

Cogeneration Facility 2011 Annual Air Emissions Inventory

**The University of North Carolina at Chapel Hill
Chapel Hill, North Carolina**

**Facility ID # 6800043
Permit # 03069T29**

Prepared for:

The University of North Carolina at Chapel Hill
Department of Environment, Health, and Safety
1120 Estes Drive Extension
Chapel Hill, North Carolina 27599-1650

Prepared by:

RST Engineering
5416 Orchard Oriole Trail
Wake Forest, North Carolina 27587-6770

June 2012

Cogeneration Facility 2011 Annual Air Emissions Inventory

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Orange County

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2011 Cogeneration Emissions Inventory

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University of North Carolina at Chapel Hill

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2011 Cogeneration Emissions Inventory

Cogeneration Boilers

Seasonal Fuel Usage Breakdown

Month	Boiler #6				Boiler #7				Boiler #8	
	Coal (tons)	Wood(tons)	Gas (1,000cf)	Oil (gallons)	Coal (tons)	Wood(tons)	Gas (1,000cf)	Oil (gallons)	Gas (1,000cf)	Oil (gallons)
December 2011	5,755		30	0	3,817	0	2,035	0	7,725	0
January 2011	6,943		0	3	4,754	0	1,161	3.5	22,310	50
February 2011	4,438		0	33	3,856	0	0	1.5	8,161	0
<i>1st Quarter Total</i>	<i>17,136</i>	<i>0</i>	<i>30</i>	<i>36</i>	<i>12,427</i>	<i>0</i>	<i>3,196</i>	<i>5</i>	<i>38,196</i>	<i>50</i>
March 2011	5,060	391	1,170	0	4,127	0	570	0	2,700	0
April 2011	3,628		1,333	0	439	0	873	0	19,984	0
May 2011	3,831		380	0	3,430	0	40	0	290	0
<i>2nd Quarter Total</i>	<i>12,518</i>	<i>391</i>	<i>2,883</i>	<i>0</i>	<i>7,997</i>	<i>0</i>	<i>1,483</i>	<i>0</i>	<i>22,974</i>	<i>0</i>
June 2011	4,099		84	0	3,565	0	927	0	700	1,736
July 2011	4,970		0	0	4,745	0	0	0	400	0
August 2011	4,351		45	0	4,046	0	15	0	0	0
<i>3rd Quarter Total</i>	<i>13,420</i>	<i>0</i>	<i>129</i>	<i>0</i>	<i>12,356</i>	<i>0</i>	<i>942</i>	<i>0</i>	<i>1,100</i>	<i>1,736</i>
September 2011	2,177		1,617	0	3,728	0	1,263	0	530	0
October 2011	1,300		619	0	1,987	0	280	0	31,283	0
November 2011	4,099		21,795	0	2,295	0	761	0	5,455	0
<i>4th Quarter Total</i>	<i>7,576</i>	<i>0</i>	<i>24,031</i>	<i>0</i>	<i>8,009</i>	<i>0</i>	<i>2,304</i>	<i>0</i>	<i>37,268</i>	<i>0</i>
2011 TOTAL	50,649	391	27,073	36	40,789	0	7,925	5	99,538	1,786

Seasonal Btu Breakdown

Coal (btu/lb)	12,787	Wood (btu/lb)	8,185	Natural Gas (btu/ft ³)	1,030	Fuel Oil (btu/gal)	139,043
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Month	Boiler #6				Boiler #7				Boiler #8	
	Coal	Wood	Gas	Oil	Coal	Wood	Gas	Oil	Gas	Oil
December 2010	1.47E+11	0.00E+00	3.09E+07	0.00E+00	9.76E+10	0.00E+00	2.10E+09	0.00E+00	7.96E+09	0.00E+00
January 2010	1.78E+11	0.00E+00	0.00E+00	4.59E+05	1.22E+11	0.00E+00	1.20E+09	4.87E+05	2.30E+10	6.95E+06
February 2010	1.13E+11	0.00E+00	0.00E+00	4.56E+06	9.86E+10	0.00E+00	0.00E+00	2.09E+05	8.41E+09	0.00E+00
<i>1st Quarter Total</i>	<i>4.38E+11</i>	<i>0.00E+00</i>	<i>3.09E+07</i>	<i>5.02E+06</i>	<i>3.18E+11</i>	<i>0.00E+00</i>	<i>3.29E+09</i>	<i>6.95E+05</i>	<i>3.93E+10</i>	<i>6.95E+06</i>
March 2010	1.29E+11	6.40E+09	1.21E+09	0.00E+00	1.06E+11	0.00E+00	5.87E+08	0.00E+00	2.78E+09	0.00E+00
April 2010	9.28E+10	0.00E+00	1.37E+09	0.00E+00	1.12E+10	0.00E+00	8.99E+08	0.00E+00	2.06E+10	0.00E+00
May 2010	9.80E+10	0.00E+00	3.91E+08	0.00E+00	8.77E+10	0.00E+00	4.12E+07	0.00E+00	2.99E+08	0.00E+00
<i>2nd Quarter Total</i>	<i>3.20E+11</i>	<i>6.40E+09</i>	<i>2.97E+09</i>	<i>0.00E+00</i>	<i>2.05E+11</i>	<i>0.00E+00</i>	<i>1.53E+09</i>	<i>0.00E+00</i>	<i>2.37E+10</i>	<i>0.00E+00</i>
June 2010	1.05E+11	0.00E+00	8.65E+07	0.00E+00	9.12E+10	0.00E+00	9.55E+08	0.00E+00	7.21E+08	2.41E+08
July 2010	1.27E+11	0.00E+00	0.00E+00	0.00E+00	1.21E+11	0.00E+00	0.00E+00	0.00E+00	4.12E+08	0.00E+00
August 2010	1.11E+11	0.00E+00	4.64E+07	0.00E+00	1.03E+11	0.00E+00	1.55E+07	0.00E+00	0.00E+00	0.00E+00
<i>3rd Quarter Total</i>	<i>3.43E+11</i>	<i>0.00E+00</i>	<i>1.33E+08</i>	<i>0.00E+00</i>	<i>3.16E+11</i>	<i>0.00E+00</i>	<i>9.70E+08</i>	<i>0.00E+00</i>	<i>1.13E+09</i>	<i>2.41E+08</i>
September 2010	5.57E+10	0.00E+00	1.67E+09	0.00E+00	9.53E+10	0.00E+00	1.30E+09	0.00E+00	5.46E+08	0.00E+00
October 2010	3.32E+10	0.00E+00	6.38E+08	0.00E+00	5.08E+10	0.00E+00	2.88E+08	0.00E+00	3.22E+10	0.00E+00
November 2010	1.05E+11	0.00E+00	2.24E+10	0.00E+00	5.87E+10	0.00E+00	7.84E+08	0.00E+00	5.62E+09	0.00E+00
<i>4th Quarter Total</i>	<i>1.94E+11</i>	<i>0.00E+00</i>	<i>2.48E+10</i>	<i>0.00E+00</i>	<i>2.05E+11</i>	<i>0.00E+00</i>	<i>2.37E+09</i>	<i>0.00E+00</i>	<i>3.84E+10</i>	<i>0.00E+00</i>
2010 TOTAL	1.30E+12	6.40E+09	2.79E+10	5.02E+06	1.04E+12	0.00E+00	8.16E+09	6.95E+05	1.03E+11	2.48E+08

Seasonal Total Fuel Usage (%)

	Boiler #6	Boiler #7	Boiler #8
Dec., Jan., Feb.	32.96	30.54	38.29
Mar., Apr., May	24.78	19.60	23
June, July, Aug.	25.82	30.15	1.34
Sept., Oct., Nov.	16.43	19.71	37.35
	100	100	100

University of North Carolina at Chapel Hill

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2011 Cogeneration Emissions Inventory

Coal Usage Breakdown

Month	Boiler #6 Coal (tons)	Boiler #7 Coal (tons)
December 2011	5,755	3,817
January 2011	6,943	4,754
February 2011	4,438	3,856
<i>1st Quarter Total</i>	17,136	12,427
March 2011	5,060	4,127
April 2011	3,628	439
May 2011	3,831	3,430
<i>2nd Quarter Total</i>	12,518	7,997
June 2011	4,099	3,565
July 2011	4,970	4,745
August 2011	4,351	4,046
<i>3rd Quarter Total</i>	13,420	12,356
September 2011	2,177	3,728
October 2011	1,300	1,987
November 2011	4,099	2,295
<i>4th Quarter Total</i>	7,576	8,009
2011 TOTAL	50,649	40,789

Facility-Wide Coal Usage 91,438 Tons/year

Seasonal Coal Usage (%)

	Boiler #6	Boiler #7	Average (%)
Dec., Jan., Feb.	33.83%	30.47%	32.15%
Mar., Apr., May	24.72%	19.61%	22.16%
June, July, Aug.	26.50%	30.29%	28.39%
Sept., Oct., Nov.	14.96%	19.64%	17.30%
	100%	100%	100%

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2011 Cogeneration Emissions Inventory

Blackstart Generator Fuel Usage Breakdown

Month	DG1 & DG2 #2 Oil (gallons)
December 2011	347
January 2011	87
February 2011	951
<i>1st Quarter Total</i>	1,385
March 2011	429
April 2011	204
May 2011	235
<i>2nd Quarter Total</i>	868
June 2011	2,234
July 2011	224
August 2011	263
<i>3rd Quarter Total</i>	2,722
September 2011	243
October 2011	0
November 2011	223
<i>4th Quarter Total</i>	466
2011 TOTAL	5,440

Seasonal Oil Usage (%)

	DG1 & DG2
Dec., Jan., Feb.	25.46%
Mar., Apr., May	15.95%
June, July, Aug.	50.03%
Sept., Oct., Nov.	8.56%
	100%

The University of North Carolina at Chapel Hill

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2011 Annual Emissions Inventory

**DG No.1 and No.2 - Two 2,000 kW Generators
Cogeneration Facility**

(ES-007 & ES-008)

Emission Source/Operating Scenario Data Page 1 of 3		Facility ID #: 6800043					
<i>Emergency Generators Classified as Insignificant Sources</i>		Permit #: 03069T29					
Facility Name: <u>University of North Carolina at Chapel Hill</u>		County: Orange					
		DAQ Region: Raleigh					
North Carolina Department of Environment and Natural Resources Division of Air Quality Air Pollutant Point Source Emissions Inventory - Calendar Year 2011							
1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-007 & ES-008					
2. Emission Source Description		Two Blackstart Generators located at Cogeneration Facility					
3. Operating Scenario Description		Operating Scenario #1 - No. 2 Fuel Oil					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		270 gal/hr - 2 units					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		5,440					
		gallons/year, Total No. 2 Fuel Oil					
6. Fuel Information (if fuel used)		% Sulfur	0.1%				
		% Ash	N/A				
		Heat Content (Btu/lb or mmCF)	139,043 Btu/gallon				
If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.							
7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)		N/A					
8. Control Device Information, if none, write "none"							
	Control Device ID # (as listed in permit)	Control Device Description					
i. (nearest stack)	None	None					
ii.	None	None					
iii.	None	None					
iv.	None	None					
9. Stack Information (sources vented to more than one stack use additional entry lines)							
Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)	
Common Stack Parameters with 2-generators and Boiler No. 8 operating concurrently							
Stk No.4	208	6	400	70	118,752	Vertical	
--	--	--	--	--	--	--	
10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)							
Hours/Day	N/A	Days/Week	N/A	Weeks/Year	N/A	Hours/Year	N/A
Typical Start & End Times in CY:				Start:	N/A	End:	N/A
11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)							
Jan-Feb, 2007 + Dec, 2007	25.5%	Mar-May	16.0%	June-Aug	50.0%	Sept-Nov	8.6%

Two-2,000 kW No.2 oil-fired generators

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-007 & ES-008

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	0.10	8	N/A
NOx	NOx	0.72	8	N/A
PM Total	PM	0.04	8	N/A
PM-2.5	PM-2.5	0.04	8	N/A
PM-10	PM-10	0.04	8	N/A
SO2	SO2	0.04	8	N/A
VOC	VOC	0.03	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Acetaldehyde	75-07-0	0.019	8	N/A
Acrolein	107-02-8	0.0060	8	N/A
Arsenic	ARSENICCPDS	0.0030	8	N/A
Benzene	71-43-2	0.59	8	N/A
Benzo(a)pyrene	50-32-8	0.00019	8	N/A
Beryllium	BERYLCPDS	0.00227	8	N/A
Cadmium	CADMIUMCPDS	0.00227	8	N/A
Chromium	CROMCPDS	0.0023	8	N/A
Formaldehyde	50-00-0	0.060	8	N/A
Lead	LEADCPDS	0.0068	8	N/A
Manganese	MANGCPDS	0.0045	8	N/A
Mercury	MERCCPDS	0.0023	8	N/A
Naphthalene	91-20-3	0.0983	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	61.67	8	N/A
Methane	CH ₄	2.50E-03	8	N/A
Nitrous Oxide	N ₂ O	5.00E-04	8	N/A

University of North Carolina at Chapel Hill

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Orange County

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Permit # 03069T29

2011 Cogeneration Emissions Inventory

Blackstart Generators G1 & G2

(ES-007 & ES-008)

Fuel Input Rates	
Hourly Fuel Usage (gallons):	270 (2-units)
Annual Fuel Usage (gallons):	5,440 (2-units)
Fuel Sulfur Content (%)	0.1
Heat Input Rates	
Fuel Heating Values (Btu/gallon)	139,043
Hourly Fuel Usage (mmBtu):	37.54
Annual Fuel Usage (mmBtu):	756.42

70.00% CO control*
*Cat. Oxydizer

Emissions Output				Emission Factor
Criteria Pollutants				(lb/mmBtu)
Pollutant	lb/hr	lb/yr	tpy	
PM	3.8E+00	7.6E+01	3.78E-02	1.00E-01
PM-10	3.8E+00	7.6E+01	3.78E-02	1.00E-01
PM-2.5	3.8E+00	7.6E+01	3.78E-02	1.00E-01
NOx	7.1E+01	1.4E+03	7.19E-01	1.90E+00
NMTOC, Total	3.1E+00	6.2E+01	3.10E-02	8.19E-02
CO	9.6E+00	1.9E+02	9.64E-02	2.55E-01
SO _x	3.8E+00	7.6E+01	3.82E-02	1.01E-01
Toxic/Hazardous Air Pollutants				
Pollutant	lb/hr	lb/day	lb/yr	
Acetaldehyde	9.5E-04	2.3E-02	1.91E-02	2.52E-05
Acrolein	3.0E-04	7.1E-03	5.96E-03	7.88E-06
Arsenic	1.5E-04	3.6E-03	3.03E-03	4.00E-06
Benzene	2.9E-02	7.0E-01	5.87E-01	7.76E-04
Benzo(a)pyrene	9.6E-06	2.3E-04	1.94E-04	2.57E-07
Beryllium	1.1E-04	2.7E-03	2.27E-03	3.00E-06
Cadmium	1.1E-04	2.7E-03	2.27E-03	3.00E-06
Chromium	1.1E-04	2.7E-03	2.27E-03	3.00E-06
Formaldehyde	3.0E-03	7.1E-02	5.97E-02	7.89E-05
Lead	3.4E-04	8.1E-03	6.81E-03	9.00E-06
Manganese	2.3E-04	5.4E-03	4.54E-03	6.00E-06
Mercury	1.1E-04	2.7E-03	2.27E-03	3.00E-06
Naphthalene	4.9E-03	1.2E-01	9.83E-02	1.30E-04
Nickel	1.1E-04	2.7E-03	2.27E-03	3.00E-06
PAH	8.0E-03	1.9E-01	1.60E-01	2.12E-04
Selenium	5.6E-04	1.4E-02	1.13E-02	1.50E-05
Toluene	1.1E-02	2.5E-01	2.13E-01	2.81E-04
Xylene	7.2E-03	1.7E-01	1.46E-01	1.93E-04
Greenhouse Gas Pollutants				Em. Factor
Pollutant	lb/hr	lb/yr	tpy	(lb/mmBtu)
Carbon dioxide	6,121	123,336	61.67	163
Methane	2.5E-01	5.0E+00	2.50E-03	6.61E-03
Nitrous Oxide	5.0E-02	1.0E+00	5.00E-04	1.32E-03

Most emission factors are from DAQ spreadsheet for Large Stationary Diesel Engines >600 Hp. Greenhouse gas emission factors are from the Greenhouse Gas Reporting regulations.

The University of North Carolina at Chapel Hill

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2011 Annual Emissions Inventory

**Three Enclosed Railcar Dump Pits
(ES-010)**

Emission Source/Operating Scenario Data Page 1 of 2	Facility ID #: 6800043
Railcar Dump Pits	Permit #: 03069T29
If Emission Source has multiple Operating Scenarios, complete one form for each. (All permitted, Insignificant and/or Non-permitted Sources)	County: Orange
Facility Name: University of North Carolina at Chapel Hill	DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-010
2. Emission Source Description	Three Enclosed Railcar Dump Pits	
3. Operating Scenario Description	N/A	
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)	350 tons/hr	
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)	91,438	tons/yr
6. Fuel Information (if fuel used)	% Sulfur	N/A
	% Ash	N/A
	Heat Content (Btu/lb or mmCF)	N/A

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	N/A
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8. Control Device Information, if none, write "none"

	Control Device ID # <small>(as listed in permit)</small>	Control Device Description
<i>i. (nearest stack)</i>	N/A	Enclosed Dump Pits
<i>ii.</i>	CD-018	Wet Spray Dust Suppression System
<i>iii.</i>	N/A	N/A
<i>iv.</i>	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height <small>(in whole feet)</small>	Diameter (feet) <small>Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)</small>	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description <small>(Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)</small>
Fugitive						
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	1.5	Days/Week	5	Weeks/Year	52	Hours/Year	390
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	32.15%	Mar-May	22.16%	June-Aug	28.39%	Sept-Nov	17.30%
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2011 Cogeneration Emissions Inventory

Fugitive Losses from the unloading of coal from railcars into a dump pit.

(ES-010)

Boiler #6	50,649	Tons/yr
Boiler #7	40,789	Tons/yr
Total	91,438	Tons/yr

From section 13.2.4 of the AP-42, coal handling is well approximated by aggregate handling operations. The following equation represents the particulate emissions generated by the dropping of coal into the dump pit.

$$E = k (0.0032) \frac{(u/5)^{1.3}}{(m/2)^{1.4}}$$

E = Emission Factor (lb/ton)

k = Particle Size Multiplier

u = Mean Wind Speed (mph)

m = Material Moisture Content (%)

k Value	Particulate Size	Emission Factor (lb/ton)
0.74	PM	1.32E-04
0.35	PM-10	6.25E-05
0.11	PM-2.5	1.96E-05

Average moisture content of coal is 4.5%

The dump area is fully enclosed, therefore the minimum wind speed of 1.3 mph was used.

Total Coal 91,438 tons/yr

Emissions from the unloading of coal:

	Emission Factor (lb/ton)	Emissions (lb/yr)	Emissions (ton/yr)
PM	1.32E-04	12.08	6.04E-03
PM-10	6.25E-05	5.71	2.86E-03
PM-2.5	1.96E-05	1.80	8.98E-04

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

**Coal Silos
(ES-1, ES-2)**

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Emissions from the loading of 2 coal storage silos.

(ES-1, ES-2)

Boiler #6	50,649	Tons/yr
Boiler #7	40,789	Tons/yr
Total	91,438	Tons/yr

The bulk density of coal is 47 lb/ft³

Total volume of coal combusted is = 3,890,983 ft³/yr
(Volume of coal combusted = volume of displaced air through bin filter)

These emissions are routed through bin filters (baghouses). Emissions from the bin filters are conservatively estimated at 0.015 gr/acfm (displaced air through bin filters).

$$\text{lb/yr} = (\text{volume of coal, ft}^3/\text{yr}) (0.015 \text{ gr/acf}) (1/7000 \text{ lb/gr})$$

Total Emissions from the silos	58,365	gr/yr
	8.338	lb/yr
	0.0042	ton/yr

100% of these emissions are PM-10

95% of these emissions are PM-2.5

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

**Silo Feed Conveyors
(ES-3)**

Emission Source/Operating Scenario Data Page 1 of 2	Facility ID #: 6800043
<i>Silo Feed Conveyors</i>	Permit #: 03069T29
If Emission Source has multiple Operating Scenarios, complete one form for each. (All permitted, Insignificant and/or Non-permitted Sources)	County: Orange
Facility Name: University of North Carolina at Chapel Hill	DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-3
2. Emission Source Description	Silo Feed Conveyors	
3. Operating Scenario Description	N/A	
4. Maximum Permitted Operating Rate <small>With Units (Ex. gal/hr, mmBtu/hr)</small>	700 tons/hr	
5. Throughput in CY (e.g. production or fuel use) <small>With Units (Ex. lbs/yr, gal/yr)</small>	91,438	tons/yr
6. Fuel Information (if fuel used)	% Sulfur	N/A
	% Ash	N/A
	Heat Content (Btu/lb or mmCF)	N/A

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # <small>(as listed in permit)</small>	Control Device Description
i. (nearest stack)	CD-019	Bagfilter
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height <small>(in whole feet)</small>	Diameter (feet) <small>Circle (center #), Rectangle (L#, W#) (in 0.1 feet)</small>	Temperature <small>(F)</small>	Velocity <small>(feet/sec)</small>	Volume Flow Rate <small>(acfm)</small>	Release Point Description <small>(Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)</small>
EP-12-6901	200	2	Ambient	45	8,500	Vertical
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	N/A	Days/Week	N/A	Weeks/Year	N/A	Hours/Year	N/A
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	32.15%	Mar-May	22.16%	June-Aug	28.39%	Sept-Nov	17.30%
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University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Emissions from silo feed conveyors.

(ES-3)

Boiler #6	50,649	Tons/yr
Boiler #7	40,789	Tons/yr
Total	91,438	Tons/yr

The bulk density of coal is 47 lb/ft³

Total volume of coal combusted is = 3,890,983 ft³/yr
(Volume of coal combusted = volume of displaced air through bin filter)

These emissions are routed through bin filters (baghouses). Emissions from the bin filters are conservatively estimated at 0.015 gr/acfm (displaced air through bin filters).

$$\text{lb/yr} = (\text{volume of coal, ft}^3/\text{yr}) (0.015 \text{ gr/acf}) (1/7000 \text{ lb/gr})$$

Total Emissions from the conveyors	58,365	gr/yr
	8.338	lb/yr
	0.0042	ton/yr

100% of these emissions are PM-10

95% of these emissions are PM-2.5

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Fuel Oil Storage Tanks

(T-001 and T-002)

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Summary of Emissions from Tanks T-001 & T-002 **(ES-T-001 and ES-T-002)**

VOC Emissions calculated with EPA TANKS 4.0 Program

T-001	214.50	lb/yr	0.107	Tons/yr
T-002	214.50	lb/yr	0.107	Tons/yr
Total	429.00	lb/yr	0.215	Tons/yr

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Boiler #6 (ES-001-Boiler #6)

Operating Scenarios

#1 - Coal Firing

#2 - Natural Gas Firing

#4 - No.2 Fuel Oil Firing

#5 - Wood Pellet Firing

(#3 - No.6 Fuel Oil Firing is no longer permitted)

Boilers #6 and #7 are equipped with Continuous Emission Monitoring (CEMs) devices to measure SO₂, NO_x, and CO₂ emissions from each of the boilers. The monthly averages presented in the attached spreadsheets are for the total emissions from firing all types of fuel. The Annual Emission Inventory forms require that the emissions be divided among the three possible operating scenarios.

NO_x and CO₂ emissions have been divided between the four operating scenarios based on the percentage of total heat input by each fuel. These calculations are detailed in the attached spreadsheets.

SO₂ emissions from natural gas and wood pellet combustion are insignificant, therefore, SO₂ emissions have been divided between the fuel oil and coal operating scenarios based on the percentage of total heat input by each fuel. These calculations are detailed in the attached spreadsheets.

Emissions Calculations

SO₂, NO_x, and CO₂ Emissions are taken from CEMs data
Other emission factors are from stack test or DAQ spreadsheets

Boiler #6 - Operating Scenario #4 - No. 2 Fuel Oil

If Emission Source has multiple Operating Scenarios, complete one form for each.

(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "T" for insignificant)		ES-001-Boiler #6					
2. Emission Source Description		Coal / Natural Gas / No. 2 Fuel Oil/Wood Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #4 - No. 2 Fuel Oil					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		323.17 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		36		gallons/yr			
6. Fuel Information (if fuel used)		% Sulfur	0.08%	% Ash		Heat Content (Btu/lb or mmCF)	139,043 Btu/gal

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	CD-004	Bagfilter with Calcium Carbonate (CaCO ₃) Sorbent Injection
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
EP-14-136	220	9	305	56.1	214,000	Vertical
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	8,057 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	100.00%	Mar-May	0.00%	June-Aug	0.00%	Sept-Nov	0.00%
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Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-001-Boiler #6

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	9.03E-05	8	N/A
NOx	NOx	8.83E-04	1	N/A
PM Total	PM	2.38E-05	8	99.0%
PM-2.5	PM-2.5	5.96E-06	8	99.0%
PM-10	PM-10	2.38E-05	8	99.0%
SO2	SO2	4.16E-04	1	90.0%
VOC	VOC	3.61E-06	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Antimony	ANTIMONYPDS	0.00E+00	8	99.0%
Arsenic	ARSENICPDS	2.02E-07	8	99.0%
Benzene	71-43-2	9.93E-05	8	N/A
Beryllium	BERYLCPDS	1.52E-07	8	99.0%
Cadmium	CADMIUMCPDS	1.52E-07	8	99.0%
Chromium	CROMCPDS	1.52E-07	8	99.0%
Chromium VI	CHROM6CPDS	4.45E-08	8	99.0%
Cobalt	COBALTCPDS	0.00E+00	8	99.0%
Ethylbenzene	100-41-4	2.95E-05	8	N/A
Fluoride	16984-48-8	0.00	8	N/A
Formaldehyde	50-00-0	0.00	8	N/A
Lead	LEADCPDS	4.55E-07	8	99.0%
Manganese	MANGCPDS	3.03E-07	8	99.0%
Mercury	MERCPDS	1.52E-05	8	99.0%
Methyl chloroform	71-55-6	8.52E-06	8	N/A
Napthalene	91-20-3	1.20E-07	8	N/A
Nickel	NICKCPDS	1.52E-07	8	99.0%
POM	POM	1.19E-06	8	99.0%
Selenium	SEC	7.58E-07	8	99.0%
Toluene	108-88-3	0.00	8	N/A
Xylene	1330-20-7	5.06E-05	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	0.45	8	N/A
Methane	CH ₄	1.66E-05	8	N/A
Nitrous oxide	N ₂ O	3.32E-06	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Boiler #6 - Operating Scenario #1 - Coal

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility Name: University of North Carolina at Chapel Hill

Facility ID #: 6800043
 Permit #: 03069T29
 County: Orange
 DAQ Region: Raleigh

**North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-001-Boiler #6					
2. Emission Source Description		Coal / Natural Gas / No. 2 Fuel Oil/Wood Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #1 - Coal					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		323.17 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		50,649				tons/yr	
6. Fuel Information (if fuel used)		% Sulfur	1.74%	% Ash	8.36%	Heat Content (Btu/lb or mmCF)	12,880 Btu/lb

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	CD-004	Bagfilter with Calcium Carbonate (CaCO ₃) Sorbent Injection
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
EP-14-136	220	9	305	56.1	214,000	Vertical
--	--	--	--	--	--	--
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	8057 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	33.83%	Mar-May	24.72%	June-Aug	26.50%	Sept-Nov	14.96%
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Boiler #6 - Operating Scenario #1 - Coal

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility Name:

University of North Carolina at Chapel Hill

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-001-Boiler #6

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	22.25	8	N/A
NOx	NOx	229.41	1	N/A
PM Total	PM	5.52	8	99.80%
PM-2.5	PM-2.5	3.18	8	97.90%
PM-10	PM-10	5.52	8	99.60%
SO2	SO2	108.24	1	90.00%
VOC	VOC	0.30	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Acetaldehyde	750-07-0	28.87	8	N/A
Acetophenone	98-86-2	0.76	8	N/A
Acrolein	107-02-8	14.69	8	N/A
Arsenic*	ARSENICPDS	0.39	8	99.60%
Benzene	71-43-2	65.84	8	N/A
Benzo(a)pyrene	50-32-8	1.92E-03	8	N/A
Benzyl chloride	100-44-7	35.45	8	N/A
Beryllium*	BERYLCPDS	0.07	8	N/A
Biphenyl	92-52-4	8.61E-02	8	N/A
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	3.70	8	N/A
Bromine	7726-95-6	10.70	8	99.60%
Bromoform	75-25-2	1.98	8	N/A
Cadmium*	CADMIUMCPDS	1.81E-01	8	99.60%
Carbon disulfide	75-10-0	6.58	8	N/A
2-Chloroacetophenone	532-27-4	0.35	8	N/A
Chlorobenzene	108-90-7	1.11	8	N/A
Chloroform	67-66-3	2.99	8	N/A
Chromium*	CROMCPDS	6.26	8	99.60%
Chromium (VI)	CHROM6CPDS	0.01	8	99.60%
Cumene	98-82-8	0.27	8	N/A
Cyanide	CNC	126.62	8	N/A
Dibenzofurans	132-64-9	1.02E-02	8	N/A
Dimethyl sulfate	77-78-1	2.43	8	N/A
2,4-Dinitrotoluene	121-14-2	1.42E-02	8	N/A
Ethyl benzene	100-41-4	4.76	8	N/A
Ethyl chloride	75-00-3	2.13	8	N/A
Ethylene dibromide	106-93-4	6.08E-02	8	N/A
Ethylene dichloride	107-06-2	2.03	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Boiler #6 - Operating Scenario #1 - CoalIf Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility Name:

University of North Carolina at Chapel Hill

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources

Division of Air Quality

Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-001-Boiler #6

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	N/A	N/A	N/A
NOx	NOx	N/A	N/A	N/A
PM Total	PM	N/A	N/A	N/A
PM-2.5	PM-2.5	N/A	N/A	N/A
PM-10	PM-10	N/A	N/A	N/A
SO2	SO2	N/A	N/A	N/A
VOC	VOC	N/A	N/A	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Formaldehyde*	50-0-00	85.85	8	N/A
Hexane	HEXANEISO	3.39	8	N/A
Hydrogen Chloride *	7647-01-0	16700.49	8	N/A
Hydrogen Fluoride *	7664-39-3	300.09	8	90% Control with CaCO ₃
Isophorone	78-59-1	29.38	8	N/A
Lead*	LEADCPDS	2.30	8	99.60%
Manganese*	MANGCPDS	15.66	8	99.60%
Mercury*	MERCCPDS	1.09	8	N/A
Methyl bromide	74-83-9	8.10	8	N/A
Methyl chloride	74-87-3	26.84	8	N/A
Methyl ethyl ketone	78-93-3	19.75	8	N/A
Methyl hydrazine	60-34-4	8.61	8	N/A
Methyl methacrylate	80-62-6	1.01	8	N/A
Methyl tert butyl ether	1634-04-4	1.77	8	N/A
Methylene chloride	75-09-2	14.69	8	N/A
Naphthalene	91-20-3	0.66	8	N/A
Nickel	NICKCPDS	12.75	8	99.60%
Phenol	108-95-2	0.81	8	N/A
POM	POM	2.92	8	N/A
Propionaldehyde	123-38-6	19.25	8	N/A
Styrene	100-42-5	1.27	8	N/A
2,3,7,8-TCDD	1746-01-6	7.24E-07	8	N/A
Tetrachloroethylene	79-34-5	2.18	8	N/A
Toluene	108-88-3	12.16	8	N/A
1,1,1-Trichloroethane	79-00-5	1.01	8	N/A
Vinyl acetate	108-05-4	0.38	8	N/A
Xylenes	1330-20-7	1.87	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	146,299.82	8	N/A
Methane	CH ₄	0.25	8	N/A
Nitrous oxide	N ₂ O	2.30	8	N/A

Boiler #6 - Operating Scenario #3 - Natural Gas

If Emission Source has multiple Operating Scenarios, complete one form for each.

(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "T" for insignificant)		ES-001-Boiler #6					
2. Emission Source Description		Coal / Natural Gas / No. 2 Fuel Oil/Wood Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #2 - Natural Gas					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		323.17 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		27,073			1,000 ft ³ /yr		
6. Fuel Information (if fuel used)		% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	1,030 Btu/ft ³

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	CD-004	Bagfilter with Calcium Carbonate (CaCO ₃) Sorbent Injection
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
EP-14-136	220	9	305	56.1	214,000	Vertical
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--	--	--	--	--	--	--

10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	8059 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	0.11%	Mar-May	10.65%	June-Aug	0.48%	Sept-Nov	88.76%
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Boiler #6 - Operating Scenario #3 - Natural Gas

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-001-Boiler #6

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	1.14	8	N/A
NOx	NOx	4.90	1	N/A
PM Total	PM	0.10	8	N/A
PM-2.5	PM-2.5	0.10	8	N/A
PM-10	PM-10	0.10	8	N/A
SO2	SO2	0.00	1	N/A
VOC	VOC	0.07	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Arsenic	ARSENICPDS	5.41E-03	8	N/A
Benzene	71-43-2	0.06	8	N/A
Cadmium	CADMIUMCPDS	2.98E-02	8	N/A
Chromium	CROMCPDS	3.79E-02	8	N/A
Chromium VI	CHROM6CPDS	3.79E-02	8	N/A
Dichlorobenzene	106-46-7	3.25E-02	8	N/A
Formaldehyde	50-00-0	2.03	8	N/A
Hexane	HEXANEISO	48.73	8	N/A
Lead	LEADCPDS	1.35E-02	8	N/A
Manganese	MANGCPDS	1.03E-02	8	N/A
Mercury	MERCPDS	7.04E-03	8	N/A
Napthalene	91-20-3	1.65E-02	8	N/A
Nickel	NICKCPDS	0.06	8	N/A
POM	POM	1.79E-02	8	N/A
Toluene	108-88-3	0.09	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	1,774.98	8	N/A
Methane	CH ₄	3.074E-02	8	N/A
Nitrous oxide	N ₂ O	3.074E-03	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Boiler #6 - Operating Scenario #5 - Wood Pellets
 If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: **6800043**
 Permit #: **03069T29**
 County: **Orange**
 DAQ Region: **Raleigh**

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-001-Boiler #6					
2. Emission Source Description		Coal / Natural Gas / No. 2 Fuel Oil/Wood Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #5 - Wood Pellets					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		64.63 MMBtu/hr (20% HI from wood pellets)					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)			390.9			tons/yr	
6. Fuel Information (if fuel used)		% Sulfur	NA	% Ash	NA	Heat Content (Btu/lb or mmCF)	8,125 Btu/lb

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	CD-004	Bagfilter with Calcium Carbonate (CaCO ₃) Sorbent Injection
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
EP-14-136	220	9	305	56.1	214,000	Vertical
--	--	--	--	--	--	--
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	8057 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	0.00%	Mar-May	100.00%	June-Aug	0.00%	Sept-Nov	0.00%
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Boiler #6 - Operating Scenario #5 - Wood Pellets
 If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-001-Boiler #6

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	0.544	8	N/A
NOx	NOx	1.125	1	N/A
PM Total	PM	0.00267	8	99.80%
PM-2.5	PM-2.5	0.00209	8	97.90%
PM-10	PM-10	0.00241	8	99.60%
SO2	SO2	CEM w/coal	1	90.00%
VOC	VOC	0.0544	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Acetaldehyde	750-07-0	5.31E+00	8	N/A
Acetophenone	98-86-2	2.05E-05	8	N/A
Acrolein	107-02-8	2.56E+01	8	N/A
Antimony	7440-36-0	2.02E-04	8	99.60%
Arsenic	ARSENICPDS	5.63E-04	8	99.60%
Benzene	71-43-2	2.69E+01	8	N/A
Benzo(a)pyrene	50-32-8	1.66E-02	8	N/A
Beryllium	BERYLCPDS	2.82E-05	8	99.60%
Cadmium	CADMIUMCPDS	1.05E-04	8	99.60%
Carbon tetrachloride	56-23-5	2.88E-01	8	N/A
Chlorine	7782-50-5	5.06E+00	8	N/A
Chlorobenzene	108-90-7	2.11E-01	8	N/A
Chloroform	67-66-3	1.79E-01	8	N/A
Chromium	CROMCPDS	4.48E-04	8	99.60%
Cobalt	7440-48-4	1.66E-04	8	99.60%
Di(2-ethylhexyl)phthalate	117-81-7	3.01E-04	8	N/A
Dinitrophenol, 2,4-	51-28-5	1.15E-03	8	N/A
Ethyl benzene	100-41-4	1.98E-01	8	N/A
Ethylene dichloride	107-06-2	1.86E-01	8	N/A
Formaldehyde*	50-0-00	2.82E+01	8	N/A
Hexachlorodib-dioxin	57653-85-7	1.02E-02	8	N/A
Hydrogen Chloride *	7647-01-0	3.91E+01	8	68% Control with CaCO ₃
Lead*	LEADCPDS	1.23E-03	8	99.60%
Manganese*	MANGCPDS	4.10E-02	8	99.60%
Mercury*	MERCCPDS	1.72E-03	8	92%
Methyl bromide	74-83-9	9.60E-02	8	N/A
Methyl chloride	74-87-3	1.47E-01	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Boiler #6 - Operating Scenario #1 - Coal

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-001-Boiler #6

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	N/A	N/A	N/A
NOx	NOx	N/A	N/A	N/A
PM Total	PM	N/A	N/A	N/A
PM-2.5	PM-2.5	N/A	N/A	N/A
PM-10	PM-10	N/A	N/A	N/A
SO2	SO2	N/A	N/A	N/A
VOC	VOC	N/A	N/A	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Methyl chloroform	71-55-6	1.98E-01	8	N/A
Methyl ethyl ketone	78-93-3	3.46E-02	8	N/A
Methylene chloride	75-09-2	1.86E+00	8	N/A
Naphthalene	91-20-3	6.21E-01	8	N/A
Nickel	NICKCPDS	8.45E-04	8	99.60%
Nitrophenol, 4-	100-02-07	7.04E-04	8	N/A
Pentachlorophenol	87-86-5	3.26E-04	8	N/A
Perchloroethylene	127-18-4	2.43E-01	8	N/A
Phenol	108-95-2	3.26E-01	8	N/A
Phosphorus	7723-14-0	6.91E-04	8	99.60%
Polychlorinated biphenyls	1336-36-3	5.22E-05	8	N/A
POM	POM	8.00E-01	8	N/A
Propionaldehyde	123-38-6	3.90E-01	8	N/A
Propylene dichloride	78-87-5	2.11E-01	8	N/A
Selenium	7782-49-2	7.17E-05	8	99.60%
Styrene	100-42-5	1.22E+01	8	N/A
2,3,7,8-TCDD	1746-01-6	5.50E-08	8	N/A
Toluene	108-88-3	5.89E+00	8	N/A
Trichloroethylene	79-01-6	1.92E-01	8	N/A
Trichlorofluoromethane	75-69-4	2.62E-01	8	N/A
Trichlorophenol	95-95-4	1.41E-04	8	N/A
Vinyl chloride	75-01-4	1.15E-01	8	N/A
Xylenes	1330-20-7	1.60E-01	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	720.60	8	N/A
Methane	CH ₄	0.2256	8	N/A
Nitrous oxide	N ₂ O	0.0296	8	N/A

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Boiler #6

(ES-001-Boiler #6)

Emissions Calculations

SO₂, NO_x, and CO₂ Emissions are Taken from CEMs Data
Other emission factors are from stack test or DAQ spreadsheets

**Fuel Oil Combustion Emissions Calculator FO2000 Revision A
2011 Cogeneration Emissions Inventory**

**Boiler #6
(ES-001-Boiler #6)
Facility ID # 6800043
Permit # 03069T29**

Operating Scenario #4 - No.2 Fuel Oil

User Input	
Company Name:	University of North Carolina at Chapel Hill
Plant County:	Orange County
Plant City:	Chapel Hill
Permit Number:	03069T29
User:	RST Engineering
Heat Input Capacity (mmBtu/hr):	323.17
Fuel Input Capacity (10 ³ gal/hr):	2.31
Annual Fuel Throughput (1000 gal):	0.036
Maximum fuel sulfur content (%):	0.08
Latest Construction/Modification Date:	N/A
Enter the boiler type below ↘	
	15

Boilers =>100 mmBtu/hr	Boilers =>100 mmBtu/hr (cont'd)
1 = No. 6 oil fired, normal firing (U)	16 = No. 2 oil fired (C)
2 = No. 6 oil fired, normal firing (I)	17 = No. 2 oil fired, LNB/FGR (U,I)
3 = No. 6 oil fired, normal firing (C)	18 = No. 2 oil fired, LNB/FGR (C)
4 = No. 6 oil fired, normal firing, low NOx burner (U)	
5 = No. 6 oil fired, normal firing, low NOx burner (I)	19 = Vertical fired utility boiler
6 = No. 6 oil fired, normal firing, low NOx burner (C)	
7 = No. 6 oil fired, tangential firing (U)	Small Boilers (<100 mmBtu/hr)
8 = No. 6 oil fired, tangential firing, low NOx burner (U)	20 = No. 6 oil fired (I)
9 = No. 5 oil fired, normal firing (U)	21 = No. 6 oil fired (C)
10 = No. 5 oil fired, normal firing (I)	22 = No. 5 oil fired (C)
11 = No. 5 oil fired, tangential firing (U)	23 = No. 4 oil fired (C)
12 = No. 4 oil fired, normal firing (U)	24 = No. 2 oil fired (I)
13 = No. 4 oil fired, normal firing (I)	25 = No. 2 oil fired (C)
14 = No. 4 oil fired, tangential firing (U)	
15 = No. 2 oil fired (U,I)	26 = Residential Furnace

Fuel Oil Combustion Emissions Calculator **FO2000 Revision A**

2011 Cogeneration Emissions Inventory

Boiler #6

(ES-001-Boiler #6)

Facility ID # 6800043

Permit # 03069T29

Operating Scenario #4 - No.2 Fuel Oil

User Input	
Company Name:	University of North Carolina at Chapel Hill
Plant County:	Orange County
Plant City:	Chapel Hill
Permit Number:	03069T29
User:	RST Engineering
Heat Input Capacity (mmBtu/hr):	323.17
Fuel Input Capacity (10 ³ gal/hr):	2.31
Annual Fuel Throughput (1000 gal):	0.036
Maximum fuel sulfur content (%):	0.08
Latest Construction/Modification Date:	N/A

Emission Controls

Particulate controls

Enter the control type below ▾	Message Area	Or enter a PM control efficiency below to override built in values.
3		
Control Device	Avg. Cont. Effic.	User Input PM Cont. Effic.
0 = None/other		
1 = ESP		
2 = Scrubber		
3 = Bagfilter	99.0	
4 = Multiple cyclone		
		Message Area

Postcombustion SO₂ controls

Enter the control type below ▾	Message Area	Or enter an SO ₂ control efficiency below to override built in values.
0		
Control Technology/Process	Avg. Cont. Effic.	User Input SO ₂ Cont. Effic.
0 = None/other		90.0
1 = Wet scrubber, Lime/limestone		
2 = Wet scrubber, Sodium carbonate	0.0	
3 = Wet scrubber, Magnesium oxide/hydroxide		
4 = Wet scrubber, Dual alkali		
5 = Spray drying, calcium hydroxide slurry, vap. in spray vessel		
6 = Furnace injection, Dry calcium carbonate/hydrate inj. in upper furn. cavity		
7 = Duct injection, Dry sorbent injection into duct, sometimes combined with water spray	Remarks	
	NA	
		User entered control efficiency may be overestimated and should be documented.

NO_x controls

Enter the control type below ▾	Message Area	Or enter a NO _x control efficiency below to override built in values.
5		
Control Technology/Process	Avg. Cont. Effic.	User Input NO _x Cont. Effic.
0 = None/other		0.0
1 = Low excess air (LEA)		
2 = Staged combustion (SC)		
3 = Burners out of service (BOOS)	39.0	
4 = Flue gas recirculation (FGR)		
5 = Flue gas recirculation plus staged combustion		
6 = Low NO _x burners (LNB)		
7 = Reduced air preheat (RAP)		
8 = Selective noncatalytic reduction (SNCR)		
9 = Conventional selective catalytic reduction (SCR)	Remarks	
	Available for boilers with sufficient operational flexibility	
		Message Area

Fuel Oil Combustion Emissions Calculator FO2000 Revision A
2011 Cogeneration Emissions Inventory

Boiler #6
(ES-001-Boiler #6)
Facility ID # 6800043
Permit # 03069T29

Operating Scenario #4 - No.2 Fuel Oil

User Input	
Company Name:	University of North Carolina at Chapel Hill
Plant County:	Orange County
Plant City:	Chapel Hill
Permit Number:	03069T29
User:	RST Engineering
Heat Input Capacity (mmBtu/hr):	323.17
Fuel Input Capacity (10 ³ gal/hr):	2.31
Annual Fuel Throughput (1000 gal):	0.036
Maximum fuel sulfur content (%):	0.08
Latest Construction/Modification Date:	N/A

Emissions Output (for operation 3.42 hr/yr)				Emission Factor ¹
Criteria Pollutants				(lb/10 ³ gal)
Pollutant	lb/hr ²	tpy	lb/yr ³	
Total PM (FPM + CPM)	3.0	0.000	0	3.30E+00
Filterable PM (FPM) rates @ 99% control	0.0	0.000	0	2.00E+00
Condensable PM (CPM) ⁴	3.0	0.000	0	1.30E+00
Filterable PM-10 ⁵	0.0	0.000	0	1.00E+00
Filterable PM-2.5 ⁵	0.0	0.000	0	2.50E-01
NOx rates @ 39% control	see attached CEMs-based calculations			2.40E+01
NMTOC	0	0.000	0	2.00E-01
CO	12	0.000	0	5.00E+00
SO2 rates @ 90% control	see attached CEMs-based calculations			2.98E+02
Total HAP ⁶	4.17E-01	0.000	0	1.81E-01
Largest HAP ⁶	1.84E-01	0.000	0	7.97E-02

Toxic/Hazardous Air Pollutants				Emission Factor ¹
Pollutant	lb/hr ²	lb/day ⁷	lb/yr ³	(lb/10 ³ gal)
Antimony rates @ 99% control	0.00E+00	NA	0.00E+00	0.00E+00
Arsenic rates @ 99% control	1.29E-05	NA	2.02E-07	5.60E-04
Benzene	6.35E-03	NA	9.93E-05	2.75E-03
Beryllium rates @ 99% control	9.70E-06	NA	1.52E-07	4.20E-04
Cadmium rates @ 99% control	9.70E-06	NA	1.52E-07	4.20E-04
Chromium rates @ 99% control	9.70E-06	NA	1.52E-07	4.20E-04
Chromium VI rates @ 99% control	2.85E-06	NA	4.45E-08	1.23E-04
Cobalt rates @ 99% control	0.00E+00	NA	0.00E+00	0.00E+00
Ethylbenzene	1.89E-03	NA	2.95E-05	8.17E-04
Fluoride	8.61E-02	2.07E+00	1.35E-03	3.73E-02
Formaldehyde	1.11E-01	2.66E+00	1.73E-03	4.80E-02
Lead rates @ 99% control	2.91E-05	NA	4.55E-07	1.26E-03
Manganese rates @ 99% control	1.94E-05	4.65E-04	3.03E-07	8.40E-04
Mercury	9.70E-04	2.33E-02	1.52E-05	4.20E-04
Methyl chloroform (1,1,1-Trichloroethane)	5.45E-04	1.31E-02	8.52E-06	2.36E-04
Naphthalene	7.69E-04	NA	1.20E-07	3.33E-04
Nickel rates @ 99% control	9.70E-06	2.33E-04	1.52E-07	4.20E-04
POM rates @ 99% control	7.62E-05	NA	1.19E-06	3.30E-03
Selenium rates @ 99% control	4.85E-05	NA	7.58E-07	2.10E-03
Toluene	1.84E-01	4.41E+00	2.88E-03	7.97E-02
Xylene	3.23E-03	7.76E-02	5.06E-05	1.40E-03

Greenhouse Gases				Emission Factor
Pollutant	lb/hr ²	tpy	lb/yr ³	(lb/10 ³ gal)
Carbon dioxide	see attached CEMs-based calculations			22671.27
Methane	2.12E+00	1.66E-05	3.32E-02	0.920
Nitrous Oxide	4.25E-01	3.32E-06	6.64E-03	0.18

¹Emission factors represent AP-42 uncontrolled values. Emission rates are reflective of controls where applicable.

²Hourly emission rates for all pollutants are based on hourly rated capacity.

³Annual emission rates for all pollutants are based on maximum annual fuel throughput.

⁴Wet scrubbers are assumed to control CPM whereas other PM control devices are assumed to only control FPM.

⁵AP-42 assumes PM-10 and PM-2.5 assumes these pollutants are controlled with the same efficiency as total PM.

⁶Total and largest HAP factors and emission rates do not reflect control of metals. Individual metal emission rates are reflective of particulate matter controls where applicable.

Fuel Oil Combustion Emissions Calculator **FO2000 Revision A**
2011 Cogeneration Emissions Inventory

Boiler #6
(ES-001-Boiler #6)
Facility ID # 6800043
Permit # 03069T29

Operating Scenario #4 - No.2 Fuel Oil

User Input	
Company Name:	University of North Carolina at Chapel Hill
Plant County:	Orange County
Plant City:	Chapel Hill
Permit Number:	03069T29
User:	RST Engineering
Heat Input Capacity (mmBtu/hr):	323.17
Fuel Input Capacity (10 ³ gal/hr):	2.31
Annual Fuel Throughput (1000 gal):	0.036
Maximum fuel sulfur content (%):	0.08
Latest Construction/Modification Date:	N/A

⁷Daily emission rates are based on operation 24 hours per day at rated capacity.

Bituminous Coal Combustion

2011 Cogeneration Emissions Inventory

Facility **University of North Carolina at Chapel Hill**
 City **Chapel Hill**
 County **Orange County**

APP #/Fac ID **6800043**
 Input By **RST Engineering**
 Source ID **Boiler #6**
 (ES-001-Boiler #6)

Operating Scenario #1

Data Input

Maximum Heat Input	<input type="text" value="323.17"/>	mmBtu/hr	Boiler Type:	<input type="text" value="7"/>
Boiler Size/Type	Large Industrial		1) Pulverized/Dry Bottom	6) Underfeed Stoker
Actual Fuel Usage	<input type="text" value="50,649"/>	ton/yr	2) Pulverized/Wet Bottom	7) Fluidized Bed Cir.
or	or		3) Cyclone Furnace	8) Fluidized Bed Bub.
Hours of Operation	<input type="text"/>	hr/yr	4) Spreader Stoker	9) Hand Fed
and	and		5) Overfeed Stoker	
Heating Value	<input type="text" value="12,880"/>	Btu/lb	Control Device Efficiencies:	
		ton/yr	PM	<input type="text" value="99.80"/> %
Sulfur Content	<input type="text" value="1.74"/>	%	PM-10	<input type="text" value="98.00"/> %
Ash Content :	<input type="text" value="8.4"/>	%	PM-2.5	<input type="text" value="97.90"/> %
(B)ituminous or (S)ubbituminous?	<input type="text" value="B"/>	(B/S)	SOx*	<input type="text" value="90.00"/> %
Calcium to Sulfur Ratio	<input type="text" value="2.22"/>		NOx*	<input type="text" value="0.00"/> %

**SOx and NOx emission estimates were calculated using CEMS data. Please refer to the SOx and NOx emissions data presented in the following CEMs spreadsheets.
 HCl, HF, and Hg emissions based on stack test data.*

Bituminous Coal Combustion

2011 Cogeneration Emissions Inventory

Facility **University of North Carolina at Chapel Hill**
 City **Chapel Hill**
 County **Orange County**

APP #/Fac ID **6800043**
 Input By **RST Engineering**
 Source ID **Boiler #6**
(ES-001-Boiler #6)

Operating Scenario #1

ACTUAL CRITERIA EMISSIONS

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
PM*	0.22	2.73	11,031	5.52
PM-10*	0.22	2.73	11,031	5.52
PM-2.5*	0.13	1.58	6,361	3.18
SO2	15.14	**	**	**
SO3	0.11	**	**	**
NOx	3.90	**	**	**
VOC*	0.01	0.15	600	0.30
CO*	0.88	11.02	44,491	22.25

ACTUAL TOXIC EMISSIONS

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
Acetaldehyde	5.70E-04	7.15E-03	2.89E+01	1.44E-02
Acetophenone	1.50E-05	1.88E-04	7.60E-01	3.80E-04
Acrolein	2.90E-04	3.64E-03	1.47E+01	7.34E-03
Antimony*	8.32E-06	1.04E-04	4.21E-01	2.11E-04
Arsenic*	7.75E-06	9.73E-05	3.93E-01	1.96E-04
Benzene	1.30E-03	1.63E-02	6.58E+01	3.29E-02
Benzo(a)pyrene	3.80E-08	4.77E-07	1.92E-03	9.62E-07
Benzyl chloride	7.00E-04	8.78E-03	3.55E+01	1.77E-02
Beryllium*	1.36E-06	1.71E-05	6.89E-02	3.44E-05
Biphenyl	1.70E-06	2.13E-05	8.61E-02	4.31E-05
Bis(2-ethylhexyl)phthalate (DEHP)	7.30E-05	9.16E-04	3.70E+00	1.85E-03
Bromine	1.06E-01	2.65E-03	1.07E+01	5.35E-03
Bromoform	3.90E-05	4.89E-04	1.98E+00	9.88E-04
Cadmium*	3.58E-06	4.49E-05	1.81E-01	9.07E-05
Carbon disulfide	1.30E-04	1.63E-03	6.58E+00	3.29E-03
2-Chloroacetophenone	7.00E-06	8.78E-05	3.55E-01	1.77E-04
Chlorobenzene	2.20E-05	2.76E-04	1.11E+00	5.57E-04
Chlorine*	2.78E-03	3.49E-02	1.41E+02	7.05E-02
Chloroform	5.90E-05	7.40E-04	2.99E+00	1.49E-03
Chromium*	1.24E-04	1.55E-03	6.26E+00	3.13E-03
Chromium (VI)	1.24E-04	3.10E-06	1.25E-02	6.26E-06
Cobalt*	7.11E-06	8.92E-05	3.60E-01	1.80E-04
Cumene	5.30E-06	6.65E-05	2.68E-01	1.34E-04
Cyanide	2.50E-03	3.14E-02	1.27E+02	6.33E-02
Dibenzofurans	2.01E-07	2.52E-06	1.02E-02	5.09E-06
Dimethyl sulfate	4.80E-05	6.02E-04	2.43E+00	1.22E-03
2,4-Dinitrotoluene	2.80E-07	3.51E-06	1.42E-02	7.09E-06
Ethyl benzene	9.40E-05	1.18E-03	4.76E+00	2.38E-03
Ethyl chloride	4.20E-05	5.27E-04	2.13E+00	1.06E-03
Ethylene dibromide	1.20E-06	1.51E-05	6.08E-02	3.04E-05
Ethylene dichloride	4.00E-05	5.02E-04	2.03E+00	1.01E-03
Formaldehyde*	1.70E-03	2.13E-02	8.59E+01	4.29E-02
Hexane	6.70E-05	8.41E-04	3.39E+00	1.70E-03
Hydrogen Chloride *	3.30E-01	4.14E+00	1.67E+04	8.35E+00
Hydrogen Fluoride *	5.92E-03	7.43E-02	3.00E+02	1.50E-01
Isophorone	5.80E-04	7.28E-03	2.94E+01	1.47E-02
Lead*	4.53E-05	5.69E-04	2.30E+00	1.15E-03

**SO₂ and NOx emissions were estimated using CEMS data, please refer to the attached data sheets entitled "Sulfur Dioxide Emissions from Boiler #6" and Nitrogen Dioxide Emissions from Boiler #6".

Bituminous Coal Combustion

2011 Cogeneration Emissions Inventory

Facility **University of North Carolina at Chapel Hill**
 City **Chapel Hill**
 County **Orange County**

APP #/Fac ID **6800043**
 Input By **RST Engineering**
 Source ID **Boiler #6**
(ES-001-Boiler #6)

Operating Scenario #1

ACTUAL TOXIC EMISSIONS (continued)

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
<i>Manganese*</i>	3.09E-04	3.88E-03	1.57E+01	7.83E-03
<i>Mercury*</i>	2.16E-05	2.70E-04	1.09E+00	5.46E-04
Methyl bromide	1.60E-04	2.01E-03	8.10E+00	4.05E-03
Methyl chloride	5.30E-04	6.65E-03	2.68E+01	1.34E-02
Methyl ethyl ketone	3.90E-04	4.89E-03	1.98E+01	9.88E-03
Methyl hydrazine	1.70E-04	2.13E-03	8.61E+00	4.31E-03
Methyl methacrylate	2.00E-05	2.51E-04	1.01E+00	5.06E-04
Methyl tert butyl ether	3.50E-05	4.39E-04	1.77E+00	8.86E-04
Methylene chloride	2.90E-04	3.64E-03	1.47E+01	7.34E-03
Naphthalene	1.30E-05	1.63E-04	6.58E-01	3.29E-04
<i>Nickel*</i>	2.52E-04	3.16E-03	1.27E+01	6.37E-03
Phenol	1.60E-05	2.01E-04	8.10E-01	4.05E-04
<i>Phosphorus*</i>	3.76E-05	4.72E-04	1.90E+00	9.52E-04
POM	5.77E-05	7.24E-04	2.92E+00	1.46E-03
Propionaldehyde	3.80E-04	4.77E-03	1.92E+01	9.62E-03
<i>Selenium*</i>	5.54E-06	6.95E-05	2.81E-01	1.40E-04
Styrene	2.50E-05	3.14E-04	1.27E+00	6.33E-04
2,3,7,8-TCDD	1.43E-11	1.79E-10	7.24E-07	3.62E-10
Tetrachloroethylene	4.30E-05	5.39E-04	2.18E+00	1.09E-03
Toluene	2.40E-04	3.01E-03	1.22E+01	6.08E-03
1,1,1-Trichloroethane	2.00E-05	2.51E-04	1.01E+00	5.06E-04
Vinyl acetate	7.60E-06	9.53E-05	3.85E-01	1.92E-04
Xylenes	3.70E-05	4.64E-04	1.87E+00	9.37E-04
Total HAPs		4.39	17,725.81	8.86

Greenhouse Gases

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
Carbon dioxide			see attached CEMs-based calculations	
<i>Methane*</i>	0.010	0.12	495.80	0.25
Nitrous Oxide	0.09	1.14	4,602	2.30

***Emission rates for pollutants in italics from August 2009 Section 114 test of Boiler #6.**

Notes :

- 1) Emission factors are from Supplement B to the 5th edition of AP-42, unless otherwise noted
- 2) Emission calculations will be based on the hours of operation only when actual fuel usage is not supplied
- 3) Particulate controls affect PM, PM-10, PM-2.5, and all toxics that are regulated as particulates except Mercury
- 4) VOC = NMTOC = TOC * (1-%METHANE)
- 5) PM-2.5 and SO3 do not currently need to be reported
- 6) Dibenzofurans = Polychlorinated dibenzo-p-furans
- 7) The Br emission factor is based on a mass balance generated from a 3 year coal analysis for Duke Power (1990-1992, 7 samples per year). The average concentration of bromine was 55.33 ppm (wet basis) and a heating value of 13,500 Btu/lb was assumed
- 8) For fluidized bed combustion the emission factor for underfeed stokers is utilized whenever the calcium-to-sulfur ratio is outside of the acceptable range of 1.5 to 7

Natural Gas Combustion Emissions Calculator NG2000 Revision C
2011 Cogeneration Emissions Inventory

Boiler #6

(ES-001-Boiler #6)

Facility ID # 6800043
 Permit # 03069T29

Operating Scenario #2

User Input	Emissions Output																																																																																							
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">Company Name:</td> <td>University of North Carolina at Chapel Hill</td> </tr> <tr> <td>Plant County:</td> <td>Orange County</td> </tr> <tr> <td>Plant City:</td> <td>Chapel Hill</td> </tr> <tr> <td>Permit Number:</td> <td>03069T29</td> </tr> <tr> <td>User:</td> <td>RST Engineering</td> </tr> <tr> <td>Heat Input Capacity (mmBtu/hr):</td> <td align="right">323.17</td> </tr> <tr> <td>Fuel Input Capacity (10⁶ scf/hr):</td> <td align="right">0.32</td> </tr> <tr> <td>Annual Fuel Throughput (10⁶ scf):</td> <td align="right">27.07</td> </tr> <tr> <td>Latest Construction/Modification Date:</td> <td>N/A</td> </tr> </table>	Company Name:	University of North Carolina at Chapel Hill	Plant County:	Orange County	Plant City:	Chapel Hill	Permit Number:	03069T29	User:	RST Engineering	Heat Input Capacity (mmBtu/hr):	323.17	Fuel Input Capacity (10 ⁶ scf/hr):	0.32	Annual Fuel Throughput (10 ⁶ scf):	27.07	Latest Construction/Modification Date:	N/A	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th colspan="4">Criteria Pollutants</th> <th style="text-align: center;">Emission Factor (lb/mmscf)</th> </tr> <tr> <th>Pollutant</th> <th>lb/hr</th> <th>lb/yr</th> <th>tpy</th> <th></th> </tr> <tr> <td>PM</td> <td align="right">2.4E+00</td> <td align="right">2.1E+02</td> <td align="right">1.0E-01</td> <td align="right">7.6E+00</td> </tr> <tr> <td>PM-10</td> <td align="right">2.4E+00</td> <td align="right">2.1E+02</td> <td align="right">1.0E-01</td> <td align="right">7.6E+00</td> </tr> <tr> <td>PM-2.5</td> <td align="right">2.4E+00</td> <td align="right">2.1E+02</td> <td align="right">1.0E-01</td> <td align="right">7.6E+00</td> </tr> <tr> <td>NOx</td> <td colspan="3">see attached CEMs-based calculations</td> <td align="right">1.9E+02</td> </tr> <tr> <td>VOC</td> <td align="right">1.7E+00</td> <td align="right">1.5E+02</td> <td align="right">7.4E-02</td> <td align="right">5.5E+00</td> </tr> <tr> <td>CO</td> <td align="right">2.7E+01</td> <td align="right">2.3E+03</td> <td align="right">1.1E+00</td> <td align="right">8.4E+01</td> </tr> <tr> <td>SO2</td> <td colspan="3">see attached CEMs-based calculations</td> <td align="right">6.0E-01</td> </tr> <tr> <td>Total HAP</td> <td align="right">6.0E-01</td> <td align="right">5.1E+01</td> <td align="right">2.6E-02</td> <td align="right">1.9E+00</td> </tr> <tr> <td>Largest HAP</td> <td align="right">5.7E-01</td> <td align="right">4.9E+01</td> <td align="right">2.4E-02</td> <td align="right">1.8E+00</td> </tr> </table>	Criteria Pollutants				Emission Factor (lb/mmscf)	Pollutant	lb/hr	lb/yr	tpy		PM	2.4E+00	2.1E+02	1.0E-01	7.6E+00	PM-10	2.4E+00	2.1E+02	1.0E-01	7.6E+00	PM-2.5	2.4E+00	2.1E+02	1.0E-01	7.6E+00	NOx	see attached CEMs-based calculations			1.9E+02	VOC	1.7E+00	1.5E+02	7.4E-02	5.5E+00	CO	2.7E+01	2.3E+03	1.1E+00	8.4E+01	SO2	see attached CEMs-based calculations			6.0E-01	Total HAP	6.0E-01	5.1E+01	2.6E-02	1.9E+00	Largest HAP	5.7E-01	4.9E+01	2.4E-02	1.8E+00														
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University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Boiler # 6 Wood Pellet Combustion

390.9 ton/yr, wood pellets burned 6.40E+03 MMBtu/yr
 64.63 MMBtu/hr, HI from wood 99.8% PM control 99.6% Metals control
 8,000 Btu/lb, wood heating value 67.8% HCl efficiency*
 4.04 ton/hr, max. wood firing rate 92.3% Hg efficiency*
 8,760 hr/yr *Calculated from August 2009 EPA Tests

Pollutant	Emission Factor (lb/MMBtu) ¹	Emissions (lb/hr)	Emissions (lb/yr)	Emissions (ton/yr)
NOx	see attached CEMs-based calculations			
CO	0.17	10.99	1,087.8	0.54
SO₂	see attached CEMs-based calculations			
PM	0.417	0.054	5.34	0.00267
PM ₁₀	0.377	0.049	4.82	0.00241
PM _{2.5}	0.327	0.042	4.18	0.00209
VOC	0.017	1.10	108.8	0.054
	lb/MMBtu			
Acetaldehyde	8.30E-04	5.36E-02	5.31E+00	2.66E-03
Acetophenone	3.20E-09	2.07E-07	2.05E-05	1.02E-08
Acrolein	4.00E-03	2.59E-01	2.56E+01	1.28E-02
Antimony	7.90E-06	2.04E-06	2.02E-04	1.01E-07
Arsenic	2.20E-05	5.69E-06	5.63E-04	2.82E-07
Benzene	4.20E-03	2.71E-01	2.69E+01	1.34E-02
Benzo(a)pyrene	2.60E-06	1.68E-04	1.66E-02	8.32E-06
Beryllium	1.10E-06	2.84E-07	2.82E-05	1.41E-08
Cadmium	4.10E-06	1.06E-06	1.05E-04	5.25E-08
Carbon tetrachloride	4.50E-05	2.91E-03	2.88E-01	1.44E-04
Chlorine	7.90E-04	5.11E-02	5.06E+00	2.53E-03
Chlorobenzene	3.30E-05	2.13E-03	2.11E-01	1.06E-04
Chloroform	2.80E-05	1.81E-03	1.79E-01	8.96E-05
Chromium	1.75E-05	4.52E-06	4.48E-04	2.24E-07
Cobalt	6.50E-06	1.68E-06	1.66E-04	8.32E-08
Di(2-ethylhexyl)phthalate	4.70E-08	3.04E-06	3.01E-04	1.50E-07
Dinitrophenol, 2,4-	1.80E-07	1.16E-05	1.15E-03	5.76E-07
Ethyl Benzene	3.10E-05	2.00E-03	1.98E-01	9.92E-05
Ethylene dichloride	2.90E-05	1.87E-03	1.86E-01	9.28E-05
Formaldehyde	4.40E-03	2.84E-01	2.82E+01	1.41E-02
Hexachlorodibenzo-p-dioxin	1.60E-06	1.03E-04	1.02E-02	5.12E-06
Hydrogen Chloride	1.90E-02	3.95E-01	3.91E+01	1.96E-02
Lead	4.80E-05	1.24E-05	1.23E-03	6.14E-07
Manganese	1.60E-03	4.14E-04	4.10E-02	2.05E-05
Mercury	3.50E-06	1.74E-05	1.72E-03	8.62E-07
Methyl bromide	1.50E-05	9.70E-04	9.60E-02	4.80E-05
Methyl chloride	2.30E-05	1.49E-03	1.47E-01	7.36E-05
Methyl chloroform	3.10E-05	2.00E-03	1.98E-01	9.92E-05
Methyl ethyl ketone	5.40E-06	3.49E-04	3.46E-02	1.73E-05
Methylene chloride	2.90E-04	1.87E-02	1.86E+00	9.28E-04
Naphthalene	9.70E-05	6.27E-03	6.21E-01	3.10E-04
Nickel	3.30E-05	8.53E-06	8.45E-04	4.22E-07
Nitrophenol, 4-	1.10E-07	7.11E-06	7.04E-04	3.52E-07
Pentachlorophenol	5.10E-08	3.30E-06	3.26E-04	1.63E-07
Perchloroethylene	3.80E-05	2.46E-03	2.43E-01	1.22E-04
Phenol	5.10E-05	3.30E-03	3.26E-01	1.63E-04
Phosphorus	2.70E-05	6.98E-06	6.91E-04	3.46E-07
Polychlorinated biphenyls	8.15E-09	5.27E-07	5.22E-05	2.61E-08
POM	1.25E-04	8.08E-03	8.00E-01	4.00E-04
Propionaldehyde	6.10E-05	3.94E-03	3.90E-01	1.95E-04
Propylene dichloride	3.30E-05	2.13E-03	2.11E-01	1.06E-04
Selenium	2.80E-06	7.24E-07	7.17E-05	3.58E-08
Styrene	1.90E-03	1.23E-01	1.22E+01	6.08E-03
2,3,7,8-TCDD	8.60E-12	5.56E-10	5.50E-08	2.75E-11
Toluene	9.20E-04	5.95E-02	5.89E+00	2.94E-03
Trichloroethylene	3.00E-05	1.94E-03	1.92E-01	9.60E-05
Trichlorofluoromethane	4.10E-05	2.65E-03	2.62E-01	1.31E-04
Trichlorophenol	2.20E-08	1.42E-06	1.41E-04	7.04E-08
Vinyl chloride	1.80E-05	1.16E-03	1.15E-01	5.76E-05
Xylenes	2.50E-05	1.62E-03	1.60E-01	8.00E-05
Carbon Dioxide	see attached CEMs-based calculations			
Methane	0.0705	4.557	451.1	0.2256
N ₂ O	0.00926	0.60	59.3	0.0296

1-Emission factors based on DAQ wood combustion spreadsheet

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Sulfur Dioxide Emissions from Boiler #6

(ES-001-Boiler #6)

The exhaust duct at Boiler #6 is equipped with a continuous emissions monitor (CEMs) for SO₂ emissions.

For the 2011 calendar year, 30 day facility averages for the SO₂ emission rate measured by the CEM are as follows:

Month	30 day average CEM reading (lb/MMBtu)
January 2011	0.16
February 2011	0.16
March 2011	0.16
April 2011	0.17
May 2011	0.16
June 2011	0.16
July 2011	0.16
August 2011	0.16
September 2011	0.16
October 2011	0.16
November 2011	0.17
December 2011	0.16
Annual Average	0.162

This average includes SO₂ emissions from coal, wood, fuel oil, and natural gas from Boiler #6 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #6 for 2011

Boiler #6			
Coal Tons/yr	Gas 1,000cf/yr	No. 2 Oil Gallons/yr	Wood Pellets, Tons/yr
50,649	27,073	36	390.9
Coal (12,880 btu/lb)	Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)	Wood (8,185 btu/lb)
MMBtu/yr			
1.30E+06	2.79E+04	5.02E+00	6399.033

Total for Boiler #6 (MMBtu/yr)	1.34E+06
--------------------------------	----------

Total SO ₂ Emissions from Boiler #6 (lb/yr)	216,474
Total SO₂ Emissions from Boiler #6 (ton/yr)	108.24

SO ₂ Emissions Associated with Coal Combustion (ton/yr)	108.24
SO ₂ Emissions Associated with No. 2 Fuel Oil Combustion (ton/yr)	0.00042
SO ₂ Emissions Associated with Natural Gas Combustion (ton/yr)	0*
SO ₂ Emissions Associated with Wood Pellet Combustion (ton/yr)	0*

*All SO₂ measured by CEMS allocated to coal and No.2 fuel oil.

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Nitrogen Dioxide Emissions from Boiler #6 (ES-001-Boiler #6)

The exhaust duct at Boiler #6 is equipped with a continuous emissions monitor (CEMs) for NOx emissions. For the 2011 calendar year, 30 day facility averages for the NOx emission rate measured by the CEM are as follows:

Month	30 day average CEM reading (lb/MMBtu)
January 2011	0.41
February 2011	0.41
March 2011	0.41
April 2011	0.38
May 2011	0.29
June 2011	0.31
July 2011	0.34
August 2011	0.31
September 2011	0.28
October 2011	0.31
November 2011	0.40
December 2011	0.37
Annual Average	0.35

This average includes NOx emissions from coal, fuel oil, and natural gas from Boiler #6 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #6 for 2011

Boiler #6			
Coal Tons/yr	Gas 1,000cf/yr	No. 2 Oil Gallons/yr	Wood Pellets, Tons/yr
50,649	27,073	36	390.9
Coal (12,880 btu/lb)	Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)	Wood (8,185 btu/lb)
MMBtu/yr			
1.30E+06	2.79E+04	5.02E+00	6399.033

Total for Boiler #6 (MMBtu/yr)	1.34E+06
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Total NOx Emissions from Boiler #6 (lb/yr)	470,887
Total NOx Emissions from Boiler #6 (ton/yr)	235.44

NOx Emissions Associated with Coal Combustion (ton/yr)	229.41
NOx Emissions Associated with Fuel Oil No. 2 Combustion (ton/yr)	0.0009
NOx Emissions Associated with Natural Gas Combustion (ton/yr)	4.90
NOx Emissions Associated with Wood Pellet Combustion (ton/yr)	1.125

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

CO₂ Emissions from Boiler No.6 (ES-3)

The exhaust system on Boiler #6 is equipped with a continuous emissions monitor (CEMs) for CO₂ concentrations. The exhaust also includes a flow monitor. Mass CO₂ emissions are calculated by the DAHS for GHG reporting. For the 2011 calendar year, the monthly CO₂ emissions measured by the CEM/DAHS System are as follows:

Month	Metric Tons	Tons
January 2011	18,192	20,053
February 2011	11,409	12,576
March 2011	14,626	16,122
April 2011	9,785	10,785
May 2011	10,067	11,097
June 2011	10,708	11,804
July 2011	13,275	14,633
August 2011	11,581	12,766
September 2011	5,802	6,396
October 2011	3,583	3,950
November 2011	12,269	13,524
December 2011	13,689	15,089
Annual Total	134,987	148,796

This total includes CO₂ emissions from coal, fuel oil, wood pellets, and natural gas from Boiler #6 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #6 for 2011

Boiler #6			
Coal Tons/yr	Gas 1,000cf/yr	No. 2 Oil Gallons/yr	Wood Pellets, Tons/yr
50,649	27,073	36	390.9
Coal (12,880 btu/lb)	Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)	Wood (8,185 btu/lb)
MMBtu/yr			
1.30E+06	2.79E+04	5.02E+00	6399.033

Total for Boiler #6 (MMBtu/yr)	1.34E+06
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CO₂ Emission Rate Ratios

	kg/MMBtu	Ratio
coal	93.40	1
n.gas	53.02	0.56767
No.2 oil	73.96	0.79186
wood	93.80	1.00428

CO₂ Emissions Associated with Coal Combustion (ton/yr)	146,299.8
CO₂ Emissions Associated with Fuel Oil No. 2 Combustion (ton/yr)	0.45
CO₂ Emissions Associated with Natural Gas Combustion (ton/yr)	1775.0
CO₂ Emissions Associated with Wood Pellet Combustion (ton/yr)	720.60

1.33E+06 Dist. Factor

148,796

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Boiler #7 (ES-002-Boiler #7)

Operating Scenarios

#1 - Coal Firing

#2 - Natural Gas Firing

#4 - No.2 Fuel Oil Firing

#5 - Wood Pellet Firing

(#3 - No.6 Fuel Oil Firing is no longer permitted)

Boilers #6 and #7 are equipped with Continuous Emission Monitoring (CEMs) devices to measure SO₂, NO_x, and CO₂ emissions from each of the boilers. The monthly averages presented in the attached spreadsheets are for the total emissions from firing all types of fuel. The Annual Emission Inventory forms require that the emissions be divided among the three possible operating scenarios.

NO_x and CO₂ emissions have been divided between the four operating scenarios based on the percentage of total heat input by each fuel. These calculations are detailed in the attached spreadsheets.

SO₂ emissions from natural gas and wood pellet combustion are insignificant, therefore, SO₂ emissions have been divided between the fuel oil and coal operating scenarios based on the percentage of total heat input by each fuel. These calculations are detailed in the attached spreadsheets.

Emissions Calculations

SO₂, NO_x, and CO₂ Emissions are taken from CEMs data

Other emission factors are from stack test or DAQ spreadsheets

Emission Source/Operating Scenario Data Page 1 of 2		Facility ID #: 6800043					
<i>Boiler #7 - Operating Scenario #4 - No. 2 Fuel Oil</i>		Permit #: 03069T29					
If Emission Source has multiple Operating Scenarios, complete one form for each. (All permitted, Insignificant and/or Non-permitted Sources)		County: Orange					
Facility Name: University of North Carolina at Chapel Hill		DAQ Region: Raleigh					
North Carolina Department of Environment and Natural Resources Division of Air Quality Air Pollutant Point Source Emissions Inventory - Calendar Year 2011							
1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)			ES-002-Boiler #7				
2. Emission Source Description		Coal / Natural Gas / No. 6 Fuel Oil Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #4 - No. 2 Fuel Oil					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		323.17 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		5 gallons/yr					
6. Fuel Information (if fuel used)		% Sulfur	0.08%				
		% Ash					
		Heat Content (Btu/lb or mmCF)	139,043 Btu/gal				
If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.							
7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)			100%				
8. Control Device Information , if none, write "none"							
	Control Device ID # (as listed in permit)	Control Device Description					
<i>i. (nearest stack)</i>	CD-004	Bagfilter with Calcium Carbonate (CaCO₃) Sorbent Injection					
<i>ii.</i>	N/A	N/A					
<i>iii.</i>	N/A	N/A					
<i>iv.</i>	N/A	N/A					
9. Stack Information (sources vented to more than one stack use additional entry lines)							
Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)	
EP-14-136	220	9	305	56.1	214,000	Vertical	
--	--	--	--	--	--	--	
--	--	--	--	--	--	--	
10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)							
Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	7,848 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A
11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)							
Jan-Feb, 2002 + Dec, 2002	100.00%	Mar-May	0.00%	June-Aug	0%	Sept-Nov	0.00%

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed

Boiler #7 - Operating Scenario #4 - No. 2 Fuel Oil

If Emission Source has multiple Operating Scenarios, complete one form for each.

(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: **6800043**Permit #: **03069T29**County: **Orange**DAQ Region: **Raleigh**Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-002-Boiler #7

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	0.00	8	N/A
NOx	NOx	0.00	1	N/A
PM Total	PM	0.00	8	99.0%
PM-2.5	PM-2.5	0.00	8	99.0%
PM-10	PM-10	0.00	8	99.0%
SO2	SO2	0.00	1	90.00%
VOC	VOC	0.00	8	N/A

HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Antimony	ANTIMONYPDS	0.00E+00	8	99.0%
Arsenic	ARSENICPDS	2.80E-08	8	99.0%
Benzene	71-43-2	1.38E-05	8	N/A
Beryllium	BERYLCPDS	2.10E-08	8	99.0%
Cadmium	CADMIUMCPDS	2.10E-08	8	99.0%
Chromium	CROMCPDS	2.10E-08	8	99.0%
Chromium VI	CHROM6CPDS	6.16E-09	8	99.0%
Cobalt	COBALTCPDS	0.00E+00	8	99.0%
Ethylbenzene	100-41-4	4.09E-06	8	N/A
Fluoride	16984-48-8	0.00	8	N/A
Formaldehyde	50-00-0	0.00	8	N/A
Lead	LEADCPDS	6.30E-08	8	99.0%
Manganese	MANGCPDS	4.20E-08	8	99.0%
Mercury	MERCPDS	2.10E-06	8	99.0%
Methyl chloroform	71-55-6	1.18E-06	8	N/A
Napthalene	91-20-3	0.000	8	N/A
Nickel	NICKCPDS	2.10E-08	8	99.0%
POM	POM	1.65E-07	8	99.0%
Selenium	SEC	1.05E-07	8	99.0%
Toluene	108-88-3	0.00	8	N/A
Xylene	1330-20-7	7.00E-06	8	N/A

Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	0.06	8	N/A
Methane	CH ₄	2.30E-06	8	N/A
Nitrous oxide	N ₂ O	4.60E-07	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Boiler #7 - Operating Scenario #1 - Coal

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility Name: University of North Carolina at Chapel Hill

Facility ID #: 6800043
 Permit #: 03069T29
 County: Orange
 DAQ Region: Raleigh

**North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-002-Boiler #7					
2. Emission Source Description		Coal / Natural Gas / No. 2 Fuel Oil Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #1 - Coal					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		323.17 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		40,789				tons/yr	
6. Fuel Information (if fuel used)		% Sulfur	1.71%	% Ash	8.81%	Heat Content (Btu/lb or mmCF)	12,693 Btu/lb

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	CD-004	Bagfilter with Calcium Carbonate (CaCO ₃) Sorbent Injection
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
EP-14-136	220	9	305	56.1	214,000	Vertical
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	8,154 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	30.47%	Mar-May	19.61%	June-Aug	30.29%	Sept-Nov	19.64%
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Boiler #7 - Operating Scenario #1 - Coal

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-002-Boiler #7

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	17.65	8	N/A
NOx	NOx	179.91	1	N/A
PM Total	PM	4.44	8	99.80%
PM-2.5	PM-2.5	2.56	8	97.90%
PM-10	PM-10	4.44	8	99.60%
SO2	SO2	84.79	1	90.00%
VOC	VOC	0.24	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Acetaldehyde	750-07-0	23.25	8	N/A
Acetophenone	98-86-2	0.61	8	N/A
Acrolein	107-02-8	11.83	8	N/A
Arsenic*	ARSENICPDS	0.31	8	99.60%
Benzene	71-43-2	53.03	8	N/A
Benzo(a)pyrene	50-32-8	1.55E-03	8	N/A
Benzyl chloride	100-44-7	28.55	8	N/A
Beryllium*	BERYLCPDS	0.05	8	N/A
Biphenyl	92-52-4	6.93E-02	8	N/A
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	2.98	8	N/A
Bromine	7726-95-6	8.49	8	99.60%
Bromoform	75-25-2	1.59	8	N/A
Cadmium*	CADMIUMCPDS	1.44E-01	8	99.60%
Carbon disulfide	75-10-0	5.30	8	N/A
2-Chloroacetophenone	532-27-4	0.29	8	N/A
Chlorobenzene	108-90-7	0.90	8	N/A
Chloroform	67-66-3	2.41	8	N/A
Chromium*	CROMCPDS	4.97	8	99.60%
Chromium (VI)	CHROM6CPDS	0.01	8	99.60%
Cumene	98-82-8	0.22	8	N/A
Cyanide	CNC	101.97	8	N/A
Dibenzofurans	132-64-9	8.20E-03	8	N/A
Dimethyl sulfate	77-78-1	1.96	8	N/A
2,4-Dinitrotoluene	121-14-2	1.14E-02	8	N/A
Ethyl benzene	100-41-4	3.83	8	N/A
Ethyl chloride	75-00-3	1.71	8	N/A
Ethylene dibromide	106-93-4	4.89E-02	8	N/A
Ethylene dichloride	107-06-2	1.63	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Boiler #7 - Operating Scenario #1 - Coal

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility Name:

University of North Carolina at Chapel Hill

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources

Division of Air Quality

Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-002-Boiler #7

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	N/A	N/A	N/A
NOx	NOx	N/A	N/A	N/A
PM Total	PM	N/A	N/A	N/A
PM-2.5	PM-2.5	N/A	N/A	N/A
PM-10	PM-10	N/A	N/A	N/A
SO2	SO2	N/A	N/A	N/A
VOC	VOC	N/A	N/A	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Formaldehyde*	50-0-00	68.13	8	N/A
Hexane	HEXANEISO	2.73	8	N/A
Hydrogen Chloride *	7647-01-0	13253.95	8	N/A
Hydrogen Fluoride *	7664-39-3	238.16	8	90% Control with CaCO ₃
Isophorone	78-59-1	23.66	8	N/A
Lead*	LEADCPDS	1.82	8	99.60%
Manganese*	MANGCPDS	12.43	8	99.60%
Mercury*	MERCCPDS	0.87	8	N/A
Methyl bromide	74-83-9	6.53	8	N/A
Methyl chloride	74-87-3	21.62	8	N/A
Methyl ethyl ketone	78-93-3	15.91	8	N/A
Methyl hydrazine	60-34-4	6.93	8	N/A
Methyl methacrylate	80-62-6	0.82	8	N/A
Methyl tert butyl ether	1634-04-4	1.43	8	N/A
Methylene chloride	75-09-2	11.83	8	N/A
Naphthalene	91-20-3	0.53	8	N/A
Nickel	NICKCPDS	10.12	8	99.60%
Phenol	108-95-2	0.65	8	N/A
POM	POM	2.32	8	N/A
Propionaldehyde	123-38-6	15.50	8	N/A
Styrene	100-42-5	1.02	8	N/A
2,3,7,8-TCDD	1746-01-6	5.83E-07	8	N/A
Tetrachloroethylene	79-34-5	1.75	8	N/A
Toluene	108-88-3	9.79	8	N/A
1,1,1-Trichloroethane	79-00-5	0.82	8	N/A
Vinyl acetate	108-05-4	0.31	8	N/A
Xylenes	1330-20-7	1.51	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	120,755.33	8	N/A
Methane	CH ₄	0.20	8	N/A
Nitrous oxide	N ₂ O	1.83	8	N/A

Emission Source/Operating Scenario Data Page 1 of 2		Facility ID #: 6800043					
Boiler #7 - Operating Scenario #2 - Natural Gas <small>If Emission Source has multiple Operating Scenarios, complete one form for each. (All permitted, Insignificant and/or Non-permitted Sources)</small>		Permit #: 03069T29					
Facility Name: University of North Carolina at Chapel Hill		County: Orange					
		DAQ Region: Raleigh					
North Carolina Department of Environment and Natural Resources Division of Air Quality Air Pollutant Point Source Emissions Inventory - Calendar Year 2011							
1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "T" for insignificant)		ES-002-Boiler #7					
2. Emission Source Description		Coal / Natural Gas / No. 2 Fuel Oil Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #2 - Natural Gas					
4. Maximum Permitted Operating Rate <small>With Units (Ex. gal/hr, mmBtu/hr)</small>		323.17 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) <small>With Units (Ex. lbs/yr, gal/yr)</small>		7,925	1,000 ft ³ /yr				
6. Fuel Information (if fuel used)		% Sulfur	N/A				
		% Ash	N/A				
		Heat Content (Btu/lb or mmCF)	1,030 Btu/ft ³				
If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.							
7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)		100%					
8. Control Device Information , if none, write "none"							
	Control Device ID # <small>(as listed in permit)</small>	Control Device Description					
<i>i. (nearest stack)</i>	CD-004	Bagfilter with Calcium Carbonate (CaCO ₃) Sorbent Injection					
<i>ii.</i>	N/A	N/A					
<i>iii.</i>	N/A	N/A					
<i>iv.</i>	N/A	N/A					
9. Stack Information (sources vented to more than one stack use additional entry lines)							
Stack ID #	Height <small>(in whole feet)</small>	Diameter (feet) <small>Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)</small>	Temperature <small>(F)</small>	Velocity <small>(feet/sec)</small>	Volume Flow Rate <small>(acfm)</small>	Release Point Description <small>(Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)</small>	
EP-14-136	220	9	305	56.1	214,000	Vertical	
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)							
Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	7,848 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A
11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)							
Jan-Feb, 2002 + Dec, 2002	40.33%	Mar-May	18.71%	June-Aug	11.89%	Sept-Nov	29.07%

Emission Source/Operating Scenario Data Page 2 of 2 <i>Boiler #7 - Operating Scenario #2 - Natural Gas</i> <small>If Emission Source has multiple Operating Scenarios, complete one form for each. (All permitted, Insignificant and/or Non-permitted Sources)</small>	Facility ID #: <u>6800043</u> Permit #: <u>03069T29</u> County: <u>Orange</u> DAQ Region: <u>Raleigh</u>
Facility Name: <u>University of North Carolina at Chapel Hill</u>	

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant) ES-002-Boiler #7

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	0.33	8	N/A
NOx	NOx	1.42	1	N/A
PM Total	PM	0.03	8	N/A
PM-2.5	PM-2.5	0.03	8	N/A
PM-10	PM-10	0.03	8	N/A
SO2	SO2	0.00	1	N/A
VOC	VOC	0.02	8	N/A

HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Arsenic	ARSENICPDS	1.58E-03	8	N/A
Benzene	71-43-2	0.02	8	N/A
Cadmium	CADMIUMCPDS	8.72E-03	8	N/A
Chromium	CROMCPDS	1.11E-02	8	N/A
Chromium VI	CHROM6CPDS	1.11E-02	8	N/A
Dichlorobenzene	106-46-7	9.51E-03	8	N/A
Formaldehyde	50-00-0	0.59	8	N/A
Hexane	HEXANEISO	1.43E+01	8	N/A
Lead	LEADCPDS	3.96E-03	8	N/A
Manganese	MANGCPDS	3.01E-03	8	N/A
Mercury	MERCPDS	2.06E-03	8	N/A
Napthalene	91-20-3	4.83E-03	8	N/A
Nickel	NICKCPDS	0.02	8	N/A
POM	POM	5.24E-03	8	N/A
Toluene	108-88-3	0.03	8	N/A

Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	540.37	8	N/A
Methane	CH ₄	9.00E-03	8	N/A
Nitrous oxide	N ₂ O	9.00E-04	8	N/A

Boiler #7 - Operating Scenario #5 - Wood Pellets
 If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: **6800043**
 Permit #: **03069T29**
 County: **Orange**
 DAQ Region: **Raleigh**

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-002-Boiler #7					
2. Emission Source Description		Coal / Natural Gas / No. 2 Fuel Oil/Wood Fired Circulating Fluidized Bed Combustion - Steam Generating Unit					
3. Operating Scenario Description		Operating Scenario #5 - Wood Pellets					
4. Maximum Permitted Operating Rate <small>With Units (Ex. gal/hr, mmBtu/hr)</small>		64.63 MMBtu/hr (20% HI from wood pellets)					
5. Throughput in CY (e.g. production or fuel use) <small>With Units (Ex. lbs/yr, gal/yr)</small>			0.0			tons/yr	
6. Fuel Information (if fuel used)		% Sulfur	NA	% Ash	NA	Heat Content (Btu/lb or mmCF)	8,185 Btu/lb

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # <small>(as listed in permit)</small>	Control Device Description
i. (nearest stack)	CD-004	Bagfilter with Calcium Carbonate (CaCO ₃) Sorbent Injection
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height <small>(in whole feet)</small>	Diameter (feet) <small>Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)</small>	Temperature <small>(F)</small>	Velocity <small>(feet/sec)</small>	Volume Flow Rate <small>(acfm)</small>	Release Point Description <small>(Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)</small>
EP-14-136	220	9	305	56.1	214,000	Vertical
--	--	--	--	--	--	--
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	24	Days/Week	7	Weeks/Year	50	Hours/Year	8057 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	#DIV/0!	Mar-May	#DIV/0!	June-Aug	#DIV/0!	Sept-Nov	#DIV/0!
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Boiler #7 - Operating Scenario #5 - Wood Pellets
 If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-002-Boiler #7

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	0.000	8	N/A
NOx	NOx	0.000	1	N/A
PM Total	PM	0.00000	8	99.80%
PM-2.5	PM-2.5	0.00000	8	97.90%
PM-10	PM-10	0.00000	8	99.60%
SO2	SO2	CEM w/coal	1	90.00%
VOC	VOC	0.0000	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Acetaldehyde	750-07-0	0.00E+00	8	N/A
Acetophenone	98-86-2	0.00E+00	8	N/A
Acrolein	107-02-8	0.00E+00	8	N/A
Antimony	7440-36-0	0.00E+00	8	99.60%
Arsenic	ARSENICPDS	0.00E+00	8	99.60%
Benzene	71-43-2	0.00E+00	8	N/A
Benzo(a)pyrene	50-32-8	0.00E+00	8	N/A
Beryllium	BERYLCPDS	0.00E+00	8	99.60%
Cadmium	CADMIUMCPDS	0.00E+00	8	99.60%
Carbon tetrachloride	56-23-5	0.00E+00	8	N/A
Chlorine	7782-50-5	0.00E+00	8	N/A
Chlorobenzene	108-90-7	0.00E+00	8	N/A
Chloroform	67-66-3	0.00E+00	8	N/A
Chromium	CROMCPDS	0.00E+00	8	99.60%
Cobalt	7440-48-4	0.00E+00	8	99.60%
Di(2-ethylhexy)phthalate		0.00E+00	8	N/A
Dinitrophenol, 2,4-	51-28-5	0.00E+00	8	N/A
Ethyl benzene	100-41-4	0.00E+00	8	N/A
Ethylene dichloride	107-06-2	0.00E+00	8	N/A
Formaldehyde*	50-0-00	0.00E+00	8	N/A
Hexachlorodib-dioxin	57653-85-7	0.00E+00	8	N/A
Hydrogen Chloride *	7647-01-0	0.00E+00	8	68% Control with CaCO ₃
Lead*	LEADCPDS	0.00E+00	8	99.60%
Manganese*	MANGCPDS	0.00E+00	8	99.60%
Mercury*	MERCCPDS	0.00E+00	8	92%
Methyl bromide	74-83-9	0.00E+00	8	N/A
Methyl chloride	74-87-3	0.00E+00	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Boiler #7 - Operating Scenario #5 - Wood Pellets

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-002-Boiler #7

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	N/A	N/A	N/A
NOx	NOx	N/A	N/A	N/A
PM Total	PM	N/A	N/A	N/A
PM-2.5	PM-2.5	N/A	N/A	N/A
PM-10	PM-10	N/A	N/A	N/A
SO2	SO2	N/A	N/A	N/A
VOC	VOC	N/A	N/A	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Methyl chloroform	71-55-6	0.00E+00	8	N/A
Methyl ethyl ketone	78-93-3	0.00E+00	8	N/A
Methylene chloride	75-09-2	0.00E+00	8	N/A
Naphthalene	91-20-3	0.00E+00	8	N/A
Nickel	NICKCPDS	0.00E+00	8	99.60%
Nitrophenol, 4-	100-02-07	0.00E+00	8	N/A
Pentachlorophenol	87-86-5	0.00E+00	8	N/A
Perchloroethylene	127-18-4	0.00E+00	8	N/A
Phenol	108-95-2	0.00E+00	8	N/A
Phosphorus	7723-14-0	0.00E+00	8	99.60%
Polychlorinated biphenyls	1336-36-3	0.00E+00	8	N/A
POM	POM	0.00E+00	8	N/A
Propionaldehyde	123-38-6	0.00E+00	8	N/A
Propylene dichloride	78-87-5	0.00E+00	8	N/A
Selenium	7782-49-2	0.00E+00	8	99.60%
Styrene	100-42-5	0.00E+00	8	N/A
2,3,7,8-TCDD	1746-01-6	0.00E+00	8	N/A
Toluene	108-88-3	0.00E+00	8	N/A
Trichloroethylene	79-01-6	0.00E+00	8	N/A
Trichlorofluoromethane	75-69-4	0.00E+00	8	N/A
Trichlorophenol		0.00E+00	8	N/A
Vinyl chloride	75-01-4	0.00E+00	8	N/A
Xylenes	1330-20-7	0.00E+00	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	0.00	8	N/A
Methane	CH ₄	0.0000	8	N/A
Nitrous oxide	N ₂ O	0.0000	8	N/A

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Boiler #7

(ES-002-Boiler #7)

Emissions Calculations

SO₂, NO_x, and CO₂ Emissions are Taken from CEMs Data
Other emission factors are from stack test or DAQ spreadsheets

Fuel Oil Combustion Emissions Calculator FO2000 Revision A
2011 Cogeneration Emissions Inventory
Boiler #7
(ES-002-Boiler #7)
Facility ID # 6800043
Permit # 03069T29

Operating Scenario #4 - No.2 Fuel Oil

User Input	
Company Name:	University of North Carolina at
Plant County:	Chapel Hill
Plant City:	Orange County
Permit Number:	Chapel Hill
User:	03069T29
Heat Input Capacity (mmBtu/hr):	RST Engineering
Fuel Input Capacity (10 ³ gal/hr):	323.17
Annual Fuel Throughput (1000 gal):	2.31
Maximum fuel sulfur content (%):	0.005
Latest Construction/Modification Date:	0.08
	N/A
Enter the boiler type below ▾	
	15

Boilers =>100 mmBtu/hr 1 = No. 6 oil fired, normal firing (U) 2 = No. 6 oil fired, normal firing (I) 3 = No. 6 oil fired, normal firing (C) 4 = No. 6 oil fired, normal firing, low NOx burner (U) 5 = No. 6 oil fired, normal firing, low NOx burner (I) 6 = No. 6 oil fired, normal firing, low NOx burner (C) 7 = No. 6 oil fired, tangential firing (U) 8 = No. 6 oil fired, tangential firing, low NOx burner (U) 9 = No. 5 oil fired, normal firing (U) 10 = No. 5 oil fired, normal firing (I) 11 = No. 5 oil fired, tangential firing (U) 12 = No. 4 oil fired, normal firing (U) 13 = No. 4 oil fired, normal firing (I) 14 = No. 4 oil fired, tangential firing (U) 15 = No. 2 oil fired (U,I)	Boilers =>100 mmBtu/hr (cont'd) 16 = No. 2 oil fired (C) 17 = No. 2 oil fired, LNB/FGR (U,I) 18 = No. 2 oil fired, LNB/FGR (C)
	19 = Vertical fired utility boiler
	Small Boilers (<100 mmBtu/hr) 20 = No. 6 oil fired (I) 21 = No. 6 oil fired (C) 22 = No. 5 oil fired (C) 23 = No. 4 oil fired (C) 24 = No. 2 oil fired (I) 25 = No. 2 oil fired (C)
	26 = Residential Furnace

Emission Controls

Particulate controls

Enter the control type below ▾	Message Area	Or enter a PM control efficiency below to override built in values.
	3	
Control Device	Avg. Cont. Effic.	User Input PM Cont. Effic.
0 = None/other		Message Area
1 = ESP		
2 = Scrubber		
3 = Bagfilter	99.0	
4 = Multiple cyclone		

Postcombustion SO₂ controls

Enter the control type below ▾	Message Area	Or enter an SO ₂ control efficiency
---------------------------------------	--------------	--

0	below to override built in values.
Control Technology/Process	User Input SO ₂ Cont. Effic.
0 = None/other	90.0
1 = Wet scrubber, Lime/limestone	Avg. Cont. Effic. User entered control efficiency may be overestimated and should be documented.
2 = Wet scrubber, Sodium carbonate	0.0
3 = Wet scrubber, Magnesium oxide/hydroxide	
4 = Wet scrubber, Dual alkali	Remarks
5 = Spray drying, calcium hydroxide slurry, vap. in spray vessel	NA
6 = Furnace injection, Dry calcium carbonate/hydrate inj. in upper furn. cavity	
7 = Duct injection, Dry sorbent injection into duct, sometimes combined with water spray	

NO_x controls

Enter the control type below ▾	Message Area	Or enter a NO _x control efficiency below to override built in values.
0		
Control Technology/Process		User Input NO _x Cont. Effic.
0 = None/other		0.0
1 = Low excess air (LEA)	Avg. Cont. Effic.	Message Area
2 = Staged combustion (SC)	0.0	
3 = Burners out of service (BOOS)		
4 = Flue gas recirculation (FGR)	Remarks	
5 = Flue gas recirculation plus staged combustion	NA	
6 = Low NO _x burners (LNB)		
7 = Reduced air preheat (RAP)		
8 = Selective noncatalytic reduction (SNCR)		
9 = Conventional selective catalytic reduction (SCR)		

Emissions Output (for operation 6.79 hr/yr)

Criteria Pollutants	lb/hr ²	tpy	lb/yr ³	Emission Factor ¹ (lb/10 ³ gal)
Total PM (FPM + CPM)	3.0	0.0000	0	3.30E+00
Filterable PM (FPM) rates @ 99% control	0.0	0.0000	0	2.00E+00
Condensable PM (CPM) ⁴	3.0	0.0000	0	1.30E+00
Filterable PM-10 ⁵	0.0	0.0000	0	1.00E+00
Filterable PM-2.5 ⁵	0.0	0.0000	0	2.50E-01
NO _x rates uncontrolled	see attached CEMs-based calculations			2.40E+01
NMTOC	0	0.0000	0	2.00E-01
CO	12	0.0000	0	5.00E+00
SO ₂ rates @ 90% control	see attached CEMs-based calculations			2.98E+02
Total HAP ⁶	4.17E-01	0.0000	0	1.81E-01
Largest HAP ⁶	1.84E-01	0.0000	0	7.97E-02

Toxic/Hazardous Air Pollutants.

Pollutant	lb/hr ²	lb/day ⁷	lb/yr ³	Emission Factor ¹ (lb/10 ³ gal)
Antimony rates @ 99% control	0.00E+00	NA	0.00E+00	0.00E+00
Arsenic rates @ 99% control	1.29E-05	NA	2.80E-08	5.60E-04
Benzene	6.35E-03	NA	1.38E-05	2.75E-03
Beryllium rates @ 99% control	9.70E-06	NA	2.10E-08	4.20E-04
Cadmium rates @ 99% control	9.70E-06	NA	2.10E-08	4.20E-04
Chromium rates @ 99% control	9.70E-06	NA	2.10E-08	4.20E-04
Chromium VI rates @ 99% control	2.85E-06	NA	6.16E-09	1.23E-04
Cobalt rates @ 99% control	0.00E+00	NA	0.00E+00	0.00E+00
Ethylbenzene	1.89E-03	NA	4.09E-06	8.17E-04
Fluoride	8.61E-02	2.07E+00	1.87E-04	3.73E-02
Formaldehyde	1.11E-01	2.66E+00	2.40E-04	4.80E-02
Lead rates @ 99% control	2.91E-05	NA	6.30E-08	1.26E-03
Manganese rates @ 99% control	1.94E-05	4.65E-04	4.20E-08	8.40E-04
Mercury	9.70E-04	2.33E-02	2.10E-06	4.20E-04
Methyl chloroform (1,1,1-Trichloroethane)	5.45E-04	1.31E-02	1.18E-06	2.36E-04
Napthalene	7.69E-04	NA	1.67E-06	3.33E-04
Nickel rates @ 99% control	9.70E-06	2.33E-04	2.10E-08	4.20E-04
POM rates @ 99% control	7.62E-05	NA	1.65E-07	3.30E-03
Selenium rates @ 99% control	4.85E-05	NA	1.05E-07	2.10E-03

Toluene	1.84E-01	4.41E+00	3.98E-04	7.97E-02
Xylene	3.23E-03	7.76E-02	7.00E-06	1.40E-03

Greenhouse Gases				Emission Factor (lb/10 ³ gal)
Pollutant	lb/hr ²	tpy	lb/yr ³	
Carbon dioxide	see attached CEMs-based calculations			22671.27
Methane	2.12E+00	2.30E-06	4.60E-03	0.920
Nitrous Oxide	4.25E-01	4.60E-07	9.20E-04	0.18

¹Emission factors represent AP-42 uncontrolled values. Emission rates are reflective of controls where applicable.

²Hourly emission rates for all pollutants are based on hourly rated capacity.

³Annual emission rates for all pollutants are based on maximum annual fuel throughput.

⁴Wet scrubbers are assumed to control CPM whereas other PM control devices are assumed to only control FPM.

⁵AP-42 assumes PM-10 and PM-2.5 assumes these pollutants are controlled with the same efficiency as total PM.

⁶Total and largest HAP factors and emission rates do not reflect control of metals. Individual metal emission rates are reflective of particulate matter controls where applicable.

⁷Daily emission rates are based on operation 24 hours per day at rated capacity.

Bituminous Coal Combustion

2011 Cogeneration Emissions Inventory

Facility **University of North Carolina at Chapel Hill**
 City **Chapel Hill**
 County **Orange County**

APP #/Fac ID **6800043**
 Input By **RST Engineering**
 Source ID **Boiler #7**

Operating Scenario #1

(ES-002-Boiler #7)

Data Input

Maximum Heat Input	<input type="text" value="323.17"/>	mmBtu/hr	Boiler Type:	<input type="text" value="7"/>
Boiler Size/Type	Large Industrial		1) Pulverized/Dry Bottom	6) Underfeed Stoker
Actual Fuel Usage	<input type="text" value="40,789"/>	ton/yr	2) Pulverized/Wet Bottom	7) Fluidized Bed Cir.
or	or		3) Cyclone Furnace	8) Fluidized Bed Bub.
Hours of Operation	<input type="text"/>	hr/yr	4) Spreader Stoker	9) Hand Fed
and	and		Control Device Efficiencies:	
Heating Value	<input type="text" value="12,693"/>	Btu/lb	PM	<input type="text" value="99.80"/> %
		ton/yr	PM-10	<input type="text" value="98.00"/> %
Sulfur Content	<input type="text" value="1.71"/>	%	PM-2.5	<input type="text" value="97.90"/> %
Ash Content :	<input type="text" value="8.8"/>	%	SOx*	<input type="text" value="90.00"/> %
(B)ituminous or (S)ubbituminous?	<input type="text" value="B"/>	(B/S)	NOx*	<input type="text" value="0.00"/> %
Calcium to Sulfur Ratio	<input type="text" value="2.22"/>		<p><i>*SOx and NOx emission estimates were calculated using CEMS data. Please refer to the SOx and NOX emissions data presented in the following CEMs spreadsheets. HCl, HF, and Hg emissions based on stack test data.</i></p>	

Bituminous Coal Combustion

2011 Cogeneration Emissions Inventory

Facility **University of North Carolina at Chapel Hill**
 City **Chapel Hill**
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APP #/Fac ID **6800043**
 Input By **RST Engineering**
 Source ID **Boiler #7**

Operating Scenario #1

(ES-002-Boiler #7)

ACTUAL CRITERIA EMISSIONS

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
PM*	0.22	2.73	8,884	4.44
PM-10*	0.22	2.73	8,884	4.44
PM-2.5*	0.13	1.58	5,122	2.56
SO2	14.88	**	**	**
SO3	0.10	**	**	**
NOx	3.90	**	**	**
VOC*	0.01	0.15	476	0.24
CO*	0.87	11.02	35,309	17.65

ACTUAL TOXIC EMISSIONS

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
Acetaldehyde	5.70E-04	7.26E-03	2.32E+01	1.16E-02
Acetophenone	1.50E-05	1.91E-04	6.12E-01	3.06E-04
Acrolein	2.90E-04	3.69E-03	1.18E+01	5.91E-03
Antimony*	8.20E-06	1.04E-04	3.34E-01	1.67E-04
Arsenic*	7.64E-06	9.73E-05	3.12E-01	1.56E-04
Benzene	1.30E-03	1.65E-02	5.30E+01	2.65E-02
Benzo(a)pyrene	3.80E-08	4.84E-07	1.55E-03	7.75E-07
Benzyl chloride	7.00E-04	8.91E-03	2.86E+01	1.43E-02
Beryllium*	1.34E-06	1.71E-05	5.47E-02	2.73E-05
Biphenyl	1.70E-06	2.16E-05	6.93E-02	3.47E-05
Bis(2-ethylhexyl)phthalate (DEHP)	7.30E-05	9.29E-04	2.98E+00	1.49E-03
Bromine	1.04E-01	2.65E-03	8.49E+00	4.25E-03
Bromoforn	3.90E-05	4.96E-04	1.59E+00	7.95E-04
Cadmium*	3.53E-06	4.49E-05	1.44E-01	7.20E-05
Carbon disulfide	1.30E-04	1.65E-03	5.30E+00	2.65E-03
2-Chloroacetophenone	7.00E-06	8.91E-05	2.86E-01	1.43E-04
Chlorobenzene	2.20E-05	2.80E-04	8.97E-01	4.49E-04
Chlorine*	2.74E-03	3.49E-02	1.12E+02	5.59E-02
Chloroform	5.90E-05	7.51E-04	2.41E+00	1.20E-03
Chromium*	1.22E-04	1.55E-03	4.97E+00	2.49E-03
Chromium (VI)	1.22E-04	3.10E-06	9.94E-03	4.97E-06
Cobalt*	7.01E-06	8.92E-05	2.86E-01	1.43E-04
Cumene	5.30E-06	6.75E-05	2.16E-01	1.08E-04
Cyanide	2.50E-03	3.18E-02	1.02E+02	5.10E-02
Dibenzofurans	2.01E-07	2.56E-06	8.20E-03	4.10E-06
Dimethyl sulfate	4.80E-05	6.11E-04	1.96E+00	9.79E-04
2,4-Dinitrotoluene	2.80E-07	3.56E-06	1.14E-02	5.71E-06
Ethyl benzene	9.40E-05	1.20E-03	3.83E+00	1.92E-03
Ethyl chloride	4.20E-05	5.35E-04	1.71E+00	8.57E-04
Ethylene dibromide	1.20E-06	1.53E-05	4.89E-02	2.45E-05
Ethylene dichloride	4.00E-05	5.09E-04	1.63E+00	8.16E-04
Formaldehyde*	1.67E-03	2.13E-02	6.81E+01	3.41E-02
Hexane	6.70E-05	8.53E-04	2.73E+00	1.37E-03
Hydrogen Chloride *	3.25E-01	4.14E+00	1.33E+04	6.63E+00
Hydrogen Fluoride *	5.84E-03	7.43E-02	2.38E+02	1.19E-01
Isophorone	5.80E-04	7.38E-03	2.37E+01	1.18E-02
Lead*	4.47E-05	5.69E-04	1.82E+00	9.11E-04

**SO₂ and NOx emissions were estimated using CEMS data, please refer to the attached data sheets entitled "Sulfur Dioxide Emissions from Boiler #7" and Nitrogen Dioxide Emissions from Boiler #7".

Bituminous Coal Combustion

2011 Cogeneration Emissions Inventory

Facility **University of North Carolina at Chapel Hill**
 City **Chapel Hill**
 County **Orange County**

APP #/Fac ID **6800043**
 Input By **RST Engineering**
 Source ID **Boiler #7**

Operating Scenario #1

(ES-002-Boiler #7)

ACTUAL TOXIC EMISSIONS (continued)

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
<i>Manganese*</i>	<i>3.05E-04</i>	<i>3.88E-03</i>	<i>1.24E+01</i>	<i>6.21E-03</i>
<i>Mercury*</i>	<i>2.12E-05</i>	<i>2.70E-04</i>	<i>8.67E-01</i>	<i>4.33E-04</i>
Methyl bromide	1.60E-04	2.04E-03	6.53E+00	3.26E-03
Methyl chloride	5.30E-04	6.75E-03	2.16E+01	1.08E-02
Methyl ethyl ketone	3.90E-04	4.96E-03	1.59E+01	7.95E-03
Methyl hydrazine	1.70E-04	2.16E-03	6.93E+00	3.47E-03
Methyl methacrylate	2.00E-05	2.55E-04	8.16E-01	4.08E-04
Methyl tert butyl ether	3.50E-05	4.46E-04	1.43E+00	7.14E-04
Methylene chloride	2.90E-04	3.69E-03	1.18E+01	5.91E-03
Naphthalene	1.30E-05	1.65E-04	5.30E-01	2.65E-04
<i>Nickel*</i>	<i>2.48E-04</i>	<i>3.16E-03</i>	<i>1.01E+01</i>	<i>5.06E-03</i>
Phenol	1.60E-05	2.04E-04	6.53E-01	3.26E-04
<i>Phosphorus*</i>	<i>3.71E-05</i>	<i>4.72E-04</i>	<i>1.51E+00</i>	<i>7.56E-04</i>
POM	5.69E-05	7.24E-04	2.32E+00	1.16E-03
Propionaldehyde	3.80E-04	4.84E-03	1.55E+01	7.75E-03
<i>Selenium*</i>	<i>5.46E-06</i>	<i>6.95E-05</i>	<i>2.23E-01</i>	<i>1.11E-04</i>
Styrene	2.50E-05	3.18E-04	1.02E+00	5.10E-04
2,3,7,8-TCDD	1.43E-11	1.82E-10	5.83E-07	2.92E-10
Tetrachloroethylene	4.30E-05	5.47E-04	1.75E+00	8.77E-04
Toluene	2.40E-04	3.06E-03	9.79E+00	4.89E-03
1,1,1-Trichloroethane	2.00E-05	2.55E-04	8.16E-01	4.08E-04
Vinyl acetate	7.60E-06	9.67E-05	3.10E-01	1.55E-04
Xylenes	3.70E-05	4.71E-04	1.51E+00	7.55E-04
Total HAPs		4.39	14,072.97	7.04

Greenhouse Gases

Pollutant	Factor		Emission Rates	
	(lb poll./ton coal)	(lb/hr)	(lb/yr)	(tpy)
Carbon dioxide			see attached CEMs-based calculations	
<i>Methane*</i>	<i>0.010</i>	<i>0.12</i>	<i>393.48</i>	<i>0.20</i>
Nitrous Oxide	0.09	1.14	3,652	1.83

*Emission rates for pollutants in italics from August 2009 Section 114 test of Boiler #6.

Notes :

- 1) Emission factors are from Supplement B to the 5th edition of AP-42, unless otherwise noted
- 2) Emission calculations will be based on the hours of operation only when actual fuel usage is not supplied
- 3) Particulate controls affect PM, PM-10, PM-2.5, and all toxics that are regulated as particulates except Mercury
- 4) VOC = NMTOC = TOC * (1-%METHANE)
- 5) PM-2.5 and SO3 do not currently need to be reported
- 6) Dibenzofurans = Polychlorinated dibenzo-p-furans
- 7) The Br emission factor is based on a mass balance generated from a 3 year coal analysis for Duke Power (1990-1992, 7 samples per year). The average concentration of bromine was 55.33 ppm (wet basis) and a heating value of 13,500 Btu/lb was assumed
- 8) For fluidized bed combustion the emission factor for underfeed stokers is utilized whenever the calcium-to-sulfur ratio is outside of the acceptable range of 1.5 to 7

Natural Gas Combustion Emissions Calculator NG2000 Revision C
2011 Cogeneration Emissions Inventory
Boiler #7
(ES-002-Boiler #7)

Facility ID # 6800043
 Permit # 03069T29

Operating Scenario #2

User Input	Emissions Output (for operation 19.22 hr/yr)																																																																																							
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University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Boiler # 7 Wood Pellet Combustion

0.0 ton/yr, wood pellets burned 0.00E+00 MMBtu/yr
 64.63 MMBtu/hr, HI from wood 99.8% PM control 99.6% Metals control
 8,000 Btu/lb, wood heating value 67.8% HCl efficiency*
 4.04 ton/hr, max. wood firing rate 92.3% Hg efficiency*
 8,760 hr/yr *Calculated from August 2009 EPA Tests

Pollutant	Emission Factor (lb/MMBtu) ¹	Emissions (lb/hr)	Emissions (lb/yr)	Emissions (ton/yr)
NOx	see attached CEMs-based calculations			
CO	0.17	10.99	0.0	0.00
SO₂	see attached CEMs-based calculations			
PM	0.417	0.054	0.00	0.00000
PM ₁₀	0.377	0.049	0.00	0.00000
PM _{2.5}	0.327	0.042	0.00	0.00000
VOC	0.017	1.10	0.0	0.000
	lb/MMBtu			
Acetaldehyde	8.30E-04	5.36E-02	0.00E+00	0.00E+00
Acetophenone	3.20E-09	2.07E-07	0.00E+00	0.00E+00
Acrolein	4.00E-03	2.59E-01	0.00E+00	0.00E+00
Antimony	7.90E-06	2.04E-06	0.00E+00	0.00E+00
Arsenic	2.20E-05	5.69E-06	0.00E+00	0.00E+00
Benzene	4.20E-03	2.71E-01	0.00E+00	0.00E+00
Benzo(a)pyrene	2.60E-06	1.68E-04	0.00E+00	0.00E+00
Beryllium	1.10E-06	2.84E-07	0.00E+00	0.00E+00
Cadmium	4.10E-06	1.06E-06	0.00E+00	0.00E+00
Carbon tetrachloride	4.50E-05	2.91E-03	0.00E+00	0.00E+00
Chlorine	7.90E-04	5.11E-02	0.00E+00	0.00E+00
Chlorobenzene	3.30E-05	2.13E-03	0.00E+00	0.00E+00
Chloroform	2.80E-05	1.81E-03	0.00E+00	0.00E+00
Chromium	1.75E-05	4.52E-06	0.00E+00	0.00E+00
Cobalt	6.50E-06	1.68E-06	0.00E+00	0.00E+00
Di(2-ethylhexyl)phthalate	4.70E-08	3.04E-06	0.00E+00	0.00E+00
Dinitrophenol, 2,4-	1.80E-07	1.16E-05	0.00E+00	0.00E+00
Ethyl Benzene	3.10E-05	2.00E-03	0.00E+00	0.00E+00
Ethylene dichloride	2.90E-05	1.87E-03	0.00E+00	0.00E+00
Formaldehyde	4.40E-03	2.84E-01	0.00E+00	0.00E+00
Hexachlorodibenzo-p-dioxin	1.60E-06	1.03E-04	0.00E+00	0.00E+00
Hydrogen Chloride	1.90E-02	3.95E-01	0.00E+00	0.00E+00
Lead	4.80E-05	1.24E-05	0.00E+00	0.00E+00
Manganese	1.60E-03	4.14E-04	0.00E+00	0.00E+00
Mercury	3.50E-06	1.74E-05	0.00E+00	0.00E+00
Methyl bromide	1.50E-05	9.70E-04	0.00E+00	0.00E+00
Methyl chloride	2.30E-05	1.49E-03	0.00E+00	0.00E+00
Methyl chloroform	3.10E-05	2.00E-03	0.00E+00	0.00E+00
Methyl ethyl ketone	5.40E-06	3.49E-04	0.00E+00	0.00E+00
Methylene chloride	2.90E-04	1.87E-02	0.00E+00	0.00E+00
Naphthalene	9.70E-05	6.27E-03	0.00E+00	0.00E+00
Nickel	3.30E-05	8.53E-06	0.00E+00	0.00E+00
Nitrophenol, 4-	1.10E-07	7.11E-06	0.00E+00	0.00E+00
Pentachlorophenol	5.10E-08	3.30E-06	0.00E+00	0.00E+00
Perchloroethylene	3.80E-05	2.46E-03	0.00E+00	0.00E+00
Phenol	5.10E-05	3.30E-03	0.00E+00	0.00E+00
Phosphorus	2.70E-05	6.98E-06	0.00E+00	0.00E+00
Polychlorinated biphenyls	8.15E-09	5.27E-07	0.00E+00	0.00E+00
POM	1.25E-04	8.08E-03	0.00E+00	0.00E+00
Propionaldehyde	6.10E-05	3.94E-03	0.00E+00	0.00E+00
Propylene dichloride	3.30E-05	2.13E-03	0.00E+00	0.00E+00
Selenium	2.80E-06	7.24E-07	0.00E+00	0.00E+00
Styrene	1.90E-03	1.23E-01	0.00E+00	0.00E+00
2,3,7,8-TCDD	8.60E-12	5.56E-10	0.00E+00	0.00E+00
Toluene	9.20E-04	5.95E-02	0.00E+00	0.00E+00
Trichloroethylene	3.00E-05	1.94E-03	0.00E+00	0.00E+00
Trichlorofluoromethane	4.10E-05	2.65E-03	0.00E+00	0.00E+00
Trichlorophenol	2.20E-08	1.42E-06	0.00E+00	0.00E+00
Vinyl chloride	1.80E-05	1.16E-03	0.00E+00	0.00E+00
Xylenes	2.50E-05	1.62E-03	0.00E+00	0.00E+00
Carbon Dioxide	see attached CEMs-based calculations			
Methane	0.0705	4.557	0.0	0.0000
N ₂ O	0.00926	0.60	0.0	0.0000

1-Emission factors based on DAQ wood combustion spreadsheet

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Sulfur Dioxide Emissions from Boiler #7 (ES-002-Boiler #7)

The exhaust duct at Boiler #7 is equipped with a continuous emissions monitor (CEMs) for SO₂ emissions.

For the 2011 calendar year, 30 day facility averages for the SO₂ emission rate measured by the CEM are as follows:

Month	30 day average CEM reading (lb/MMBtu)
January 2011	0.16
February 2011	0.16
March 2011	0.16
April 2011	0.16
May 2011	0.15
June 2011	0.16
July 2011	0.15
August 2011	0.15
September 2011	0.17
October 2011	0.19
November 2011	0.19
December 2011	0.15
Annual Average	0.163

This average includes SO₂ emissions from coal, fuel oil, wood, and natural gas from Boiler #7 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #7 for 2011

Boiler #7			
Coal Tons/yr	Gas 1,000cf/yr	No. 2 Oil Gallons/yr	Wood Pellets, Tons/yr
40,789	7,925	5	0.0
Coal (12,693 btu/lb)	Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)	Wood (8,185 btu/lb)
MMBtu/yr			
1.04E+06	8.16E+03	6.95E-01	0

Total for Boiler #7 (MMBtu/yr)	1.04E+06
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Total SO ₂ Emissions from Boiler #7 (lb/yr)	169,590
Total SO₂ Emissions from Boiler #7 (ton/yr)	84.795

SO ₂ Emissions Associated with Coal Combustion (ton/yr)	84.79
SO ₂ Emissions Associated with No. 2 Fuel Oil Combustion (ton/yr)	0.00006
SO ₂ Emissions Associated with Natural Gas Combustion (ton/yr)	0*
SO ₂ Emissions Associated with Wood Pellet Combustion (ton/yr)	0*

*All SO₂ measured by CEMS allocated to coal and No.2 fuel oil.

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Nitrogen Dioxide Emissions from Boiler #7

(ES-002-Boiler #7)

The exhaust duct at Boiler #7 is equipped with a continuous emissions monitor (CEMs) for NOx emissions.

For the 2011 calendar year, 30 day facility averages for the NOx emission rate measured by the CEM are as follows:

Month	30 day average CEM reading (lb/MMBtu)
January 2011	0.40
February 2011	0.39
March 2011	0.36
April 2011	0.34
May 2011	0.27
June 2011	0.29
July 2011	0.35
August 2011	0.31
September 2011	0.33
October 2011	0.37
November 2011	0.37
December 2011	0.39
Annual Average	0.35

This average includes NOx emissions from coal, fuel oil, wood, and natural gas within Boiler #7 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #7 for 2011

Boiler #7			
Coal Tons/yr	Gas 1,000cf/yr	No. 2 Oil Gallons/yr	Wood Pellets, Tons/yr
40,789	7,925	5	0.0
Coal (12,693 btu/lb)	Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)	Wood (8,185 btu/lb)
MMBtu/yr			
1.04E+06	8.16E+03	6.95E-01	0

Total for Boiler #7 (MMBtu/yr)	1.04E+06
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NOx Emissions from Boiler #7 (lb/yr)	362,661
NOx Emissions from Boiler #7 (ton/yr)	181.33

NOx Emissions Associated with Coal Combustion (ton/yr)	179.91
NOx Emissions Associated with Fuel Oil No. 2 Combustion (ton/yr)	0.00
NOx Emissions Associated with Natural Gas Combustion (ton/yr)	1.42
NOx Emissions Associated with Wood Pellet Combustion (ton/yr)	0.0

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

CO₂ Emissions from Boiler No.7 (ES-3)

The exhaust system on Boiler #7 is equipped with a continuous emissions monitor (CEMs) for CO₂ concentrations. The exhaust also includes a flow monitor. Mass CO₂ emissions are calculated by the DAHS for GHG reporting. For the 2011 calendar year, the monthly CO₂ emissions measured by the CEM/DAHS System are as follows:

Month	Metric Tons	Tons
January 2011	12,775	14,082
February 2011	10,926	12,044
March 2011	11,574	12,758
April 2011	1,206	1,330
May 2011	9,036	9,960
June 2011	9,211	10,153
July 2011	12,600	13,889
August 2011	10,546	11,625
September 2011	10,177	11,218
October 2011	5,447	6,005
November 2011	6,266	6,907
December 2011	10,275	11,326
Annual Total	110,039	121,296

This total includes CO₂ emissions from coal, fuel oil, wood pellets, and natural gas from Boiler #7 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #7 for 2011

Boiler #7			
Coal Tons/yr	Gas 1,000cf/yr	No. 2 Oil Gallons/yr	Wood Pellets, Tons/yr
40,789	7,925	5	0.0
Coal (12,693 btu/lb)	Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)	Wood (8,185 btu/lb)
MMBtu/yr			
1.04E+06	8.16E+03	6.95E-01	0

Total for Boiler #7 (MMBtu/yr)	1.04E+06
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CO₂ Emission Rate Ratios

	kg/MMBtu	Ratio
coal	93.40	1
n.gas	53.02	0.56767
No.2 oil	73.96	0.79186
wood	93.80	1.00428

CO₂ Emissions Associated with Coal Combustion (ton/yr)	120,755.3
CO₂ Emissions Associated with Fuel Oil No. 2 Combustion (ton/yr)	0.06
CO₂ Emissions Associated with Natural Gas Combustion (ton/yr)	540.4
CO₂ Emissions Associated with Wood Pellet Combustion (ton/yr)	0.0

1.04E+06 Dist. Factor

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Boiler #8

(ES-003-Boiler #8)

Operating Scenario #1 - Natural Gas Firing
Operating Scenario #2 - No. 2 Fuel Oil Firing

Boiler #8 - Operating Scenario #1 - Natural Gas

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: **6800043**

Permit #: **03069T29**

County: **Orange**

DAQ Region: **Raleigh**

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-003-Boiler #8					
2. Emission Source Description		Natural Gas / No. 2 Fuel Oil Fired Boiler					
3. Operating Scenario Description		Operating Scenario #1 - Natural Gas					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		338.0 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		99,538			1,000 ft³/yr		
6. Fuel Information (if fuel used)		% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	1,030 Btu/ft³

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	N/A
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
<i>i. (nearest stack)</i>	None	None
<i>ii.</i>	None	None
<i>iii.</i>	None	None
<i>iv.</i>	None	None

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	Standby	Days/Week	Standby	Weeks/Year	Standby	Hours/Year	1,833 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	38%	Mar-May	23%	June-Aug	1%	Sept-Nov	37%
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Boiler #8 - Operating Scenario #1 - Natural Gas
 If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043
 Permit #: 03069T29
 County: Orange
 DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-003-Boiler #8

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	4.18	8	N/A
NOx	NOx	3.97	8	N/A
PM Total	PM	0.38	8	N/A
PM-2.5	PM-2.5	0.38	8	N/A
PM-10	PM-10	0.38	8	N/A
SO2	SO2	0.03	8	N/A
VOC	VOC	0.27	8	N/A
HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Arsenic	ARSENICCPDS	1.99E-02	8	N/A
Benzene	71-43-2	0.21	8	N/A
Cadmium	CADMIUMCPDS	1.09E-01	8	N/A
Chromium	CROMCPDS	1.39E-01	8	N/A
Chromium VI	CHROM6CPDS	1.39E-01	8	N/A
Dichlorobenzene	106-46-7	1.19E-01	8	N/A
Formaldehyde	50-00-0	7.47	8	N/A
Hexane	HEXANEISO	1.79E+02	8	N/A
Lead	LEADCPDS	4.98E-02	8	N/A
Manganese	MANGCPDS	3.78E-02	8	N/A
Mercury	MERCPDS	2.59E-02	8	N/A
Napthalene	91-20-3	6.07E-02	8	N/A
Nickel	NICKCPDS	0.21	8	N/A
POM	POM	6.59E-02	8	N/A
Toluene	108-88-3	0.34	8	N/A
Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	6,528.47	8	N/A
Methane	CH ₄	1.13E-01	8	N/A
Nitrous oxide	N ₂ O	1.13E-02	8	N/A

Boiler #8 - Operating Scenario #2 - No. 2 Fuel OilIf Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)Facility ID #: **6800043**Permit #: **03069T29**County: **Orange**DAQ Region: **Raleigh**Facility Name: **University of North Carolina at Chapel Hill**

North Carolina Department of Environment and Natural Resources

Division of Air Quality

Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-003-Boiler #8					
2. Emission Source Description		Natural Gas / No. 2 Fuel Oil Fired Boiler					
3. Operating Scenario Description		Operating Scenario #2 - No. 2 Fuel Oil					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		338.0 MMBtu/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		1,786		gallons/year			
6. Fuel Information (if fuel used)		% Sulfur	0.08%	% Ash		Heat Content (Btu/lb or mmCF)	139,043 Btu/gal

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	N/A
--	-----

8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	N/A	N/A
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
--	--	--	--	--	--	--
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	Standby	Days/Week	Standby	Weeks/Year	Standby	Hours/Year	1,833 Total
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	3%	Mar-May	0%	June-Aug	97%	Sept-Nov	0%
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Emission Source/Operating Scenario Data Page 2 of 2
Boiler #8 - Operating Scenario #2 - No. 2 Fuel Oil
If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility Name: University of North Carolina at Chapel Hill

Facility ID #: 6800043
 Permit #: 03069T29
 County: Orange
 DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant) ES-003-Boiler #8

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	0.00	8	N/A
NOx	NOx	0.01	8	N/A
PM Total	PM	0.00	8	N/A
PM-2.5	PM-2.5	0.00	8	N/A
PM-10	PM-10	0.00	8	N/A
SO2	SO2	0.02	8	N/A
VOC	VOC	0.00	8	N/A

HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Arsenic	ARSENICPDS	1.00E-03	8	N/A
Benzene	71-43-2	4.91E-03	8	N/A
Beryllium	BERYLCPDS	7.50E-04	8	N/A
Cadmium	CADMUMCPDS	7.50E-04	8	N/A
Chromium	CROMCPDS	7.50E-04	8	N/A
Chromium VI	CHROM6CPDS	2.20E-04	8	N/A
Ethylbenzene	100-41-4	1.46E-03	8	N/A
Fluoride	16984-48-8	0.07	8	N/A
Formaldehyde	50-00-0	0.09	8	N/A
Lead	LEADCPDS	2.25E-03	8	N/A
Manganese	MANGCPDS	1.50E-03	8	N/A
Mercury	MERCPDS	7.50E-04	8	N/A
Methyl chloroform	71-55-6	4.21E-04	8	N/A
Napthalene	91-20-3	0.0006	8	N/A
Nickel	NICKCPDS	7.50E-04	8	N/A
POM	POM	5.89E-03	8	N/A
Selenium	SEC	3.75E-03	8	N/A
Toluene	108-88-3	0.14	8	N/A
Xylene	1330-20-7	2.50E-03	8	N/A

Greenhouse Gas Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Dioxide	CO ₂	22.06	8	N/A
Methane	CH ₄	8.21E-04	8	N/A
Nitrous oxide	N ₂ O	1.64E-04	8	N/A

Emissions and data on this form required to report or verify emissions cannot be held confidential.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed.

Natural Gas Combustion Emissions Calculator NG2000 Revision C
2011 Cogeneration Emissions Inventory
Boiler #8
(ES-003-Boiler #8)

Facility ID # 6800043
 Permit # 03069T29

Operating Scenario #1

User Input	Emissions Output																																																																																																																																																						
<p>Company Name: University of North Carolina at Chapel Hill</p> <p>Plant County: Orange County</p> <p>Plant City: Chapel Hill</p> <p>Permit Number: 03069T29</p> <p>User: RST Engineering</p> <p>Heat Input Capacity (mmBtu/hr): 338</p> <p>Fuel Input Capacity (10⁶ scf/hr): 0.33</p> <p>Annual Fuel Throughput (10⁶ scf): 99.54</p> <p>Latest Construction/Modification Date: N/A</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Criteria Pollutants</th> <th>lb/hr</th> <th>lb/yr</th> <th>tpy</th> <th>Emission Factor (lb/mmscf)</th> </tr> </thead> <tbody> <tr> <td>PM</td> <td>2.5E+00</td> <td>7.6E+02</td> <td>3.8E-01</td> <td>7.6E+00</td> </tr> <tr> <td>PM-10</td> <td>2.5E+00</td> <td>7.6E+02</td> <td>3.8E-01</td> <td>7.6E+00</td> </tr> <tr> <td>PM-2.5</td> <td>2.5E+00</td> <td>7.6E+02</td> <td>3.8E-01</td> <td>7.6E+00</td> </tr> <tr> <td>NOx</td> <td colspan="3">see attached CEMs-based calculations</td> <td>1.9E+02</td> </tr> <tr> <td>VOC</td> <td>1.8E+00</td> <td>5.5E+02</td> <td>2.7E-01</td> <td>5.5E+00</td> </tr> <tr> <td>CO</td> <td>2.8E+01</td> <td>8.4E+03</td> <td>4.2E+00</td> <td>8.4E+01</td> </tr> <tr> <td>SO2</td> <td>2.0E-01</td> <td>6.0E+01</td> <td>3.0E-02</td> <td>6.0E-01</td> </tr> <tr> <td>Total HAP</td> <td>6.3E-01</td> <td>1.9E+02</td> <td>9.4E-02</td> <td>1.9E+00</td> </tr> <tr> <td>Largest HAP</td> <td>6.0E-01</td> <td>1.8E+02</td> <td>9.0E-02</td> <td>1.8E+00</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Toxic/Hazardous Air Pollutants</th> <th>lb/hr</th> <th>lb/day</th> <th>lb/yr</th> <th>Emission Factor (lb/mmBtu)</th> </tr> </thead> <tbody> <tr> <td>Arsenic</td> <td>6.6E-05</td> <td>NA</td> <td>2.0E-02</td> <td>2.0E-04</td> </tr> <tr> <td>Benzene</td> <td>7.0E-04</td> <td>NA</td> <td>2.1E-01</td> <td>2.1E-03</td> </tr> <tr> <td>Cadmium</td> <td>3.6E-04</td> <td>NA</td> <td>1.1E-01</td> <td>1.1E-03</td> </tr> <tr> <td>Chromium</td> <td>4.6E-04</td> <td>NA</td> <td>1.4E-01</td> <td>1.4E-03</td> </tr> <tr> <td>Chromium VI</td> <td>4.6E-04</td> <td>NA</td> <td>1.4E-01</td> <td>1.4E-03</td> </tr> <tr> <td>Dichlorobenzene</td> <td>4.0E-04</td> <td>NA</td> <td>1.2E-01</td> <td>1.2E-03</td> </tr> <tr> <td>Formaldehyde</td> <td>2.5E-02</td> <td>NA</td> <td>7.5E+00</td> <td>7.5E-02</td> </tr> <tr> <td>Hexane</td> <td>6.0E-01</td> <td>1.4E+01</td> <td>1.8E+02</td> <td>1.8E+00</td> </tr> <tr> <td>Lead</td> <td>1.7E-04</td> <td>NA</td> <td>5.0E-02</td> <td>5.0E-04</td> </tr> <tr> <td>Manganese</td> <td>1.3E-04</td> <td>3.0E-03</td> <td>3.8E-02</td> <td>3.8E-04</td> </tr> <tr> <td>Mercury</td> <td>8.6E-05</td> <td>2.1E-03</td> <td>2.6E-02</td> <td>2.6E-04</td> </tr> <tr> <td>Naphthalene</td> <td>2.0E-04</td> <td>NA</td> <td>6.1E-02</td> <td>6.1E-04</td> </tr> <tr> <td>Nickel</td> <td>7.0E-04</td> <td>1.7E-02</td> <td>2.1E-01</td> <td>2.1E-03</td> </tr> <tr> <td>POM</td> <td>2.2E-04</td> <td>NA</td> <td>6.6E-02</td> <td>6.6E-04</td> </tr> <tr> <td>Toluene</td> <td>1.1E-03</td> <td>2.7E-02</td> <td>3.4E-01</td> <td>3.4E-03</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Greenhouse Gas Pollutants</th> <th>lb/hr</th> <th>lb/yr</th> <th>tpy</th> <th>Em. Factor (lb/mmBtu)</th> </tr> </thead> <tbody> <tr> <td>Carbon dioxide</td> <td colspan="3">see attached CEMs-based calculations</td> <td>116.89</td> </tr> <tr> <td>Methane</td> <td>0.75</td> <td>226.02</td> <td>1.13E-01</td> <td>2.20E-03</td> </tr> <tr> <td>Nitrous Oxide</td> <td>0.075</td> <td>22.60</td> <td>1.13E-02</td> <td>2.20E-04</td> </tr> </tbody> </table>	Criteria Pollutants	lb/hr	lb/yr	tpy	Emission Factor (lb/mmscf)	PM	2.5E+00	7.6E+02	3.8E-01	7.6E+00	PM-10	2.5E+00	7.6E+02	3.8E-01	7.6E+00	PM-2.5	2.5E+00	7.6E+02	3.8E-01	7.6E+00	NOx	see attached CEMs-based calculations			1.9E+02	VOC	1.8E+00	5.5E+02	2.7E-01	5.5E+00	CO	2.8E+01	8.4E+03	4.2E+00	8.4E+01	SO2	2.0E-01	6.0E+01	3.0E-02	6.0E-01	Total HAP	6.3E-01	1.9E+02	9.4E-02	1.9E+00	Largest HAP	6.0E-01	1.8E+02	9.0E-02	1.8E+00	Toxic/Hazardous Air Pollutants	lb/hr	lb/day	lb/yr	Emission Factor (lb/mmBtu)	Arsenic	6.6E-05	NA	2.0E-02	2.0E-04	Benzene	7.0E-04	NA	2.1E-01	2.1E-03	Cadmium	3.6E-04	NA	1.1E-01	1.1E-03	Chromium	4.6E-04	NA	1.4E-01	1.4E-03	Chromium VI	4.6E-04	NA	1.4E-01	1.4E-03	Dichlorobenzene	4.0E-04	NA	1.2E-01	1.2E-03	Formaldehyde	2.5E-02	NA	7.5E+00	7.5E-02	Hexane	6.0E-01	1.4E+01	1.8E+02	1.8E+00	Lead	1.7E-04	NA	5.0E-02	5.0E-04	Manganese	1.3E-04	3.0E-03	3.8E-02	3.8E-04	Mercury	8.6E-05	2.1E-03	2.6E-02	2.6E-04	Naphthalene	2.0E-04	NA	6.1E-02	6.1E-04	Nickel	7.0E-04	1.7E-02	2.1E-01	2.1E-03	POM	2.2E-04	NA	6.6E-02	6.6E-04	Toluene	1.1E-03	2.7E-02	3.4E-01	3.4E-03	Greenhouse Gas Pollutants	lb/hr	lb/yr	tpy	Em. Factor (lb/mmBtu)	Carbon dioxide	see attached CEMs-based calculations			116.89	Methane	0.75	226.02	1.13E-01	2.20E-03	Nitrous Oxide	0.075	22.60	1.13E-02	2.20E-04
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<p>Other NOx Control</p> <p>Enter 1 below if SNCR is applied to the boiler.</p> <p style="text-align: right; color: blue;">0</p>																																																																																																																																																							
<p>Large Wall-Fired Boilers (=>100 mmBtu/hr)</p> <p>1 = Uncontrolled (Pre-NSPS)</p> <p>2 = Uncontrolled (Post-NSPS)</p> <p>3 = Controlled - Low NOx burners</p> <p>4 = Controlled - Flue gas recirculation (FGR)</p>																																																																																																																																																							
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<p>Tangential-Fired Boilers (All Sizes)</p> <p>8 = Uncontrolled</p> <p>9 = Controlled - FGR</p>																																																																																																																																																							
<p>Residential Furnaces (<0.3 mmBtu/hr)</p> <p>10 = Uncontrolled</p>																																																																																																																																																							

Fuel Oil Combustion Emissions Calculator FO2000 Revision A

Boiler #8

2011 Cogeneration Emissions Inventory

(ES-003-Boiler #8)

Facility ID # 6800043

Permit # 03069T29

Operating Scenario #2

User Input	
Company Name:	University of North Carolina at
Plant County:	Chapel Hill
Plant City:	Orange County
Permit Number:	Chapel Hill
User:	03069T29
Heat Input Capacity (mmBtu/hr):	RST Engineering
Fuel Input Capacity (10 ³ gal/hr):	338
Annual Fuel Throughput (1000 gal):	2.41
Maximum fuel sulfur content (%):	1.79
Latest Construction/Modification Date:	0.08
	N/A

Enter the boiler type below ▾	
	17

<p>Boilers =>100 mmBtu/hr</p> <p>1 = No. 6 oil fired, normal firing (U) 2 = No. 6 oil fired, normal firing (I) 3 = No. 6 oil fired, normal firing (C) 4 = No. 6 oil fired, normal firing, low NOx burner (U) 5 = No. 6 oil fired, normal firing, low NOx burner (I) 6 = No. 6 oil fired, normal firing, low NOx burner (C) 7 = No. 6 oil fired, tangential firing (U) 8 = No. 6 oil fired, tangential firing, low NOx burner (U) 9 = No. 5 oil fired, normal firing (U) 10 = No. 5 oil fired, normal firing (I) 11 = No. 5 oil fired, tangential firing (U) 12 = No. 4 oil fired, normal firing (U) 13 = No. 4 oil fired, normal firing (I) 14 = No. 4 oil fired, tangential firing (U) 15 = No. 2 oil fired (U,I)</p>	<p>Boilers =>100 mmBtu/hr (cont'd)</p> <p>16 = No. 2 oil fired (C) 17 = No. 2 oil fired, LNB/FGR (U,I) 18 = No. 2 oil fired, LNB/FGR (C)</p> <hr/> <p>19 = Vertical fired utility boiler</p> <hr/> <p>Small Boilers (<100 mmBtu/hr)</p> <p>20 = No. 6 oil fired (I) 21 = No. 6 oil fired (C) 22 = No. 5 oil fired (C) 23 = No. 4 oil fired (C) 24 = No. 2 oil fired (I) 25 = No. 2 oil fired (C)</p> <hr/> <p>26 = Residential Furnace</p>
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Fuel Oil Combustion Emissions Calculator FO2000 Revision A

Boiler #8

2011 Cogeneration Emissions Inventory

(ES-003-Boiler #8)

Facility ID # 6800043

Permit # 03069T29

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User Input	
Company Name:	University of North Carolina at Chapel Hill
Plant County:	Orange County
Plant City:	Chapel Hill
Permit Number:	03069T29
User:	RST Engineering
Heat Input Capacity (mmBtu/hr):	338
Fuel Input Capacity (10 ³ gal/hr):	2.41
Annual Fuel Throughput (1000 gal):	1.79
Maximum fuel sulfur content (%):	0.08
Latest Construction/Modification Date:	N/A

Emission Controls

Particulate controls

Enter the control type below ▾	Message Area	Or enter a PM control efficiency below to override built in values.
0		
<u>Control Device</u>	<u>Avg. Cont. Effic.</u>	<u>User Input PM Cont. Effic.</u>
0 = None/other	0.0	0.0
1 = ESP		Message Area
2 = Scrubber		
3 = Bagfilter	0.0	
4 = Multiple cyclone		

Postcombustion SO₂ controls

Enter the control type below ▾	Message Area	Or enter an SO ₂ control efficiency below to override built in values.
0		
<u>Control Technology/Process</u>	<u>Avg. Cont. Effic.</u>	<u>User Input SO₂ Cont. Effic.</u>
0 = None/other		0.0
1 = Wet scrubber, Lime/limestone	0.0	Message Area
2 = Wet scrubber, Sodium carbonate		
3 = Wet scrubber, Magnesium oxide/hydroxide		
4 = Wet scrubber, Dual alkali		
5 = Spray drying, calcium hydroxide slurry, vap. in spray vessel	<u>Remarks</u>	
6 = Furnace injection, Dry calcium carbonate/hydrate inj. in upper furn. cavity	NA	
7 = Duct injection, Dry sorbent injection into duct, sometimes combined with water spray		

NO_x controls

Enter the control type below ▾		Or enter a NO _x control efficiency below to override built in values.
5 + 6		
<u>Control Technology/Process</u>	<u>Avg. Cont. Effic.</u>	<u>User Input NO_x Cont. Effic.</u>
0 = None/other		0.0
1 = Low excess air (LEA)	0.0	Message Area
2 = Staged combustion (SC)		
3 = Burners out of service (BOOS)		
4 = Flue gas recirculation (FGR)	<u>Remarks</u>	
5 = Flue gas recirculation plus staged combustion	NA	
6 = Low NO _x burners (LNB)		
7 = Reduced air preheat (RAP)		
8 = Selective noncatalytic reduction (SNCR)		
9 = Conventional selective catalytic reduction (SCR)		

Fuel Oil Combustion Emissions Calculator FO2000 Revision A

Boiler #8

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(ES-003-Boiler #8)

Facility ID # 6800043

Permit # 03069T29

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Plant County:	Orange County
Plant City:	Chapel Hill
Permit Number:	03069T29
User:	RST Engineering
Heat Input Capacity (mmBtu/hr):	338
Fuel Input Capacity (10 ³ gal/hr):	2.41
Annual Fuel Throughput (1000 gal):	1.79
Maximum fuel sulfur content (%):	0.08
Latest Construction/Modification Date:	N/A

Emissions Output

Criteria Pollutants

Pollutant	lb/hr ²	tpy	lb/yr ³	Emission Factor ¹ (lb/10 ³ gal)
Total PM (FPM + CPM)	8.0	0.0029	6	3.30E+00
Filterable PM (FPM) rates uncontrolled	4.8	0.0018	4	2.00E+00
Condensable PM (CPM) ⁴	3.1	0.0012	2	1.30E+00
Filterable PM-10 ⁵	2.4	0.0009	2	1.00E+00
Filterable PM-2.5 ⁵	0.6	0.0002	0	2.50E-01
NOx rates uncontrolled	see attached CEMs-based calculations			2.40E+01
NMTOC	0	0.0002	0	2.00E-01
CO	12	0.0045	9	5.00E+00
SO2 rates uncontrolled	59.2	0.0219	44	2.45E+01
Total HAP ⁶	4.36E-01	0.0002	0	1.81E-01
Largest HAP ⁶	1.92E-01	0.0001	0	7.97E-02

***NOx emissions based on CEMs data.*

Toxic/Hazardous Air Pollutants.

Pollutant	lb/hr ²	lb/day ⁷	lb/yr ³	Emission Factor ¹ (lb/10 ³ gal)
Antimony rates uncontrolled	0.00E+00	NA	0.00E+00	0.00E+00
Arsenic rates uncontrolled	1.35E-03	NA	1.00E-03	5.60E-04
Benzene	6.64E-03	NA	4.91E-03	2.75E-03
Beryllium rates uncontrolled	1.01E-03	NA	7.50E-04	4.20E-04
Cadmium rates uncontrolled	1.01E-03	NA	7.50E-04	4.20E-04
Chromium rates uncontrolled	1.01E-03	NA	7.50E-04	4.20E-04
Chromium VI rates uncontrolled	2.98E-04	NA	2.20E-04	1.23E-04
Cobalt rates uncontrolled	0.00E+00	NA	0.00E+00	0.00E+00
Ethylbenzene	1.97E-03	NA	1.46E-03	8.17E-04
Fluoride	9.01E-02	2.16E+00	6.66E-02	3.73E-02
Formaldehyde	1.16E-01	2.78E+00	8.57E-02	4.80E-02
Lead rates uncontrolled	3.04E-03	NA	2.25E-03	1.26E-03
Manganese rates uncontrolled	2.03E-03	4.87E-02	1.50E-03	8.40E-04
Mercury	1.01E-03	2.43E-02	7.50E-04	4.20E-04
Methyl chloroform (1,1,1-Trichloroethane)	5.70E-04	1.37E-02	4.21E-04	2.36E-04
Naphthalene	8.04E-04	NA	5.95E-04	3.33E-04
Nickel rates uncontrolled	1.01E-03	2.43E-02	7.50E-04	4.20E-04
POM rates uncontrolled	7.97E-03	NA	5.89E-03	3.30E-03
Selenium rates uncontrolled	5.07E-03	NA	3.75E-03	2.10E-03
Toluene	1.92E-01	4.62E+00	1.42E-01	7.97E-02
Xylene	3.38E-03	8.12E-02	2.50E-03	1.40E-03

Greenhouse Gases

Pollutant	lb/hr ²	tpy	lb/yr ³	Emission Factor (lb/10 ³ gal)
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Fuel Oil Combustion Emissions Calculator FO2000 Revision A

Boiler #8

2011 Cogeneration Emissions Inventory

(ES-003-Boiler #8)

Facility ID # 6800043

Permit # 03069T29

Operating Scenario #2

User Input	
Company Name:	University of North Carolina at Chapel Hill
Plant County:	Orange County
Plant City:	Chapel Hill
Permit Number:	03069T29
User:	RST Engineering
Heat Input Capacity (mmBtu/hr):	338
Fuel Input Capacity (10 ³ gal/hr):	2.41
Annual Fuel Throughput (1000 gal):	1.79
Maximum fuel sulfur content (%):	0.08
Latest Construction/Modification Date:	N/A

Carbon dioxide	see attached CEMs-based calculations			22671.27
Methane	2.22E+00	8.21E-04	1.64E+00	0.920
Nitrous Oxide	4.44E-01	1.64E-04	3.28E-01	0.18

¹Emission factors represent AP-42 uncontrolled values. Emission rates are reflective of controls where applicable.

²Hourly emission rates for all pollutants are based on hourly rated capacity.

³Annual emission rates for all pollutants are based on maximum annual fuel throughput.

⁴Wet scrubbers are assumed to control CPM whereas other PM control devices are assumed to only control FPM.

⁵AP-42 assumes PM-10 and PM-2.5 assumes these pollutants are controlled with the same efficiency as total PM.

⁶Total and largest HAP factors and emission rates do not reflect control of metals. Individual metal emission rates are reflective of particulate matter controls where applicable.

⁷Daily emission rates are based on operation 24 hours per day at rated capacity.

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Nitrogen Dioxide Emissions from Boiler #8 (ES-003-Boiler #8)

The exhaust duct at Boiler #8 is equipped with a continuous emissions monitor (CEMs) for NOx emissions. For the 2011 calendar year, 30 day facility averages for the NOx emission rate measured by the CEM are as follows:

Month	30 day average CEM reading (lb/MMBtu)
January 2011	0.08
February 2011	0.08
March 2011	0.08
April 2011	0.08
May 2011	0.08
June 2011	0.08
July 2011	0.08
August 2011	0.08
September 2011	0.08
October 2011	0.07
November 2011	0.07
December 2011	0.07
Annual Average	0.08

This average includes NOx emissions from fuel oil and natural gas from Boiler #8 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #8 for 2011

Boiler #8	
Gas 1,000cf/yr	Oil Gallons/yr
99,538	1,786
Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)
MMBtu/yr	
1.03E+05	2.48E+02

Total for Boiler #8 (MMBtu/yr)	1.03E+05
--------------------------------	----------

NOx Emissions from Boiler #8 (lb/yr)	7,965
NOx Emissions from Boiler #8 (ton/yr)	3.98

NOx Emissions Associated with Fuel Oil Combustion (ton/yr)	0.010
NOx Emissions Associated with Natural Gas Combustion (ton/yr)	3.973

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

CO₂ Emissions from Boiler No.8

(ES-3)

The exhaust system on Boiler #8 is equipped with a continuous emissions monitor (CEMs) for CO₂ concentrations. The natural gas and oil flow rates to the boiler are monitored. Mass CO₂ emissions are calculated by the DAHS for GHG reporting. For the 2011 calendar year, the monthly CO₂ emissions measured by the CEM/DAHS System are as follows:

Month	Metric Tons	Tons
January 2011	1,341	1,479
February 2011	490	540
March 2011	166	182
April 2011	1,205	1,328
May 2011	22	24
June 2011	57	63
July 2011	24	26
August 2011	0	0
September 2011	34	37
October 2011	1,872	2,064
November 2011	281	310
December 2011	451	497
Annual Total	5,943	6,551

This total includes CO₂ emissions from No.2 fuel oil and natural gas from Boiler #8 over the entire year, representing a composite average for all fuels combusted.

Fuel Inputs to Boiler #8 for 2011

Boiler #8	
Gas 1,000cf/yr	No. 2 Oil Gallons/yr
99,538	1,786
Nat. Gas (1,030 btu/cf)	Oil (139,043 btu/gal)
MMBtu/yr	
1.03E+05	2.48E+02
Total for Boiler #7 (MMBtu/yr)	
1.03E+05	

CO₂ Emissions Associated with Fuel Oil No. 2 Combustion (ton/yr)	22.06
CO₂ Emissions Associated with Natural Gas Combustion (ton/yr)	6,528.47

CO₂ Emission Rate Ratios

	kg/MMBtu	Ratio
n.gas	53.02	1
No.2 oil	73.96	1.3949

1.03E+05 Dist. Factor

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

**Coal Crusher/Conveyor Building
(ES-010A)**

Emission Source/Operating Scenario Data Page 1 of 2	Facility ID #: 6800043
Coal Crusher/Conveyor Building	Permit #: 03069T29
If Emission Source has multiple Operating Scenarios, complete one form for each. (All permitted, Insignificant and/or Non-permitted Sources)	County: Orange
Facility Name: University of North Carolina at Chapel Hill	DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)	ES-010A						
2. Emission Source Description	Coal Crusher / Conveyor Building						
3. Operating Scenario Description	N/A						
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)	60 tons/hr						
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)	91,438 tons/yr						
6. Fuel Information (if fuel used)	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%;">% Sulfur</td> <td style="width:15%;">N/A</td> <td style="width:15%;">% Ash</td> <td style="width:15%;">N/A</td> <td style="width:40%;">Heat Content (Btu/lb or mmCF)</td> <td style="width:10%;">N/A</td> </tr> </table>	% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	N/A
% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	N/A		

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	CD-013	Bagfilter
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
EP-12-053	47	1.8	Ambient	44	6,500	Vertical
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	6	Days/Week	7	Weeks/Year	52	Hours/Year	1,524
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	32.15%	Mar-May	22.16%	June-Aug	28.39%	Sept-Nov	17.30%
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Facility ID #: 6800043
 Permit #: 03069T29
 County: Orange
 DAQ Region: Raleigh

Coal Crusher/Conveyor Building

If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility Name: University of North Carolina at Chapel Hill

**North Carolina Department of Environment and Natural Resources
 Division of Air Quality
 Air Pollutant Point Source Emissions Inventory - Calendar Year 2011**

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant) ES-010A

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	N/A	N/A	N/A
NOx	NOx	N/A	N/A	N/A
PM Total	PM	0.65	2	99.80%
PM-2.5	PM-2.5	0.62	2	97.90%
PM-10	PM-10	0.65	2	99.60%
SO2	SO2	N/A	N/A	N/A
VOC	VOC	N/A	N/A	N/A

HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)

Emissions and data on this form required to report or verify emissions cannot be held confidential.
 To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>
 Copy and Use additional Sheets as needed.

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Emissions from the Conveyor/Crusher Building

(ES-010A)

Assume that the total amount of coal conveyed to the crusher is equal to the total amount of coal combusted in 2011.

Boiler #6	50,649	Tons/yr
Boiler #7	40,789	Tons/yr
Total	91,438	Tons/yr

The conveyor transfer points and crushers in the Coal Crusher Building are controlled by a vacuum dust pick-up system ducted to a baghouse. The air flow rate through the baghouse is 6,650 acfm. Emissions from the baghouse are conservatively estimated at 0.015 gr/acfm.

60 ton/hr, conveying rate
1,524.0 hrs/yr, conveying time

$\text{lb/yr} = (6,650 \text{ acfm}) (60 \text{ min/hr}) (\text{hr/yr}) (0.015 \text{ gr/acfm}) (1/7000 \text{ lb/gr})$

Total Emissions from the Crusher	9,120,950	gr/yr
	1,303	lb/yr
	0.65	ton/yr

100% of these emissions are PM-10

95% of these emissions are PM-2.5

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

**Ash Silo with Loadout
(ES-030)**

Ash Silo with Loadout

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility Name: University of North Carolina at Chapel Hill

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

**North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2010**

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-030					
2. Emission Source Description		Ash Silo with Loadout					
3. Operating Scenario Description		N/A					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		16 tons/hr					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		23,809			tons/yr		
6. Fuel Information (if fuel used)	% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	N/A	

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	100%
--	-------------

8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	CD-031	Bagfilter
ii.	N/A	N/A
iii.	N/A	N/A
iv.	N/A	N/A

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
Fugitive						
--	--	--	--	--	--	--
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10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	10	Days/Week	7	Weeks/Year	52	Hours/Year	4,449
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	32.15%	Mar-May	22.16%	June-Aug	28.39%	Sept-Nov	17.30%
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Ash Silo with Loadout

If Emission Source has multiple Operating Scenarios, complete one form for each.
 (All permitted, Insignificant and/or Non-permitted Sources)

Facility ID #: 6800043
 Permit #: 03069T29
 County: Orange
 DAQ Region: Raleigh

Facility Name: University of North Carolina at Chapel Hill

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

Emissions: Attach calculations and documentation of emission factors or other estimation methods used.

Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)

ES-030

Criteria (NAAQS) Pollutants	Pollutant Code	Emissions Criteria (Tons/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)
Carbon Monoxide	CO	N/A	N/A	N/A
NOx	NOx	N/A	N/A	N/A
PM Total	PM	1.60	2	99.80%
PM-2.5	PM-2.5	1.52	2	97.90%
PM-10	PM-10	1.60	2	99.60%
SO2	SO2	N/A	N/A	N/A
VOC	VOC	N/A	N/A	N/A

HAP/TAP Pollutants (In Alphabetical Order)	CAS # (or other code - see instructions)	Emissions HAP/TAP (Pounds/Year)	Emissions Estimation Method Code (see instructions for code)	Control Efficiency (Net after all controls)

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Ash Silo with Loadout

(ES-030)

Ash is conveyed to the silo and loaded into trucks for off-site transport. The ash is pneumatically conveyed to the silo with the conveying air filtered through a baghouse (CD-031) prior to discharge. The ash loadout to the transfer trucks is via a pipe within a pipe configuration. The annular space between the internal and external pipes is under a vacuum. This vacuum system collects the dust generated during truck loading and ducts it to the baghouse (CD-031). Ash is composed of coal flyash and CaCO_3 / CaSO_3 from desulfurization. Ash is similar to flyash used in concrete batching operations.

23,809.00 ton/yr, ash loaded in 2011

1. Uncaptured Truck Loading Fugitives

Truck loading operations are in an enclosure with discharge into an enclosed truck bed. The vacuum at the ash discharge point and enclosures should insure a minimum of 95% capture. Uncontrolled emissions are based on a conservatively high estimated 0.5 lb/ton emission factor (0.02 lb/ton AP-42 for batch truck loading at concrete plants).

23,809	ton/yr, Ash Generated
0.5	lb/ton, Emission Factor
95%	Capture Efficiency
595.2	lb/yr, Emissions
0.30	ton/yr, Emissions

Fugitives from the Enclosure:

0.016	ton/yr, Emissions
-------	-------------------

2. Baghouse Emissions

The air flow rate through the baghouse is 4,490 acfm. Emissions from the baghouse are conservatively estimated at 0.015 gr/acfm.

$\text{lb/yr} = (4,490 \text{ acfm}) (60 \text{ min/hr}) (\text{hr/yr}) (0.015 \text{ gr/acfm}) (1/7000 \text{ lb/gr})$

4,490	acfm, Baghouse Flow Rate
4,449	hrs/yr, Operating Hours
0.015	gr/acfm, Emission Factor from Baghouse
2,569	lb/yr, Emissions
1.28	ton/yr, Emissions

3. Total Emissions

0.30	ton/yr, Emissions Truck Loading
0.016	ton/yr, Emissions, Truck Fugitives
1.28	ton/yr, Emissions, Baghouse
1.60	ton/yr, Total Emissions PM
1.60	ton/yr, Total Emissions PM-10
1.52	ton/yr, Total Emissions PM-2.5

100% as PM-10

95% as PM-2.5

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

**Wet Ash Loadout
(ES-030A)**

(This unit was not in operation during CY 2011)

Wet Ash Loadout

If Emission Source has multiple Operating Scenarios, complete one form for each.
(All permitted, Insignificant and/or Non-permitted Sources)

Facility Name: University of North Carolina at Chapel Hill

Facility ID #: 6800043

Permit #: 03069T29

County: Orange

DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources

Division of Air Quality

Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)		ES-030A					
2. Emission Source Description		Wet Ash Loadout					
3. Operating Scenario Description		N/A					
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)		N/A					
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)		0		ton/yr			
6. Fuel Information (if fuel used)		% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	N/A

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	N/A
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8. Control Device Information, if none, write "none"

	Control Device ID # (as listed in permit)	Control Device Description
i. (nearest stack)	None	None
ii.	None	None
iii.	None	None
iv.	None	None

9. Stack Information (sources vented to more than one stack use additional entry lines)

Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
--	--	--	--	--	--	--
--	--	--	--	--	--	--

10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)

Hours/Day	N/A	Days/Week	N/A	Weeks/Year	N/A	Hours/Year	N/A
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)

Jan-Feb, 2002 + Dec, 2002	0%	Mar-May	0%	June-Aug	0%	Sept-Nov	0%
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This Unit Was Not in Operation During CY 2008.

To review instructions or get a blank copy, go to web page: <http://daq.state.nc.us/Offices/Planning/Attainment/est.html>

Copy and Use additional Sheets as needed

The University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Annual Emissions Inventory

Enclosed Sorbent Railcar Dump Pit (Insignificant Source)

IS-53

18,279 tons of sorbent delivered by rail in 2011. There are no emission sources associated with truck delivery.

Emission Source/Operating Scenario Data Page 1 of 2	Facility ID #: 6800043
<i>Enclosed Sorbent Railcar Dump Pit</i>	Permit #: 03069T29
If Emission Source has multiple Operating Scenarios, complete one form for each. (All permitted, Insignificant and/or Non-permitted Sources)	County: Orange
Facility Name: University of North Carolina at Chapel Hill	DAQ Region: Raleigh

North Carolina Department of Environment and Natural Resources
Division of Air Quality
Air Pollutant Point Source Emissions Inventory - Calendar Year 2011

1. Emission Source ID No. (same as in permit - Use "U" prefix for non-permitted and "I" for insignificant)	"I" Insignificant - ID No. 020						
2. Emission Source Description	Enclosed Sorbent Railcar Dump Pit						
3. Operating Scenario Description	N/A						
4. Maximum Permitted Operating Rate With Units (Ex. gal/hr, mmBtu/hr)	50 ton/hr						
5. Throughput in CY (e.g. production or fuel use) With Units (Ex. lbs/yr, gal/yr)	18,279 tons/yr						
6. Fuel Information (if fuel used)	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:15%;">% Sulfur</td> <td style="width:15%;">N/A</td> <td style="width:15%;">% Ash</td> <td style="width:15%;">N/A</td> <td style="width:40%;">Heat Content (Btu/lb or mmCF)</td> <td style="width:10%;">N/A</td> </tr> </table>	% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	N/A
% Sulfur	N/A	% Ash	N/A	Heat Content (Btu/lb or mmCF)	N/A		

If you do not provide annual throughput/fuel use, your inventory will be deemed incomplete and returned to you.

7. Capture Efficiency (% Emissions from Emission Source Vented to Control Device or Stack)	N/A	
8. Control Device Information , if none, write "none"		
	Control Device ID # (as listed in permit)	Control Device Description
<i>i. (nearest stack)</i>	None	None
<i>ii.</i>	None	None
<i>iii.</i>	None	None
<i>iv.</i>	None	None

9. Stack Information (sources vented to more than one stack use additional entry lines)						
Stack ID #	Height (in whole feet)	Diameter (feet) Circle (enter #), Rectangle (L#, W#) (in 0.1 feet)	Temperature (F)	Velocity (feet/sec)	Volume Flow Rate (acfm)	Release Point Description (Fugitive, Vertical, Vertical w/ cap, Horizontal, Downward - see instructions)
Fugitive						
--	--	--	--	--	--	--
--	--	--	--	--	--	--

10. Operating Schedule (Source/Operating Scenario that best characterizes calendar year)							
Hours/Day	1	Days/Week	3	Weeks/Year	52	Hours/Year	156
Typical Start & End Times in CY:				Start:	N/A	End:	N/A

11. Seasonal Periods Percent Annual Throughput (for Emission Source in CY, MUST total 100%)							
Jan-Feb, 2002 + Dec, 2002	32.15%	Mar-May	22.16%	June-Aug	28.39%	Sept-Nov	17.30%

University of North Carolina at Chapel Hill

Chapel Hill, North Carolina

Orange County

Facility ID # 6800043

Permit # 03069T29

2011 Cogeneration Emissions Inventory

Enclosed Sorbent (Lime) Railcar Dump Pit

(Insignificant Source - ID No. 020)

Sorbent is transported from the railcar dump pit in enclosed conveyors to the storage area. Emissions can be best estimated using the drop equation.

From section 13.2.4 of the AP-42: The following equation represents the particulate emissions generated by the dropping of sorbent into the dump pit.

$$E = k (0.0032) \frac{(u/5)^{1.3}}{(m/2)^{1.4}}$$

E = Emission Factor (lb/ton)

k = Particle Size Multiplier

u = Mean Wind Speed (mph)

m = Material Moisture Content (%)

k Value	Particulate Size	Emission Factor (lb/ton)
0.74	PM	1.787E-03
0.35	PM-10	8.45E-04
0.11	PM-2.5	2.66E-04

Average moisture content of sorbent is 0.7%

The dump area is fully enclosed, therefore the minimum wind speed of 1.3 mph was used.

Total Sorbent 18,279 tons/yr

Emissions from the unloading of sorbent into the dump pit:

	Emission Factor (lb/ton)	Emissions (lb/yr)	Emissions (ton/yr)
PM	1.79E-03	32.67	1.63E-02
PM-10	8.45E-04	15.45	7.73E-03
PM-2.5	2.66E-04	4.86	2.43E-03