2.30E-06	lb/ton	1.70E-04	7.45E-04	2.30E-06	lb/ton	2.50E-04	1.10E-03					3.57E-05	lb/MMBtu	7.31E-03	3.20E-02
2,4,6-Trichlorophenol	88062													2.53E-08	lb/MMBtu	5.19E-06	2.27E-05
Vinyl acetate	108054	8.74E-06	lb/ton	6.47E-04	2.83E-03	8.74E-06	lb/ton	9.51E-04	4.17E-03								
Vinyl Chloride	75014													2.07E-05	lb/MMBtu	4.24E-03	1.86E-02
Xylenes	1330207	4.26E-06	lb/ton	3.15E-04	1.38E-03	4.26E-06	lb/ton	4.63E-04	2.03E-03								
o-Xylene	95476													2.88E-05	lb/MMBtu	5.89E-03	2.58E-02
Poly Nuclear Aromatic Hydrocarbons (PAH)																	
Acenaphthene	83329	5.87E-07	lb/ton	4.34E-06	1.90E-05	5.87E-07	lb/ton	6.38E-06	2.80E-05	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.05E-06	lb/MMBtu	2.15E-04	9.40E-04
Acenaphthylene	208968	2.88E-07	lb/ton	2.13E-06	9.32E-06	2.88E-07	lb/ton	3.13E-06	1.37E-05	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	5.76E-06	lb/MMBtu	1.18E-03	5.16E-03
Acetone	67641													2.19E-04	lb/MMBtu	4.48E-02	1.96E-01
Anthracene	120127	2.42E-07	lb/ton	1.79E-06	7.83E-06	2.42E-07	lb/ton	2.63E-06	1.15E-05	2.76E-06	lb/MMscf	5.01E-07	2.19E-06	3.45E-06	lb/MMBtu	7.07E-04	3.10E-03
Benzaldehyde	100527													9.76E-07	lb/MMBtu	2.00E-04	8.76E-04
Benzo(a)anthracene	56553	9.20E-08	lb/ton	6.81E-07	2.98E-06	9.20E-08	lb/ton	1.00E-06	4.39E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	7.48E-09	lb/MMBtu	1.53E-06	6.71E-06
Benzo(a)pyrene	50328	4.37E-08	lb/ton	3.23E-07	1.42E-06	4.37E-08	lb/ton	4.75E-07	2.08E-06	1.38E-06	lb/MMscf	2.50E-07	1.10E-06	2.99E-06	lb/MMBtu	6.13E-04	2.68E-03
Benzo(e)pyrene	192972									1.38E-06	lb/MMscf	2.50E-07	1.10E-06	2.99E-09	lb/MMBtu	6.13E-07	2.68E-06
Benzo(b)fluoranthene	205992									2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.15E-07	lb/MMBtu	2.36E-05	1.03E-04
Benzo(j,k)fluoranthene	206440													1.84E-07	lb/MMBtu	3.77E-05	1.65E-04
Benzo(k)fluoranthene	205823									2.07E-06	lb/MMscf	3.75E-07	1.64E-06	4.14E-08	lb/MMBtu	8.49E-06	3.72E-05
Benzo(b,j,k)fluoranthene		1.27E-07	lb/ton	9.39E-07	4.10E-06	1.27E-07	lb/ton	1.38E-06	6.05E-06					1.15E-07	lb/MMBtu	2.36E-05	1.03E-04
Benzo(g,h,i)perylene	191242	3.11E-08	lb/ton	2.30E-07	1.01E-06	3.11E-08	lb/ton	3.38E-07	1.48E-06	1.38E-06	lb/MMscf	2.50E-07	1.10E-06	1.07E-07	lb/MMBtu	2.19E-05	9.60E-05
Biphenyl	92524	1.96E-06	lb/ton	1.46E-05	6.40E-05	1.96E-06	lb/ton	2.13E-05	9.32E-05								
Chrysene	218019	1.15E-07	lb/ton	8.51E-07	3.73E-06	1.15E-07	lb/ton	1.25E-06	5.48E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	4.37E-08	lb/MMBtu	8.96E-06	3.92E-05
Crotonaldehyde	4170303													1.14E-05	lb/MMBtu	2.33E-03	1.02E-02
Decachlorobiphenyl	2051243													3.11E-10	lb/MMBtu	6.37E-08	2.79E-07
Dibenzo(a,h)anthracene	53703									1.38E-06	lb/MMscf	2.50E-07	1.10E-06	1.05E-08	lb/MMBtu	2.16E-06	9.40E-06
1,2-Dibromoethane	540496													6.33E-05	lb/MMBtu	1.30E-02	5.69E-02
Dichlorobiphenyl	2050682													8.51E-10	lb/MMBtu	1.74E-07	7.64E-07
1,2-Dichloroethane	107062													3.34E-05	lb/MMBtu	6.84E-03	2.99E-02
1,2-Dichloropropane	78875													3.80E-05	lb/MMBtu	7.78E-03	3.41E-02
7,12-Dimethylbenz(a)anthracene	57976									1.84E-05	lb/MMscf	3.34E-06	1.46E-05				
Fluoranthene	206440	8.17E-07	lb/ton	6.04E-06	2.65E-05	8.17E-07	lb/ton	8.88E-06	3.89E-05	3.45E-06	lb/MMscf	6.26E-07	2.74E-06	1.84E-06	lb/MMBtu	3.77E-04	1.65E-03
Fluorene	86737	1.05E-06	lb/ton	7.74E-06	3.39E-05	1.05E-06	lb/ton	1.14E-05	4.99E-05	3.22E-06	lb/MMscf	5.84E-07	2.56E-06	3.91E-06	lb/MMBtu	8.02E-04	3.51E-03
Indeno(1,2,3,c,d)pyrene	193395	7.02E-08	lb/ton	5.19E-07	2.27E-06	7.02E-08	lb/ton	7.63E-07	3.34E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.00E-07	lb/MMBtu	2.05E-05	8.98E-05
Naphthalene	91203	1.50E-05	lb/ton	1.11E-04	4.86E-04	1.50E-05	lb/ton	1.63E-04	7.13E-04	7.02E-04	lb/MMscf	1.27E-04	5.57E-04	1.12E-04	lb/MMBtu	2.29E-02	1.00E-01
Phenanthrene	85018	3.11E-06	lb/ton	2.30E-05	1.01E-04	3.11E-06	lb/ton	3.38E-05	1.48E-04	1.96E-05	lb/MMscf	3.55E-06	1.56E-05	8.05E-06	lb/MMBtu	1.65E-03	7.23E-03
Pyrene	129000	3.80E-07	lb/ton	2.81E-06	1.23E-05	3.80E-07	lb/ton	4.13E-06	1.81E-05	5.75E-06	lb/MMscf	1.04E-06	4.57E-06	4.26E-06	lb/MMBtu	8.72E-04	3.82E-03
5-Methyl chrysene	3697243	2.53E-08	lb/ton	1.87E-07	8.20E-07	2.53E-08	lb/ton	2.76E-07	1.21E-06					9.09E-12	lb/MMBtu	2.03E-09	8.88E-09

CFB Boiler Maximum Single HAP Emission Rate (HCl) = 5.3 tpy

CFB Boiler Maximum Combined Total HAP Emission Rate = [illegible] 22.7 tpy

[illegible]
[illegible]
These shaded areas depict HAPs.
Unless otherwise noted below, emission factors are from the EPA AP-42 database, and are increased by a 15% safety factor.
* Coal firing emission factor based on Wyandotte Energy stack test results. Wyandotte Energy is located in Wyandotte, Michigan.
** The lead estimated emission rates for PRB & Bituminous fuels are based on a statistical analysis of respective typical coals, with a 99% control efficiency of the baghouse collector.
*** Both HCl and HF emission factors include a 15% safety factor and 92% control using limestone in the CFB.
[1] Emissions are based on the proposed BACT.
[2] Sulfuric acid mist emission based on RBLC search, Plum Point Energy entry. This facility is located in Arkansas.
[3] Total dioxin/furan for the coal firing is from the Wyandotte Energy stack test results, and dioxin/furan for the wood combustion is from the EPA AP-42, Chapter 1.6, Table 1.6-3.
[4] Total chromium is supplied here for information purposes only. Total chromium is a sum of hexavalent and trivalent chromium.

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
Trichlorofluoromethane	9.87E-03	4.23E-02	Wood	4.72E-05
Trichloroethane	7.07E-03	3.10E-02	Wood	3.45E-05
1,1,1-Trichloroethane	7.31E-03	3.20E-02	Wood	3.57E-05
2,4,6-Trichlorophenol	5.19E-06	2.27E-05	Wood	2.53E-08
Vinyl acetate	9.51E-04	4.17E-03	PRB Coal	6.14E-06
Vinyl Chloride	4.24E-03	1.86E-02	Wood	2.07E-05
Xylenes	4.63E-04	2.03E-03	PRB Coal	2.50E-06
o-Xylene	5.89E-03	2.58E-02	Wood	2.88E-05
Poly Nuclear Aromatic Hydrocarbons (PAH)				
Acenaphthene	2.15E-04	9.40E-04	Wood	1.05E-06
Acenaphthylene	1.18E-03	5.16E-03	Wood	5.76E-06
Acetone	4.48E-02	1.96E-01	Wood	2.19E-04
Anthracene	7.07E-04	3.10E-03	Wood	3.45E-06
Benzaldehyde	2.00E-04	8.76E-04	Wood	9.76E-07
Benzo(a)anthracene	1.53E-06	6.71E-06	Wood	7.48E-09
Benzo(a)pyrene	6.13E-04	2.68E-03	Wood	2.99E-06
Benzo(e)pyrene	6.13E-07	2.68E-06	Wood	2.99E-09
Benzo(b)fluoranthene	2.36E-05	1.03E-04	Wood	1.15E-07
Benzo(j,k)fluoranthene	3.77E-05	1.65E-04	Wood	1.84E-07
Benzo(k)fluoranthene	8.49E-06	3.72E-05	Wood	4.14E-08
Benzo(b,j,k)fluoranthene	2.36E-05	1.03E-04	Wood	1.15E-07
Benzo(g,h,i)perylene	2.19E-05	9.60E-05	Wood	1.07E-07
Biphenyl	2.13E-05	9.32E-05	PRB Coal	1.15E-07
Chrysene	8.96E-06	3.92E-05	Wood	4.37E-08
Crotonaldehyde	2.33E-03	1.02E-02	Wood	1.14E-05
Decachlorobiphenyl	6.37E-08	2.79E-07	Wood	3.11E-10
Dibenzo(a,h)anthracene	2.16E-06	9.40E-06	Wood	1.05E-08
1,2-Dibromoethane	1.30E-02	5.69E-02	Wood	6.33E-05
Dichlorobiphenyl	1.74E-07	7.64E-07	Wood	8.51E-10
1,2-Dichloroethane	6.84E-03	2.99E-02	Wood	3.34E-05
1,2-Dichloropropane	7.78E-03	3.41E-02	Wood	3.80E-05
7,12-Dimethylbenz(a)anthracene	3.34E-06	1.46E-05	Nat Gas	1.80E-08
Fluoranthene	3.77E-04	1.65E-03	Wood	1.84E-06
Fluorene	8.02E-04	3.51E-03	Wood	3.91E-06
Indeno(1,2,3,c,d)pyrene	2.05E-05	8.98E-05	Wood	1.00E-07
Naphthalene	2.29E-02	1.00E-01	Wood	1.12E-04
Phenanthrene	1.65E-03	7.23E-03	Wood	8.05E-06
Pyrene	8.72E-04	3.82E-03	Wood	4.26E-06
5-Methyl chrysene	2.76E-07	1.21E-06	PRB Coal	1.49E-08

Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Input (mmBtu/hour, dry basis)	165
Gross Output (MW/hr)	10 (Approximately normally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (mmBTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	1.50%	100.0%	165	12,500	14,800	7.40	64,824	0.1614
Coal, PRB	0.50%	100.0%	165	8,340	21,343	10.68	93,529	
Natural Gas	0.00%	100.0%	165	23,000	7,073	3.54	30,977	
Waste Wood	0.00%	100.0%	165	4,500	48,356	22.18	190,553	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
PM (Filterable)		0.03	lb/MMBtu	5.0	24.3	0.03	lb/MMBtu	5.0	24.3					0.03	lb/MMBtu	5.1	26.9
PM10 (Filterable)	7446095	0.03	lb/MMBtu	37.7	165.3	0.008	lb/MMBtu	17.6	77.0					0.025	lb/MMBtu	5.1	23.4
PM2.5 (Filterable)	10102440	0.10	lb/MMBtu	16.5	81.0	0.10	lb/MMBtu	16.5	81.0					0.10	lb/MMBtu	20.5	95.6
SO2	7550760	0.15	lb/MMBtu	27.5	121.5	0.15	lb/MMBtu	27.5	121.5					0.15	lb/MMBtu	34.9	162.6
Lead **	7439921	1.34E-03	lb/MMBtu	0.002	0.010	4.52E-05	lb/MMBtu	0.001	0.004					5.52E-07	lb/MMBtu	1.13E-04	4.89E-04
VOC		0.002	lb/MMBtu	0.43	1.86	0.003	lb/MMBtu	0.63	2.79	0.03	lb/MMscf	5.16	8.0	0.02	lb/MMBtu	4.0	17.6
Mercury	7439976	3.00E-06	lb/MMBtu	9.85E-04	2.43E-03	3.00E-06	lb/MMBtu	2.55E-03	2.43E-03	2.60E-04	lb/MMscf	5.42E-05	7.39E-04	3.00E-06	lb/MMBtu	5.13E-04	2.09E-03
HCl **	7647010	0.11	lb/ton	0.8	3.5	0.11	lb/ton	1.20	5.29								
HF **	7664393	0.01	lb/ton	0.1	0.4	0.0130	lb/ton	0.10	0.60								
H_2SO_4 (As Sulfuric Acid Mist) *	7664939	6.10E-03	lb/MMBtu	1.1	4.9	6.10E-03	lb/MMBtu	1.1	4.9								
Total Dioxin/Furan **	1746016	2.34E-12	lb/MMBtu	4.33E-10	1.90E-09	2.34E-12	lb/MMBtu	4.33E-10	1.90E-09								
Metals																	
Antimony *	7440360	8.49E-06	lb/MMBtu	1.56E-03	6.80E-03	8.49E-06	lb/MMBtu	1.56E-03	7.39E-03					8.49E-06	lb/MMBtu	1.82E-05	8.16E-05
Arsenic *	7440382	7.87E-07	lb/MMBtu	1.45E-04	6.32E-04	7.87E-07	lb/MMBtu	1.42E-04	6.72E-04	2.30E-04	lb/MMscf	4.77E-05	1.63E-04	2.63E-07	lb/MMBtu	5.19E-05	2.27E-04
Barium	7440393									5.50E-03	lb/MMscf	0.185-04	4.02E-03	1.26E-05	lb/MMBtu	4.01E-04	1.76E-03
Beryllium *	7440417	2.00E-06	lb/MMBtu	3.70E-06	1.62E-05	2.00E-06	lb/MMBtu	3.70E-06	1.60E-02	1.56E-06	lb/MMscf	2.62E-06	1.10E-06	1.27E-06	lb/MMBtu	2.96E-06	1.14E-05
Cadmium *	7440439	9.59E-06	lb/MMBtu	1.77E-05	7.77E-05	9.59E-06	lb/MMBtu	1.77E-05	7.77E-05	1.27E-03	lb/MMscf	2.23E-04	1.25E-03	4.72E-06	lb/MMBtu	5.67E-04	4.03E-05
Chromium, total **	7440473	1.20E-06	lb/MMBtu	2.21E-04	3.86E-04	1.20E-06	lb/MMBtu	2.21E-04	0.69E-04	1.61E-03	lb/MMscf	2.82E-04	1.28E-03	1.56E-05	lb/MMBtu	4.66E-03	3.37E-04
Chromium, hexavalent *	18540299	3.79E-07	lb/MMBtu	6.54E-05	2.91E-04	3.55E-07	lb/MMBtu	6.55E-05	2.91E-04					1.47E-06	lb/MMBtu	8.82E-04	3.81E-03
Chromium, trivalent *	16065831	8.37E-07	lb/MMBtu	1.55E-03	6.76E-04	8.37E-07	lb/MMBtu	1.55E-04	6.79E-04					1.65E-05	lb/MMBtu	1.98E-03	8.76E-03
Cobalt	7440484	1.12E-04	lb/ton	0.51E-04	3.73E-03	1.15E-04	lb/ton	1.26E-03	5.40E-03					1.25E-05	lb/MMBtu	1.93E-03	8.71E-03
Copper	7440508													9.64E-07	lb/MMBtu	2.12E-04	9.06E-04
Iron	7439896													1.14E-05	lb/MMBtu	2.28E-03	1.02E-02
Magnesium	7439954	1.27E-02	lb/ton	0.30E-02	4.10E-01	1.27E-02	lb/ton	1.90E-02	8.03E-01								
Manganese *	7439965	9.30E-06	lb/MMBtu	1.72E-03	7.54E-03	9.30E-06	lb/MMBtu	1.72E-05	7.54E-03	4.90E-04	lb/MMscf	7.33E-05	3.47E-04	1.94E-05	lb/MMBtu	3.77E-03	1.65E-02
Molybdenum	7439987									1.27E-03	lb/MMscf	2.23E-04	1.09E-03	2.46E-06	lb/MMBtu	4.65E-04	2.07E-03
Nickel *	7440020	1.97E-06	lb/MMBtu	3.00E-04	1.35E-03	1.97E-06	lb/MMBtu	9.09E-04	1.39E-03					3.81E-06	lb/MMBtu	7.76E-04	3.41E-03
Phosphorus	7723140													3.11E-07	lb/MMBtu	6.37E-05	2.79E-04
Potassium	7440097													4.49E-04	lb/MMBtu	9.19E-02	4.03E-01
Selenium	7782492	1.50E-03	lb/ton	1.11E-02	4.89E-02	1.50E-03	lb/ton	1.89E-02	2.16E-02					3.22E-06	lb/MMBtu	6.60E-04	2.81E-03
Silver	7440224													3.59E-06	lb/MMBtu	4.01E-03	1.76E-02
Sodium	7440235													4.14E-06	lb/MMBtu	8.48E-04	3.72E-03
Strontium	7440246													1.56E-07	lb/MMBtu	3.20E-05	1.40E-04
Tin	7440315													2.65E-07	lb/MMBtu	5.42E-05	2.37E-04
Titanium	7440326													1.30E-07	lb/MMBtu	4.72E-05	2.07E-04
Vanadium	7440622													1.13E-06	lb/MMBtu	2.31E-04	1.01E-03
Yttrium	7440655													3.45E-06	lb/MMBtu	7.07E-07	3.10E-06
Zinc (as zinc oxide) *	1314132	2.63E-04	lb/MMBtu	5.23E-02	2.29E-01	3.63E-04	lb/MMBtu	5.23E-02	2.29E-01	3.54E-02	lb/MMscf	6.09E-03	2.65E-02	4.63E-06	lb/MMBtu	9.10E-04	4.31E-03
Organic Compounds														2.07E-06	lb/MMBtu	4.24E-04	1.86E-03
Acetaldehyde	75070	6.56E-04	lb/ton	4.65E-03	2.12E-02	6.60E-04	lb/ton	7.13E-03	3.12E-03					9.68E-04	lb/MMBtu	1.90E-01	8.27E-01
Acetophenone *	98862	1.73E-05	lb/ton	1.23E-04	5.58E-04	1.73E-05	lb/ton	1.86E-04	8.22E-04					3.65E-06	lb/MMBtu	7.34E-07	3.30E-06
Acrolein	107028	3.34E-04	lb/ton	2.47E-03	1.08E-02	3.34E-01	lb/ton	3.60E-03	1.60E-02					1.16E-04	lb/MMBtu	2.39E-02	1.00E-01
Benzene	71432	1.58E-03	lb/ton	1.11E-02	4.85E-02	1.58E-03	lb/ton	1.83E-02	7.13E-02	2.42E-03	lb/MMscf	4.38E-04	1.91E-03	1.83E-03	lb/MMBtu	3.90E-01	1.64E-00
Benzyl chloride	100447	8.05E-04	lb/ton	5.96E-03	2.61E-02	8.05E-04	lb/ton	8.70E-03	3.84E-02					9.98E-04	lb/MMBtu	1.96E-01	8.30E-01
Benzoic acid	65850													5.41E-06	lb/MMBtu	1.11E-03	4.85E-03
Bis(2-Ethylhexyl)phthalate	117817	2.40E-06	lb/ton	0.21E-04	2.72E-03	5.40E-06	lb/ton	0.14E-04	4.09E-03					5.41E-06	lb/MMBtu	1.11E-03	4.85E-03
Bromoform	75252	4.49E-05	lb/ton	3.32E-04	1.46E-03	4.49E-05	lb/ton	4.86E-04	2.14E-03								
Carbon disulfide	75150	1.50E-04	lb/ton	1.11E-03	4.85E-03	1.50E-04	lb/ton	1.63E-03	7.13E-03								
Carbonyls	00748													2.07E-06	lb/MMBtu	4.24E-04	1.86E-03

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
PM (Filterable)	5.13	26.9	Wood	3.00E-02
PM10 (Filterable)	37.74	165.3	Coal	2.04E-01
PM2.5 (Filterable)	20.50	95.6	Wood	1.00E-01
SO2	34.95	162.6	Wood	1.70E-01
Lead **	0.002	0.011	Coal	1.34E-05
VOC	4.01	17.6	Wood	1.90E-02
Mercury	0.15E-04	2.86E-03	Wood	3.00E-08
HCl	1.2	5.26	PRB Coal	5.49E-03
HF **	0.2	0.86	PRB Coal	4.72E-04
H_2SO_4	1.1	4.94	Coal	6.10E-03
Total Dioxin/Furans **	4.33E-10	1.90E-09	Coal	2.34E-12
Metals				
Antimony *	1.86E-03	7.39E-03	Coal	9.69E-05
Arsenic *	1.42E-04	6.22E-04	Coal	7.87E-07
Barium	9.18E-04	4.02E-03	Nat Gas	4.90E-06
Beryllium *	3.70E-06	1.62E-05	Coal	2.00E-08
Cadmium *	2.29E-04	1.00E-03	Nat Gas	1.24E-06
Chromium, total	4.92E-03	2.17E-02	Wood	2.42E-05
Chromium, hexavalent *	8.25E-04	3.61E-03	Wood	4.03E-06
Chromium, trivalent *	1.69E-01	6.76E-04	Coal	8.37E-07
Cobalt	1.25E-05	5.48E-03	PRB Coal	6.76E-06
Copper	1.19E-04	5.20E-04	Wood	6.64E-07
Iron	1.14E-05	1.02E-02	Wood	1.14E-05
Magnesium	1.56E-01	8.03E-01	PRB Coal	7.44E-04
Manganese *	3.77E-03	1.65E-02	Wood	1.94E-05
Molybdenum	2.26E-04	1.09E-03	Nat Gas	1.24E-06
Nickel *	3.66E-04	1.23E-03	Coal	1.67E-00
Phosphorus	0.57E-05	2.79E-04	Wood	3.11E-07
Potassium	9.19E-02	4.03E-01	Wood	4.49E-04
Selenium	1.63E-02	7.15E-02	PRB Coal	8.82E-05
Silver	4.01E-03	1.76E-02	Wood	1.96E-05
Sodium	8.48E-04	3.72E-03	Wood	4.14E-06
Strontium	3.20E-05	1.40E-04	Wood	1.56E-07
Tin	5.42E-05	2.37E-04	Wood	2.65E-07
Titanium	4.72E-05	2.07E-04	Wood	2.30E-07
Vanadium	1.60E-04	2.10E-03	Nat Gas	2.50E-06
Yttrium	7.07E-07	3.10E-06	Wood	3.45E-09
Zinc	5.23E-02	2.29E-01	Coal	2.63E-04
Organic Compounds				
Acetaldehyde	1.90E-01	8.27E-01	Wood	9.50E-04
Acetophenone *	7.34E-07	3.30E-06	PRB Coal	1.01E-08
Acrolein	2.39E-02	1.00E-01	Wood	1.19E-04
Benzene	0.90E-01	4.34E+00	Wood	4.83E-03
Benzyl chloride	0.76E-03	3.84E-02	PRB Coal	4.74E-05
Benzoic acid	1.11E-03	4.85E-03	Wood	5.41E-06
Bis(2-Ethylhexyl)phthalate	5.14E-04	4.09E-03	PRB Coal	4.95E-08
Bromoform	4.86E-04	2.14E-03	PRB Coal	2.64E-06
Carbon disulfide	1.63E-03	7.13E-03	PRB Coal	8.79E-06
Carbonyls	4.24E-04	1.86E-03	Wood	2.07E-06

Prepared by NTH Consultants, Ltd.

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Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input, (MM btu/hr)	185
Gross Output (MW/hr)	10

(Approximate; normally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	1.50%	100.0%	185	12,500	14,800	7.40	64,824	0.1814
Coal, PRB	0.50%	100.0%	185	8,500	21,765	10.88	95,329	
Natural Gas	0.00%	100.0%	185	23,200	7,974	3.99	34,927	
Virgin Wood	0.00%	100.0%	205	4,500	45,556	22.78	199,533	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
Carbon tetrachloride	56235													5.18E-06	lb/MMBtu	1.06E-02	4.65E-02
Chlorine	7782505													9.09E-04	lb/MMBtu	1.86E-01	8.16E-01
2-Chloroacetophenone	532274	8.05E-06	lb/ton	5.96E-05	2.61E-04	8.05E-06	lb/ton	8.76E-05	3.84E-04					2.76E-09	lb/MMBtu	5.66E-07	2.48E-06
Chlorobenzene	108907	2.53E-05	lb/ton	1.87E-04	8.20E-04	2.53E-05	lb/ton	2.76E-04	1.21E-03					3.80E-05	lb/MMBtu	7.78E-03	3.41E-02
Chloroform	67663	6.79E-06	lb/ton	5.02E-04	2.20E-03	6.79E-05	lb/ton	7.38E-04	3.23E-03					3.22E-05	lb/MMBtu	6.60E-03	2.89E-02
2-Chloronaphthalene	91587													2.76E-09	lb/MMBtu	5.66E-07	2.48E-06
2-Chlorophenol	95578													2.76E-08	lb/MMBtu	5.66E-06	2.48E-05
Cumene	98828	6.10E-06	lb/ton	4.51E-05	1.98E-04	6.10E-06	lb/ton	6.63E-05	2.91E-04								
Cyanide	74908	2.88E-03	lb/ton	2.13E-02	9.32E-02	2.88E-03	lb/ton	3.13E-02	1.37E-01								
1,4-Dichlorobenzene	106467									1.38E-03	lb/MMscf	2.50E-04	1.10E-03				
2,4-Dinitrotoluene	121142	3.22E-07	lb/ton	2.38E-06	1.04E-05	3.22E-07	lb/ton	3.50E-06	1.53E-05								
Dimethyl sulfate	77781	5.52E-05	lb/ton	4.08E-04	1.79E-03	5.52E-05	lb/ton	6.01E-04	2.63E-03								
2,4-Dinitrophenol	51285													2.07E-07	lb/MMBtu	4.24E-05	1.86E-04
Ethylbenzene	108676	1.08E-04	lb/ton	8.00E-04	3.50E-03	1.08E-04	lb/ton	1.18E-03	5.15E-03					3.67E-05	lb/MMBtu	7.31E-03	3.20E-02
Ethylchloride	75003	4.83E-05	lb/ton	3.57E-04	1.57E-03	4.83E-05	lb/ton	5.26E-04	2.30E-03								
Ethylene dichloride	107062	4.60E-05	lb/ton	3.40E-04	1.49E-03	4.60E-05	lb/ton	5.01E-04	2.19E-03								
Ethylene dibromide	106934	1.38E-05	lb/ton	1.02E-04	4.47E-04	1.38E-05	lb/ton	1.50E-04	6.58E-04								
Formaldehyde	50000	2.76E-04	lb/ton	2.04E-03	8.95E-03	2.75E-04	lb/ton	3.00E-03	1.32E-02	8.63E-02	lb/MMscf	1.66E-02	6.85E-02	5.06E-03	lb/MMBtu	1.04E+00	4.54E+00
Heptachlorobiphenyl	28655712													7.59E-11	lb/MMBtu	1.56E-08	6.82E-08
Hexachlorobiphenyl	28601649													6.33E-10	lb/MMBtu	1.30E-07	5.68E-07
Hexanal	66251													8.05E-06	lb/MMBtu	1.65E-03	7.23E-03
Hexane	110543	7.71E-05	lb/ton	5.70E-04	2.50E-03	7.71E-05	lb/ton	8.38E-04	3.67E-03	2.07E+00	lb/MMscf	3.75E-01	1.64E+00				
Isobutyraldehyde	78842													1.36E-05	lb/MMBtu	2.83E-03	1.24E-02
Isophorone	78591	8.67E-04	lb/ton	4.94E-03	2.16E-02	8.67E-04	lb/ton	7.26E-03	3.18E-02					7.26E-09	lb/MMBtu	1.49E-06	6.52E-06
2-Methylnaphthalene	91576									2.76E-05	lb/MMscf	5.01E-06	2.19E-05	1.84E-07	lb/MMBtu	3.77E-05	1.65E-04
3-Methylchloranthrene										2.07E-06	lb/MMscf	3.75E-07	1.64E-06				
Monochlorobiphenyl														2.53E-10	lb/MMBtu	5.19E-08	2.27E-07
Methyl bromide (bromomethane)	74839	1.84E-04	lb/ton	1.36E-03	5.98E-03	1.84E-04	lb/ton	2.00E-03	8.77E-03					1.73E-05	lb/MMBtu	3.54E-03	1.55E-02
Methyl chloride	74873	6.10E-04	lb/ton	4.51E-03	1.98E-02	6.10E-04	lb/ton	6.63E-03	2.91E-02					2.05E-05	lb/MMBtu	5.42E-03	2.37E-02
Methyl ethyl ketone	78933	4.49E-04	lb/ton	3.32E-03	1.45E-02	4.49E-04	lb/ton	4.88E-03	2.14E-02					9.21E-06	lb/MMBtu	1.27E-03	5.58E-03
Methyl hydrazine	60344	1.96E-04	lb/ton	1.46E-03	6.34E-03	1.96E-04	lb/ton	2.13E-03	9.32E-03								
Methyl methacrylate	80626	2.30E-05	lb/ton	1.70E-04	7.45E-04	2.30E-05	lb/ton	2.50E-04	1.10E-03								
Methyl tert butyl ether	1634044	4.03E-05	lb/ton	2.98E-04	1.30E-03	4.03E-05	lb/ton	4.38E-04	1.92E-03								
Methylene chloride (Dichloromethane)	75092	3.34E-04	lb/ton	2.47E-03	1.08E-02	3.34E-04	lb/ton	3.63E-03	1.59E-02					3.34E-04	lb/MMBtu	6.84E-02	2.99E-01
2-Nitrophenol	88755													2.76E-07	lb/MMBtu	5.66E-05	2.48E-04
4-Nitrophenol	100027													1.27E-07	lb/MMBtu	2.59E-05	1.14E-04
Pentachlorobiphenyl	25429292													1.38E-09	lb/MMBtu	2.83E-07	1.24E-06
Pentachlorophenol	87865													5.87E-08	lb/MMBtu	1.20E-05	5.27E-05
Perylene	198550													5.98E-10	lb/MMBtu	1.23E-07	5.37E-07
Phenol	108952	1.84E-05	lb/ton	1.36E-04	5.98E-04	1.84E-05	lb/ton	2.00E-04	8.77E-04					5.87E-05	lb/MMBtu	1.20E-02	5.27E-02
Propionaldehyde	123386	4.37E-04	lb/ton	3.23E-03	1.42E-02	4.37E-04	lb/ton	4.76E-03	2.08E-02					7.02E-05	lb/MMBtu	1.44E-02	6.30E-02
Propanal	123386													3.68E-08	lb/MMBtu	7.54E-04	3.30E-03
Styrene	100425	2.88E-05	lb/ton	2.13E-04	9.32E-04	2.88E-05	lb/ton	3.13E-04	1.37E-03					2.19E-03	lb/MMBtu	4.48E-01	1.96E+00
Tetrachlorobiphenyl	26914330													2.68E-09	lb/MMBtu	5.49E-07	2.58E-06
Tetrachloroethylene	127184	4.95E-05	lb/ton	3.68E-04	1.60E-03	4.95E-05	lb/ton	5.38E-04	2.36E-03					4.37E-05	lb/MMBtu	8.96E-03	3.92E-02
Toluene	108883	2.76E-04	lb/ton	2.04E-03	8.95E-03	2.76E-04	lb/ton	3.00E-03	1.32E-02	3.91E-03	lb/MMscf	7.09E-04	3.11E-03	1.06E-03	lb/MMBtu	2.17E-01	9.50E-01
o-Tolualdehyde	529204													8.28E-08	lb/MMBtu	1.70E-03	7.43E-03
p-Tolualdehyde	104870													1.27E-05	lb/MMBtu	2.59E-03	1.14E-02
Trichlorobiphenyl														2.98E-09	lb/MMBtu	6.13E-07	2.68E-06

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
Carbon tetrachloride	1.06E-02	4.65E-02	Wood	5.18E-06
Chlorine	1.86E-01	8.16E-01	Wood	9.09E-04
2-Chloroacetophenone	5.76E-05	3.84E-04	PRB Coal	4.74E-07
Chlorobenzene	7.78E-03	3.41E-02	Wood	3.80E-05
Chloroform	6.60E-03	2.89E-02	Wood	3.22E-05
2-Chloronaphthalene	5.66E-07	2.48E-06	Wood	2.76E-09
2-Chlorophenol	5.66E-06	2.48E-05	Wood	2.76E-08
Cumene	8.03E-05	2.91E-04	PRB Coal	3.59E-07
Cyanide	3.13E-02	1.37E-01	PRB Coal	1.69E-04
1,4-Dichlorobenzene	2.50E-04	1.10E-03	Nat Gas	1.35E-06
2,4-Dinitrotoluene	3.50E-06	1.53E-05	PRB Coal	1.89E-08
Dimethyl sulfate	6.01E-04	2.63E-03	PRB Coal	3.25E-06
2,4-Dinitrophenol	4.24E-05	1.86E-04	Wood	2.07E-07
Ethylbenzene	7.31E-03	3.20E-02	Wood	3.67E-05
Ethylchloride	5.26E-04	2.30E-03	PRB Coal	2.84E-06
Ethylene dichloride	5.01E-04	2.19E-03	PRB Coal	2.71E-06
Ethylene dibromide	1.50E-05	6.58E-05	PRB Coal	8.12E-08
Formaldehyde	1.04E+00	4.54E+00	Wood	5.06E-03
Heptachlorobiphenyl	1.56E-08	6.82E-08	Wood	7.59E-11
Hexachlorobiphenyl	1.30E-07	5.68E-07	Wood	6.33E-10
Hexanal	1.65E-03	7.23E-03	Wood	8.05E-06
Hexane	3.75E-01	1.64E+00	Nat Gas	2.09E-03
Isobutyraldehyde	2.83E-03	1.24E-02	Wood	1.36E-05
Isophorone	7.26E-03	3.18E-02	PRB Coal	3.92E-05
2-Methylnaphthalene	3.77E-05	1.65E-04	Wood	1.84E-07
3-Methylchloranthrene	3.75E-07	1.64E-06	Nat Gas	2.03E-09
Monochlorobiphenyl	5.19E-08	2.27E-07	Wood	2.53E-10
Methyl bromide	3.54E-03	1.55E-02	Wood	1.73E-05
Methyl chloride	6.63E-03	2.91E-02	PRB Coal	3.59E-05
Methyl ethyl ketone	4.88E-03	2.14E-02	PRB Coal	2.64E-05
Methyl hydrazine	2.13E-03	9.32E-03	PRB Coal	1.15E-05
Methyl methacrylate	2.50E-04	1.10E-03	PRB Coal	1.35E-06
Methyl tert butyl ether	4.38E-04	1.92E-03	PRB Coal	2.37E-06
Methylene chloride	6.84E-02	2.99E-01	Wood	3.34E-04
2-Nitrophenol	5.66E-05	2.48E-04	Wood	2.76E-07
4-Nitrophenol	2.59E-05	1.14E-04	Wood	1.27E-07
Pentachlorobiphenyl	2.83E-07	1.24E-06	Wood	1.38E-09
Pentachlorophenol	1.20E-05	5.27E-05	Wood	5.87E-08
Perylene	1.23E-07	5.37E-07	Wood	5.98E-10
Phenol	1.20E-02	5.27E-02	Wood	5.87E-05
Propionaldehyde	1.44E-02	6.30E-02	Wood	7.02E-05
Propanal	7.54E-04	3.30E-03	Wood	3.68E-08
Styrene	4.48E-01	1.96E+00	Wood	2.19E-03
Tetrachlorobiphenyl	5.49E-07	2.58E-06	Wood	2.68E-09
Tetrachloroethylene	8.96E-03	3.92E-02	Wood	4.37E-05
Toluene	2.17E-01	9.50E-01	Wood	1.06E-03
o-Tolualdehyde	1.70E-03	7.43E-03	Wood	8.28E-06
p-Tolualdehyde	2.59E-03	1.14E-02	Wood	1.27E-05
Trichlorobiphenyl	6.13E-07	2.68E-06	Wood	2.98E-09

Prepared by NTH Consultants, Ltd.

Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input, (MM btu/hr)	185
Gross Output (MW/hr)	10 (Approximate; normally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	1.50%	100.0%	185	12,500	14,800	7.40	64,824	0.1814
Coal, PRB	0.60%	100.0%	185	8,500	21,765	10.88	95,329	
Natural Gas	0.00%	100.0%	185	23,200	7,974	3.99	34,927	
Virgin Wood	0.00%	100.0%	205	4,500	45,556	22.78	199,633	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
Trichlorofluoromethane	75694													4.72E-05	lb/MMBtu	9.67E-03	4.23E-02
Trichloroethene	79016													3.45E-05	lb/MMBtu	7.07E-03	3.10E-02
1,1,1-Trichloroethane	71556	2.30E-05	lb/ton	1.70E-04	7.45E-04	2.30E-05	lb/ton	2.50E-04	1.10E-03					3.57E-05	lb/MMBtu	7.31E-03	3.20E-02
2,4,6-Trichlorophenol	88062													2.53E-05	lb/MMBtu	5.18E-06	2.27E-05
Vinyl acetate	108054	8.74E-05	lb/ton	6.47E-04	2.83E-03	8.74E-05	lb/ton	9.51E-04	4.17E-03								
Vinyl Chloride	75014													2.07E-05	lb/MMBtu	4.24E-03	1.86E-02
Xylenes	1330207	4.25E-05	lb/ton	3.15E-04	1.38E-03	4.25E-05	lb/ton	4.63E-04	2.03E-03								
o-Xylene	95476													2.53E-05	lb/MMBtu	5.18E-03	2.27E-02
Polynuclear Aromatic Hydrocarbons (PAH)																	
Acenaphthene	83329	5.67E-07	lb/ton	4.34E-06	1.90E-05	5.67E-07	lb/ton	6.38E-06	2.80E-05	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.05E-08	lb/MMBtu	2.16E-04	9.40E-04
Acenaphthylene	208968	2.68E-07	lb/ton	2.13E-06	9.32E-06	2.68E-07	lb/ton	3.13E-06	1.37E-05	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	5.75E-08	lb/MMBtu	1.18E-03	5.16E-03
Acetone	67641													2.19E-04	lb/MMBtu	4.48E-02	1.96E-01
Anthracene	120127	2.42E-07	lb/ton	1.79E-06	7.83E-06	2.42E-07	lb/ton	2.83E-06	1.16E-05	2.76E-06	lb/MMscf	5.00E-07	2.19E-06	3.45E-06	lb/MMBtu	7.07E-04	3.10E-03
Benzaldehyde	100527													9.78E-07	lb/MMBtu	2.00E-04	8.78E-04
Benzo(a)anthracene	56553	9.20E-08	lb/ton	6.81E-07	2.98E-06	9.20E-08	lb/ton	1.08E-06	4.39E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	7.48E-08	lb/MMBtu	1.53E-05	6.71E-05
Benzo(a)pyrene	50328	4.37E-08	lb/ton	3.23E-07	1.42E-06	4.37E-08	lb/ton	4.76E-07	2.08E-06	1.38E-06	lb/MMscf	2.50E-07	1.10E-06	2.68E-08	lb/MMBtu	6.13E-04	2.68E-03
Benzo(e)pyrene	192972									1.38E-06	lb/MMscf	2.50E-07	1.10E-06	2.68E-09	lb/MMBtu	6.13E-07	2.68E-06
Benzo(b)fluoranthene	205992									2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.15E-07	lb/MMBtu	2.36E-05	1.03E-04
Benzo(j,k)fluoranthene	206440													1.84E-07	lb/MMBtu	3.77E-05	1.65E-04
Benzo(k)fluoranthene	205823									2.07E-06	lb/MMscf	3.75E-07	1.64E-06	4.14E-08	lb/MMBtu	8.48E-06	3.72E-05
Benzo(b,j,k)fluoranthene		1.27E-07	lb/ton	9.36E-07	4.10E-06	1.27E-07	lb/ton	1.38E-06	6.03E-06					1.16E-07	lb/MMBtu	2.36E-05	1.03E-04
Benzo(g,h,i)perylene	191242	3.11E-08	lb/ton	2.30E-07	1.01E-06	3.11E-08	lb/ton	3.38E-07	1.48E-06	1.38E-06	lb/MMscf	2.50E-07	1.10E-06	1.07E-07	lb/MMBtu	2.19E-05	9.60E-05
Biphenyl	92524	1.96E-06	lb/ton	1.45E-05	6.34E-05	1.86E-06	lb/ton	2.13E-05	9.32E-05								
Chrysene	218019	1.15E-07	lb/ton	8.51E-07	3.73E-06	1.15E-07	lb/ton	1.25E-06	5.48E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	4.37E-08	lb/MMBtu	8.66E-06	3.82E-05
Crotonaldehyde	4170303													1.14E-05	lb/MMBtu	2.33E-03	1.02E-02
Decachlorobiphenyl	2051243													3.11E-10	lb/MMBtu	6.37E-08	2.79E-07
Dibenzo(a,h)anthracene	53703									1.38E-06	lb/MMscf	2.50E-07	1.10E-06	1.05E-05	lb/MMBtu	2.15E-05	9.40E-06
1,2-Dibromoethane	540488													6.33E-05	lb/MMBtu	1.30E-02	5.68E-02
Dichlorobiphenyl	2050982													8.51E-10	lb/MMBtu	1.74E-07	7.64E-07
1,2-Dichloroethane	107062													3.34E-05	lb/MMBtu	6.84E-03	2.99E-02
1,2-Dichloropropane	78875													3.80E-05	lb/MMBtu	7.78E-03	3.41E-02
7,12-Dimethylbenz(a)anthracene	57976																
Fluoranthene	206440	8.17E-07	lb/ton	6.04E-06	2.65E-05	8.17E-07	lb/ton	8.89E-06	3.89E-05	3.45E-06	lb/MMscf	6.26E-07	2.74E-06	1.84E-08	lb/MMBtu	3.77E-04	1.65E-03
Fluorene	86737	1.05E-06	lb/ton	7.74E-06	3.39E-05	1.05E-06	lb/ton	1.14E-05	4.99E-05	3.22E-06	lb/MMscf	5.84E-07	2.56E-06	3.91E-06	lb/MMBtu	8.02E-04	3.51E-03
Indeno(1,2,3,c,d)pyrene	193395	7.02E-08	lb/ton	5.19E-07	2.27E-06	7.02E-08	lb/ton	7.63E-07	3.34E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.00E-07	lb/MMBtu	2.05E-05	8.98E-05
Naphthalene	91203	1.50E-05	lb/ton	1.11E-04	4.85E-04	1.50E-05	lb/ton	1.63E-04	7.13E-04	7.02E-04	lb/MMscf	1.27E-04	5.57E-04	1.12E-04	lb/MMBtu	2.29E-02	1.00E-01
Phenanthrene	85018	3.11E-06	lb/ton	2.30E-05	1.01E-04	3.11E-06	lb/ton	3.38E-05	1.48E-04	1.96E-05	lb/MMscf	3.55E-06	1.55E-05	8.05E-06	lb/MMBtu	1.65E-03	7.23E-03
Pyrene	129000	3.80E-07	lb/ton	2.81E-06	1.23E-05	3.80E-07	lb/ton	4.13E-06	1.81E-05	5.75E-06	lb/MMscf	1.04E-06	4.57E-06	4.26E-06	lb/MMBtu	8.72E-04	3.82E-03
5-Methyl chrysene	3697243	2.53E-08	lb/ton	1.87E-07	8.20E-07	2.53E-08	lb/ton	2.75E-07	1.21E-06					9.69E-12	lb/MMBtu	2.03E-09	8.88E-09

These shaded areas depict air contaminants subject to PSD review.
These shaded areas depict non-criteria pollutants.
These shaded areas depict HAPs.

CFB Boiler Maximum Single HAP Emission Rate (HCl) = 5.3 tpy

CFB Boiler Maximum Combined Total HAP Emission Rate = 22.7 tpy

Unless otherwise noted below, emission factors are from the EPA AP-42 database, and are increased by a 15% safety factor.
* Coal firing emission factor based on Wyandotte Energy stack test results. Wyandotte Energy is located in Wyandotte, Michigan.
** The lead estimated emission rates for PRB & Bituminous fuels are based on a statistical analysis of respective typical coals, with a 99% control efficiency of the baghouse collector.
*** Both HCl and HF emission factors include a 15% safety factor and 02% control using limestone in the CFB.
[1] Emissions are based on the proposed BACT.
[2] Sulfuric acid mist emission based on RBLC search, Plum Point Energy entry. This facility is located in Arkansas.
[3] Total dioxin/furan for the coal firing is from the Wyandotte Energy stack test results, and dioxin/furan for the wood combustion is from the EPA AP-42, Chapter 1.6, Table 1.6-3.
[4] Total chromium is supplied here for information purposes only. Total chromium is a sum of hexavalent and trivalent chromium.

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
Trichlorofluoromethane	9.67E-03	4.23E-02	Wood	4.72E-05
Trichloroethene	7.07E-03	3.10E-02	Wood	3.45E-05
1,1,1-Trichloroethane	7.31E-03	3.20E-02	Wood	3.57E-05
2,4,6-Trichlorophenol	5.18E-06	2.27E-05	Wood	2.53E-08
Vinyl acetate	9.51E-04	4.17E-03	PRB Coal	5.14E-06
Vinyl Chloride	4.24E-03	1.86E-02	Wood	2.07E-05
Xylenes	4.63E-04	2.03E-03	PRB Coal	2.50E-06
o-Xylene	5.69E-03	2.59E-02	Wood	2.85E-05
Polynuclear Aromatic Hydrocarbons (PAH)				
Acenaphthene	2.15E-04	9.40E-04	Wood	1.05E-06
Acenaphthylene	1.18E-03	5.16E-03	Wood	5.75E-06
Acetone	4.48E-02	1.96E-01	Wood	2.19E-04
Anthracene	7.07E-04	3.10E-03	Wood	3.45E-06
Benzaldehyde	2.00E-04	8.78E-04	Wood	9.78E-07
Benzo(a)anthracene	1.53E-05	6.71E-05	Wood	7.48E-08
Benzo(a)pyrene	6.13E-04	2.68E-03	Wood	2.99E-06
Benzo(e)pyrene	6.13E-07	2.68E-06	Wood	2.99E-09
Benzo(b)fluoranthene	2.36E-05	1.03E-04	Wood	1.15E-07
Benzo(j,k)fluoranthene	3.77E-05	1.65E-04	Wood	1.84E-07
Benzo(k)fluoranthene	8.48E-06	3.72E-05	Wood	4.14E-08
Benzo(b,j,k)fluoranthene	2.36E-05	1.03E-04	Wood	1.15E-07
Benzo(g,h,i)perylene	2.19E-05	9.60E-05	Wood	1.07E-07
Biphenyl	2.13E-05	9.32E-05	PRB Coal	1.15E-07
Chrysene	8.66E-06	3.82E-05	Wood	4.37E-08
Crotonaldehyde	2.33E-03	1.02E-02	Wood	1.14E-05
Decachlorobiphenyl	6.37E-08	2.79E-07	Wood	3.11E-10
Dibenzo(a,h)anthracene	2.15E-05	9.40E-06	Wood	1.05E-08
1,2-Dibromoethane	1.30E-02	5.68E-02	Wood	6.33E-05
Dichlorobiphenyl	1.74E-07	7.64E-07	Wood	8.51E-10
1,2-Dichloroethane	6.84E-03	2.99E-02	Wood	3.34E-05
1,2-Dichloropropane	7.78E-03	3.41E-02	Wood	3.80E-05
7,12-Dimethylbenz(a)anthracene	3.34E-06	1.46E-05	Nat Gas	1.80E-08
Fluoranthene	3.77E-04	1.65E-03	Wood	1.84E-06
Fluorene	8.02E-04	3.51E-03	Wood	3.91E-06
Indeno(1,2,3,c,d)pyrene	2.05E-05	8.98E-05	Wood	1.00E-07
Naphthalene	2.29E-02	1.00E-01	Wood	1.12E-04
Phenanthrene	1.65E-03	7.23E-03	Wood	8.05E-06
Pyrene	8.72E-04	3.82E-03	Wood	4.26E-06
5-Methyl chrysene	2.76E-07	1.21E-06	PRB Coal	1.49E-09

Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input, (MM btu/hr)	185
Gross Output (MW/hr)	10 (Approximate; nominally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	1.50%	100.0%	185	12,500	14,800	7.40	64,824	0.1814
Coal, PRB	0.90%	100.0%	185	8,500	21,765	10.88	95,329	
Natural Gas	0.00%	100.0%	185	23,200	7,974	3.99	34,927	
Virgin Wood	0.00%	100.0%	205	4,500	45,556	22.78	199,533	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
PM (filterable and condensable)		0.03	lb/MMBtu	5.6	24.3	0.03	lb/MMBtu	5.6	24.3					0.03	lb/MMBtu	6.2	26.9
SO_2	7446095	0.20	lb/MMBtu	37.7	165.3	0.096	lb/MMBtu	17.8	77.8					0.025	lb/MMBtu	5.1	22.4
NO_x	10102440	0.10	lb/MMBtu	18.5	81.0	0.10	lb/MMBtu	18.5	81.0	0.10	lb/MMBtu	18.5	81.0	0.10	lb/MMBtu	20.5	89.8
CO [1]	630080	0.15	lb/MMBtu	27.8	121.5	0.15	lb/MMBtu	27.8	121.5	0.15	lb/MMBtu	27.8	121.5	0.17	lb/MMBtu	34.9	152.6
Lead **	7439921	1.34E-05	lb/MMBtu	0.002	0.011	4.52E-06	lb/MMBtu	0.001	0.004					5.62E-07	lb/MMBtu	1.13E-04	4.86E-04
VOC		0.002	lb/MMBtu	0.43	1.89	0.003	lb/MMBtu	0.63	2.74	6.33	lb/MMscf	1.15	5.0	0.02	lb/MMBtu	4.0	17.5
Mercury	7439976	3.00E-06	lb/MMBtu	5.55E-04	2.43E-03	3.00E-06	lb/MMBtu	5.55E-04	2.43E-03	2.99E-04	lb/MMscf	5.42E-05	2.38E-04	3.00E-06	lb/MMBtu	6.15E-04	2.69E-03
HCl ***	7647010	0.11	lb/ton	0.8	3.6	0.11	lb/ton	1.20	5.26								
HF ***	73902618	0.01	lb/ton	0.1	0.4	0.0138	lb/ton	0.15	0.66								
H_2SO_4 (As Sulfuric Acid Mist) [2]	7664939	6.10E-03	lb/MMBtu	1.1	4.9	6.10E-03	lb/MMBtu	1.1	4.9								
Total Dioxin/Furan [2,3]	1746016	2.34E-12	lb/MMBtu	4.33E-10	1.90E-09	2.34E-12	lb/MMBtu	4.33E-10	1.90E-09								
Metals																	
Antimony *	7440360	9.09E-06	lb/MMBtu	1.68E-03	7.36E-03	9.09E-06	lb/MMBtu	1.68E-03	7.36E-03					9.09E-06	lb/MMBtu	1.86E-05	8.16E-05
Arsenic *	7440382	7.67E-07	lb/MMBtu	1.42E-04	6.22E-04	7.67E-07	lb/MMBtu	1.42E-04	6.22E-04	2.30E-04	lb/MMscf	4.17E-05	1.83E-04	2.53E-07	lb/MMBtu	5.19E-05	2.27E-04
Barium	7440393									5.00E-03	lb/MMscf	9.18E-04	4.02E-03	1.06E-06	lb/MMBtu	4.01E-04	1.76E-03
Beryllium *	7440417	2.00E-08	lb/MMBtu	3.70E-06	1.62E-05	2.00E-08	lb/MMBtu	3.70E-06	1.62E-05	1.36E-05	lb/MMscf	2.50E-06	1.10E-05	1.27E-08	lb/MMBtu	2.69E-06	1.14E-05
Cadmium *	7440439	9.59E-06	lb/MMBtu	1.77E-05	7.77E-05	9.59E-06	lb/MMBtu	1.77E-05	7.77E-05	1.27E-03	lb/MMscf	2.29E-04	1.00E-03	4.72E-08	lb/MMBtu	9.97E-06	4.23E-05
Chromium, total *,4	7440473	1.20E-06	lb/MMBtu	2.21E-04	9.69E-04	1.20E-06	lb/MMBtu	2.21E-04	9.69E-04	1.81E-03	lb/MMscf	2.99E-04	1.28E-03	2.42E-05	lb/MMBtu	4.55E-03	2.17E-02
Chromium, hexavalent *	18540299	3.59E-07	lb/MMBtu	6.64E-05	2.91E-04	3.59E-07	lb/MMBtu	6.64E-05	2.91E-04					4.03E-06	lb/MMBtu	8.25E-04	3.61E-03
Chromium, trivalent *	16065831	8.37E-07	lb/MMBtu	1.55E-04	6.78E-04	8.37E-07	lb/MMBtu	1.55E-04	6.78E-04								
Cobalt	7440484	1.16E-04	lb/ton	8.51E-04	3.73E-03	1.15E-04	lb/ton	1.25E-03	5.48E-03					7.48E-08	lb/MMBtu	1.53E-05	6.71E-05
Copper	7440508													5.64E-07	lb/MMBtu	1.16E-04	5.06E-04
Iron	7439896													1.14E-05	lb/MMBtu	2.33E-03	1.02E-02
Magnesium	7439954	1.27E-02	lb/ton	9.38E-02	4.10E-01	1.27E-02	lb/ton	1.38E-01	6.03E-01								
Manganese *	7439965	9.30E-06	lb/MMBtu	1.72E-03	7.54E-03	9.30E-06	lb/MMBtu	1.72E-03	7.54E-03	4.37E-04	lb/MMscf	7.93E-05	3.47E-04	1.84E-05	lb/MMBtu	3.77E-03	1.65E-02
Molybdenum	7439987									1.27E-03	lb/MMscf	2.29E-04	1.00E-03	2.42E-08	lb/MMBtu	4.95E-06	2.17E-05
Nickel *	7440020	1.67E-06	lb/MMBtu	3.09E-04	1.35E-03	1.67E-06	lb/MMBtu	3.09E-04	1.35E-03					3.60E-07	lb/MMBtu	7.76E-05	3.41E-04
Phosphorus	7723140													3.11E-07	lb/MMBtu	6.37E-05	2.79E-04
Potassium	7440097													4.49E-04	lb/MMBtu	9.19E-02	4.03E-01
Selenium	7782492	1.50E-03	lb/ton	1.11E-02	4.86E-02	1.50E-03	lb/ton	1.63E-02	7.15E-02					3.22E-06	lb/MMBtu	6.60E-05	2.89E-05
Silver	7440224													1.96E-05	lb/MMBtu	4.01E-03	1.76E-02
Sodium	7440235													4.14E-06	lb/MMBtu	8.49E-04	3.72E-03
Strontium	7440246													1.15E-07	lb/MMBtu	2.36E-05	1.03E-04
Tin	7440315													2.65E-07	lb/MMBtu	5.42E-05	2.37E-04
Titanium	7440326													2.30E-07	lb/MMBtu	4.72E-05	2.07E-04
Vanadium	7440622									2.65E-03	lb/MMscf	4.80E-04	2.10E-03	1.13E-06	lb/MMBtu	2.31E-04	1.01E-05
Yttrium	7440655													3.45E-09	lb/MMBtu	7.07E-07	3.10E-06
Zinc (se zinc oxide) *	1314132	2.83E-04	lb/MMBtu	5.23E-02	2.29E-01	2.83E-04	lb/MMBtu	5.23E-02	2.29E-01	3.34E-02	lb/MMscf	6.05E-03	2.65E-02	4.83E-09	lb/MMBtu	9.90E-04	4.34E-03
Organic Compounds																	
Acetaldehyde	75070	6.66E-04	lb/ton	4.85E-03	2.12E-02	6.56E-04	lb/ton	7.13E-03	3.12E-02					9.55E-04	lb/MMBtu	1.96E-01	9.57E-01
Acetophenone	98862	1.72E-05	lb/ton	1.26E-04	5.52E-04	1.73E-05	lb/ton	1.88E-04	8.22E-04					3.68E-09	lb/MMBtu	7.54E-07	3.30E-06
Acrolein	107028	3.34E-04	lb/ton	2.47E-03	1.08E-02	3.34E-04	lb/ton	3.63E-03	1.59E-02					1.15E-04	lb/MMBtu	2.39E-02	1.05E-01
Benzene	71432	1.50E-03	lb/ton	1.11E-02	4.85E-02	1.50E-03	lb/ton	1.63E-02	7.13E-02	2.42E-03	lb/MMscf	4.38E-04	1.92E-03	4.83E-03	lb/MMBtu	9.90E-01	4.34E+00
Benzyl chloride	100447	8.05E-04	lb/ton	5.96E-03	2.61E-02	8.05E-04	lb/ton	8.76E-03	3.84E-02					8.76E-03	lb/MMBtu	3.84E-02	PRB Coal
Benzoic acid	65850													5.41E-08	lb/MMBtu	1.11E-05	4.85E-05
Bis(2-Ethylhexyl)phthalate	117817	8.40E-05	lb/ton	6.21E-04	2.72E-03	8.40E-05	lb/ton	9.14E-04	4.00E-03					5.41E-08	lb/MMBtu	1.11E-05	4.85E-05
Bromoform	75252	4.49E-05	lb/ton	3.32E-04	1.45E-03	4.49E-05	lb/ton	4.88E-04	2.14E-03					4.89E-04	lb/MMBtu	2.14E-03	PRB Coal
Carbon disulfide	75150	1.50E-04	lb/ton	1.11E-03	4.85E-03	1.50E-04	lb/ton	1.63E-03	7.13E-03					1.63E-03	lb/MMBtu	7.13E-03	PRB Coal
Carbazole	86748													2.07E-06	lb/MMBtu	4.24E-04	1.89E-03

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
PM (filterable and condensable)	6.15	26.9	Wood	3.00E-02
SO_2	37.74	165.3	Coal	2.04E-01
NO_x	20.60	89.8	Wood	1.00E-01
CO	34.85	152.6	Wood	1.70E-01
Lead	0.002	0.011	Coal	1.34E-05
VOC	4.01	17.5	Wood	1.96E-02
Mercury	6.15E-04	2.69E-03	Wood	3.00E-06
HCl	1.2	5.26	PRB Coal	6.49E-03
HF	0.2	0.88	PRB Coal	8.12E-04
H_2SO_4	1.1	4.84	Coal	6.10E-03
Total Dioxin/Furan	4.33E-10	1.90E-09	Coal	2.34E-12
Metals				
Antimony	1.68E-03	7.36E-03	Coal	9.09E-06
Arsenic	1.42E-04	6.22E-04	Coal	7.67E-07
Barium	9.18E-04	4.02E-03	Nat Gas	4.90E-06
Beryllium	3.70E-06	1.62E-05	Coal	2.00E-08
Cadmium	2.29E-04	1.00E-03	Nat Gas	1.24E-06
Chromium, total	4.95E-03	2.17E-02	Wood	2.42E-05
Chromium, hexavalent	8.25E-04	3.61E-03	Wood	4.03E-06
Chromium, trivalent	1.55E-04	6.78E-04	Coal	8.37E-07
Cobalt	1.25E-03	5.48E-03	PRB Coal	6.76E-06
Copper	1.16E-04	5.06E-04	Wood	5.64E-07
Iron	2.33E-03	1.02E-02	Wood	1.14E-05
Magnesium	1.38E-01	6.03E-01	PRB Coal	7.44E-04
Manganese	3.77E-03	1.65E-02	Wood	1.84E-05
Molybdenum	2.29E-04	1.00E-03	Nat Gas	1.24E-09
Nickel	3.09E-04	1.35E-03	Coal	1.67E-06
Phosphorus	6.37E-05	2.79E-04	Wood	3.11E-07
Potassium	9.19E-02	4.03E-01	Wood	4.49E-04
Selenium	1.63E-02	7.16E-02	PRB Coal	8.82E-05
Silver	4.01E-03	1.76E-02	Wood	1.96E-05
Sodium	8.49E-04	3.72E-03	Wood	4.14E-06
Strontium	2.36E-05	1.03E-04	Wood	1.15E-07
Tin	5.42E-05	2.37E-04	Wood	2.65E-07
Titanium	4.72E-05	2.07E-04	Wood	2.30E-07
Vanadium	4.80E-04	2.10E-03	Nat Gas	2.59E-06
Yttrium	7.07E-07	3.10E-06	Wood	3.45E-09
Zinc	5.23E-02	2.29E-01	Coal	2.83E-04
Organic Compounds				
Acetaldehyde	1.96E-01	8.57E-01	Wood	9.55E-04
Acetophenone	1.88E-04	8.22E-04	PRB Coal	1.01E-06
Acrolein	2.39E-02	1.05E-01	Wood	1.15E-04
Benzene	9.90E-01	4.34E+00	Wood	4.83E-03
Benzyl chloride	8.76E-03	3.84E-02	PRB Coal	4.74E-05
Benzoic acid	1.11E-05	4.85E-05	Wood	5.41E-08
Bis(2-Ethylhexyl)phthalate	9.14E-04	4.00E-03	PRB Coal	4.94E-06
Bromoform	4.89E-04	2.14E-03	PRB Coal	2.64E-06
Carbon disulfide	1.63E-03	7.13E-03	PRB Coal	8.79E-06
Carbazole	4.24E-04	1.89E-03	Wood	2.07E-06

Prepared by NTH Consultants, Ltd.

APPENDIX B

Emission Summary Tables

Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input, (MM btu/hr)	185
Gross Output (MW/hr)	10

(Approximate; normally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	3.50%	100.0%	185	11,800	15,678	7.84	68,666	0.1814
Coal, PRB	0.60%	100.0%	185	8,500	21,765	10.88	95,329	
Natural Gas	0.00%	100.0%	185	23,200	7,974	3.99	34,927	
Virgin Wood	0.00%	100.0%	205	4,600	44,565	22.28	195,233	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
PM_{10} [1] (filterable and condensable)		0.03	lb/MMBtu	5.6	24.3	0.03	lb/MMBtu	5.6	24.3					0.03	lb/MMBtu	6.2	26.9
SO_2	7446095	0.475	lb/MMBtu	87.9	384.5	0.200	lb/MMBtu	37.0	162.1					0.025	lb/MMBtu	5.1	22.4
NO_x [1]	10102440	0.10	lb/MMBtu	18.5	81.0	0.10	lb/MMBtu	18.5	81.0	0.10	lb/MMBtu	18.5	81.0	0.10	lb/MMBtu	20.5	89.8
CO [1]	630080	0.15	lb/MMBtu	27.8	121.6	0.15	lb/MMBtu	27.8	121.6	0.15	lb/MMBtu	27.8	121.6	0.17	lb/MMBtu	34.9	152.8
Lead **	7439921	1.34E-05	lb/MMBtu	0.002	0.011	4.52E-06	lb/MMBtu	0.001	0.004					5.52E-07	lb/MMBtu	1.13E-04	4.95E-04
VOC		0.002	lb/MMBtu	0.45	1.97	0.003	lb/MMBtu	0.63	2.74	5.33	lb/MMscf	1.15	5.0	0.02	lb/MMBtu	4.0	17.6
Mercury	7439976	3.00E-06	lb/MMBtu	5.55E-04	2.43E-03	3.00E-06	lb/MMBtu	5.55E-04	2.43E-03	2.66E-04	lb/MMscf	5.42E-05	2.36E-04	3.00E-06	lb/MMBtu	6.15E-04	2.69E-03
HCl ***	7647010	0.11	lb/ton	0.9	3.8	0.11	lb/ton	1.20	5.26								
HF ***	7664393	0.01	lb/ton	0.1	0.5	0.0138	lb/ton	0.15	0.66								
H_2SO_4 (As Sulfuric Acid Mist) [2]	7664939	6.10E-03	lb/MMBtu	1.1	4.9	6.10E-03	lb/MMBtu	1.1	4.9								
Total Dioxin/Furan [2,3]	1746016	2.34E-12	lb/MMBtu	4.33E-10	1.90E-09	2.34E-12	lb/MMBtu	4.33E-10	1.90E-09								
Metals																	
Antimony *	7440360	9.09E-06	lb/MMBtu	1.68E-03	7.36E-03	9.09E-06	lb/MMBtu	1.68E-03	7.36E-03					9.09E-06	lb/MMBtu	1.86E-05	8.16E-05
Arsenic *	7440382	7.67E-07	lb/MMBtu	1.42E-04	6.22E-04	7.67E-07	lb/MMBtu	1.42E-04	6.22E-04	2.30E-04	lb/MMscf	4.17E-05	1.83E-04	2.53E-07	lb/MMBtu	5.19E-05	2.27E-04
Barium	7440393									6.00E-03	lb/MMscf	9.18E-04	4.02E-03	1.96E-06	lb/MMBtu	4.01E-04	1.76E-03
Beryllium *	7440417	2.00E-08	lb/MMBtu	3.70E-06	1.62E-05	2.00E-08	lb/MMBtu	3.70E-06	1.62E-05	1.38E-05	lb/MMscf	2.50E-06	1.10E-05	1.27E-08	lb/MMBtu	2.59E-06	1.14E-05
Cadmium *	7440439	9.69E-06	lb/MMBtu	1.77E-05	7.77E-05	9.69E-06	lb/MMBtu	1.77E-05	7.77E-05	1.27E-03	lb/MMscf	2.29E-04	1.00E-03	4.72E-06	lb/MMBtu	9.67E-06	4.23E-05
Chromium, total *,4	7440473	1.20E-05	lb/MMBtu	2.21E-04	9.69E-04	1.20E-05	lb/MMBtu	2.21E-04	9.69E-04	1.61E-03	lb/MMscf	2.92E-04	1.28E-03	2.42E-05	lb/MMBtu	4.95E-03	2.17E-02
Chromium, hexavalent *	18540299	3.59E-07	lb/MMBtu	6.64E-05	2.91E-04	3.59E-07	lb/MMBtu	6.64E-05	2.91E-04					4.03E-08	lb/MMBtu	8.25E-04	3.61E-03
Chromium, trivalent *	16065831	8.37E-07	lb/MMBtu	1.55E-04	6.78E-04	8.37E-07	lb/MMBtu	1.55E-04	6.78E-04								
Cobalt	7440484	1.15E-04	lb/ton	9.01E-04	3.95E-03	1.15E-04	lb/ton	1.25E-03	5.48E-03								
Copper	7440508													7.46E-06	lb/MMBtu	1.53E-05	6.71E-05
Iron	7439896													5.64E-07	lb/MMBtu	1.16E-04	5.06E-04
Magnesium	7439954	1.27E-02	lb/ton	9.92E-02	4.34E-01	1.27E-02	lb/ton	1.38E-01	6.03E-01					1.14E-05	lb/MMBtu	2.33E-03	1.02E-02
Manganese *	7439965	9.30E-06	lb/MMBtu	1.72E-03	7.54E-03	9.30E-06	lb/MMBtu	1.72E-03	7.54E-03	4.37E-04	lb/MMscf	7.93E-05	3.47E-04	1.84E-05	lb/MMBtu	3.77E-03	1.65E-02
Molybdenum	7439987									1.27E-03	lb/MMscf	2.29E-04	1.00E-03	2.42E-06	lb/MMBtu	4.95E-06	2.17E-05
Nickel *	7440020	1.67E-06	lb/MMBtu	3.09E-04	1.35E-03	1.67E-06	lb/MMBtu	3.09E-04	1.35E-03					3.80E-07	lb/MMBtu	7.78E-05	3.41E-04
Phosphorus	7723140													3.11E-07	lb/MMBtu	6.37E-05	2.79E-04
Potassium	7440097													4.49E-04	lb/MMBtu	9.19E-02	4.03E-01
Selenium	7782492	1.60E-03	lb/ton	1.18E-02	5.15E-02	1.60E-03	lb/ton	1.63E-02	7.15E-02					3.22E-06	lb/MMBtu	6.60E-05	2.89E-05
Silver	7440224													1.96E-05	lb/MMBtu	4.01E-03	1.76E-02
Sodium	7440235													4.14E-06	lb/MMBtu	8.48E-04	3.72E-03
Strontium	7440246													1.15E-07	lb/MMBtu	2.36E-05	1.03E-04
Tin	7440315													2.65E-07	lb/MMBtu	5.42E-05	2.37E-04
Titanium	7440326													2.30E-07	lb/MMBtu	4.72E-05	2.07E-04
Vanadium	7440622									2.65E-03	lb/MMscf	4.80E-04	2.10E-03	1.13E-06	lb/MMBtu	2.31E-06	1.01E-05
Yttrium	7440655													3.45E-06	lb/MMBtu	7.07E-07	3.10E-06
Zinc (as zinc oxide) *	1314132	2.83E-04	lb/MMBtu	5.23E-02	2.29E-01	2.83E-04	lb/MMBtu	5.23E-02	2.29E-01	3.34E-02	lb/MMscf	6.03E-03	2.65E-02	4.83E-06	lb/MMBtu	9.90E-04	4.34E-03
Organic Compounds																	
Acetaldehyde	75070	6.56E-04	lb/ton	5.14E-03	2.26E-02	6.56E-04	lb/ton	7.13E-03	3.12E-02					9.66E-04	lb/MMBtu	1.96E-01	8.57E-01
Acetophenone	98862	1.73E-05	lb/ton	1.36E-04	5.92E-04	1.73E-05	lb/ton	1.88E-04	8.22E-04					3.68E-09	lb/MMBtu	7.54E-07	3.30E-06
Acrolein	107028	3.34E-04	lb/ton	2.61E-03	1.15E-02	3.34E-04	lb/ton	3.63E-03	1.59E-02					1.16E-04	lb/MMBtu	2.39E-02	1.05E-01
Benzene	71432	1.50E-03	lb/ton	1.17E-02	5.13E-02	1.50E-03	lb/ton	1.63E-02	7.13E-02	2.42E-03	lb/MMscf	4.38E-04	1.92E-03	4.83E-03	lb/MMBtu	9.90E-01	4.34E+00
Benzyl chloride	100447	8.06E-04	lb/ton	6.31E-03	2.76E-02	8.06E-04	lb/ton	8.76E-03	3.84E-02								
Benzoic acid	65850													5.41E-06	lb/MMBtu	1.11E-03	4.85E-03
Bis(2-Ethylhexyl)phthalate	117817	8.40E-05	lb/ton	6.58E-04	2.89E-03	8.40E-05	lb/ton	9.14E-04	4.00E-03					5.41E-06	lb/MMBtu	1.11E-03	4.85E-03
Bromoform	75252	4.49E-05	lb/ton	3.52E-04	1.54E-03	4.49E-05	lb/ton	4.88E-04	2.14E-03								
Carbon disulfide	75150	1.60E-04	lb/ton	1.17E-03	5.13E-03	1.60E-04	lb/ton	1.63E-03	7.13E-03								
Carbazole	86748													2.07E-06	lb/MMBtu	4.24E-04	1.85E-03

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
PM_{10} (filterable and condensable)	6.15	26.9	Wood	3.00E-02
SO_2	87.80	384.5	Coal	4.75E-01
NO_x	20.50	89.8	Wood	1.00E-01
CO	34.85	152.6	Wood	1.70E-01
Lead	0.002	0.011	Coal	1.34E-05
VOC	4.01	17.6	Wood	1.98E-02
Mercury	6.15E-04	2.69E-03	Wood	3.00E-06
HCl	1.2	5.26	PRB Coal	6.49E-03
HF	0.2	0.66	PRB Coal	8.12E-04
H_2SO_4	1.1	4.94	Coal	6.10E-03
Total Dioxin/Furan	4.33E-10	1.90E-09	Coal	2.34E-12
Metals				
Antimony	1.86E-03	7.36E-03	Coal	9.09E-06
Arsenic	1.42E-04	6.22E-04	Coal	7.67E-07
Barium	9.18E-04	4.02E-03	Nat Gas	4.96E-06
Beryllium	3.70E-06	1.62E-05	Coal	2.00E-08
Cadmium	2.20E-04	1.00E-03	Nat Gas	1.24E-06
Chromium, total	4.95E-03	2.17E-02	Wood	2.42E-05
Chromium, hexavalent	8.25E-04	3.61E-03	Wood	4.03E-06
Chromium, trivalent	1.55E-04	6.78E-04	Coal	8.37E-07
Cobalt	1.25E-03	5.48E-03	PRB Coal	6.76E-06
Copper	1.16E-04	5.06E-04	Wood	5.64E-07
Iron	2.33E-03	1.02E-02	Wood	1.14E-05
Magnesium	1.38E-01	6.03E-01	PRB Coal	7.44E-04
Manganese	3.77E-03	1.65E-02	Wood	1.84E-05
Molybdenum	2.29E-04	1.00E-03	Nat Gas	1.24E-06
Nickel	3.09E-04	1.35E-03	Coal	1.67E-06
Phosphorus	6.37E-05	2.79E-04	Wood	3.11E-07
Potassium	9.19E-02	4.03E-01	Wood	4.49E-04
Selenium	1.63E-02	7.15E-02	PRB Coal	8.82E-05
Silver	4.01E-03	1.76E-02	Wood	1.96E-05
Sodium	8.48E-04	3.72E-03	Wood	4.14E-06
Strontium	2.36E-05	1.03E-04	Wood	1.15E-07
Tin	5.42E-05	2.37E-04	Wood	2.65E-07
Titanium	4.72E-05	2.07E-04	Wood	2.30E-07
Vanadium	4.80E-04	2.10E-03	Nat Gas	2.59E-06
Yttrium	7.07E-07	3.10E-06	Wood	3.45E-09
Zinc	5.23E-02	2.29E-01	Coal	2.83E-04
Organic Compounds				
Acetaldehyde	1.96E-01	8.57E-01	Wood	9.66E-04
Acetophenone	1.88E-04	8.22E-04	PRB Coal	1.01E-06
Acrolein	2.39E-02	1.05E-01	Wood	1.16E-04
Benzene	9.90E-01	4.34E+00	Wood	4.83E-03
Benzyl chloride	8.76E-03	3.84E-02	PRB Coal	4.74E-05
Benzoic acid	1.11E-03	4.85E-03	Wood	5.41E-06
Bis(2-Ethylhexyl)phthalate	9.14E-04	4.00E-03	PRB Coal	4.04E-06
Bromoform	4.88E-04	2.14E-03	PRB Coal	2.64E-06
Carbon disulfide	1.63E-03	7.13E-03	PRB Coal	8.79E-06
Carbazole	4.24E-04	1.86E-03	Wood	2.07E-06

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Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input, (MM btu/hr)	186
Gross Output (kW/hr)	10 (Approximate; normally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	3.60%	100.0%	185	11,800	15,678	7.84	68,669	0.1814
Coal, PRB	0.60%	100.0%	185	8,500	21,786	10.88	95,329	
Natural Gas	0.00%	100.0%	185	23,200	7,974	3.99	34,927	
Virgin Wood	0.00%	100.0%	205	4,500	45,556	22.78	199,533	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
Carbon tetrachloride	56235													5.18E-05	lb/MMBtu	1.06E-02	4.65E-02
Chlorine	7782505													9.09E-04	lb/MMBtu	1.86E-01	8.16E-01
2-Chloroacetophenone	532274	8.05E-06	lb/ton	9.31E-05	2.76E-04	8.06E-06	lb/ton	8.76E-05	3.84E-04					2.76E-09	lb/MMBtu	5.66E-07	2.48E-06
Chlorobenzene	108907	2.63E-05	lb/ton	1.98E-04	8.69E-04	2.63E-05	lb/ton	2.75E-04	1.21E-03					3.80E-05	lb/MMBtu	7.78E-03	3.41E-02
Chloroform	67663	6.79E-05	lb/ton	5.32E-04	2.33E-03	6.79E-05	lb/ton	7.38E-04	3.23E-03					3.22E-05	lb/MMBtu	6.60E-03	2.89E-02
2-Chloronaphthalene	91587													2.76E-09	lb/MMBtu	5.66E-07	2.48E-06
2-Chlorophenol	95578													2.76E-09	lb/MMBtu	5.66E-06	2.48E-05
Cumene	98828	6.10E-06	lb/ton	4.78E-05	2.09E-04	6.10E-06	lb/ton	6.63E-05	2.91E-04								
Cyanide	74908	2.88E-03	lb/ton	2.25E-02	9.87E-02	2.88E-03	lb/ton	3.13E-02	1.37E-01								
1,4-Dichlorobenzene	106467									1.35E-03	lb/MMscf	2.50E-04	1.10E-03				
2,4-Dinitrotoluene	121142	3.22E-07	lb/ton	2.52E-06	1.11E-05	3.22E-07	lb/ton	3.50E-06	1.53E-05								
Dimethyl sulfate	77781	5.52E-05	lb/ton	4.33E-04	1.90E-03	5.52E-05	lb/ton	6.01E-04	2.63E-03								
2,4-Dinitrophenol	51285													2.07E-07	lb/MMBtu	4.24E-05	1.86E-04
Ethylbenzene	100878	1.08E-04	lb/ton	8.47E-04	3.71E-03	1.08E-04	lb/ton	1.18E-03	5.15E-03					3.57E-05	lb/MMBtu	7.31E-03	3.20E-02
Ethylchloride	75003	4.83E-05	lb/ton	3.79E-04	1.66E-03	4.83E-05	lb/ton	5.26E-04	2.30E-03								
Ethylene dichloride	107062	4.60E-05	lb/ton	3.61E-04	1.58E-03	4.60E-05	lb/ton	5.01E-04	2.19E-03								
Ethylene dibromide	106934	1.35E-06	lb/ton	1.06E-05	4.74E-05	1.35E-06	lb/ton	1.50E-05	6.58E-05								
Formaldehyde	50000	2.76E-04	lb/ton	2.16E-03	9.48E-03	2.76E-04	lb/ton	3.00E-03	1.32E-02	8.63E-02	lb/MMscf	1.56E-02	6.85E-02	5.09E-03	lb/MMBtu	1.04E+00	4.54E+00
Heptachlorobiphenyl	28655712													7.59E-11	lb/MMBtu	1.56E-08	6.82E-08
Hexachlorobiphenyl	26601649													6.33E-10	lb/MMBtu	1.30E-07	5.68E-07
Hexanol	68251													8.05E-06	lb/MMBtu	1.65E-03	7.23E-03
Hexane	110543	7.71E-05	lb/ton	6.04E-04	2.65E-03	7.71E-05	lb/ton	8.35E-04	3.67E-03	2.07E+00	lb/MMscf	3.75E-01	1.64E+00				
Isobutyraldehyde	78842													1.38E-05	lb/MMBtu	2.83E-03	1.24E-02
Isophorone	78591	6.67E-04	lb/ton	5.23E-03	2.29E-02	6.67E-04	lb/ton	7.26E-03	3.18E-02								
2-Methylnaphthalene	91576									2.76E-05	lb/MMscf	5.01E-06	2.19E-05	1.84E-07	lb/MMBtu	3.77E-05	1.65E-04
3-Methylchloranthrene										2.07E-08	lb/MMscf	3.75E-07	1.64E-06				
Monochlorobiphenyl														2.53E-10	lb/MMBtu	5.19E-08	2.27E-07
Methyl bromide (bromomethane)	74839	1.64E-01	lb/ton	1.44E-03	6.32E-03	1.64E-04	lb/ton	2.00E-03	8.77E-03					1.73E-05	lb/MMBtu	3.54E-03	1.55E-02
Methyl chloride	74873	0.10E-04	lb/ton	4.78E-03	2.09E-02	6.10E-04	lb/ton	6.63E-03	2.91E-02					2.86E-05	lb/MMBtu	5.42E-03	2.37E-02
Methyl ethyl ketone	78933	4.49E-04	lb/ton	3.52E-03	1.54E-02	4.49E-04	lb/ton	4.88E-03	2.14E-02					6.21E-06	lb/MMBtu	1.27E-03	5.56E-03
Methyl hydrazine	60344	1.96E-04	lb/ton	1.53E-03	6.71E-03	1.96E-04	lb/ton	2.13E-03	9.32E-03								
Methyl methacrylate	80626	2.30E-05	lb/ton	1.80E-04	7.90E-04	2.30E-05	lb/ton	2.50E-04	1.10E-03								
Methyl tert butyl ether	1634044	4.03E-05	lb/ton	3.16E-04	1.38E-03	4.03E-05	lb/ton	4.38E-04	1.92E-03								
Methylene chloride (Dichloromethane)	75092	3.34E-04	lb/ton	2.61E-03	1.15E-02	3.34E-04	lb/ton	3.63E-03	1.59E-02					3.34E-04	lb/MMBtu	6.84E-02	2.99E-01
2-Nitrophenol	88755													2.76E-07	lb/MMBtu	5.66E-05	2.48E-04
4-Nitrophenol	100027													1.27E-07	lb/MMBtu	2.59E-05	1.14E-04
Pentachlorobiphenyl	25429282													1.38E-09	lb/MMBtu	2.83E-07	1.24E-06
Pentachlorophenol	87865													5.87E-08	lb/MMBtu	1.20E-05	5.27E-05
Perylene	198550													6.66E-10	lb/MMBtu	1.23E-07	5.37E-07
Phenol	108952	1.84E-05	lb/ton	1.44E-04	6.32E-04	1.84E-05	lb/ton	2.00E-04	8.77E-04					5.87E-05	lb/MMBtu	1.20E-02	5.27E-02
Propionaldehyde	123386	4.37E-04	lb/ton	3.43E-03	1.50E-02	4.37E-04	lb/ton	4.76E-03	2.08E-02					7.02E-05	lb/MMBtu	1.44E-02	6.30E-02
Propanal	123386													3.68E-06	lb/MMBtu	7.54E-04	3.30E-03
Styrene	100425	2.68E-05	lb/ton	2.25E-04	9.87E-04	2.68E-05	lb/ton	3.13E-04	1.37E-03					2.19E-03	lb/MMBtu	4.48E-01	1.96E+00
Tetrachlorobiphenyl	26914330													2.68E-09	lb/MMBtu	5.69E-07	2.58E-06
Tetrachloroethylene	127184	4.95E-05	lb/ton	3.85E-04	1.70E-03	4.95E-05	lb/ton	5.38E-04	2.36E-03					4.37E-05	lb/MMBtu	8.96E-03	3.92E-02
Toluene	108883	2.76E-04	lb/ton	2.16E-03	9.48E-03	2.76E-04	lb/ton	3.00E-03	1.32E-02	3.91E-03	lb/MMscf	7.09E-04	3.11E-03	1.08E-03	lb/MMBtu	2.17E-01	9.50E-01
o-Tolualdehyde	529204													8.29E-06	lb/MMBtu	1.70E-03	7.43E-03
p-Tolualdehyde	104870													1.27E-05	lb/MMBtu	2.59E-03	1.14E-02
Trichlorobiphenyl														2.98E-09	lb/MMBtu	6.13E-07	2.68E-06

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MMBtu
Carbon tetrachloride	1.06E-02	4.65E-02	Wood	5.18E-06
Chlorine	1.86E-01	8.16E-01	Wood	9.09E-04
2-Chloroacetophenone	8.76E-06	3.84E-04	PRB Coal	4.74E-07
Chlorobenzene	7.78E-03	3.41E-02	Wood	3.80E-06
Chloroform	6.60E-03	2.89E-02	Wood	3.22E-06
2-Chloronaphthalene	5.66E-07	2.48E-06	Wood	2.76E-08
2-Chlorophenol	5.66E-06	2.48E-05	Wood	2.76E-06
Cumene	6.63E-05	2.91E-04	PRB Coal	3.69E-07
Cyanide	3.13E-02	1.37E-01	PRB Coal	1.69E-04
1,4-Dichlorobenzene	2.50E-04	1.10E-03	Nat Gas	1.35E-06
2,4-Dinitrotoluene	3.50E-06	1.53E-05	PRB Coal	1.69E-06
Dimethyl sulfate	6.01E-04	2.63E-03	PRB Coal	3.25E-06
2,4-Dinitrophenol	4.24E-05	1.86E-04	Wood	2.07E-07
Ethylbenzene	7.31E-03	3.20E-02	Wood	3.57E-05
Ethylchloride	5.26E-04	2.30E-03	PRB Coal	2.84E-06
Ethylene dichloride	5.01E-04	2.19E-03	PRB Coal	2.71E-06
Ethylene dibromide	1.50E-05	6.58E-05	PRB Coal	8.12E-08
Formaldehyde	1.04E+00	4.54E+00	Wood	5.09E-03
Heptachlorobiphenyl	1.56E-08	6.82E-08	Wood	7.59E-11
Hexachlorobiphenyl	1.30E-07	5.68E-07	Wood	6.33E-10
Hexanol	1.65E-03	7.23E-03	Wood	8.05E-06
Hexane	3.75E-01	1.64E+00	Nat Gas	2.00E-03
Isobutyraldehyde	2.83E-03	1.24E-02	Wood	1.38E-05
Isophorone	7.26E-03	3.18E-02	PRB Coal	3.62E-05
2-Methylnaphthalene	3.77E-05	1.65E-04	Wood	1.84E-07
3-Methylchloranthrene	3.75E-07	1.64E-06	Nat Gas	2.03E-09
Monochlorobiphenyl	5.19E-08	2.27E-07	Wood	2.53E-10
Methyl bromide	3.54E-03	1.55E-02	Wood	1.73E-05
Methyl chloride	6.63E-03	2.01E-02	PRD Coal	3.59E-05
Methyl ethyl ketone	4.88E-03	2.14E-02	PRB Coal	2.84E-05
Methyl hydrazine	2.13E-03	9.32E-03	PRB Coal	1.15E-05
Methyl methacrylate	2.50E-04	1.10E-03	PRB Coal	1.35E-06
Methyl tert butyl ether	4.38E-04	1.92E-03	PRB Coal	2.37E-06
Methylene chloride	6.84E-02	2.99E-01	Wood	3.34E-04
2-Nitrophenol	5.66E-05	2.48E-04	Wood	2.76E-07
4-Nitrophenol	2.59E-05	1.14E-04	Wood	1.27E-07
Pentachlorobiphenyl	2.83E-07	1.24E-06	Wood	1.38E-09
Pentachlorophenol	1.20E-05	5.27E-05	Wood	5.87E-08
Perylene	1.23E-07	5.37E-07	Wood	5.99E-10
Phenol	1.20E-02	5.27E-02	Wood	5.87E-06
Propionaldehyde	1.44E-02	6.30E-02	Wood	7.02E-05
Propanal	7.54E-04	3.30E-03	Wood	3.68E-06
Styrene	4.48E-01	1.96E+00	Wood	2.19E-03
Tetrachlorobiphenyl	5.69E-07	2.58E-06	Wood	2.68E-09
Tetrachloroethylene	8.96E-03	3.92E-02	Wood	4.37E-05
Toluene	2.17E-01	9.50E-01	Wood	1.06E-03
o-Tolualdehyde	1.70E-03	7.43E-03	Wood	8.29E-06
p-Tolualdehyde	2.59E-03	1.14E-02	Wood	1.27E-05
Trichlorobiphenyl	6.13E-07	2.68E-06	Wood	2.98E-09

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Northern Michigan University
Marquette, MI
CFB Boiler Project

Proposed Circulating Fluidized Bed Boiler
Potential Emissions

Boiler Parameters	Specification
Boiler Type	Circulating Fluidized Bed
Maximum Rated Heat Input, (MM btu/hr)	185
Gross Output (MW/hr)	10 (Approximate; normally 7)

Material	Sulfur Content	Material Usage (%)	Heat Input (MM BTU/hr)	Heating Value (BTU/lb)	Material Throughput (lb/hr)	Material Throughput (tph)	Material Throughput (tpy)	Natural Gas Maximum Usage Rate MMscf/hr
Coal, Bituminous	3.60%	100.0%	185	11,600	15,078	7.84	68,689	0.1814
Coal, PRB	0.60%	100.0%	185	8,500	21,765	10.88	95,329	
Natural Gas	0.00%	100.0%	185	23,200	7,974	3.99	34,927	
Virgin Wood	0.00%	100.0%	205	4,500	45,556	22.78	199,533	

TABLE B-1. EMISSION RATES OF CRITERIA POLLUTANTS, HAPS, AND TACS FROM THE NEW BOILER ON A PER-FUEL BASIS

Compound	CAS Reference Number	Coal, Bituminous				Coal, PRB				Natural Gas				Waste Wood			
		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates		Emission Factors		Emission Rates	
		Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)	Value	Units	(lb/hr)	(tpy)
Trichlorofluoromethane	75694													4.72E-05	lb/MMBtu	9.67E-03	4.23E-02
Trichloroethene	79016													3.45E-05	lb/MMBtu	7.07E-03	3.10E-02
1,1,1-Trichloroethane	71556	2.30E-05	lb/ton	1.60E-04	7.00E-04	2.30E-05	lb/ton	2.50E-04	1.10E-03					3.57E-05	lb/MMBtu	7.31E-03	3.20E-02
2,4,6-Trichlorophenol	88062													2.53E-08	lb/MMBtu	5.19E-06	2.27E-05
Vinyl acetate	108054	8.74E-05	lb/ton	6.65E-04	3.00E-03	8.74E-05	lb/ton	9.51E-04	4.17E-03								
Vinyl Chloride	75014													2.07E-05	lb/MMBtu	4.24E-03	1.86E-02
Xylenes	1330207	4.26E-05	lb/ton	3.24E-04	1.46E-03	4.26E-05	lb/ton	4.63E-04	2.03E-03								
o-Xylene	95476													2.68E-05	lb/MMBtu	5.59E-03	2.59E-02
Polynuclear Aromatic Hydrocarbons (PAH)																	
Acenaphthene	83329	5.87E-07	lb/ton	4.60E-06	2.01E-05	5.87E-07	lb/ton	6.38E-06	2.80E-05	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.05E-06	lb/MMBtu	2.15E-04	9.40E-04
Acenaphthylene	208968	2.68E-07	lb/ton	2.26E-06	9.87E-06	2.68E-07	lb/ton	3.13E-06	1.37E-05	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	5.75E-06	lb/MMBtu	1.18E-03	5.16E-03
Acetone	67641													2.19E-04	lb/MMBtu	4.48E-02	1.96E-01
Anthracene	120127	2.42E-07	lb/ton	1.69E-06	8.29E-06	2.42E-07	lb/ton	2.83E-06	1.15E-05	2.76E-06	lb/MMscf	5.01E-07	2.19E-06	3.45E-06	lb/MMBtu	7.07E-04	3.10E-03
Benzaldehyde	100527													9.78E-07	lb/MMBtu	2.00E-04	8.78E-04
Benzo(a)anthracene	56553	9.20E-08	lb/ton	7.21E-07	3.16E-06	9.20E-08	lb/ton	1.00E-06	4.38E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	7.48E-06	lb/MMBtu	1.53E-06	6.71E-05
Benzo(a)pyrene	50328	4.37E-08	lb/ton	3.43E-07	1.50E-06	4.37E-08	lb/ton	4.70E-07	2.06E-06	1.38E-06	lb/MMscf	2.50E-07	1.10E-06	2.99E-06	lb/MMBtu	6.13E-04	2.68E-03
Benzo(e)pyrene	192972									1.38E-06	lb/MMscf	2.50E-07	1.10E-06	2.99E-06	lb/MMBtu	6.13E-07	2.68E-05
Benzo(b)fluoranthene	205992									2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.15E-07	lb/MMBtu	2.36E-05	1.03E-04
Benzo(j,k)fluoranthene	206440													1.84E-07	lb/MMBtu	3.77E-05	1.65E-04
Benzo(k)fluoranthene	205823									2.07E-06	lb/MMscf	3.75E-07	1.64E-06	4.14E-08	lb/MMBtu	8.49E-06	3.72E-05
Benzo(b,j,k)fluoranthene		1.27E-07	lb/ton	9.62E-07	4.34E-06	1.27E-07	lb/ton	1.38E-06	6.03E-06					1.16E-07	lb/MMBtu	2.36E-05	1.03E-04
Benzo(g,h,i)perylene	191242	3.11E-08	lb/ton	2.43E-07	1.07E-06	3.11E-08	lb/ton	3.38E-07	1.48E-06	1.38E-06	lb/MMscf	2.50E-07	1.10E-06	1.07E-07	lb/MMBtu	2.19E-05	9.60E-05
Biphenyl	92524	1.96E-06	lb/ton	1.53E-05	6.71E-05	1.96E-06	lb/ton	2.13E-05	9.32E-05								
Chrysene	218019	1.15E-07	lb/ton	9.01E-07	3.95E-06	1.15E-07	lb/ton	1.26E-06	5.48E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	4.37E-08	lb/MMBtu	8.96E-06	3.92E-05
Crotonaldehyde	4170303													1.14E-05	lb/MMBtu	2.33E-03	1.02E-02
Decachlorobiphenyl	2051243													3.11E-10	lb/MMBtu	6.37E-08	2.79E-07
Dibenzo(a,h)anthracene	53703									1.38E-06	lb/MMscf	2.50E-07	1.10E-06	1.05E-06	lb/MMBtu	2.15E-06	9.40E-06
1,2-Dibromoethene	540498													6.33E-05	lb/MMBtu	1.30E-02	5.68E-02
Dichlorobiphenyl	2050682													8.51E-10	lb/MMBtu	1.74E-07	7.64E-07
1,2-Dichloroethane	107062													3.34E-05	lb/MMBtu	6.84E-03	2.99E-02
1,2-Dichloropropane	78875													3.80E-05	lb/MMBtu	7.78E-03	3.41E-02
7,12-Dimethylbenz(a)anthracene	57976									1.84E-05	lb/MMscf	3.34E-06	1.46E-05				
Fluoranthene	206440	8.17E-07	lb/ton	6.40E-06	2.80E-05	8.17E-07	lb/ton	8.89E-06	3.89E-05	3.45E-06	lb/MMscf	6.26E-07	2.74E-06	1.84E-06	lb/MMBtu	3.77E-04	1.65E-03
Fluorene	86737	1.05E-06	lb/ton	8.20E-06	3.59E-05	1.05E-06	lb/ton	1.14E-05	4.99E-05	3.22E-06	lb/MMscf	5.84E-07	2.56E-06	3.91E-06	lb/MMBtu	8.02E-04	3.51E-03
Indeno(1,2,3,c,d)pyrene	193395	7.02E-08	lb/ton	5.50E-07	2.41E-06	7.02E-08	lb/ton	7.63E-07	3.34E-06	2.07E-06	lb/MMscf	3.75E-07	1.64E-06	1.00E-07	lb/MMBtu	2.05E-05	8.98E-05
Naphthalene	91203	1.50E-05	lb/ton	1.17E-04	5.13E-04	1.50E-05	lb/ton	1.63E-04	7.13E-04	7.02E-04	lb/MMscf	1.27E-04	5.57E-04	1.12E-04	lb/MMBtu	2.29E-02	1.00E-01
Phenanthrene	85018	3.11E-06	lb/ton	2.43E-05	1.07E-04	3.11E-06	lb/ton	3.38E-05	1.48E-04	1.96E-05	lb/MMscf	3.55E-06	1.55E-05	8.05E-06	lb/MMBtu	1.65E-03	7.23E-03
Pyrene	129000	3.80E-07	lb/ton	2.97E-06	1.30E-05	3.80E-07	lb/ton	4.13E-06	1.81E-05	5.75E-06	lb/MMscf	1.04E-06	4.57E-06	4.26E-06	lb/MMBtu	8.72E-04	3.82E-03
5-Methyl chrysene	3697243	2.53E-08	lb/ton	1.98E-07	8.69E-07	2.53E-08	lb/ton	2.75E-07	1.21E-06					9.09E-12	lb/MMBtu	2.03E-09	8.88E-09

These shaded areas depict air contaminants subject to PSD review.
These shaded areas indicate no data available.
These shaded areas depict HAPs.
Unless otherwise noted below, emission factors are from the EPA AP-42 database, and are increased by a 15% safety factor.
* Coal firing emission factor based on Wyandotte Energy stack test results. Wyandotte Energy is located in Wyandotte, Michigan.
** The lead estimated emission rates for PRB & Bituminous fuels are based on a statistical analysis of respective typical coals, with a 99% control efficiency of the baghouse collector.
*** Both HCl and HF emission factors include a 15% safety factor and 92% control using limestone in the CFB.
[1] Emissions are based on the proposed BACT.
[2] Sulfuric acid mist emission based on RBLC search, Plum Point Energy entry. This facility is located in Arkansas.
[3] Total dioxin/furan for the coal firing is from the Wyandotte Energy stack test results, and dioxin/furan for the wood combustion is from the EPA AP-42, Chapter 1.6, Table 1.6-3.
[4] Total chromium is supplied here for information purposes only. Total chromium is a sum of hexavalent and trivalent chromium.

CFB Boiler Maximum Single HAP Emission Rate (HCl) = 5.3 tpy

CFB Boiler Maximum Combined Total HAP Emission Rate = 22.7 tpy

TABLE B-2. MAXIMUM EMISSION RATES

Compound	Maximum Emission Rates		Fuel	Emission Factor
	(lb/hr)	(tpy)		lb/MM Btu
Trichlorofluoromethane	9.67E-03	4.23E-02	Wood	4.72E-05
Trichloroethene	7.07E-03	3.10E-02	Wood	3.45E-05
1,1,1-Trichloroethane	7.31E-03	3.20E-02	Wood	3.57E-05
2,4,6-Trichlorophenol	5.19E-06	2.27E-05	Wood	2.53E-08
Vinyl acetate	9.51E-04	4.17E-03	PRB Coal	8.14E-06
Vinyl Chloride	4.24E-03	1.86E-02	Wood	2.07E-05
Xylenes	4.63E-04	2.03E-03	PRB Coal	2.50E-06
o-Xylene	5.59E-03	2.59E-02	Wood	2.68E-05
Polynuclear Aromatic Hydrocarbons (PAH)				
Acenaphthene	2.15E-04	9.40E-04	Wood	1.05E-06
Acenaphthylene	1.18E-03	5.16E-03	Wood	5.75E-06
Acetone	4.48E-02	1.96E-01	Wood	2.19E-04
Anthracene	7.07E-04	3.10E-03	Wood	3.45E-06
Benzaldehyde	2.00E-04	8.78E-04	Wood	9.78E-07
Benzo(a)anthracene	1.53E-06	6.71E-06	Wood	7.48E-06
Benzo(a)pyrene	6.13E-04	2.68E-03	Wood	2.99E-06
Benzo(e)pyrene	6.13E-07	2.68E-06	Wood	2.99E-09
Benzo(b)fluoranthene	2.36E-05	1.03E-04	Wood	1.15E-07
Benzo(j,k)fluoranthene	3.77E-06	1.65E-04	Wood	1.84E-07
Benzo(k)fluoranthene	8.49E-06	3.72E-05	Wood	4.14E-08
Benzo(b,j,k)fluoranthene	2.36E-05	1.03E-04	Wood	1.15E-07
Benzo(g,h,i)perylene	2.19E-06	9.60E-06	Wood	1.07E-07
Biphenyl	2.13E-05	9.32E-05	PRB Coal	1.16E-07
Chrysene	8.96E-06	3.92E-05	Wood	4.37E-08
Crotonaldehyde	2.33E-03	1.02E-02	Wood	1.14E-05
Decachlorobiphenyl	6.37E-08	2.79E-07	Wood	3.11E-10
Dibenzo(a,h)anthracene	2.15E-06	9.40E-06	Wood	1.05E-06
1,2-Dibromoethene	1.30E-02	5.68E-02	Wood	6.33E-05
Dichlorobiphenyl	1.74E-07	7.64E-07	Wood	8.51E-10
1,2-Dichloroethane	6.84E-03	2.99E-02	Wood	3.34E-05
1,2-Dichloropropane	7.78E-03	3.41E-02	Wood	3.80E-05
7,12-Dimethylbenz(a)anthracene	3.34E-06	1.46E-05	Nat Gas	1.80E-08
Fluoranthene	3.77E-04	1.65E-03	Wood	1.84E-06
Fluorene	8.02E-04	3.51E-03	Wood	3.91E-06
Indeno(1,2,3,c,d)pyrene	2.06E-05	8.98E-05	Wood	1.00E-07
Naphthalene	2.29E-02	1.00E-01	Wood	1.12E-04
Phenanthrene	1.65E-03	7.23E-03	Wood	8.05E-06
Pyrene	8.72E-04	3.82E-03	Wood	4.26E-06
5-Methyl chrysene	2.76E-07	1.21E-06	PRB Coal	1.48E-09

Prepared by NTH Consultants, Ltd.

1/25/2007 4:59 PM

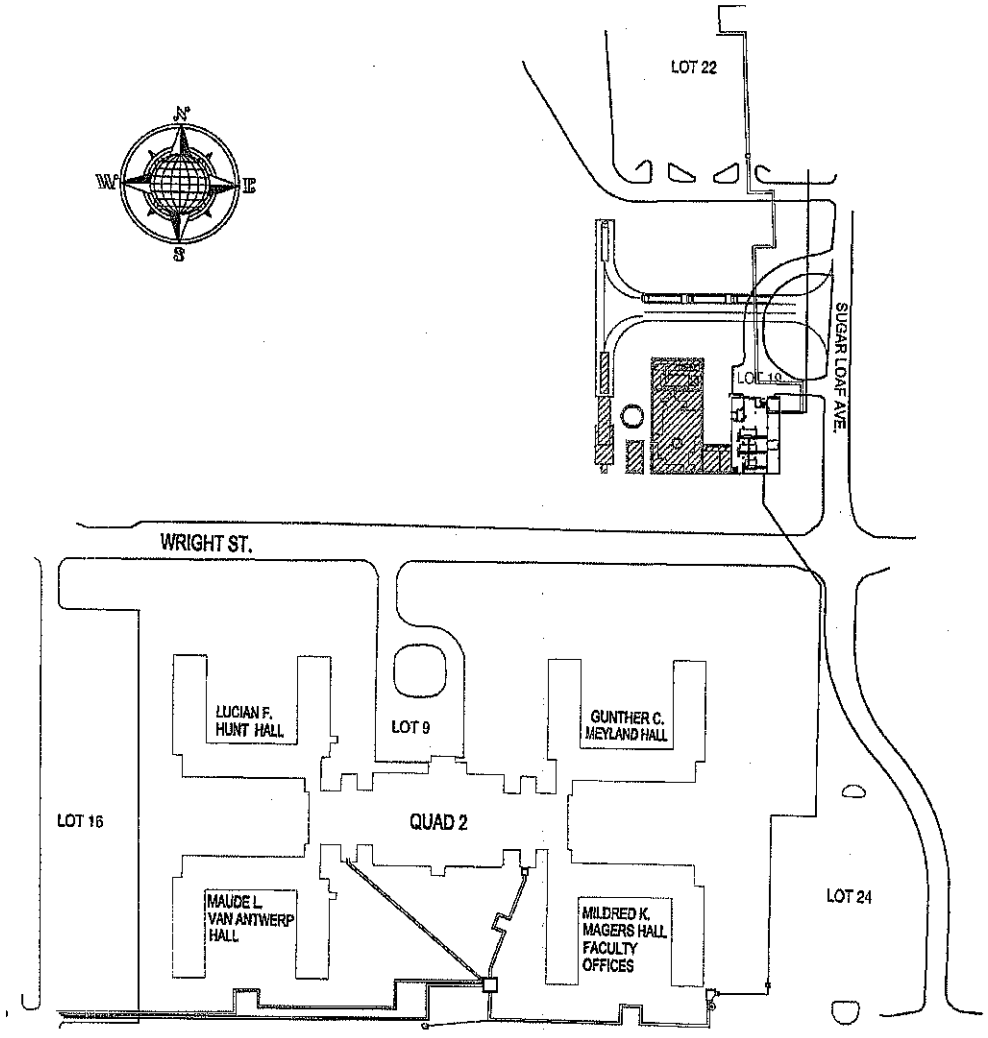
APPENDIX A

Site Drawings

CAMPUS MAP - NORTHERN SECTION

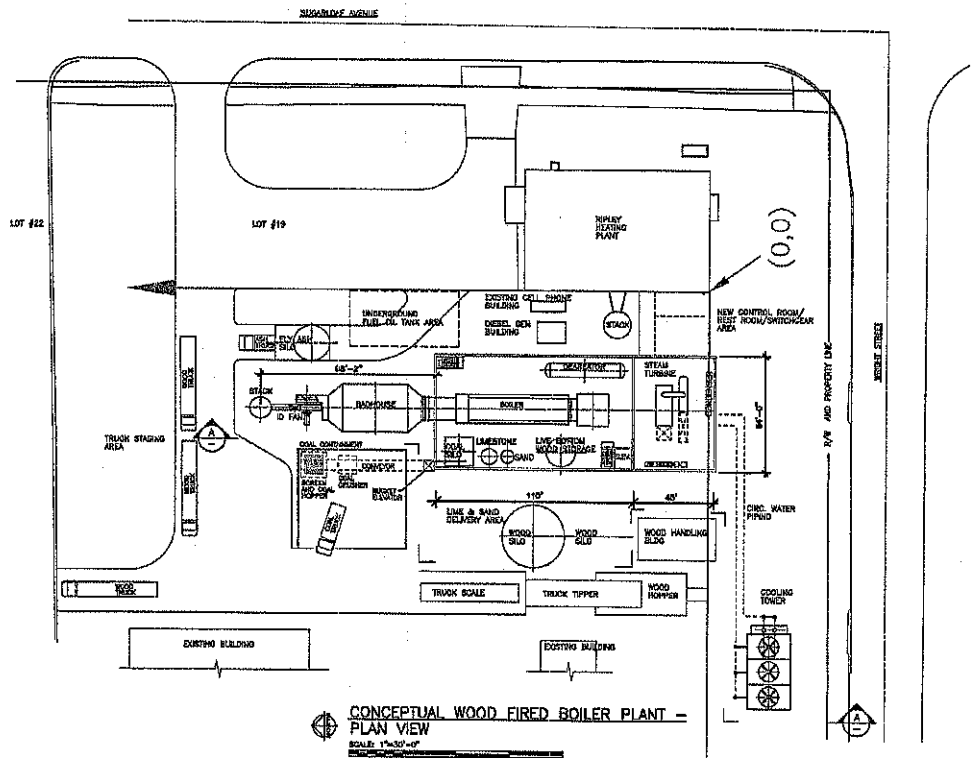
NORTHERN MICHIGAN UNIVERSITY

MARQUETTE, MICHIGAN
DATE: SEPTEMBER 4, 2003



ELECTRICAL LEGEND	
SYMBOL	UTILITY
	ELECTRIC
	HIGH MAST LIGHTPOLE
	SINGLE SHOEBOX LIGHTPOLE
	DOUBLE SHOEBOX LIGHTPOLE
	QUAD SHOEBOX LIGHTPOLE
	LIGHTPOLE
	CODE BLUE STATION
	MANHOLE
	LIGHTED BUILDING SIGNS

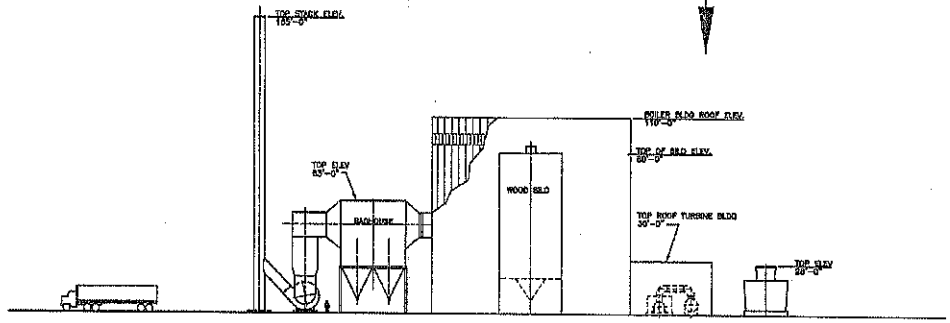
STEAM LEGEND	
SYMBOL	UTILITY
	STEAM
	ABANDONED STEAM
	MANHOLE
	STEAM VAULT (SV)



CONCEPTUAL WOOD FIRED BOILER PLANT – PLAN VIEW

SCALE: 1"=30'-0"

30 15 0 30 60 90



A SECTION PLANT ELEVATION

NOT TO BE USED FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DWN	ENGR	CHK	APPV

CUMMINS & BARNARD, INC.
CONSULTING ENGINEERS SINCE 1903
5405 DATA COURT
ANN ARBOR, MICHIGAN 48108
(734) 761-6130 Fax (734) 761-9681
www.Cummins-Barnard.com

NORTHERN MICHIGAN UNIVERSITY
WOOD/COAL FIRED BOILER

EQUIPMENT ARRANGEMENT

SCALE: 30"=1'-0" | PROJECT NO. 5048.01

DWG. NO. 5048-CGA-M1001A | REV. A

Northern Michigan University
New CFB Boiler
Toxic Air Contaminant Modeling Results

1.0 Gram/Sec Modeled Impacts

Averaging Period	Impact (ug/m^3 / 1 g/s)
Annual	0.211
24 Hour	1.589
8 Hour	2.712
1 Hour	15.779

Table C-1. TAC Emission Rates and Modeling Impact Results

Compound	CAS No.	Maximum Emission Rates (lb/hr)	Maximum Emission Rates (tpy)	Modeled Rate (gram/sec)	ITSL (ug/m3)	IRSL (ug/m3)	Averaging Period	Ambient Impact (ug/m3)	% of SL
Lead	7439-92-1	2.48E-03	1.09E-02	3.12E-04	1.5		24 hour	4.96E-04	0.03%
HCl	7647-01-0	1.20	5.26	1.51E-01	20		24 hour	2.41E-01	1.20%
HF	7664-39-3	0.15	0.66	1.89E-02	26		1 hour	2.99E-01	1.15%
H_2SO_4	7664-93-9	1.13	4.94	1.42E-01	10		8 hour	3.86E-01	3.86%
Total Dioxin/Furan	1746-01-6	4.33E-10	1.90E-09	5.45E-11		2.30E-07	Annual	1.15E-11	0.00%
Metals									
Antimony	7440-36-0	1.68E-03	7.36E-03	2.12E-04	0.2		24 hour	3.37E-04	0.168%
Arsenic	7440-38-2	1.42E-04	6.22E-04	1.79E-05		0.0002	Annual	3.77E-06	1.88%
Barium	7440-39-3	9.18E-04	4.02E-03	1.16E-04	5		8 hour	3.14E-04	0.006%
Beryllium	7440-41-7	3.70E-06	1.62E-05	4.66E-07	0.02		24 hour	7.41E-07	0.004%
Beryllium	7440-41-7	3.70E-06	1.62E-05	4.66E-07		0.0004	Annual	9.83E-08	0.025%
Cadmium	7440-43-9	2.29E-04	1.00E-03	2.89E-05		0.0006	Annual	6.09E-06	1.02%
Chromium, total	7440-47-3	4.95E-03	2.17E-02	6.24E-04	0.1		Annual	1.31E-04	0.131%
Chromium, hexavalent	18540-29-9	8.25E-04	3.61E-03	1.04E-04	0.1		24 hour	1.65E-04	0.17%
Chromium, hexavalent	18540-29-9	8.25E-04	3.61E-03	1.04E-04		8.30E-05	Annual	2.19E-05	26.40%
Chromium, trivalent	16065-83-1	1.55E-04	6.78E-04	1.95E-05	5		8 hour	5.29E-05	0.001%
Cobalt	7440-48-4	1.25E-03	5.48E-03	1.58E-04	0.2		8 hour	4.28E-04	0.214%
Copper	7440-50-8	1.16E-04	5.08E-04	1.46E-05	2		8 hour	3.95E-05	0.002%
Iron		2.33E-03	1.02E-02	2.94E-04	0.1		Annual	6.20E-05	0.06%
Magnesium	7439-95-4	1.38E-01	6.03E-01	1.73E-02	100		8 hour	4.70E-02	0.047%
Manganese	7439-96-5	3.77E-03	1.65E-02	4.75E-04	0.05		24 hour	7.55E-04	1.51%
Molybdenum		2.29E-04	1.00E-03	2.89E-05	0.1		Annual	6.09E-06	0.006%
Nickel	7440-02-0	3.09E-04	1.35E-03	3.89E-05		0.0042	Annual	8.21E-06	0.20%
Phosphorus	7723-14-0	6.37E-05	2.79E-04	8.02E-06	1		8 hour	2.17E-05	0.002%
Potassium		9.19E-02	4.03E-01	1.16E-02	0.1		Annual	2.44E-03	2.44%
Selenium	7782-49-2	1.63E-02	7.15E-02	2.06E-03	2		8 hour	5.58E-03	0.279%
Silver	7440-22-4	4.01E-03	1.76E-02	5.05E-04	0.1		8 hour	1.37E-03	1.37%
Sodium		8.49E-04	3.72E-03	1.07E-04	0.1		Annual	2.25E-05	0.02%
Strontium		2.36E-05	1.03E-04	2.97E-06	0.1		Annual	6.26E-07	0.001%
Tin	7440-31-5	5.42E-05	2.37E-04	6.83E-06	20		8 hour	1.85E-05	0.000%
Titanium		4.72E-05	2.07E-04	5.94E-06	0.1		Annual	1.25E-06	0.001%
Vanadium		4.80E-04	2.10E-03	6.04E-05	0.1		Annual	1.27E-05	0.013%
Yttrium		7.07E-07	3.10E-06	8.91E-08	0.1		Annual	1.88E-08	0.000%
Zinc (as ZnO)	1314-13-2	5.23E-02	2.29E-01	6.59E-03	50		8 hour	1.79E-02	0.036%
Organic Toxic Air Contaminants (TACs)									
Acetaldehyde	75-07-0	1.96E-01	8.57E-01	2.47E-02	9		24 hour	3.92E-02	0.435%
Acetaldehyde	75-07-0	1.96E-01	8.57E-01	2.47E-02		0.5	Annual	5.20E-03	1.04%
Acetophenone	98-86-2	1.88E-04	8.22E-04	2.37E-05	490		8 hour	6.41E-05	0.000%
Acrolein	107-02-8	2.39E-02	1.05E-01	3.01E-03	0.02		Annual	6.34E-04	3.17%
Acrolein	107-02-8	2.39E-02	1.05E-01	3.01E-03	0.5		1 hour	4.75E-02	9.50%
Benzene	71-43-2	9.90E-01	4.34E+00	1.25E-01	30		24 hour	1.98E-01	0.66%
Benzene	71-43-2	9.90E-01	4.34E+00	1.25E-01		0.1	Annual	2.63E-02	26.30%
Benzyl chloride	100-44-7	8.76E-03	3.84E-02	1.10E-03		0.02	Annual	2.33E-04	1.16%
Benzoic acid	65-85-0	1.11E-05	4.85E-05	1.40E-06	0.1		Annual	2.94E-07	0.000%
Biphenyl	92-52-4	2.13E-05	9.32E-05	2.68E-06	15		8 hour	7.27E-06	0.000%
Bis(2-Ethylhexyl)phthalate	117-81-7	9.14E-04	4.00E-03	1.15E-04		0.2	Annual	2.43E-05	0.012%
Bromoform	75-25-2	4.88E-04	2.14E-03	6.15E-05		0.9	Annual	1.30E-05	0.001%
Carbon disulfide	75-15-0	1.63E-03	7.13E-03	2.05E-04	700		24 hour	3.26E-04	0.000%
Carbazole	86-74-8	4.24E-04	1.86E-03	5.35E-05	0.1		Annual	1.13E-05	0.011%
Carbon tetrachloride	56-23-5	1.06E-02	4.65E-02	1.34E-03		0.07	Annual	2.82E-04	0.40%
Chlorine	7782-50-5	1.86E-01	8.16E-01	2.35E-02	15		8 hour	6.36E-02	0.42%
2-Chloroacetophenone	532-27-4	8.76E-05	3.84E-04	1.10E-05	0.03		24 hour	1.75E-05	0.058%
Chlorobenzene	108-90-7	7.78E-03	3.41E-02	9.80E-04	70		24 hour	1.56E-03	0.002%
Chloroform	67-66-3	6.60E-03	2.89E-02	8.32E-04		0.4	Annual	1.75E-04	0.044%
2-Chloronaphthalene	91-58-7	5.66E-07	2.48E-06	7.13E-08	0.1		Annual	1.50E-08	0.000%
2-Chlorophenol	95-57-8	5.66E-06	2.48E-05	7.13E-07	0.1		Annual	1.50E-07	0.000%
Cumene	98-82-8	6.63E-05	2.91E-04	8.36E-06	400		24 hour	1.33E-05	0.000%
Cyanide	57-12-5	3.13E-02	1.37E-01	3.94E-03	50		1 hour	6.22E-02	0.12%
1,4-Dichlorobenzene	106-46-7	2.50E-04	1.10E-03	3.15E-05	800		24 hour	5.01E-05	0.000%
1,4-Dichlorobenzene	106-46-7	2.50E-04	1.10E-03	3.15E-05		0.14	Annual	6.65E-06	0.005%
2,4-Dinitrophenol	51-28-5	4.24E-05	1.86E-04	5.35E-06	0.1		Annual	1.13E-06	0.001%
2,4-Dinitrotoluene	121-14-2	3.50E-06	1.53E-05	4.42E-07	2		8 hour	1.20E-06	0.000%
2,4-Dinitrotoluene	121-14-2	3.50E-06	1.53E-05	4.42E-07		0.009	Annual	9.31E-08	0.001%
Dimethyl sulfate	77-78-1	6.01E-04	2.63E-03	7.57E-05	0.5		8 hour	2.05E-04	0.041%
Ethylbenzene	100-41-4	7.31E-03	3.20E-02	9.21E-04	1000		24 hour	1.46E-03	0.000%
Ethylbenzene	100-41-4	7.31E-03	3.20E-02	9.21E-04		3	Annual	1.94E-04	0.006%
Ethylchloride	75-00-3	5.26E-04	2.30E-03	6.62E-05	10000		24 hour	1.05E-04	0.000%
Ethylene dichloride	107-06-2	5.01E-04	2.19E-03	6.31E-05		0.04	Annual	1.33E-05	0.033%
Ethylene dibromide	106-93-4	1.50E-05	6.58E-05	1.89E-06	9		24 hour	3.01E-06	0.000%
Ethylene dibromide	106-93-4	1.50E-05	6.58E-05	1.89E-06		0.002	Annual	3.99E-07	0.020%
Formaldehyde	50-00-0	1.04E+00	4.54E+00	1.31E-01		0.08	Annual	2.75E-02	34.44%

Northern Michigan University
New CFB Boiler
Toxic Air Contaminant Modeling Results

1.0 Gram/Sec Modeled Impacts

Averaging Period	Impact (ug/m^3 / 1 g/s)
Annual	0.211
24 Hour	1.589
8 Hour	2.712
1 Hour	15.779

Table C-1. TAC Emission Rates and Modeling Impact Results

Compound	CAS No.	Maximum Emission Rates (lb/hr)	Maximum Emission Rates (tpy)	Modeled Rate (gram/sec)	ITSL (ug/m3)	IRSL (ug/m3)	Averaging Period	Ambient Impact (ug/m3)	% of SL
Heptachlorobiphenyl	28655-71-2	1.56E-08	6.82E-08	1.96E-09	**0.1**		Annual	**4.13E-10**	0.000%
Hexachlorobiphenyl	26601-64-9	1.30E-07	5.68E-07	1.63E-08	**0.1**		Annual	**3.44E-09**	0.000%
Hexanal	66-25-1	1.65E-03	7.23E-03	2.08E-04	2		Annual	**4.38E-05**	0.002%
Hexane	110-54-3	3.75E-01	1.64E+00	4.73E-02	700		24 hour	**7.52E-02**	0.011%
Isobutyraldehyde	78-84-2	2.83E-03	1.24E-02	3.56E-04	160		24 hour	**5.66E-04**	0.000%
Isophorone	78-59-1	7.26E-03	3.18E-02	9.15E-04	280		1 hour	**1.44E-02**	0.005%
Isophorone	78-59-1	7.26E-03	3.18E-02	9.15E-04		3.7	Annual	**1.93E-04**	0.005%
2-Methylnaphthalene	91-57-6	3.77E-05	1.65E-04	4.75E-06	10		Annual	**1.00E-06**	0.000%
3-Methylchloranthrene		3.75E-07	1.64E-06	4.73E-08	**0.1**		Annual	**9.97E-09**	0.000%
Monochlorobiphenyl		5.19E-08	2.27E-07	6.53E-09	**0.1**		Annual	**1.38E-09**	0.000%
Methyl bromide	74-83-9	3.54E-03	1.55E-02	4.46E-04	5		24 hour	**7.08E-04**	0.014%
Methyl chloride	74-87-3	6.63E-03	2.91E-02	8.36E-04	90		24 hour	**1.33E-03**	0.001%
Methyl chloride	74-87-3	6.63E-03	2.91E-02	8.36E-04		1.6	Annual	**1.76E-04**	0.011%
Methyl ethyl ketone	78-93-3	4.88E-03	2.14E-02	6.15E-04	5000		24 hour	**9.77E-04**	0.000%
Methyl hydrazine	60-34-4	2.13E-03	9.32E-03	2.68E-04	**0.1**		Annual	**5.65E-05**	0.057%
Methyl methacrylate	80-62-6	2.50E-04	1.10E-03	3.15E-05	700		24 hour	**5.01E-05**	0.000%
Methyl tert butyl ether	1634-04-4	4.38E-04	1.92E-03	5.52E-05	3000		24 hour	**8.77E-05**	0.000%
Methylene chloride	75-09-2	6.84E-02	2.99E-01	8.61E-03		2	Annual	**1.82E-03**	0.091%
Naphthalene	91-20-3	2.29E-02	1.00E-01	2.88E-03	3		24 hour	**4.58E-03**	0.15%
Naphthalene	91-20-3	2.29E-02	1.00E-01	2.88E-03		0.08	Annual	**6.07E-04**	0.76%
2-Nitrophenol	88-75-5	5.66E-05	2.48E-04	7.13E-06	**0.1**		Annual	**1.50E-06**	0.002%
4-Nitrophenol	100-02-7	2.59E-05	1.14E-04	3.27E-06	**0.1**		Annual	**6.89E-07**	0.001%
Pentachlorobiphenyl		2.83E-07	1.24E-06	3.56E-08	**0.1**		Annual	**7.51E-09**	0.000%
Pentachlorophenol	87-86-5	1.20E-05	5.27E-05	1.51E-06	100		24 hour	**2.41E-06**	0.000%
Pentachlorophenol	87-86-5	1.20E-05	5.27E-05	1.51E-06		0.03	Annual	**3.19E-07**	0.001%
Perylene	198-55-0	1.23E-07	5.37E-07	1.54E-08	**0.1**		Annual	**3.26E-09**	0.000%
Phenol	108-95-2	1.20E-02	5.27E-02	1.51E-03	600		1 hour	**2.39E-02**	0.004%
Propionaldehyde	123-38-6	1.44E-02	6.30E-02	1.81E-03	4		Annual	**3.82E-04**	0.010%
Propanal	123-38-6	7.54E-04	3.30E-03	9.51E-05	4		Annual	**2.00E-05**	0.001%
Styrene	100-42-5	4.48E-01	1.96E+00	5.64E-02	1000		24 hour	**8.97E-02**	0.009%
Styrene	100-42-5	4.48E-01	1.96E+00	5.64E-02		1.7	Annual	**1.19E-02**	0.70%
Tetrachlorobiphenyl		5.89E-07	2.58E-06	7.43E-08	**0.1**		Annual	**1.57E-08**	0.000%
Tetrachloroethylene	127-18-4	8.96E-03	3.92E-02	1.13E-03	**0.1**		Annual	**2.38E-04**	0.24%
Toluene	108-88-3	2.17E-01	9.50E-01	2.73E-02	5000		24 hour	**4.34E-02**	0.001%
o-Tolualdehyde	529-20-4	1.70E-03	7.43E-03	2.14E-04	440		24 hour	**3.40E-04**	0.000%
p-Tolualdehyde	104-87-0	2.59E-03	1.14E-02	3.27E-04	**0.1**		Annual	**6.89E-05**	0.069%
Trichlorobiphenyl		6.13E-07	2.68E-06	7.72E-08	**0.1**		Annual	**1.63E-08**	0.000%
Trichlorofluoromethane	75-69-4	9.67E-03	4.23E-02	1.22E-03	56200		1 hour	**1.92E-02**	0.000%
Trichloroethene	79-01-6	7.07E-03	3.10E-02	8.91E-04		0.6	Annual	**1.88E-04**	0.031%
1,1,1-Trichloroethane	71-55-6	7.31E-03	3.20E-02	9.21E-04	1000		24 hour	**1.46E-03**	0.000%
2,4,6-Trichlorophenol	88-06-2	5.19E-06	2.27E-05	6.53E-07		0.3	Annual	**1.38E-07**	0.000%
Vinyl acetate	108-05-4	9.51E-04	4.17E-03	1.20E-04	200		24 hour	**1.90E-04**	0.000%
Vinyl Chloride	75-01-4	4.24E-03	1.86E-02	5.35E-04	100		24 hour	**8.50E-04**	0.001%
Vinyl Chloride	75-01-4	4.24E-03	1.86E-02	5.35E-04		0.11	Annual	**1.13E-04**	0.10%
Xylenes	1330-20-7	4.63E-04	2.03E-03	5.83E-05	100		24 hour	**9.27E-05**	0.000%
o-Xylene	95-47-6	5.89E-03	2.58E-02	7.43E-04	100		24 hour	**1.18E-03**	0.001%
Polynuclear Aromatic Hydrocarbons (PAH)									
Acenaphthene	83-32-9	2.15E-04	9.40E-04	2.70E-05	210		24 hour	**4.30E-05**	0.000%
Acenaphthylene	208-96-8	1.18E-03	5.16E-03	1.49E-04	35		24 hour	**2.36E-04**	0.001%
Acetone	67-64-1	4.48E-02	1.96E-01	5.64E-03	5900		8 hour	**1.53E-02**	0.000%
Anthracene	120-12-7	7.07E-04	3.10E-03	8.91E-05	1000		24 hour	**1.42E-04**	0.000%
Benzaldehyde	100-52-7	2.00E-04	8.78E-04	2.52E-05		0.4	Annual	**5.32E-06**	0.001%
Benzo(a)anthracene	56-55-3	1.53E-05	6.71E-05	1.93E-06	**0.1**		Annual	**4.07E-07**	0.000%
Benzo(a)pyrene	50-32-8	6.13E-04	2.68E-03	7.72E-05		0.0005	Annual	**1.63E-05**	3.26%
Benzo(e)pyrene	192-97-2	6.13E-07	2.68E-06	7.72E-08	**0.1**		Annual	**1.63E-08**	0.000%
Benzo(b)fluoranthene	205-99-2	2.36E-05	1.03E-04	2.97E-06	**0.1**		Annual	**6.26E-07**	0.001%
Benzo(j,k)fluoranthene		3.77E-05	1.65E-04	4.75E-06	**0.1**		Annual	**1.00E-06**	0.001%
Benzo(k)fluoranthene	205-82-3	8.49E-06	3.72E-05	1.07E-06	**0.1**		Annual	**2.25E-07**	0.000%
Benzo(b,j,k)fluoranthene		2.36E-05	1.03E-04	2.97E-06	**0.1**		Annual	**6.26E-07**	0.001%
Benzo(g,h,i)perylene	191-24-2	2.19E-05	9.60E-05	2.76E-06	12		24 hour	**4.39E-06**	0.000%
Chrysene	218-01-9	8.96E-06	3.92E-05	1.13E-06	**0.1**		Annual	**2.38E-07**	0.000%
Crotonaldehyde	4170-30-3	2.33E-03	1.02E-02	2.94E-04	9		1 hour	**4.64E-03**	0.052%
Decachlorobiphenyl	2051-24-3	6.37E-08	2.79E-07	8.02E-09	**0.1**		Annual	**1.69E-09**	0.000%
Dibenzo(a,h)anthracene	53-70-3	2.15E-06	9.40E-06	2.70E-07	**0.1**		Annual	**5.70E-08**	0.000%
1,2-Dibromoethene	540-49-8	1.30E-02	5.68E-02	1.63E-03	**0.1**		Annual	**3.44E-04**	0.34%
Dichlorobiphenyl		1.74E-07	7.64E-07	2.20E-08	**0.1**		Annual	**4.63E-09**	0.000%
1,2-Dichloroethane	107-06-2	6.84E-03	2.99E-02	8.61E-04		0.04	Annual	**1.82E-04**	0.45%
1,2-Dichloropropane	78-87-5	7.78E-03	3.41E-02	9.80E-04	4		24 hour	**1.56E-03**	0.039%
7,12-Dimethylbenz(a)anthracene		3.34E-06	1.46E-05	4.20E-07	**0.1**		Annual	**8.86E-08**	0.000%
Fluoranthene	206-44-0	3.77E-04	1.65E-03	4.75E-05	140		24 hour	**7.55E-05**	0.000%
Fluorene	86-73-7	8.02E-04	3.51E-03	1.01E-04	140		24 hour	**1.60E-04**	0.000%
Indeno(1,2,3,c,d)pyrene	193-39-5	2.05E-05	8.98E-05	2.58E-06	**0.1**		Annual	**5.45E-07**	0.001%
Phenanthrene	85-01-8	1.65E-03	7.23E-03	2.08E-04	0.1		Annual	**4.36E-05**	0.044%
Pyrene	129-00-0	8.72E-04	3.82E-03	1.10E-04	100		24 hour	**1.75E-04**	0.000%
5-Methyl chrysene	3697-24-3	2.75E-07	1.21E-06	3.47E-08	**0.1**		Annual	**7.31E-09**	0.000%

Note: An ITSL of 0.1 that is red bolded is a default screening level per AQD air toxics policy