TOXIC AIR CONTAMINANT EMISSIONS

Toxic Air Contaminant Emissions from Each Combustor

	Pollutants	CAS	Federal HAP	TAC for HRA	Emission Factor (lb/MMBtu)	Emission Factor (lb/ton)	Hourly Emissions (lb/hour)		Annual Emissions (tons/year)		HARP Hourly Emissions (lb/hour)	HARP Annual Emissions (lb/year)
					EPI	SJVAPCD	EPI	SJVAPCD	EPI	SJVAPCD		
	Acetaldehyde	75070	y	y		1.55E-03		4.18E-02		1.37E-01	4.18E-02	2.75E+02
	Ammonia	7664417	n	y	3.03E-03		9.40E-01		3.09E+00		9.40E-01	6.18E+03
	Arsenic	7440382	y	y		2.32E-06		6.26E-05		2.06E-04	6.26E-05	4.11E-01
	Benzene	71432	y	y		1.77E-03		4.77E-02		1.57E-01	4.77E-02	3.14E+02
	Cadmium	7440439	y	y		2.54E-05		6.85E-04		2.25E-03	6.85E-04	4.50E+00
	Chromium 6+	18540299	y	y		1.85E-06		4.99E-05		1.64E-04	4.99E-05	3.28E-01
	Copper	7440508	n	y		1.93E-05		5.21E-04		1.71E-03	5.21E-04	3.42E+00
	Formaldehyde	50000	y	y		1.33E-02		3.59E-01		1.18E+00	3.59E-01	2.36E+03
	Hydrogen Chloride	7647010	y	y	4.57E-03		1.42E+00		4.66E+00		1.42E+00	9.33E+03
	Lead	7439921	y	y		5.54E-05		1.49E-03		4.91E-03	1.49E-03	9.82E+00
	Manganese	7439965	y	y		4.99E-03		1.35E-01		4.42E-01	1.35E-01	8.84E+02
	Mercury	7439976	y	y		2.87E-07		7.74E-06		2.54E-05	7.74E-06	5.09E-02
	Toluene	108883	y	y		2.93E-04		7.90E-03		2.60E-02	7.90E-03	5.19E+01
PAHs	Naphthalene	91203	y	y		3.24E-03		8.74E-02		2.87E-01	8.74E-02	5.74E+02
PAHs	Benz [a] anthracene	56553	n	y		7.10E-07		1.92E-05		6.29E-05	1.92E-05	1.26E-01
PAHs	Benzo [b] fluoranthene	205992	n	y		7.59E-08		2.05E-06		6.73E-06	2.05E-06	1.35E-02
PAHs	Benzo [k] Fluoranthene	207089	n	y		3.12E-08		8.42E-07		2.76E-06	8.42E-07	5.53E-03
PAHs	Chrysene	218019	n	y		9.63E-07		2.60E-05		8.53E-05	2.60E-05	1.71E-01
PAHs	Indeno [1,2,3-cd] pyrene	193395	n	y		1.73E-08		4.67E-07		1.53E-06	4.67E-07	3.07E-03
Dioxins	123678 HxCDD	57653857	n	y		2.18E-11		5.88E-10		1.93E-09	5.88E-10	3.86E-06
Dioxins	1234678 HpCDD	35822469	n	y		1.23E-10		3.32E-09		1.09E-08	3.32E-09	2.18E-05
Furans	2378 TCDF	51207319	n	y		1.28E-10		3.45E-09		1.13E-08	3.45E-09	2.27E-05
Furans	23478 PeCDF	57117314	n	y		7.09E-11		1.91E-09		6.28E-09	1.91E-09	1.26E-05
Furans	12378 PeCDF	57117416	n	y		4.40E-11		1.19E-09		3.90E-09	1.19E-09	7.80E-06
Furans	123678 HxCDF	57117449	n	y		2.34E-11		6.31E-10		2.07E-09	6.31E-10	4.15E-06
Furans	234678 HxCDF	60851345	n	y		2.74E-11		7.39E-10		2.43E-09	7.39E-10	4.86E-06
Furans	1234678 HpCDF	67562394	n	y		3.63E-11		9.79E-10		3.22E-09	9.79E-10	6.43E-06
Furans	123478 HxCDF	70648269	n	y		2.35E-11		6.34E-10		2.08E-09	6.34E-10	4.16E-06
Furans	123789 HxCDF	72918219	n	y		4.05E-12		1.09E-10		3.59E-10	1.09E-10	7.18E-07

Operation schedule and heat input:

6570	annual operations based on 75% capacity = 6570 hours/year - startup hours
310.57	Full load operation HHV (MMBtu/hr) per combustor
53951	lb/hr/combustor biomass use
26.98	ton/hr/combustor biomass use
11.51	MMBtu/ton

Emission Factor source

EPI 22-Oct-08

SJVAPCD provided emission factors from similar biomass facility, Mendota Biomass Power

Toxic Air Contaminant Emissions from the 3 Burners for Each Combustor Train

3 burners per fluidized bed combustor used for startup, one 15 MMBtu/hr and two 50 MMBtu/hr burners

Total power rating (3 burners) 115 MMBtu/hr

	Number of startups per year per combustor	Duration of each startup (hours)	Total MMBtu per startup event	
Cold start	2	7	640	7 hrs/start with power rating as shown in the table provided by EPI
Annual operations	14	hrs/yr		

Emissions for the 3 burners for EACH COMBUSTOR

Pollutant	**CAS**	**Emission Factor (lb/MMBtu)**	**Emission Factor (lb/MMcf)**	**Emission factor source**	**Maximum Hourly Emission Rate (lb/hr)**	**Annual Emission Rate (lb/yr)**
Acetaldehyde	75070	3.04E-06	3.10E-03	VCAPCD 2001	3.50E-04	3.89E-03
Acrolein	107028	2.65E-06	2.70E-03	VCAPCD 2001	3.04E-04	3.39E-03
Benzene	71432	5.69E-06	5.80E-03	VCAPCD 2001	6.54E-04	7.28E-03
Ethylbenzene	100414	6.76E-06	6.90E-03	VCAPCD 2001	7.78E-04	8.66E-03
Formaldehyde	50000	1.21E-05	1.23E-02	VCAPCD 2001	1.39E-03	1.54E-02
Hexane	110543	4.51E-06	4.60E-03	VCAPCD 2001	5.19E-04	5.77E-03
Propylene	115071	5.20E-04	5.30E-01	VCAPCD 2001	5.98E-02	6.65E-01
Toluene	108883	2.60E-05	2.65E-02	VCAPCD 2001	2.99E-03	3.33E-02
Xylenes	1330207	1.93E-05	1.97E-02	VCAPCD 2001	2.22E-03	2.47E-02
Naphthalene	91203	2.94E-07	3.00E-04	VCAPCD 2001	3.38E-05	3.76E-04
PAHs other than naphthalene	1150	9.80E-08	1.00E-04	VCAPCD 2001	1.13E-05	1.25E-04
Total Annual HAP Emissions per Turbine (ton/yr)						**3.84E-04**

Notes:

- Emission factors from Ventura County Air Pollution Control District AB2588 combustion emission factors for natural gas fired external combustion equipment 10-100 MMBtuh, May 17, 2001
- Used a HHV (Btu/scf) = 1020

Toxic Air Contaminant Emissions from Each Cooling Tower

Total Project SJS 1&2

Total Project SJS 1&2 Annual average design circulating water rate	61,000	gallons/min	
Total Project SJS 1&2 Maximum daily design circulating water rate	70,000	gallons/min	
Cycles of concentration	4		
Drift Eliminator Control	0.000005	=	0.0005
Operating hours per year	8760	hr/yr	
Number of cells in each cooling tower	2		
Total number of cooling towers	2		

Toxic Air Contaminant	CAS	TAC Concentration in water[1]		Total SJS1&2 Project cooling tower emissions		Emissions per cooling tower		Emissions per cell	
		ug/liter	lb/(1000 gallon)	lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr
Arsenic	7440382	3.1	0.000026	2.17E-06	1.66E-02	1.09E-06	8.29E-03	5.43E-07	4.15E-03
Chlorine	7782505	161000	1.343450	1.13E-01	8.61E+02	5.64E-02	4.31E+02	2.82E-02	2.15E+02
Fluoride *	1101	170	0.001419	1.19E-04	9.10E-01	5.96E-05	4.55E-01	2.98E-05	2.27E-01
Mercury	7439976	0.59	0.000005	4.14E-07	3.16E-03	2.07E-07	1.58E-03	1.03E-07	7.89E-04
Silica *	1175	40900	0.341286	2.87E-02	2.19E+02	1.43E-02	1.09E+02	7.17E-03	5.47E+01
Sulfate *	9960	1200000	10.013293	8.41E-01	6.42E+03	4.21E-01	3.21E+03	2.10E-01	1.61E+03
Vanadium *	7440622	6.8	0.000057	4.77E-06	3.64E-02	2.38E-06	1.82E-02	1.19E-06	9.10E-03
Total Annual HAP Emissions (ton/yr)					**4.31E-01**				

Note:

The maximum concentration for each TAC as determined from water samples collected from the existing onsite well.

* not a CAA112 HAP

Toxic Air Contaminant Emissions from Each Emergency Diesel Generator

Max Engine Power	**1000**	**kW**
Rated Horsepower	**1341**	**HP**
Expected non-emergency usage	**12**	**hr/yr**

Pollutant	**CAS**	**Emission Factor (Power Output) (g/kW-hr)**	**Emission factor source**	**Hourly Emission Rate (lb/hr)**	**Annual Emission Rate (lb/yr)**
Diesel Particulate (PM10)	9901	0.20	Emission rates based on EPA Tier 2 emission limits	0.441	5.286

Toxic Air Contaminant Emissions from Each Emergency Diesel Firewater Pump

Max Engine Power	**186**	**kW**
Rated Horsepower	**250**	**HP**
Expected non-emergency usage	**52**	**hr/yr**

Pollutant	**CAS**	**Emission Factor (Power Output) (g/kW-hr)**	**Emission factor source**	**Hourly Emission Rate (lb/hr)**	**Annual Emission Rate (lb/yr)**
Diesel Particulate (PM10)	9901	0.20	Emission rates based on EPA Tier 2 emission limits	0.082	4.271

Fugitive Emissions from Fly Ash Handling
Total Project SJS 1&2

PM_{10} Emissions from Fly Ash 99 **% control efficiency**

Process Rate 5.40 **tons/hr** 35445.8 **tons/yr**

Pollutant	CAS	Emission Factor (lb/ton)	SJS1&2 Hourly Emission Rate (lb/hr)	SJS1&2 Annual Emission Rate (lb/yr)	Hourly Emission Rate per Combustor Train (lb/hr)	Annual Emission Rate per Combustor Train (lb/yr)
Arsenic	7440382	5.74E-05	3.10E-06	2.03E-02	7.74E-07	5.09E-03
Beryllium	7440417	2.83E-07	1.53E-08	1.00E-04	3.82E-09	2.51E-05
Cadmium	7440439	1.63E-06	8.79E-08	5.78E-04	2.20E-08	1.44E-04
Hex Chrome	18540299	1.75E-06	9.44E-08	6.20E-04	2.36E-08	1.55E-04
Copper	7440508	2.59E-04	1.40E-05	9.18E-02	3.49E-06	2.30E-02
Lead	7439921	1.41E-04	7.61E-06	5.00E-02	1.90E-06	1.25E-02
Manganese	7439965	9.79E-05	5.28E-06	3.47E-02	1.32E-06	8.68E-03
Nickel	7440020	2.31E-05	1.25E-06	8.19E-03	3.12E-07	2.05E-03
Selenium	7782492	4.81E-07	2.60E-08	1.70E-04	6.49E-09	4.26E-05

*The emission factors were taken from a TEIR for Thermal Energy N-1026, Toxics ID #21283

Biomass Unloading Combustion Exhaust Emissions

Total Project SJS 1&2

Diesel Fired Offroad Equipment - PM10 Emissions

Equipment	Quantity	Percent of time operating (%)	Hours /Day	Days/ Week	Hours/ year	Horse power	PM10 Emission factor (lb/hr)	SJS1&2 Hourly Emissions (lb/hr)	SJS1&2 Annual Emissions (lb/yr)	Per Plant Hourly Emissions (lb/hr)	Per Plant Annual Emissions (lb/year)
Front end loader	1	50	4	5	1040	100	0.0325	0.02	16.89	0.0081	8.45

Notes:

1. Emission factors from CARB Off-road 2007 application. (calendar year: 2011) used the 120hp emission factor for Skid steer loader from OFFROAD2007.
2. PM emission factors determined using guidance from SCAQMD Final - Methodology to Calculate PM_{10} and $PM_{2.5}$ Significance Thresholds 10/1/2006, Appendix A - Updated CEIDARS Table with $PM_{2.5}$ Fractions Off-road equipment
   - PM_{10} Fraction of total PM, Diesel: 1.000
5. All of the biomass fuel handling equipment will be electric powered conveyors, stackers and reclaimers.
6. Hydraulic unloaders will be used for unloading the biomass delivery trucks.
7. One- 100HP front end loader will be used part time for spill clean-up for approximately 4hrs/day, 5days/week.

Mirror cleaning truck emissions

Total Project SJS 1&2

Pollutant	Emission factor (lb/mile)	SJS1&2 Hourly Emissions (lb/hr)	SJS1&2 Daily Emissions (lb/day)	SJS1&2 Annual Emissions (lb/yr)	Per Plant Hourly Emissions (lb/hr)	Per Plant Annual Emissions (lb/yr)
PM_{10}	3.53E-04	0.0004	0.004	1.101	1.76E-04	0.550

NOTE:

1. All emission factors (except for CH_4 and N_2O) for on-road 8500 lb truck (Light-Heavy-Duty Diesel Truck, LHDT1) are from EMFAC2007 model (calendar year = 2011; model year = 1980-201
4. Humidity reference from http://www.wrcc.dri.edu/narratives/CALIFORNIA.htm
5. Operational schedule assumption

260	Annual days of operation
6	Average total trip miles
2	Number of trucks cleaning per day
12	miles/day all cleaning vehicles
12	hours/day cleaning schedule

Emissions from Onsite Heavy Duty Truck Trips (Biomass, Limestone, Lime and Ammonia Deliveries and Ash Removal)
Total Project SJS 1&2

Pollutant	Traveling Emission Factor (lb/mile)	Idling Emission Factor (g/hour)	SJS1&2 Hourly Emissions (lb/hr)	SJS1&2 Daily Emissions (lb/day)	SJS1&2 Annual Emissions (lb/yr)	Number of Delivery Truck Sources in Model	Per Source Hourly Emissions (lb/hr)	Per Source Annual Emissions (lb/yr)
PM_{10}	4.46E-03	1.48E+00	0.068	0.82	213.59	46	1.49E-03	4.64

NOTE:

1. All emission factors (except for CH_4 and N_2O) for on-road Heavy-Heavy-Duty Diesel Truck (HHDT) are from EMFAC2007 model (calendar year = 2011; model year = 1980-2011).
5. Humidity reference from http://www.wrcc.dri.edu/narratives/CALIFORNIA.htm
6. Operational schedule assumption
   - 5 days/week delivery schedule
   - 12 hours/day delivery schedule
   - 15 minutes per truck maximum idling time

Total Onsite Project Truck Trips

Source		Max Hourly Usage (lb/hr)	Annual Usage (tons/yr)	Trucks per year	Total onsite trip miles	Annual miles
Biomass Delivery Trips		215,804	709,000	28,360	1.4	39,704
Limestone Deliveries		1,232	4,047	162	1.4	227
Lime Deliveries		512	1,682	67	1.4	94
Aqueous Ammonia Deliveries		2,492	8,186	257	1.4	360
Ash Removal		10,790	35,450	1,418	1.4	1,985
Total Project Truck Trips			**758,365**	**30,264**		**42,370**

NOTE:

1. Delivery vehicle size	25	tons/truck
2. Density of 19% aqueous ammonia	7.962	lb/gal
3. Ammonia delivery vehicle size	8000	gallons/truck

SJVAPCD Provided emission factors for TACs from a similar biomass facility

Facility:
ID #:
Project #:

Emissions - Biomass Combustor

Process Rate **Tons/hr** **Tons/yr**

	Emissions	CAS Number	EF	lbs/hr	g/sec	lbs/yr	g/sec
	Sulfur Dioxide	42401	1.39E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Nitrogen Dioxide	42603	1.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Acetaldehyde	75070	1.55E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Acrolein	107028	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Arsenic	7440382	2.32E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Benzene	71432	1.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Beryllium	7440417	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Cadmium	7440439	2.54E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Copper	7440508	1.93E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Ethylbenzene	100414	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Formaldehyde	50000	1.33E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Hex Chrome	18540299	1.85E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Lead	7439921	5.54E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manganese	7439965	4.99E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Mercury	7439976	2.87E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Nickel	7440020	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Selenium	7782492	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Toluene	108883	2.93E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Vanadium	7440622	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Total PAH	1150	5.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Benz [a] anthracene	56553	7.10E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Benzo [b] fluoranthene	205992	7.59E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Benzo [k] Fluoranthene	207089	3.12E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Chrysene	218019	9.63E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Dibenzo [a,h] Anthracene	53703	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Indeno [1,2,3-cd] pyrene	193395	1.73E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Napthalene	91203	3.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PCBs	Total PCB	1336363	4.33E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dioxins	Total PCDD	1086	8.14E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dioxins	123789 HxCDD	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dioxins	123678 HxCDD	57653857	2.18E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dioxins	1234678 HpCDD	35822469	1.23E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dioxins	123478 HxCDD	39227286	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dioxins	12378 PeCDD	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	Total PCDF	1080	9.01E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	2378 TCDF	51207319	1.28E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	1234789 HpCDF	55673897	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	23478 PeCDF	57117314	7.09E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	12378 PeCDF	57117416	4.40E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	123678 HxCDF	57117449	2.34E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	234678 HxCDF	60851345	2.74E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	1234678 HpCDF	67562394	3.63E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	123478 HxCDF	70648269	2.35E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Furans	123789 HxCDF	72918219	4.05E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00
not used in HRA							
	Acenapthene	83329	6.16E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Anthracene	120127	4.63E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Antimony	7440360	1.02E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Barium	7440393	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Chromium	7440473	6.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Cobalt	7440484	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Fluorene	86737	5.49E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2 Methyl-Napthalene	91576	5.49E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Molybdenum	1313275	1.48E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Phenanthrene	85018	4.54E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Phosphorus	7723140	4.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Pyrene	129000	1.41E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Silver	7440224	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Thallium	7440280	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Zinc	7440666	1.89E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	PAH Acenaphtylene	208968	1.02E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Benzo [g,h,i] perylene	191242	4.50E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PAHs	Fluoranthene	206440	1.90E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dioxins	Total HxCDD	34465468	1.68E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Emission Factors are taken from approved TEIR for Mendota Biomass Power, Ltd. #40155