

Appendix B

Turbine Startup Emissions Data

Maximum Hourly, Daily, and Annual Emissions Calculations

Case #: LM6000 Peaking Units-Mission Rock

Number of Identical Engines: 5
Turbine Model: LM6000 PG Sprint

Estimated Shutdowns Yr: 150
Estimated Shutdowns day: 2

Input data per unit:			Avg	Startups			Shutdown			Annual			Total Annual Emissions		
Max	Annual	Startups	# of	Time	Time	Time	Startups	Time	Starts	Shutdowns	Starts	Shutdowns	Starts	Shutdowns	
Operation hrs/day	Op hrs	day	Startups	hrs	hrs	hrs	Startups	hrs	events/Yr	events/Yr	yr	day	yr	day	
24	7500	2	0	0.5	0	1	0	0.15	150	0	150	2			
Annual CF %:	29		SS Runtime	0.5					0.85						

Pollutant	Startup Emissions lbs/event	Annual Emissions lbs/yr	# of Startups	Steady State Emissions			Worst Hr Emissions			Total Startups	Total Shutdowns	Annual Non SU/SD	Total Annual Emissions		
				Case 14	Case 1	Cold Day	Case 14	Case 1	Cold Day				Starts	Shutdowns	Starts
NOx	9.10	0.00	0.00	4.04	5.10	11.65	7.99	11.65	75	22.5	2402.5	1365.0	0.0	0.00	
CO	5.50	0.00	0.00	4.92	4.97	7.99	7.99	7.99	75	22.5	2402.5	825.0	0.0	0.00	
VOC	1.00	0.00	0.00	0.70	0.70	1.60	1.60	1.60	1.36	22.5	2402.5	150.0	0.0	0.00	
SOx	0.30	0.00	0.00	0.59	0.59	1.18	1.18	1.18	1.36	22.5	2402.5	44.3	0.0	0.00	
PM10	1.00	0.00	0.00	2.00	2.00	2.00	2.00	2.00	150.0	0	2402.5	150.0	0.0	0.00	
PM2.5	1.00	0.00	0.00	2.00	2.00	2.00	2.00	2.00	150.0	0	2402.5	150.0	0.0	0.00	
NH3	1.89	0.00	0.00	3.74	3.77	1.89	1.89	1.89	283.5	0	2402.5	85.5	0.0	0.00	

Cold start plus shutdown =		hrs	hrs	hrs	hrs	hrs	hrs	hrs	hrs	hrs	hrs	hrs	hrs	hrs
0.65	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Shut down =		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Maximum Estimated Annual Emissions		NOx lbs/yr	CO lbs/yr	VOC lbs/yr	SOx lbs/yr	PM10 lbs/yr	PM2.5 lbs/yr	NH3 lbs/yr	Annual Fuel Use Values	mmbtu/hr	hrs/yr	mmbtu/yr
0.65	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	561,200	561,200	2,500	1,402,500
Shut down =		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.00	0.00	0	0
Total =		0.80	0.30	0.30	0.30	0.30	0.30	0.30	561,200	561,200	2,500	1,402,500

Ops Scenario		NOx lbs/yr	CO lbs/yr	VOC lbs/yr	SOx lbs/yr	PM10 lbs/yr	PM2.5 lbs/yr	NH3 lbs/yr	Annual Fuel Use Values	mmbtu/hr	hrs/yr	mmbtu/yr
1365.0	825.0	150.0	44.3	150.0	150.0	150.0	150.0	150.0	561,200	561,200	2,500	1,402,500
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0	0
180.0	270.0	150.0	14.7	150.0	14.7	45.0	45.0	45.0	8985.4	8985.4	40	24,000
9706.1	11820.3	1691.4	1417.5	1691.4	1417.5	4805.0	4805.0	4805.0	8985.4	8985.4	40	24,000
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0	0
11251.1	12915.3	1991.4	1476.4	1991.4	1476.4	5000.0	5000.0	5000.0	8985.4	8985.4	40	24,000
Single Turbine, tons/yr:		5.63	6.46	1.00	0.74	2.50	2.50	2.50	8985.4	8985.4	40	24,000

Total Tons/Yr All Units:												
NOx tpy	CO tpy	VOC tpy	SOx tpy	PM10 tpy	PM2.5 tpy	NH3 tpy	28.13	32.29	4.98	3.69	12.50	22.46
PSD Program Trigger Levels, TPY:	250	250	250	250	250	250	250	250	250	250	250	250
PSD Significant Emissions Rates, TPY:	40	100	40	40	15	10	15	15	10	10	15	15
Air Agency Offset Trigger Levels, TPY:	5	NA	5	15	15	NA	15	15	NA	NA	15	15

(If PTE for ROC or NOx is > 25 tpy then the offset ratio is 1.3:1. Offset ratio for PM10 or SOx is 1:1.) Ref: Rule 26.2

Maximum Estimated Daily Emissions based on a 24 Hr Ops Cold Day

Max Daily Emissions Assumptions (Per turbine):

starts per day =	2	Hours	1
shutdowns per day =	0	Hours	0
Steady state ops hrs/day =	2	Hours	0.3
		Hours	22.7

Power Production Estimates

Case 14, Avg Day, 100% Load, Kw:	286605	All Units	Gross
Case 14, Avg Day, 100% Load, Kw:	276438		Net
Annual MW	286,605		Gross
Annual MW	276,438		Net
Annual MW	716513		Gross
Annual MW	691095		Net

	lbs/day	all units
NOx	136.37	681.85
CO	127.42	637.10
VOC	19.98	99.90
SOx	14.18	70.90
PM10	48.00	240.00
PM2.5	48.00	240.00
NH3	90.50	452.50

Maximum Estimated Hourly Emissions

Max hourly emissions assumptions (Per turbine):

1. Startup, cold day
2. remainder of hour, cold day no DB, Case 1
3. NH3 is cold day data-steady state

	lbs/hr	lbs/hr All Units	Hours	Case 1 used for remaining hour of start (lb/hr)
NOx	11.65	58.25	0.5	5.10
CO	7.99	39.93	0.5	4.97
VOC	1.35	6.76	0.5	0.71
SOx	0.59	2.95	0.5	0.26
PM10	2.00	10.00	0.5	1.00
PM2.5	2.00	10.00	0.5	1.00
NH3	3.77	18.85	0.5	3.77

GHG Emissions Estimates

Fuel:	Natural Gas	HHV	Emissions	lbs/yr	short tons/yr
Btu/sft:	1021	mmBtu/yr		1.64E+08	8.20E+04
Heat Rate:	1402500	mmBtu/yr		3.09E+03	1.55E+00
Fuel Rate:	1373.6533	mmscf/yr		3.09E+02	1.55E-01

Emissions Factors

	lbs/mmBtu	lbs/mmBtu
CO2	116.89	
CH4	0.002205	
N2O	0.0002205	

Emissions Factors for GHG, 40 CFR 98, Subpart C, Tables C-1, C-2.

1 short ton = 2000 lbs, 1 metric ton = 2200 lbs.

IPCC SAR Values	short tons/yr	CO2e
1	8.20E+04	
21	3.25E+01	
310	4.79E+01	
Total CO2e:	82,050	short TPY 1 Engine
Total CO2e:	410,248	short TPY All Engines
Total CO2e:	74,590	metric TPY 1 Engine
Total CO2e:	372,952	metric TPY All Engines

Average CO2 Performance Estimate:

Gross MW:	1144.0	lbs CO2/Mw-hr
Net MW:	1186.1	lbs CO2/Mw-hr

Notes:

1. Turbine steady-state emissions based on the following:
 NOx 2.5 ppm (1-hour) and 2.0 (annual)
 CO 4.0 ppm
 VOC <= 1 ppm
2. Startup data has no margin and assumed 30 minutes
3. Start event data is based on 30 minute start cycle to achieve compliance with BACT limits.
4. Short-term emissions based on 30 degree day (Case 1 cold day)
5. Annual emissions based on annual average day (Case 14)

Data References:

1. GE Base Load Performance Data as provided by the applicant.
2. GE LM6000 PG Sprint SU/SD data as provided by the applicant.
3. Proposed operational data as provided by the applicant.
4. *
5. *