Clean Fuels Exemptions from the Air Toxics Rules

Technical Support Document
for the
Air Toxics Workgroup

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Table of Contents **Page**

Procedure for Obtaining Emission Factors (EFs)…… **2**

Ambient Air Impact Calculations Using Emission Factors…….. 3

Diesel Emission Factor Results…….. 4

Wood Boiler Emission Factor Results……. 6

Biodiesel Boiler Emission Factor Results……. 6

Natural Gas Emission Factor Results: ……. 7

Examples of Permits with Diesel, Wood and Natural Gas……. 8

Procedure for Obtaining Emission Factors

Two Processes were used to obtain EFs.

1) For Natural Gas, Diesel, and Wood/Bark, EFs were obtained from EPA's WebFIRE (Factor Information Retrieval System) http://www.epa.gov/ttn/chief/webfire/index.html

2) For Biodiesel, data in MS-Excel spreadsheet format were e-mailed (3/28/2013 2:34 PM) to MDEQ-AQD (Depa, Michael) as attachments from C.A. (Andy) Miller Miller.Andy@epa.gov. Associate Director for Climate, Air, Climate, and Energy Research Program, US EPA Office of Research and Development, Los Angeles, CA, 213-244-1809.

Detailed Procedure for Obtaining EF from WebFIRE for Each Fuel Type

(1) NATURAL GAS:

a. Go to "Detailed Search" select "External Combustion Boilers," "Uncontrolled", and "1.4 Natural Gas Combustion"
b. Go to "Detailed Search" select "Internal Combustion Engines," "Uncontrolled", and "3.1 Stationary Gas Turbines"
c. Go to "Detailed Search" select "Internal Combustion Engines," "Uncontrolled", and "3.2 Natural Gas-fired Reciprocating Engines"
d. Combine tables a., b. and c.
e. Delete EF records for coal, waste oil, diesel, residential furnaces, digester gas, landfill gas, distillate oil, etc., and EF records for criteria pollutants and non-TACs (e.g., methane, ethane, propane, zinc, total organics and VOC, etc.)

(2) DIESEL (including "dual-fuel engines"):

a. Go to "Detailed Search", select "External Combustion Boilers," "Uncontrolled", and "1.3 Fuel Oil Combustion"
b. Start another Detailed Search and select "Internal Combustion Engines", "Uncontrolled", and "3.3 Gasoline and Industrial Engines"
c. Start another Detailed Search and select "Internal Combustion Engines", "Uncontrolled", and "3.4 Large Stationary Diesel and All Stationary Dual-fuel Engines"
d. Combine tables a., b. and c.
e. Delete EF records that have criteria pollutants and notes with "Lack of supporting documentation." Delete records for wood, kerosene, naphtha, landfill gas, natural gas, residual oil. Delete records based on Level 3 entries that equal: digester gas, kerosene, naphtha, landfill gas, natural gas, residual and crude oil, etc.

(3) WOOD, BARK, WOOD-BARK

a. Go to "Detailed Search", select "External Combustion Boilers," "Uncontrolled" and "1.6 Wood Residue Combustion in Boilers."
b. Delete EF records for open burning, residential, criteria pollutants and non-TACs

(4) BIODIESEL

a. Obtained 4 spreadsheets via email from US EPA author C. Andrew Miller. EFs originally published in EPA 2008 report *Characterizing Emissions from the Combustion of Biofuels* (EPA/600/R-08/069).
b. The 4 spreadsheets contained data for PAHs, PCBs, VOCs and Carbonyls-Aldehydes.

Ambient Air Impact Calculations Using Emission Factors

All emission factors (EFs) were obtained from US EPA.

Typical calculation for ambient impact.

	Impact(µg/m^3) with **Avg. Time**	=	**EF** (lbs/mmbtu)	x	**Burn Rate** (mmbtu/hr)	x	**DF** (µg/m^3 per mmbtu/hr)
Notes:	(1)		(2)		(3)		(4)

Notes:

(1) Ambient air concentration at 150 feet from stack. Avg. Time = Averaging time; specific for each screening level

(2) Emission Factor (EF) for specific toxic air contaminant

(3) Burn Rate for fuel, i.e., heat generated per hour. Assumes that higher burn rates are associated with larger industrial processes.

(4) DF=Dispersion Factor at an averaging time. Each toxic air contaminant has a screening level with an averaging time associated with it. Based on EPA's AERSCREEN[1].

Calculation of "PASS/FAIL"

If ambient impact is below the screening level then PASS
If ambient impact is above the screening level then FAIL

The magnitude of ambient air impact above or below screening level was calculated as follows:

$$\text{Ratio} = \frac{\text{Ambient Impact } (\mu g/m^3) \text{ at Avg. Time}}{\text{Screening Level } (\mu g/m^3) \text{ at Avg. Time}}$$

Screening Levels: The health based screening level for non-carcinogenic effects of a toxic air contaminant is called the Initial Threshold Screening Level (ITSL). It is determined by a number of different methods, depending upon the available toxicological data. The rules specify a hierarchy of methods for determining the ITSL. There are two health based screening levels for carcinogenic effects. These include the Initial Risk Screening Level (IRSL), which is defined as an increased cancer risk of one in one million (10^{-6}), and the Secondary Risk Screening Level (SRSL), which is defined as an increased cancer risk of one in one hundred thousand (10^{-5}). The IRSL applies only to the new or modified source subject to the permit application. If an air permit applicant cannot demonstrate that the emissions of the toxic air contaminant (TAC) meet the IRSL, they may choose to demonstrate compliance with the SRSL, however in this case they must include all sources of that TAC emitted from the plant, not just the emission unit being permitted.

[1] AERSCREEN is the recommended screening model based on AERMOD. The model will produce estimates of "worst-case" 1-hour concentrations for a single source, without the need for hourly meteorological data, and also includes conversion factors to estimate "worst-case" 3-hour, 8-hour, 24-hour, and annual concentrations.
http://www.epa.gov/scram001/dispersion_screening.htm

DIESEL EMISSION FACTOR RESULTS

AP42 Section 1.3, 3.2, 3.3 and 3.4 generated most of the EF records for TACs from burning diesel in engines or boilers. An additional 28 records were found in WebFIRE which did not reference an AP42 section number. These records were found doing a general search in WebFIRE for "Diesel", "Internal Combustion Engines" and "Uncontrolled". Eighteen of 28 of these records were for "reciprocating: cogeneration" (n=11) or "Dual Fuel (Oil/Gas)" (n=7). Of the 28 EFs from this data set, 22 had the highest EF for a particular TAC. Cogeneration and dual-fuel processes produced EFs for three TACs that resulted in impacts above screening levels: acetaldehyde, benzene and formaldehyde, with individual cancer risks of 1.1, 4.7 and 3.0 per million, respectively.

Table 1. Diesel EF Conversion Factors

Unit	Convert to MMBTUs
IF MMBTUs	-
IF Gallons	Multiply by 7.14
IF 1000 Gallons	Multiply by 0.00714
IF Kiloliters	Multiply by 0.06

=IF(L12="Million Btus",J12,IF(L12="Gallons",J12*7.14,IF(L12="1000 Gallons",J12*0.00714,IF(L12="Kiloliters",J12*0.06,"?"))))

1 L = 0.26417 Gallons
1000 L = 264.17 Gallons

EF for Diesel (e.g., contained "diesel", and fuel/distillate that was "No. 2", or "#2")
Deleted Factors that were…

Criteria pollutants: PM, Nitrogen Oxides (NOx), Sulfur Oxides (SOx), Lead, and Carbon Monoxide (CO)

Other Non-TAC pollutants: Carbon dioxide (CO_2), Volatile organic compounds (VOC), methane, zinc, Total Organic Carbon, PAH (unspeciated), POM (polycyclic organic matter), Total non-methane organic compounds (TNMOC).

Deleted Factors that contained…

"Lack of Supporting Documentation."

Pollution control measures (e.g., water sprays) or devices (e.g., fabric filters)

Subsequent to the creation of the report "Clean Fuels Discussion" Draft2 dated 4/10/2013, a higher EF was found in WebFIRE for formaldehyde. The worst case formaldehyde EF should be 1.18E-3, not 4.7E-4 lb/mmbtu. If the worst case EF of 1.18E-3 was used, the ambient air impact would be 0.6 µg/m³ (annual) and be 750% higher than IRSL of 0.08 µg/m³, although it is below the SRSL of 0.8 µg/m³. The higher EF of 1.18E-3 is from AP42 Section 3.3 with EF ID as 11601. This is for reciprocating internal combustion engines (RICE).

As to how a higher formaldehyde EF for diesel was missed in the initial WebFIRE query, it is not known for sure. However, the higher EF for formaldehyde is not in AP42 Sections 1.3, 3.1, 3.3 or 3.4 (Fuel Oil Combustion, Stationary Gas Turbines, Gasoline and Diesel Industrial Engines, and Large Stationary Diesel and All Stationary Dual-fuel Engines, respectively) so it does not show up when querying these sections individually, which is probably how it was missed.

Multiple EFs were found for specific TACs for the same type of unit (engine or boiler) and fuel. Therefore, Table 2 has a column title “high and low” to help convey the ranges of EFs for each unit type and TAC.

Table 2. Range of Diesel EFs for TACs that had impacts Greater than SL (Highest was selected for Impact Analysis)

Pollutant	Level 1	Level 3 & 4	EF (lb/mmbtu)	Quality	High and Low	AP42	Factor ID
Acetaldehyde	Engine	Reciprocating	1.07E-3	E	highest	3.3	11582
Acetaldehyde	Engine	Large Bore Engine	2.5E-5	E	lowest (of 3)	3.4	12140
Acrolein	Engine	Reciprocating	9.3E-5*	E	highest	3.3	11583
Acrolein	Engine	Large Bore Engine	7.9E-6	E	lowest (of 3)	3.4	12141
Arsenic	Engine	Turbine	1.1E-5*	D	highest	3.1	11328
Arsenic	Boiler		4.E-6	E	lowest (of 7)	1.3	9709
Benzene	Engine	Reciprocating	9.3E-4	E	highest	3.3	11588
Benzene	Engine	Turbine	5.5E-5	C	lowest (of 7)	3.1	12304
Beryllium	Boiler		3.E-6	E	highest	1.3	2218
Beryllium	Engine	Turbine	3.1E-7*	D	lowest (of 7)	3.1	12305
Cadmium	Engine	Turbine	4.8E-6	D	highest	3.1	11339
Cadmium	Boiler		3.E-6	E	lowest (of 7)	1.3	7922
Chromium VI**	Engine	Turbine	1.1E-6	D	highest	3.1	11348
Chromium VI**	Boiler		3.E-7	E	lowest (of 7)	1.3	7926
Formaldehyde	Engine		1.2E-3***	E	highest	3.3	11601
Formaldehyde	Engine	Large Bore Engine	7.9E-5	E	lowest (of 10)	3.4	12158
Manganese	Engine	Turbine	7.9E-4	D	highest	3.1	11359
Manganese	Boiler		6.E-6	E	lowest (of 7)	1.3	9713

* listed as “<” in the WebFIRE database

** Chromium VI was estimated as 10% of Chromium. WebFIRE listed the EF for Chromium, then: $EF_{CrVI} = EF_{Cr}*0.1$

***A lower EF of 4.7E-4 lb/mmbtu was used previously in Clean Fuels Discussion, Draft2 (April 10, 2013) which was for Reciprocating ICE (actually converted from pounds formaldehyde per 1000 gallons with the emission factor of 0.00714 Million BTUs per 1000 gallons).

WOOD BOILER EMISSION FACTOR RESULTS

There were 110 TACs that had EFs. There were eight EFs per chemical for a total of 880 EFs. WebFIRE listed eight EFs per TAC because each TAC had EFs for eight different types of wood, wood/bark and various moisture content. Each EF for each TAC was the same. The eight different types of wood are shown here:

	LEVEL4
1	Bark-fired Boiler
2	Wood/Bark Fired Boiler
3	Wood-fired Boiler - Wet Wood (>=20% moisture)
4	Wood-fired Boiler - Dry Wood (<20% moisture)
5	Bark-fired Boiler
6	Wood/Bark-fired Boiler
7	Wood-fired Boiler - Wet Wood (>=20% moisture)
8	Wood-fired Boiler - Dry Wood (<20% moisture)

BIODIESEL BOILER EMISSION FACTOR RESULTS

Recall that EFs for biodiesel were obtained via email from an EPA sponsored study by Andy Miller. The author presented data for all three individual trials as well as the average and standard deviation. The averages of 3 boiler trials were used for the EFs in order to calculate ambient air impacts. The average was chosen for assessing impacts of biodiesel instead of the highest EF because this dataset is from a single study and for a single process and the average is thought to better represent the emission rates for this size and type of boiler. Animal biodiesel EFs and soy biodiesel EFs were kept separate. PAH, Aldehyde, VOC and PCB EFs were available, however, PCB EF were not included in analysis of impacts. High field blank values during the PCB analysis and contamination from previous boiler usage were cited as factors. The author stated, “It is not believed that these values are representative of PCB emissions from No. 2 fuel oil or biofuels in general.” (EPA, 2008)

NATURAL GAS EMISSION FACTOR RESULTS:

The EF for benzo (g, h, i) pyrene for tangentially fired boilers (AP42 Section 1.4) for electrical generation was about a million times (1E6x) higher than other benzo (g,h,i) pyrene EFs for boilers of other types and all other PAHs for boilers, including tangentially fired boilers. Based on these observations it was concluded that this emission factor was erroneous and therefore not included in the impact analysis.

Unit conversion: One (1) standard cubic foot of natural gas yields approximately 1000 Btu.

The following table provides the natural gas emission factors for five TACs where the highest EF resulted in ambient air impacts above a screening level.

Natural Gas Emission Factors for Five TACs

Name	EF (lb/mmbtu)	Rank	LEVEL2	LEVEL4	QUAL	AP42 SECT	EF ID
1,1,2,2-TCEthane*	6.6E-5	1	Industr.	2-cycle Lean Burn	C	3.2	11978
1,1,2,2-TCEthane*	4.0E-5	2	Industr.	4-cycle Lean Burn	E	3.2	12116
1,1,2,2-TCEthane*	2.5E-5	3	Industr.	4-cycle Rich Burn	C	3.2	12039
1,3-butadiene	8.2E-4	1	Industrial	2-cycle Lean Burn	D	3.2	11908
1,3-butadiene	6.6E-4	2	Industr.	4-cycle Rich Burn	D	3.2	11996
1,3-butadiene	2.7E-4	3	Industr.	4-cycle Lean Burn	D	3.2	12061
1,3-butadiene	4.3E-7	4	Industr.	Turbine	D	3.1	11773
1,3-butadiene	4.3E-7	5	Electr. Gen.	Turbine	D	3.1	11426
1,3-butadiene	4.3E-7	6	Commerc./ Inst.	Turbine: Co-gen.	D	3.1	12413
1,3-butadiene	4.3E-7	7	Commerc./ Inst.	Turbine	D	3.1	12373
1,3-butadiene	4.3E-7	8	Industr.	Turbine: Co-gen.	D	3.1	11834
Acetaldehyde	8.4E-3	1	Industr.	4-cycle Lean Burn	A	3.2	12051
Acetaldehyde	7.8E-3	2	Industr.	2-cycle Lean Burn	A	3.2	11894
Acetaldehyde	2.8E-3	3	Industr.	4-cycle Rich Burn	C	3.2	8804
Acetaldehyde	4.0E-5	4	Commerc./ Inst.	Turbine	C	3.1	12367
Acetaldehyde	4.0E-5	5	Industr.	Turbine	C	3.1	11763
Acetaldehyde	4.0E-5	6	Industr.	Turbine: Co-gen.	C	3.1	11647
Acetaldehyde	4.0E-5	7	Electr. Gen.	Turbine	C	3.1	11419
Acetaldehyde	4.0E-5	8	Commerc./ Inst.	Turbine: Co-gen.	C	3.1	12407
Acrolein	7.8E-3	1	Industr.	2-cycle Lean Burn	A	3.2	11895
Acrolein	5.1E-3	2	Industr.	4-cycle Lean Burn	A	3.2	12052
Acrolein	2.6E-3	3	Industr.	4-cycle Rich Burn	C	3.2	8806
Acrolein	6.4E-6	4	Industr.	Turbine: Co-gen.	C	3.1	11648
Acrolein	6.4E-6	5	Commerc./ Inst.	Turbine: Co-gen.	C	3.1	12408
Acrolein	6.4E-6	6	Industr.	Turbine	C	3.1	11766
Acrolein	6.4E-6	7	Commerc./ Inst.	Turbine	C	3.1	12368
Acrolein	6.4E-6	8	Electr. Gen.	Turbine	C	3.1	11420
Ethylene dibromide	7.3E-5	1	Industr.	2-cycle Lean Burn	C	3.2	11930
Ethylene dibromide	4.4E-5	2	Industr.	4-cycle Lean Burn	E	3.2	12080
Ethylene dibromide	2.1E-5	3	Industr.	4-cycle Rich Burn	E	3.2	12011

* 1,1,2,2-Tetrachloroethane

Examples of Permits with Diesel, Wood and Natural Gas

Note: In several of the following tables the list of TACs was truncated to include only top 33 TAC SLs resulting in the highest "% of screening level", in order to fit to 1 page. In these cases, the total numbers of TACs with non-null EF is indicated in the lower left corner.

Natural Gas Example 1

Permit #:			**27-12 (Mead Johnson & Co, LLC)**			
Summary:			Natural Gas fired boiler			
Emission source:			BOILER			
Fuel Type:			Natural Gas			
Equipment Capacity (MMBtu/hr):			97	MEDIUM		
Stack Height (feet):			42.2			
Building Height (feet):						
Distance to closest boundary:						
Emission Factor Source:			AP-42			
	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/mmbtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Benzene		0.1		9.30E-04	0.93000%	1
Benzo(a)pyrene (PAH)		0.0005	1.20E-06	5.30E-07	0.10600%	2
Benzene	30			1.00E-02	0.03333%	3
Acenaphthylene	35		1.80E-06	8.80E-06	0.00003%	4
Anthracene	1000		2.40E-06	1.20E-05	0.00000%	5

Natural Gas Example 2

Permit #:		**149-10 (Lansing Brd Water & Light)**
Summary:		Nat. Gas Auxiliary Boiler
Emission source:		BOILER
Fuel Type:		Natural Gas
Equipment Capacity (MMBtu/hr):		245 LARGE
Stack Height (feet):		120
Building Height (feet):		
Distance to closest boundary:		
Emission Factor Source:		AP-42 Sections 1.4 and 3.1 (worse-case).

	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/mmbtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Formaldehyde		0.08	0.00071	5.79E-02	72.40669%	1
PAHs		0.0005	0.0000022	0.0001795	35.89740%	2
Cadmium		0.0006	1.078E-06	8.80E-05	14.66397%	3
Chrom6 (assumes 1/11th Cr is IV)		0.000083	1.373E-06	1.02E-05	12.26500%	4
Arsenic		0.0002	1.961E-07	1.60E-05	7.99853%	5
Nickel		0.0042	2.059E-06	1.68E-04	3.99926%	6
Acrolein	0.02		0.0000064	5.22E-04	2.61072%	7
Propylene oxide		0.3	0.000058	4.73E-03	1.57731%	8
Chrom6 (assumes 1/11th Cr is IV)	0.008		1.373E-06	8.59E-05	1.07379%	9
Benzene		0.1	0.000012	9.79E-04	0.97902%	10
Vanadium	0.5		2.255E-06	2.86E-03	0.57123%	11
Acetaldehyde	9		0.00004	2.75E-02	0.30598%	12
7,12-dimethylbenz(a)anthracene		0.0005	1.569E-08	1.28E-06	0.25595%	13
Beryllium		0.0004	1.176E-08	9.60E-07	0.23996%	14
1,3-butadiene		0.03	8.6E-07	7.02E-05	0.23388%	15
Lead	0.15		4.9E-07	3.37E-04	0.22489%	16
Hexane	700		0.0017647	1.21E+00	0.17356%	17
Acrolein	5		0.0000064	8.11E-03	0.16213%	18
Propylene oxide	30		0.000058	3.99E-02	0.13310%	19
Naphthalene		0.08	0.0000013	1.06E-04	0.13258%	20
Ethylbenzene		3	0.000032	2.61E-03	0.08702%	21
Barium	5		4.314E-06	3.32E-03	0.06637%	22
Manganese	0.05		3.725E-07	3.04E-05	0.06079%	23
Mercury	0.3		2.549E-07	1.75E-04	0.05850%	24
Xylenes	100		0.000064	4.41E-02	0.04406%	25
Zinc (as zinc oxide)	50		2.843E-05	2.19E-02	0.04374%	26
Beryllium	0.02		1.176E-08	8.10E-06	0.04050%	27
Acetaldehyde	9		0.00004	3.26E-03	0.03626%	28
Copper	2		8.333E-07	6.41E-04	0.03205%	29
Cobalt	0.2		8.235E-08	6.34E-05	0.03168%	30
Naphthalene	3		0.0000013	8.95E-04	0.02983%	31
1,3-butadiene	2		8.6E-07	5.92E-04	0.02960%	32
3-Methylchloranthrene (PAH)	0.0005		1.765E-09	1.44E-07	0.02879%	33

Note: Truncated to fit to 1 page. The number of TACs that had non-null EFs = 61. (see note on page 8)

Natural Gas Example 3

Permit #:			**81-11 (WOLVERINE POWER SUPPLY)**			
Summary:			Turbine No.4 (NG) Emissions (lb/hr) - MMBtu/hr			
Emission source:			TURBINE			
Fuel Type:			Natural Gas			
Equipment Capacity (MMBtu/hr):			1117	LARGE		
Stack Height (feet):			140	(Bypass 111 ft)		
Building Height (feet):						
Distance to closest boundary:						
Emission Factor Source:			AP-42 Sections 1.4 and 3.1 (worse-case). adjusted for 4000 hr/yr limit			
	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/mmbtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Formaldehyde		0.08	7.10E-04	7.60E-04	0.95060%	1
PAHs		0.0005	2.20E-06	2.36E-06	0.47128%	2
Cadmium		0.0006	1.08E-06	1.16E-06	0.19252%	3
Chrom6 (assumes 1/11th Cr is IV)		0.000083	1.37E-06	1.34E-07	0.16102%	4
Arsenic		0.0002	1.96E-07	2.10E-07	0.10501%	5
Vanadium	0.5		2.25E-06	4.81E-04	0.09622%	6
Acrolein	0.02		6.40E-06	1.50E-05	0.07506%	7
Chrom6 (assumes 1/11th Cr is IV)	0.008		1.37E-06	4.61E-06	0.05767%	8
Nickel		0.0042	2.06E-06	2.21E-06	0.05250%	9
Acrolein	5		6.40E-06	1.37E-03	0.02731%	10
Propylene oxide		0.3	5.80E-05	6.21E-05	0.02071%	11
Acetaldehyde	9		4.00E-05	1.48E-03	0.01643%	12
Benzene		0.1	1.20E-05	1.29E-05	0.01285%	13
Lead	0.15		4.90E-07	1.81E-05	0.01208%	14
Manganese	0.05		3.73E-07	5.04E-06	0.01007%	15
Naphthalene		0.08	1.30E-06	8.02E-06	0.01003%	16
Hexane	700		1.76E-03	6.52E-02	0.00932%	17
Propylene oxide	30		5.80E-05	2.14E-03	0.00715%	18
Barium	5		4.31E-06	3.08E-04	0.00617%	19
Zinc (as zinc oxide)	50		2.84E-05	2.03E-03	0.00407%	20
Beryllium		0.0004	1.18E-08	1.26E-08	0.00315%	21
Mercury	0.3		2.55E-07	9.42E-06	0.00314%	22
1,3-butadiene		0.03	8.60E-07	9.21E-07	0.00307%	23
Copper	2		8.33E-07	5.96E-05	0.00298%	24
Cobalt	0.2		8.24E-08	5.89E-06	0.00294%	25
Xylenes	100		6.40E-05	2.37E-03	0.00237%	26
Beryllium	0.02		1.18E-08	4.35E-07	0.00217%	27
Chromium, total	5		1.37E-06	9.81E-05	0.00196%	28
Naphthalene	3		1.30E-06	4.81E-05	0.00160%	29
1,3-butadiene	2		8.60E-07	3.18E-05	0.00159%	30
Benzene	30		1.20E-05	4.44E-04	0.00148%	31
Ethylbenzene		3	3.20E-05	3.43E-05	0.00114%	32
Pentane	17700		2.55E-03	1.82E-01	0.00103%	33

Note: Truncated to fit to 1 page. The number of TACs that had non-null EFs = 53. (see note on page 8)

Natural Gas Example 4

Permit #:		**149-10 (Lansing Brd Water & Light)**
Summary:		2 Turbines (NG) Emissions (lb/hr) - MMBtu/hr
Emission source:		TURBINE
Fuel Type:		Natural Gas
Equipment Capacity (MMBtu/hr):		903.4 LARGE
Stack Height (feet):		160
Building Height (feet):		
Distance to closest boundary:		
Emission Factor Source:		AP-42 Sections 1.4 and 3.1 (worse-case).

TAC	ITSL (µg/m³)	IRSL (µg/m³)	EF (lb/mmbtu)	Impacts (µg/m³)	% of SL	Rank
	Screening Levels (SLs)					
Formaldehyde		0.08	7.10E-04	7.76E-03	9.70139%	1
PAHs		0.0005	2.20E-06	2.40E-05	4.80970%	2
Cadmium		0.0006	1.08E-06	1.18E-05	1.96475%	3
Chrom6 (assumes 1/11th Cr is IV)		0.000083	1.37E-06	1.36E-06	1.64332%	4
Arsenic		0.0002	1.96E-07	2.14E-06	1.07168%	5
Nickel		0.0042	2.06E-06	2.25E-05	0.53584%	6
Chrom6 (assumes 1/11th Cr is IV)	0.008		1.37E-06	3.13E-05	0.39171%	7
Vanadium	0.5		2.25E-06	1.96E-03	0.39112%	8
Acrolein	0.02		6.40E-06	7.00E-05	0.34980%	9
Propylene oxide		0.3	5.80E-05	6.34E-04	0.21134%	10
Benzene		0.1	1.20E-05	1.31E-04	0.13117%	11
Acetaldehyde	9		4.00E-05	1.00E-02	0.11162%	12
Acrolein	5		6.40E-06	5.55E-03	0.11101%	13
Lead	0.15		4.90E-07	1.23E-04	0.08204%	14
Hexane	700		0.0017647	4.43E-01	0.06331%	15
Barium	5		4.31E-06	2.92E-03	0.05846%	16
Propylene oxide	30		5.80E-05	1.46E-02	0.04855%	17
Zinc (as zinc oxide)	50		2.84E-05	1.93E-02	0.03853%	18
7,12-dimethylbenz(a)anthracene		0.0005	1.57E-08	1.71E-07	0.03429%	19
Beryllium		0.0004	1.18E-08	1.29E-07	0.03215%	20
1,3-butadiene		0.03	8.60E-07	9.40E-06	0.03134%	21
Copper	2		8.33E-07	5.65E-04	0.02823%	22
Cobalt	0.2		8.24E-08	5.58E-05	0.02790%	23
Mercury	0.3		2.55E-07	6.40E-05	0.02134%	24
Chromium, total	5		1.37E-06	9.30E-04	0.01860%	25
Naphthalene		0.08	1.30E-06	1.42E-05	0.01776%	26
Xylenes	100		6.40E-05	1.61E-02	0.01607%	27
Beryllium	0.02		1.18E-08	2.95E-06	0.01477%	28
Ethylbenzene		3	3.20E-05	3.50E-04	0.01166%	29
Naphthalene	3		1.30E-06	3.26E-04	0.01088%	30
1,3-butadiene	2		8.60E-07	2.16E-04	0.01080%	31
Benzene	30		1.20E-05	3.01E-03	0.01005%	32
Pentane	17700		0.002549	1.73E+00	0.00976%	33

Note: Truncated to fit to 1 page. The number of TACs that had non-null EFs = 61. (see note on page 8)

Natural Gas Example 5

Permit #:		**149-10 (Lansing Brd Water & Light)**
Summary:		Nat. Gas Engine
Emission source:		ENGINE
Fuel Type:		Natural Gas
Equipment Capacity (MMBtu/hr):		11.3 SMALL
Stack Height (feet):		120
Building Height (feet):		
Distance to closest boundary:		
Emission Factor Source:		AP-42 3.2 (worse-case). adjusted for 500 hr/yr operation

	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/mmbtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Acrolein	5		5.14E-03	6.51E-01	13.01037%	1
PAHs		0.0005	1.41E-04	5.76E-05	11.51323%	2
Acrolein	0.02		5.14E-03	2.10E-03	10.49255%	3
Formaldehyde		0.08	5.28E-02	4.31E-03	5.38917%	4
Acetaldehyde	9		8.36E-03	3.91E-01	4.34973%	5
1,3-butadiene	2		6.63E-04	3.10E-02	1.55232%	6
1,3-butadiene		0.03	6.63E-04	2.71E-04	0.90228%	7
Benzene		0.1	1.58E-03	6.45E-04	0.64507%	8
Benzene	30		1.58E-03	7.40E-02	0.24662%	9
Naphthalene	3		9.71E-05	4.55E-03	0.15156%	10
Biphenyl	15		2.12E-04	1.41E-02	0.09367%	11
1,1,2,2-Tetrachloroethane		0.02	4.00E-05	1.63E-05	0.08165%	12
Naphthalene		0.08	9.71E-05	3.96E-05	0.04955%	13
Acetaldehyde	9		8.36E-03	3.41E-03	0.03792%	14
1,2-Dichloropropane	4		2.69E-05	1.26E-03	0.03149%	15
1,2-Dichloroethane		0.04	2.36E-05	9.64E-06	0.02409%	16
Ethylene Dibromide	9		4.43E-05	2.07E-03	0.02305%	17
1,1,2-Trichloroethane		0.06	3.18E-05	1.30E-05	0.02164%	18
Methanol	3250		3.06E-03	3.87E-01	0.01192%	19
Xylenes	100		1.95E-04	9.13E-03	0.00913%	20
Hexane	700		0.00111	5.20E-02	0.00743%	21
1,3-Dichloropropene	20		2.64E-05	1.24E-03	0.00618%	22
Phenanthrene	0.1		1.04E-05	4.25E-06	0.00425%	23
Isobutyraldehyde	160		1.01E-04	4.73E-03	0.00296%	24
Chloroform	0	0.4	2.85E-05	1.16E-05	0.00291%	25
Chlorobenzene	70		3.04E-05	1.42E-03	0.00203%	26
Carbon tetrachloride	100		3.67E-05	1.72E-03	0.00172%	27
Pentane	17700		0.003	1.99E-01	0.00112%	28
Nonane	550		1.10E-04	5.15E-03	0.00094%	29
Methylene Chloride	0	2	4.12E-05	1.68E-05	0.00084%	30
Acenaphthylene	35		5.53E-06	2.59E-04	0.00074%	31
Chrysene		0.04	6.93E-07	2.83E-07	0.00071%	32
Vinyl Chloride	100		1.49E-05	6.98E-04	0.00070%	33

Note: Truncated to fit to 1 page. The number of TACs that had non-null EFs = 59. (see note on page 8)

Diesel Example 1

Permit #:			**41-11 (Health Alliance Plan)**			
Summary:			RICE distillate oil fired emergency generator.			
Emission source:			ENGINE			
Fuel Type:			Diesel			
Equipment Capacity (MMBtu/hr):			10.8	SMALL		
Stack Height (feet):			16.5			
Building Height (feet):						
Distance to closest boundary:			Only ~10 ft (from drawing)			
Emission Factor Source:			AP-42			
	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/MMBtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Benzene		0.1			25.34%	1
Formaldehyde		0.08	7.89E-05		3.22%	2
Phenanthrene	0.1		4.08E-05		1.33%	3
Acrolein	0.02		7.89E-06		1.29%	4
Napthalene		0.08	1.30E-04		0.68%	5
Benzene	30		7.76E-04		0.40%	6
Acrolein	0.5		7.89E-06		0.37%	7
Acetaldehyde		0.5			0.16%	8
Acetaldehyde	9		2.52E-05		0.04%	9
Xylenes	100		1.93E-04		0.03%	10
Acenaphthylene	35		9.23E-06		0%	11
Anthracene	1000		1.23E-06		0%	11
Benzo(g,h,l)perylene	12		5.56E-07		0%	11
Fluoranthene	140		4.03E-06		0%	11
Fluorene	140		1.28E-05		0%	11
Pyrene	100		3.71E-06		0%	11
Toluene	5000		2.81E-04		0%	11

Diesel Example 2

Permit #:		**81-11 (WOLVERINE POWER SUPPLY)**
Summary:		No.2 Fuel Oil engine
Emission source:		ENGINE
Fuel Type:		Diesel
Equipment Capacity (MMBtu/hr):		4.38 SMALL
Stack Height (feet):		20
Building Height (feet):		
Distance to closest boundary:		
Emission Factor Source:		AP-42 Emission Factors from Section 3.4 (Tables 3.4-3 & 3.4-4, worse-case) Annual emission impacts adjusted for 100 hr/yr operation

	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/MMBtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Napthalene		0.08	1.30E-04	2.01E-02	25.18172%	1
PAHs (weighted as BaP)		0.0005	2.12E-04	5.97E-05	11.93560%	2
Acrolein	0.5		7.88E-06	2.62E-03	0.52365%	3
Benzene	30		7.76E-04	1.20E-01	0.40084%	4
Benzene		0.1	7.76E-04	2.18E-04	0.21844%	5
Chrysene		0.0005	1.53E-06	4.31E-07	0.08614%	6
Acetaldehyde	9		2.52E-05	3.91E-03	0.04339%	7
Xylenes	100		1.93E-04	2.99E-02	0.02991%	8
Propylene	1500		2.79E-03	4.32E-01	0.02882%	9
Formaldehyde		0.08	7.89E-05	2.22E-05	0.02776%	10
Phenanthrene	0.1		4.08E-05	1.15E-05	0.01149%	11
Acrolein	0.02		7.88E-06	2.22E-06	0.01109%	12
Acenaphthylene	35		9.23E-06	1.43E-03	0.00409%	13
Acetaldehyde		0.5	2.52E-05	7.09E-06	0.00142%	14
Naphthalene	3		1.30E-04	3.66E-05	0.00122%	15
Toluene	5000		2.81E-04	4.35E-02	0.00087%	16
Pyrene	100		3.71E-06	5.75E-04	0.00057%	17
Acenaphthene	210		4.68E-06	7.25E-04	0.00035%	18
Anthracene	1000		1.23E-06	1.91E-04	0.00002%	19

Diesel Example 3

Permit #:			**50-12 COMFORT RESEARCH**			
Summary:			Diesel Engine			
Emission source:			ENGINE			
Fuel Type:			Diesel Engine			
Equipment Capacity (MMBtu/hr):			9.85	SMALL		
Stack Height (feet):			19.5			
Building Height (feet):			13			
Distance to closest boundary:			~125			
Emission Factor Source:			AP-42 3.3, 3.4			
	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/MMBtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Benzene		0.1	9.42E-04	3.76E-02	37.56416%	1
PAHs (weighted as BaP)		0.0005	0.00E+00	1.32E-04	26.49816%	2
Formaldehyde		0.08	4.84E-04	1.93E-02	24.13279%	3
Napthalene		0.08	9.42E-05	1.88E-02	23.50078%	4
Acrolein	0.02		9.25E-05	3.69E-03	18.45084%	5
Acrolein	0.5		9.25E-05	4.62E-02	9.23362%	6
Acetaldehyde		0.5	7.67E-04	3.06E-02	6.11970%	7
1,3 Butadiene		0.03	3.91E-05	1.56E-03	5.19948%	8
Formaldehyde	9		4.84E-04	1.69E-01	1.87872%	9
Acetaldehyde	9		7.67E-04	1.53E-01	1.70159%	10
Phenanthrene	0.1		4.08E-05	1.63E-03	1.62766%	11
Chrysene		0.0005	8.76E-08	3.49E-06	0.69887%	12
Benzene	30		9.42E-04	1.88E-01	0.62669%	13
1,3 Butadiene	2		3.91E-05	7.81E-03	0.39035%	14
Naphthalene	3		9.42E-05	3.76E-03	0.12521%	15
Benzene	30		9.42E-04	3.76E-02	0.12521%	16
Propylene	1500		2.79E-03	5.57E-01	0.03714%	17
Xylenes	100		4.99E-05	9.97E-03	0.00997%	18
Acenaphthylene	35		9.23E-06	1.84E-03	0.00527%	19
Fluorene	140		0.0000292	5.83E-03	0.00416%	20
Toluene	5000		2.82E-04	5.63E-02	0.00113%	21
Pyrene	100		4.78E-06	9.54E-04	0.00095%	22
Ethylbenzene	1000		2.24E-05	4.47E-03	0.00045%	23
Acenaphthene	210		4.68E-06	9.34E-04	0.00044%	24
Fluoranthene	140		9.56E-07	1.91E-04	0.00014%	25
Anthracene	1000		1.87E-06	3.73E-04	0.00004%	26
Benz(a)anthracene			1.11E-08	-------		
Benzo(a)pyrene			4.29E-07	-------		
Benzo(b)fluoranthene			1.11E-06	-------		
Benzo(k)fluoranthene			2.18E-07	-------		
Dibenzo(a,h)anthracene			5.83E-07	-------		
Indeno(1,2,c,d)pyrene			4.14E-07	-------		

Diesel Example 4

Permit #:		**38-09 ST MARYS CEMENT, INC**
Summary:		Four diesel-fired emergency generators
Emission source:		ENGINE
Fuel Type:		Diesel Engine
Equipment Capacity (MMBtu/hr):		76 MEDIUM (total for 4 engines)
Stack Height (feet):		164
Building Height (feet):		~180
Distance to closest boundary:		
Emission Factor Source:		

	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/MMBtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
Formaldehyde		0.08	1.18E-03	5.52E-03	6.90058%	1
Benzene		0.1		3.45E-03	3.45124%	2
Acetaldehyde		0.5		2.33E-03	0.46648%	3
Acrolein	0.02		9.25E-05	3.39E-05	0.16962%	4
Acetaldehyde	9		7.67E-04	8.14E-03	0.09042%	5
Acrolein	0.5			2.80E-04	0.05598%	6
Benzene	30		9.33E-04	1.20E-02	0.04014%	7
Napthalene		0.08	8.48E-05	2.85E-05	0.03564%	8
1,3 Butadiene		0.03		6.06E-06	0.02020%	9
Propylene	1500		2.58E-03	9.21E-02	0.00614%	10
Phenanthrene	0.1		2.94E-05	3.43E-06	0.00343%	11
Naphthalene	3			9.95E-05	0.00332%	12
Xylenes	100		2.85E-04	1.12E-03	0.00112%	13
1,3 Butadiene	2		3.91E-05	2.11E-05	0.00106%	14
PAHs (weighted as BaP)		0.0005		3.8726E-09	0.00077%	15
Toluene	5000		4.09E-04	2.31E-03	0.00005%	16
Fluorene	140		0.0000292	1.18E-05	0.00001%	17
Acenaphthylene	35		5.06E-06	3.54E-07	0.00000%	18
Fluoranthene	140		7.61E-06	8.01E-07	0.00000%	19
Pyrene	100		4.78E-06	3.16E-07	0.00000%	20
Benzo(g,h,l)perylene	12		4.89E-07	3.31E-09	0.00000%	21
Acenaphthene	210		1.42E-06	2.79E-08	0.00000%	22
Anthracene	1000		1.87E-06	4.84E-08	5E-11	23

Wood Example 1

Permit #:		**354-06 Michigan Wood Pellet Fuel, LLC**
Summary:		Wood Burner
Emission source:		Burner (BOILER???)
Fuel Type:		Wood
Equipment Capacity (MMBtu/hr):		25 SMALL
Stack Height (feet):		36
Building Height (feet):		
Distance to closest boundary:		
Emission Factor Source:		From Wood Residue Combustion in Boilers (SCC 1-02-009-08) Industrial Dry Wood-Fired Boiler

	Screening Levels (SLs)								
Chemical	**ITSL**	**AvgT**	**IRSL**	**Source**	**Emission Factor**	**Emission (lb/hr)**	**PAI**	**%SL**	**% SL Rank**
Silver	0.1	8-hr		Burner	1.7E-03	3E-02	1E-01	97.7%	1
Acrolein - ITSL	0.02	annual		Dryer	4.5E-03	2E-02	1E-02	56.2%	2
Formaldehyde			0.08	Dryer	1.8E-01	7E-01	4E-01	46.6%	3
Chromium (hexavalent) - IRSL			8.3E-05	Burner	3.5E-06	7E-05	3E-05	41.3%	4
Manganese	0.05	annual		Burner	1.6E-03	3E-02	2E-02	31.3%	5
chlorine	0.3	24-hr		Burner	7.9E-04	2E-02	8E-02	27.3%	6
Arsenic			0.0002	Burner	2.2E-05	4E-04	2E-04	10.8%	7
Acetaldehyde - IRSL			0.5	Dryer	1.3E-02	5E-02	5E-02	9.9%	8
Nickel			0.0042	Burner	3.3E-05	7E-04	3E-04	7.7%	9
Alpha-pinene	1120	8-hr		Dryer	2.8E+00	1E+01	9E+01	7.7%	10
Cadmium			0.0006	Burner	4.1E-06	8E-05	4E-05	6.7%	11
Acrolein - ITSL	5	1-hr		Dryer	4.5E-03	2E-02	3E-01	5.7%	12
Acetaldehyde - ITSL	9	24-hr		Dryer	1.3E-02	5E-02	5E-01	5.6%	13
benzo(a)pyrene			0.0005	Burner	2.6E-06	5E-05	3E-05	5.1%	14
Beryllium - IRSL			0.0004	Burner	1.1E-06	2E-05	1E-05	2.7%	15
Benzaldehyde			0.4	Dryer	2.6E-03	1E-02	8E-03	2.0%	16
Benzene - IRSL			0.1	Dryer	9.9E-04	4E-03	2E-03	1.9%	17
Hexaldehyde	2	annual		Dryer	1.6E-02	6E-02	4E-02	1.9%	18
Beta-pinene	1120	8-hr		Dryer	6.9E-01	3E+00	2E+01	1.8%	19
Buthlaldehyde	7	24-hr		Dryer	3.1E-03	1E-02	1E-01	1.5%	20
naphthalene - IRSL			0.08	Burner	9.7E-05	2E-03	9E-04	1.2%	21
Hydrogen Chloride - ITSL	20	annual		Burner	1.9E-02	4E-01	2E-01	0.9%	22
Propionaldehyde	8	24-hr		Dryer	3.2E-03	1E-02	7E-02	0.8%	23
Beryllium - ITSL	0.02	24-hr		Burner	1.1E-06	2E-05	1E-04	0.6%	24
Crotonaldehyde	9	1-hr		Burner	9.9E-06	2E-04	5E-02	0.5%	25
Barium	5	8-hr		Burner	1.7E-04	3E-03	2E-02	0.5%	26
Cobalt	0.2	8-hr		Burner	6.5E-06	1E-04	9E-04	0.5%	27
Methanol	3250	1-hr		Dryer	4.0E-02	2E-01	1E+01	0.4%	28
Antimony	0.2	24-hr		Burner	7.9E-06	2E-04	8E-04	0.4%	29
Phosphorus	1	8-hr		Burner	2.7E-05	5E-04	4E-03	0.4%	30
Chromium (hexavalent) - ITSL	0.1	24-hr		Burner	3.5E-06	7E-05	4E-04	0.4%	31
Copper	2	8-hr		Burner	4.9E-05	1E-03	7E-03	0.4%	32
naphthalene - ITSL	3	24-hr		Burner	9.7E-05	2E-03	1E-02	0.3%	33

Note: Truncated to fit to 1 page. The number of TACs that had non-null EFs = 101. (see note on page 8)

Wood Example 2

Permit #:		**404-08 Mancelona Renewable Resources**
Summary:		Bubbling fluidized bed boiler, Wood Fired
Emission source:		BOILER
Fuel Type:		Wood
Equipment Capacity (MMBtu/hr):		565 LARGE
Stack Height (feet):		270
Building Height (feet):		120
Distance to closest boundary:		400 ft
Emission Factor Source:		Some from AP-42, others supplied by applicant from testing

	Screening Levels (SLs)					
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/MMBtu)**	**Impacts (µg/m³)**	**% of SL**	Rank
chrysene		0.0005	6.37E-06	3.8E-04	75.34800%	1
1,2-dibromoethene (1,2-ethylene dibromide)		0.002	5.50E-05	2.0E-04	9.82760%	2
Arsenic		0.0002	3.29E-06	1.2E-05	5.87760%	3
Chromium (hexavalent)		0.000083	6.37E-07	2.3E-06	2.74120%	4
Formaldehyde		0.08	3.45E-04	1.2E-03	1.54050%	5
Acrolein	0.02		7.78E-05	2.8E-04	1.39040%	6
Benzene		0.1	3.54E-04	1.3E-03	1.26400%	7
Cadmium		0.0006	1.06E-06	3.8E-06	0.63200%	8
Nickel		0.0042	5.84E-06	2.1E-05	0.49657%	9
Styrene		1.7	1.89E-03	6.8E-03	0.39779%	10
Manganese	0.05		4.60E-05	1.6E-04	0.32864%	11
Zinc (SL for ZnO)	50		2.21E-03	1.3E-01	0.26163%	12
Antimony	0.2		1.27E-05	3.9E-04	0.19595%	13
Ammonia (slip from SNCR)	100		10 ppmdv	1.9E-01	0.19432%	14
Acrolein	5		7.78E-05	8.4E-03	0.16745%	15
Phosphorus	1		2.71E-05	1.6E-03	0.16011%	16
Chlorine	15		3.95E-04	2.3E-02	0.15558%	17
1,2-Dichloroethane		0.04	1.45E-05	5.2E-05	0.12956%	18
Acetaldehyde		0.5	1.77E-04	6.3E-04	0.12640%	19
Carbon tetrachloride		0.07	2.25E-05	8.0E-05	0.11466%	20
Naphthalene		0.08	2.44E-05	8.7E-05	0.10902%	21
Silver	0.1		1.25E-06	7.4E-05	0.07409%	22
Acetaldehyde	9		1.77E-04	5.4E-03	0.06048%	23
Beryllium		0.0004	6.14E-08	2.2E-07	0.05483%	24
Benzene	30		3.54E-04	1.1E-02	0.03629%	25
Strontium	0.1		1.00E-05	3.6E-05	0.03571%	26
carbazol		0.02	1.80E-06	6.4E-06	0.03223%	27
Copper	2		1.04E-05	6.2E-04	0.03087%	28
Vinyl chloride		0.11	9.02E-06	3.2E-05	0.02930%	29
dichloromethane		2	1.45E-04	5.2E-04	0.02591%	30
o-tolualdehyde	0.1		7.20E-06	2.6E-05	0.02572%	31
Naphthalene	3		2.44E-05	7.5E-04	0.02504%	32
Propanal/propionaldehyde	8		6.10E-05	1.9E-03	0.02347%	33

Note: Truncated to fit to 1 page. The number of TACs that had non-null EFs = 88. (see note on page 8)

Wood Example 3

Permit #:			**166-09A (FRONTIER KINROSS, LLC)**		
Summary:			Bubbling fluidized bed biomass boiler		
Emission source:			BOILER		
Fuel Type:			Wood		
Equipment Capacity (MMBtu/hr):			535	LARGE	
Stack Height (feet):			175		
Building Height (feet):					
Distance to closest boundary:					
Emission Factor Source:					
	Screening Levels (SLs)				
TAC	**ITSL (µg/m³)**	**IRSL (µg/m³)**	**EF (lb/MMBtu)**	**Impacts (µg/m³)**	**% of SL**
Naphthalene		0.08		1.5E-02	18.39175%
1,3-butadiene		0.03		5.2E-03	17.45576%
1,3-butadiene	2			2.6E-01	13.09182%
carbon tetrachloride		0.17		7.3E-03	4.29006%
Vinyl chloride		0.11		3.0E-03	2.69447%
Naphthalene	3			7.4E-02	2.47366%
hexachlorobenzene		0.002		3.9E-06	0.19647%
ethylene dichloride		0.04		6.1E-05	0.15154%
cumene	0.1			7.0E-05	0.06967%
2,4-dinitrotoluene		0.009		3.6E-06	0.03994%
Vinyl chloride	100			1.5E-02	0.01505%

Wood Example 4

Permit #:		**268-09 Sawyer Electric Company, LLC,**
Summary:		Gwinn, Michigan
Emission source:		
Fuel Type:		Wood
Equipment Capacity (MMBtu/hr):		560 LARGE
Stack Height (feet):		150
Building Height (feet):		75
Distance to closest boundary:		~250
Emission Factor Source:		Using representative emission factors
	Screening Levels (SLs)	

TAC	ITSL (µg/m³)	IRSL (µg/m³)	EF (lb/MMBtu)	Impacts (µg/m³)	% of screening	Rank
Arsenic		0.0002		5.6E-05	28.08960%	1
Chromium (hexavalent)		0.000083		6.0E-06	7.16964%	2
Ammonia (slip from SNCR)	100			2.6E+00	2.55039%	3
Naphthalene		0.08		1.3E-03	1.56408%	4
Phosphorus	1			1.4E-02	1.38996%	5
Combined Carcinogenic PAHs		0.0005		6.7E-06	1.34559%	6
Ammonia	100			1.3E+00	1.25495%	7
Chromium (hexavalent)	0.008			9.4E-05	1.17923%	8
Formaldehyde		0.08		9.2E-04	1.15254%	9
Cadmium		0.0006		6.5E-06	1.07922%	10
Acrolein	0.02			2.1E-04	1.03968%	11
Benzene		0.1		9.4E-04	0.94483%	12
Silver	0.1			7.4E-04	0.73842%	13
Naphthalene	3			2.0E-02	0.66121%	14
Manganese	0.05			2.9E-04	0.58779%	15
Potassium	0.1			5.0E-04	0.49795%	16
Acetaldehyde		0.5		2.1E-03	0.42390%	17
Acetaldehyde	9			3.4E-02	0.37334%	18
o-tolualdehyde	0.1			3.3E-04	0.33197%	19
Styrene		1.7		5.1E-03	0.29764%	20
benzoic acid	0.1			2.8E-04	0.28090%	21
Antimony	0.2			5.4E-04	0.26988%	22
Acrolein	5			1.3E-02	0.26807%	23
Chlorine	15			3.6E-02	0.23921%	24
ethylene dichloride		0.04		7.4E-05	0.18514%	25
Carbon tetrachloride		0.07		1.1E-04	0.16416%	26
1,2-dibromoethene (1,2-ethylene dibromide)	0.1			1.5E-04	0.14707%	27
2,3,7,8-Tetrachlorodibenzo-p-dioxin		2.3E-08		2.2E-11	0.09548%	28
Benzaldehyde		0.4		2.8E-04	0.07022%	29
Beryllium		0.0004		2.8E-07	0.06938%	30
Nickel		0.0042		2.3E-06	0.05506%	31
Benzene	30			1.5E-02	0.04993%	32

Note: Truncated to fit to 1 page. The number of TACs that had non-null EFs = 118. (see note on page 8)