Emission Factors
Dartmouth College Educational Facilities
2011 Estimation of Potential Emissions

	Fuel Type	Factor Reference	SO2	NOx	CO	PM	VOC[1]
			(g/kw-hr)				
Small Diesel Generators	Diesel	AP-42; Section 3.3; Gasoline and Industrial Diesel Engines (10/96)	1.25	18.85	4.06	1.34	1.502
Large Diesel Generators	Diesel	AP-42; Section 3.4; Large Stationary Diesel Engines (10/96) (>600 HP) S=0.4	1.97	14.59	3.34	0.426	0.429
Fahey Generator (EG14)	Diesel	Olympian data sheet for model D80P4 - Tier 2 with SO_2 converted from AP-42	1.25	6.60	5.00	0.30	6.60
			(g/bhp-hr)				
Kemeny Generator (EG16)	Diesel	Cummins data sheet for model 60 DGCB - Tier 1 NOx only, AP-42 for the rest	0.93	6.9	3.03	1.00	1.12
McLaughlin Rauner Generator (EG17)	Diesel	Cummins data sheet for model 200 DGFC - Tier 1 with SO_2 converted from AP-42	0.93	6.90	8.50	0.40	1.00
Floren Varsity Generator (EG15)	Diesel	Caterpillar data sheet for model C15/350kw/480v/3ph - Tier 3 with SO_2 converted from AP-42	0.93	3.00	2.60	0.15	3.00
Tuck LLC (EG18)	Diesel	Cummins data sheet for model 200 DSHAC - Tier 3 with SO2 converted from AP-42	0.93	3.00	2.60	0.15	3.00
Vail-Remsen (Medical Center) (EG19)	Diesel	Kohler Model 600REOZM. Emission factors from March 23, 2006 Application which referenced EPA Tier 1 rates for NOx, CO and PM10 and AP-42 for SO2 at 0.0015 %S.	0.006	6.90	8.50	0.40	1.00
Life Sciences Building (EG20)	Diesel	Caterpillar data sheet for model CAT C27 - Tier 2 with SO2 converted from AP-42[3]	0.006	4.80	2.60	0.15	4.80
			(lb/kw-hr)				
LPG fired Generators	LP Gas	AP-42; Section 3.2[2]; Natural Gas-fired Reciprocating Engines (7/00)	8.23E-06	5.71E-02	4.44E-03	1.08E-06	1.65E-03
			(g/bhp-hr)				
JJJJ Engines	LP Gas	25<hp<130		2.0	4.0		1.0

(1) VOC as NMTOC
(2) Emission Factors for generators burning LP Gas are not available. Emission factors for 4-cycle lean burn engines burning natural gas were used. Factors were converted from lb/MMBtu (input) to lb/kW-hr using 14,000 Btu/kW-hr

(3) Dartmouth installed a SCR on the Life Sciences Building EG but is **not** taking credit at this time for the reduction in NOx that the device is expected to achieve via vendor. If Dartmouth College wants to take credit for the SCR control in the future, the device will need monitoring and stack testing requirements added to the permit.

Note that many of the EPA certified emission levels for 40 CFR 60, Subpart IIII are combined emissions of NOx + NMHC (VOC). This value is used for NOx and VOC conservatively.

APPENDIX I

Potential Emissions from Emergency Generators
Dartmouth College Educational Facilities

Emission Unit	Location	Rated Generator Power Output (kW)	Rated Generator Power Output (bhp)	Type of Fuel	Potential Operating Hours[1] (hours per year)	Potential Emissions									
						SOx		NOx		CO		PM		VOC	
						(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)	(lb/hr)	(ton/yr)
EG1	Hopkins	25		Diesel	200	0.07	0.007	1.04	0.10	0.22	0.02	0.07	0.01	0.08	0.01
EG2	Burke	300		Diesel	200	0.82	0.08	12.47	1.25	2.69	0.27	0.88	0.09	0.99	0.10
EG3	Electric/Heating Plant EG	800	1190	Diesel	200	3.47	0.35	25.74	2.57	5.90	0.59	0.75	0.08	0.76	0.08
EG4	Moore	350		Diesel	200	0.96	0.10	14.54	1.45	3.13	0.31	1.03	0.10	1.16	0.12
EG5	Webster Rauner	200		Diesel	200	0.55	0.05	8.31	0.83	1.79	0.18	0.59	0.06	0.66	0.07
EG6	Berry Library	668		Diesel	200	2.90	0.29	21.49	2.15	4.92	0.49	0.63	0.06	0.63	0.06
EG7	Wilder	200		Diesel	200	0.55	0.05	8.31	0.83	1.79	0.18	0.59	0.06	0.66	0.07
EG8	Boss Tennis	50		Diesel	200	0.14	0.01	2.08	0.21	0.45	0.04	0.15	0.01	0.17	0.02
EG9	Silsby	75		Diesel	200	0.21	0.02	3.12	0.31	0.67	0.07	0.22	0.02	0.25	0.02
EG10	Whittemore	125		Diesel	200	0.34	0.03	5.19	0.52	1.12	0.11	0.37	0.04	0.41	0.04
EG11	37 Dewey Field Road	150		Diesel	200	0.41	0.04	6.23	0.62	1.34	0.13	0.44	0.04	0.50	0.05
EG12	Thompson Arena	25		Diesel	200	0.07	0.007	1.04	0.10	0.22	0.02	0.07	0.01	0.08	0.01
EG13	Cummings	350	535	Diesel	200	0.96	0.10	14.54	1.45	3.13	0.31	1.03	0.10	1.16	0.12
EG14	Fahey	80		Diesel	200	0.22	0.02	1.16	0.12	0.88	0.09	0.05	0.01	1.16	0.12
EG15	Floren Varsity	350	563	Diesel	200	1.15	0.12	3.72	0.37	3.23	0.32	0.19	0.02	3.72	0.37
EG16	Kemeny	60	99	Diesel	200	0.20	0.02	1.51	0.15	0.66	0.07	0.22	0.02	0.24	0.02
EG17	McLaughlin Rauner	200	352	Diesel	200	0.72	0.07	5.35	0.54	6.60	0.66	0.31	0.03	0.78	0.08
EG18	Tuck LLC	200	364	Diesel	200	0.75	0.07	2.41	0.24	2.09	0.21	0.12	0.01	2.41	0.24
EG19	Vail-Remsen	600	898	Diesel	200	0.01	0.001	13.66	1.37	16.83	1.68	0.79	0.08	1.98	0.20
EG20	Life Sciences Building	750	1141	Diesel	200	0.01	0.00	12.07	1.21	6.54	0.65	0.38	0.04	12.07	1.21
	Berry Gym	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Brown	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Byrne	12.5		LP	200	1.03E-04	1.03E-05	0.71	0.07	0.06	5.55E-03	1.35E-05	1.35E-06	0.02	0.002
	Collis	135		LP	200	1.11E-03	1.11E-04	7.71	0.77	0.60	5.99E-02	1.46E-04	1.46E-05	0.22	0.022
	Fayerweather-Mid	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Gilman	70		LP	200	5.76E-04	5.76E-05	4.00	0.40	0.31	3.11E-02	7.56E-05	7.56E-06	0.12	0.012
	Hitchcock	85		LP	200	7.00E-04	7.00E-05	4.86	0.49	0.38	3.77E-02	9.17E-05	9.17E-06	0.14	0.014
	Judge	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Lord	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Maxwell	7.5		LP	200	6.17E-05	6.17E-06	0.43	0.04	0.03	3.33E-03	8.10E-06	8.10E-07	0.01	0.001
	Mass-Mid	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	New Hampshire	25	40	LP	200	2.06E-04	2.06E-05	1.43	0.14	0.11	1.11E-02	2.70E-05	2.70E-06	0.04	0.004
	Robinson	30		LP	200	2.47E-04	2.47E-05	1.71	0.17	0.13	1.33E-02	3.24E-05	3.24E-06	0.05	0.005
	Rope Ferry	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Russell Sage	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Sudikoff	45		LP	200	3.70E-04	3.70E-05	2.57	0.26	0.20	2.00E-02	4.86E-05	4.86E-06	0.07	0.007
	Topliff	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Wheeler	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Woodward	15		LP	200	1.23E-04	1.23E-05	0.86	0.09	0.07	6.66E-03	1.62E-05	1.62E-06	0.02	0.002
	Zimmerman	45		LP	200	3.70E-04	3.70E-05	2.57	0.26	0.20	2.00E-02	4.86E-05	4.86E-06	0.07	0.007
	Hanover Inn Kitchen	75	119.8	LP	200	6.17E-04	6.17E-05	0.53	0.05	1.06	0.11	8.10E-05	8.10E-06	0.26	0.03
	Visual Arts	100	165	LP	200	8.23E-04	8.23E-05	0.73	0.07	1.46	0.15	1.08E-04	1.08E-05	0.36	0.04
	53 Commons	80	128	LP	200	6.59E-04	6.59E-05	0.56	0.06	1.13	0.11	8.64E-05	8.64E-06	0.28	0.03
	TOTAL:						***1.45***		***16.40***		***6.42***		***0.89***		***2.99***
	Total including LPG engines:						***1.45***		***20.12***		***7.06***		***0.89***		***3.18***

[1] Potential Emissions were calculated as follows:

$$\text{(ton/yr)} = \frac{\text{Rated Engine Power Output (kw or bhp) * Emission Factor (g/kw-hr or g/bhp-hr) * Allowable Operating Hours (hr/yr)}}{\text{2000 (lb/ton) * 453.59 (g/lb)}}$$