Dartmouth College
Hanover, NH

Engineering Calculation Sheet-NHDES/ARD

*SIC Codes: 8221 Colleges, universities and professional schools
AFS #3300900020
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PROJECT DESCRIPTION

Dartmouth College (Dartmouth) is an educational institution located in Hanover, NH. The predominant source of air pollutant emissions at Dartmouth is their power plant. This plant provides heat and hot water to various buildings on campus. Dartmouth is a major source for PT, SO_2 and NO_x and is currently operating under Title V Operating Permit, TV-OP-22.
This Temporary Permit removes short-term steam production limits, for the four steam boilers, EU1-EU4, based on the results of an updated air quality impacts analysis that demonstrates compliance with the National Air Quality Standards.

SIGNIFICANT EMISSION UNITS

Emission Unit ID	Description of Emission Unit	Install Date	Maximum Design Capacity
EU1	Boiler #1, Zurn Low NOx Bruner (LNB)	1986[1]	Boiler rated at 112.26 MMBTU/hr of heat input equivalent to 748 gallons per hour (gal/hr) of #6 fuel oil with a heating value of 150,000 BTU/gallon, 1.5 % sulfur by weight and 0.6% fuel bound nitrogen by weight.
EU2	Boiler #2, Babcock and Wilcox	1958	Boiler rated at 45 MMBTU/hr of heat input equivalent to 300 gallons per hour (gal/hr) of #6 fuel oil with a heating value of 150,000 BTU/gallon and 1.5 % sulfur by weight.
EU3	Boiler #3, Nebraska Boiler Co. LNB	1996	Boiler rated at 95.5 MMBTU/hr of heat input equivalent to 637 gallons per hour (gal/hr) of #6 fuel oil with a heating value of 150,000 BTU/gallon and 0.5 % sulfur by weight.
EU4	Boiler #4, Combustion Engineering LNB	1967	Boiler rated at 97.3 MMBTU/hr of heat input equivalent to 649 gallons per hour (gal/hr) of #6 fuel oil with a heating value of 150,000 BTU/gallon, 1.5 % sulfur and 0.6% fuel bound nitrogen by weight.
Facility-wide NOx emissions shall be limited to **175.0** tons during any consecutive 12-month period.			

[1] Conctruction of the Boiler #1 commenced on July 31, 1985.

Dartmouth College
Hanover, NH

Engineering Calculation Sheet-NHDES/ARD

EMISSION CALCULATIONS:

Boiler #1

Heat input	112.2 mmBtu/hr
#6 Fuel Oil Limit	0.748 Kgal/hr
Actual oil usage in 2003	1,528.885 kgal/yr
Sulfur	1.5 %

Pollutant	EF lb/mmBtu (1-01-004-01)	EF lb/kgal (1-01-004-01)	Actual lb/hr	Actual tpy	Potential lb/hr	Potential tpy
PT	0.11	17.01	2.97	13.00	12.72	55.73
SO_2	1.57	235.50	41.10	180.03	176.15	771.55
NOx**	0.297	44.55	7.78	34.06	33.32	145.96
CO	0.033	5.00	0.87	3.82	3.74	16.38
VOC	0.005	0.76	0.13	0.58	0.57	2.49

**NOx values are based on 2003 CEM data.
All other emission factors are AP-42 (5th ed)

Boiler #2

Heat input	45 mmBtu/hr
#6 Fuel Oil Limit	0.300 Kgal/hr
Actual oil usage in 2003	133.529 kgal/yr
Sulfur	1.5 %

Pollutant	EF lb/mmBtu (1-02-004-01)	EF lb/kgal (1-02-004-01)	Actual lb/hr	Actual tpy	Potential lb/hr	Potential tpy
PT	0.11	17.01	0.26	1.14	5.10	22.35
SO_2	1.57	235.50	3.59	15.72	70.65	309.45
NOx*	0.316	47.42	0.72	3.17	14.23	62.31
CO	0.033	5.00	0.08	0.33	1.50	6.57
VOC	0.002	0.28	0.00	0.02	0.08	0.37

All emission factors are AP42 (5th edition)
*EF based on NOx RACT stack test done on 2/26/03

Boiler #3

Heat input	95.5 mmBtu/hr
#6 Fuel Oil Limit	0.637 Kgal/hr
Actual oil usage in 2003	1,364.050 kgal/yr

Dartmouth College
Hanover, NH

Engineering Calculation Sheet-NHDES/ARD

Sulfur 0.5 %

Pollutant	EF lb/mmBtu (1-02-004-01)	EF lb/kgal (1-02-004-01)	Actual lb/hr	Actual tpy	Potential lb/hr	Potential tpy
PT	0.052	7.82	1.22	5.33	4.98	21.81
SO_2	0.523	78.50	12.22	53.54	49.98	218.92
NOx**	0.275	41.25	6.42	28.13	26.26	115.04
CO	0.033	5.00	0.78	3.41	3.18	13.94
VOC	0.002	0.28	0.04	0.19	0.18	0.78

**Stack test data done on 2/25/03

Boiler #4

Heat input 97.3 mmBtu/hr
#6 Fuel Oil Limit 0.649 Kgal/hr
Actual oil usage in 2003 2,224.377 kgal/yr
Sulfur 1.5 %

Pollutant	EF lb/mmBtu (1-02-004-01)	EF lb/kgal (1-02-004-01)	Actual lb/hr	Actual tpy	Potential lb/hr	Potential tpy
PT	0.113	17.01	4.32	18.92	11.03	48.33
SO_2	1.570	235.50	59.80	261.92	152.77	669.13
NOx**	0.342	51.30	13.03	57.06	33.28	145.76
CO	0.033	5.00	1.27	5.56	3.24	14.21
VOC	0.002	0.28	0.07	0.31	0.18	0.80

**NOx values are based stack test data performed on 3/20/02.

2003 Emissions from Boilers					
Pollutant	PT	SOx	NOx	CO	VOC
Boiler 1, 2, 3 &4 in TPY	38.39	511.21	122.41	13.13	1.10

Potential Emissions from Boilers					
Pollutant	PT	SOx	NOx	CO	VOC
Boiler 1, 2, 3 & 4 in TPY	148.22	1969.05	469.06	51.10	4.43

Summary of Actual Annual Emissions and Proposed Limits for Boilers

Dartmouth College
Hanover, NH

Engineering Calculation Sheet-NHDES/ARD

	NOx TPY	SO_2 TPY	PM_{10} TPY	PM TPY	CO TPY	VOC TPY	Pb TPY
Actual Emissions (March 2002-Feb 2003)	114.2	453.6	34.6	34.6	13.0	1.2	0.004
Actual Emissions (March 2003-Feb 2004)	124.1	532.1	39.6	39.6	13.2	1.1	0.004
Baseline Actual Emissions	119.2	492.9	37.1	37.1	13.1	1.2	0.004
Significance Threshold[1]	40	40	15	25	100	40	0.6
Proposed Heating Plant Limitations	158.2	531.9	51.1	61.1	51.1[2]	4.43[2]	0.504

[1] One ton was deducted for safety margin.
[2] Potential emissions were used as a limit since the significance threshold exceeded the potential.
The above limits were established for the purpose of NSR/PSD avoidance.
[3] Fuel caps cannot be calculated since boilers use fuels with different sulfur content. The facility will show compliance by tracking monthly emissions.

NOx RACT

The facility chose to installed low NOx burners on Boiler 1, 3 and 4 and limit their NOx emission to values specified in Table 3B of Temporary Permit to meet NOx RACT requirements.

REVISIONS

1. 1-hour and 6-hour steam production limits and associated recordkeeping requirements for boilers were taken out of the permit since the limits were based on outdated modeling and procedures. The boilers passed modeling based on current models.
2. Boiler #1 maximum design capacity was changed from 117 to 112.2 mmBtu/hr since a new burner was installed in 1996 derating a boiler to 112.2 mmBtu/hr.
3. Subpart Dc frequency of reporting for Boiler 3 was changed from quarterly to semiannually to reflect the current changes in the rule.
4. The current TV Permit Table 5, Item 2 was removed since Boiler 1 is not applicable to the particulate matter standard of 40 CFR 60.43b and 60.48b(a)

PERMITTING HISTORY

1. On May 23, 2000, Title V Permit #TV-OP-022 was issued to Dartmouth to operate four boilers, emergency generators, two diesel powered fire pumps, an air compressor, gasoline service station, water chillers and two 125,000 gallon gasoline storage tanks.
2. On October 21, 2002 TV Permit was amended to include…
3. On April xx, 2005 the Temporary Permit was issued to revise the steam production limits.

Dartmouth College
Hanover, NH

Engineering Calculation Sheet-NHDES/ARD

APPLICABLE REGULATIONS

NSPS	Boiler 1 is applicable to Subpart DB for NOx and Boiler 3 is applicable to subpart Dc for sulfur and opacity.
MACT	No;
Title V	Yes;
Env-A 300	AAQS; Applicable
Env-A 607	Temporary Permits; Applicable
Env-A 609	Title V Operating Permits; Applicable
Env-A 700	Permit Fee System; Applicable
Env-A 800	Testing & Monitoring Procedures; Applicable
Env-A 900	Owner/Operator Obligations; Applicable
Env-A 1211.01	Boilers 1, 3 and 4 are subject to the NOx RACT requirements of Env-A 1211.11
Env-A 1400	RTAPs; RTAPs emitted from the combustion of virgin petroleum products are exempt from Env-A 1400, per Env-A 1402.01(b)(4)d.
Env-A 1600	Fuel specifications; Applicable
Env-A 2000	Fuel burning devices; Applicable

SUMMARY AND CONCLUSIONS

In summary, the operations as applied for will be capable of meeting all regulations and standards for air quality. Therefore, DES has no objections to issuing a Temporary Permit.