

EMISSION CALCULATIONS

Table B-1. Potential to Emit - Site-Wide

Pollutant	Estimated Potential Emissions (tpy)					Major Source Thresholds (tpy)
	A-1 (GE / M3002-RA)	A-2 (GE / M3002-RA)	A-3 (GE / M3002-RA)	Fugitives	Total	
NO _x	179.58	179.58	179.58	-	539	100
CO	57.59	57.59	57.59	-	173	100
VOC	0.48	0.48	0.48	1.27	2.70	100
SO ₂	0.77	0.77	0.77	-	2.32	100
PM/PM ₁₀ /PM _{2.5}	1.50	1.50	1.50	-	4.51	100
Max HAP	0.16	0.16	0.16	0.10	0.16	10
Total HAPs	0.23	0.23	0.23	0.10	0.80	25
CO ₂ e	26,649	26,649	26,649	771	80,718	100,000

EMISSION CALCULATIONS

Table B-2a. Potential to Emit - Turbines - Unit Details

Unit	A-1	
Make & Model	GE / M3002-RA	
Type	Natural Gas Fired Turbine	
Rating¹	4,976	hp
BSFC¹	10,442	Btu/hp-hr
Heat Input	51.96	MMBtu/hr
Annual Operating Hours	8,760	hours

¹ Site horsepower at 80 deg F per Appendix F.

Table B-2b. Potential to Emit - Turbines - Emissions - Criteria Pollutants

Pollutant	Emission Factor		Basis	Emission Rate	
	Value	Units		(lb/hr)	(tpy)
NO _x	41.00	lb/hr	2013 Air Permit Renewal Application	41.00	179.58
CO	13.15	lb/hr	2013 Air Permit Renewal Application	13.15	57.59
VOC	0.0021	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.11	0.48
SO ₂	0.0034	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.18	0.77
PM	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50
PM ₁₀	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50
PM _{2.5}	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50

Table B-2c. Potential to Emit - Turbines - Emissions - Hazardous Air Pollutants (HAPs)

Pollutant	Emission Factor		Basis	Emission Rate	
	Value	Units		(lb/hr)	(tpy)
1,3-Butadiene	4.30E-07	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	2.23E-05	9.79E-05
Acetaldehyde	4.00E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	2.08E-03	9.10E-03
Acrolein	6.40E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.33E-04	1.46E-03
Benzene	1.20E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.24E-04	2.73E-03
Ethylbenzene	3.20E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.66E-03	7.28E-03
Formaldehyde	7.10E-04	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.69E-02	1.62E-01
Naphthalene	1.30E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.75E-05	2.96E-04
PAH	2.20E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.14E-04	5.01E-04
Propylene Oxide	2.90E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.51E-03	6.60E-03
Toluene	1.30E-04	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.75E-03	2.96E-02
Xylene	6.40E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.33E-03	1.46E-02
			Max	0.04	0.16
			Total	0.05	0.23

EMISSION CALCULATIONS

Table B-3a. Potential to Emit - Turbines - Unit Details

Unit	A-2	
Make & Model	GE / M3002-RA	
Type	Natural Gas Fired Turbine	
Rating¹	4,976	hp
BSFC¹	10,442	Btu/hp-hr
Heat Input	51.96	MMBtu/hr
Annual Operating Hours	8,760	hours

¹ Site horsepower at 80 deg F per Appendix F.

Table B-3b. Potential to Emit - Turbines - Emissions - Criteria Pollutants

Pollutant	Emission Factor		Basis	Emission Rate	
	Value	Units		(lb/hr)	(tpy)
NO _x	41.00	lb/hr	2013 Air Permit Renewal Application	41.00	179.58
CO	13.15	lb/hr	2013 Air Permit Renewal Application	13.15	57.59
VOC	0.0021	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.11	0.48
SO ₂	0.0034	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.18	0.77
PM	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50
PM ₁₀	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50
PM _{2.5}	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50

Table B-3c. Potential to Emit - Turbines - Emissions - Hazardous Air Pollutants (HAPs)

Pollutant	Emission Factor		Basis	Emission Rate	
	Value	Units		(lb/hr)	(tpy)
1,3-Butadiene	4.30E-07	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	2.23E-05	9.79E-05
Acetaldehyde	4.00E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	2.08E-03	9.10E-03
Acrolein	6.40E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.33E-04	1.46E-03
Benzene	1.20E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.24E-04	2.73E-03
Ethylbenzene	3.20E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.66E-03	7.28E-03
Formaldehyde	7.10E-04	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.69E-02	1.62E-01
Naphthalene	1.30E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.75E-05	2.96E-04
PAH	2.20E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.14E-04	5.01E-04
Propylene Oxide	2.90E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.51E-03	6.60E-03
Toluene	1.30E-04	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.75E-03	2.96E-02
Xylene	6.40E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.33E-03	1.46E-02
			Max	0.04	0.16
			Total	0.05	0.23

EMISSION CALCULATIONS

Table B-4a. Potential to Emit - Turbines - Unit Details

Unit	A-3	
Make & Model	GE / M3002-RA	
Type	Natural Gas Fired Turbine	
Rating ¹	4,976	hp
BSFC ¹	10,442	Btu/hp-hr
Heat Input	51.96	MMBtu/hr
Annual Operating Hours	8,760	hours

¹ Site horsepower at 80 deg F per Appendix F.

Table B-4b. Potential to Emit - Turbines - Emissions - Criteria Pollutants

Pollutant	Emission Factor		Basis	Emission Rate	
	Value	Units		(lb/hr)	(tpy)
NO _x	41.00	lb/hr	2013 Air Permit Renewal Application	41.00	179.58
CO	13.15	lb/hr	2013 Air Permit Renewal Application	13.15	57.59
VOC	0.0021	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.11	0.48
SO ₂	0.0034	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.18	0.77
PM	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50
PM ₁₀	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50
PM _{2.5}	0.0066	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for stationary gas turbines	0.34	1.50

Table B-4c. Potential to Emit - Turbines - Emissions - Hazardous Air Pollutants (HAPs)

Pollutant	Emission Factor		Basis	Emission Rate	
	Value	Units		(lb/hr)	(tpy)
1,3-Butadiene	4.30E-07	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	2.23E-05	9.79E-05
Acetaldehyde	4.00E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	2.08E-03	9.10E-03
Acrolein	6.40E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.33E-04	1.46E-03
Benzene	1.20E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.24E-04	2.73E-03
Ethylbenzene	3.20E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.66E-03	7.28E-03
Formaldehyde	7.10E-04	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.69E-02	1.62E-01
Naphthalene	1.30E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.75E-05	2.96E-04
PAH	2.20E-06	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.14E-04	5.01E-04
Propylene Oxide	2.90E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	1.51E-03	6.60E-03
Toluene	1.30E-04	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	6.75E-03	2.96E-02
Xylene	6.40E-05	lb/MMBtu	AP-42 Section 3.1, dated April 2000, for natural gas-fired stationary gas turbines	3.33E-03	1.46E-02
			Max	0.04	0.16
			Total	0.05	0.23

EMISSION CALCULATIONS

Table B-5. Potential to Emit - Fugitive Components - Emissions

Component	Component Count ¹	THC Emission Factor (lbs/hr-SRC) ²	Stream Content (wt%) ³				VOC Emissions		HAP Emissions		CH ₄ Emissions		CO ₂ Emissions		CO ₂ e ⁴ Emissions (tpy)
			VOC	HAP	CH ₄	CO ₂	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	
Valves	514	0.00992	4.00%	0.30%	97.00%	5.00%	0.20	0.89	0.015	0.067	4.95	21.66	0.25	1.12	542.74
Flanges	240	0.00086	4.00%	0.30%	97.00%	5.00%	0.0083	0.036	0.00062	0.0027	0.20	0.88	0.010	0.045	21.96
Connections	1,474	0.00044	4.00%	0.30%	97.00%	5.00%	0.026	0.11	0.0019	0.0085	0.63	2.76	0.032	0.14	69.17
Open-ended lines	28	0.00441	4.00%	0.30%	97.00%	5.00%	0.0049	0.022	0.00037	0.0016	0.12	0.52	0.0062	0.027	13.14
Others	60	0.01940	4.00%	0.30%	97.00%	5.00%	0.047	0.20	0.0035	0.015	1.13	4.95	0.058	0.25	123.89
Totals							0.29	1.27	0.022	0.10	7.03	30.77	0.36	1.59	770.91

¹ Component counts default values obtained from GRI-HAPCalc Version 3.01 for a "typical" compressor station, doubled as a conservative measure

The GRI HAP Calc Version 3.01 for a "typical" compressor station assumes six turbines and six reciprocating engines.

² THC emission factors from Table 2-4 of EPA-453/R-95-017, Protocol for Equipment Leak Emission Estimates (November, 1995).

The THC emissions factors were multiplied by the VOC weight percent and HAP weight percent to calculate VOC lb/hr and HAP lb/hr.

The THC emissions factors were multiplied by the CO₂ weight percent and CH₄ weight percent to calculate CO₂ lb/hr and CH₄ lb/hr.

³ Stream content calculated using the stream data contained in Table B-7.

VOC content was estimated from gas analysis, and an additional safety margin was applied. VOC wt% was assumed to be 4% in calculation rather than as shown on Gas Analysis Spreadsheet.

HAP content was estimated from gas analysis, and an additional safety margin was applied. HAP wt% was assumed to be 0.3% in calculation rather than as shown on Gas Analysis Spreadsheet.

Methane content was estimated from gas analysis, and an additional safety margin was applied. Methane wt% was assumed to be 97% in calculation rather than as shown on Gas Analysis Spreadsheet.

CO₂ content was estimated from gas analysis, and an additional safety margin was applied. CO₂ wt% was assumed to be 5% in calculation rather than as shown on Gas Analysis Spreadsheet.

⁴ CO₂e is calculated using the GWPs in the Table B-6.

EMISSION CALCULATIONS

Table B-6. Potential to Emit - Greenhouse Gases

Unit Description	Hours of Operation (hr/yr)	Rating (hp)	BSFC (Btu/hp-hr)	Max Heat Rate (HHV) (MMBtu/hr)	Annual Heat Input (HHV) (MMBtu/yr)	GHG Emissions ¹						
						CO ₂		CH ₄		N ₂ O		CO ₂ e ² (tpy)
						(kg/MMBtu)	(tpy)	(kg/MMBtu)	(tpy)	(kg/MMBtu)	(tpy)	
Natural Gas Fired Turbine - GE / M3002-RA (A-1)	8,760	4,976	10,442	51.96	455,164	53.06	26,621	1.00E-03	0.50	1.00E-04	0.050	26,649
Natural Gas Fired Turbine - GE / M3002-RA (A-2)	8,760	4,976	10,442	51.96	455,164	53.06	26,621	1.00E-03	0.50	1.00E-04	0.050	26,649
Natural Gas Fired Turbine - GE / M3002-RA (A-3)	8,760	4,976	10,442	51.96	455,164	53.06	26,621	1.00E-03	0.50	1.00E-04	0.050	26,649
Fugitives							1.59		30.77			771
Total				155.88	1,365,493		79,866		32.28		0.15	80,718

¹ Emissions of CO₂ and CH₄ and N₂O per 40 CFR 98 Subpart C Tables C-1 and C-2.

² CO₂e based on multiplying CO₂ and CH₄ and N₂O by the Global Warming Potentials contained in 40 CFR 98 Subpart A as follows:

CO ₂	1
CH ₄	25
N ₂ O	298

EMISSION CALCULATIONS

Table B-7. Potential to Emit - Gas Analysis

Component	VOC or HAP ?	Molecular Weight (lb/lb-mol)	Density ¹ (lb/scf)	Mole Percent (%)	Molecular Weight x Mole Percent (lb/lb-mol)	Weight Percent ² (%)	Weight of Component per Volume of Gas ³ (lb/scf)
Nitrogen	No	28.01	0.07	1.57%	0.44	2.63%	1.13E-03
Carbon Dioxide	No	44.01	0.11	0.11%	0.05	0.28%	1.20E-04
Methane	No	16.04	0.04	94.83%	15.21	90.67%	3.88E-02
Ethane	No	30.07	0.08	3.29%	0.99	5.89%	2.52E-03
Propane	VOC	44.10	0.11	0.18%	0.078	0.46%	1.99E-04
i-Butane	VOC	58.12	0.15	0.006%	0.0034	0.020%	8.75E-06
n-Butane	VOC	58.12	0.15	0.011%	0.0062	0.037%	1.58E-05
Pentane	VOC	72.15	0.18	0.0018%	0.0013	0.008%	3.31E-06
Hexane	VOC/HAP	86.18	0.22	0.0002%	0.0002	0.001%	4.40E-07
			Total	100%	16.78	100%	0.043

¹ Calculated using the Ideal Gas Law.

² Calculated as the individual component's (Molecular Weight x Mole Percent), divided by the total (Molecular Weight x Mole Percent).

³ Calculated as the density times the mole percent.

VOC Content	0.00023 lb/scf	0.53% VOC wt. %
HAP Content	0.00000 lb/scf	0.00% HAP wt. %
CO₂ Content	0.00012 lb/scf	0.28% CO ₂ wt. %
CH₄ Content	0.03883 lb/scf	90.67% CH ₄ wt. %

APPENDIX C: START-UP, SHUTDOWN, AND MAINTENANCE (SSM) EMISSIONS

EMISSION CALCULATIONS

Table C-1a. Potential to Emit - SSM - Details

Emission Unit ID	Event	Volume Vented per Event ¹ (Mscf/event)	Annual Events ¹ (event/yr)	Annual Volume Vented (Mscf/yr)
A-1	Unit Blowdown	24	72	1,728
A-2	Unit Blowdown	24	72	1,728
A-3	Unit Blowdown	24	72	1,728
Station	Blowdown	289	6	1,733
Station	Pipeline Pigging	10	8	80
Total				6,997

¹ Facility estimates.

Table C-1b. Potential to Emit - SSM - Emissions

Pollutant	Content (lb/scf)	Emissions ^{1,2} (tpy)
VOC	0.00023	0.80
HAP	0.00000	0.002
CO ₂	0.00012	0.42
CH ₄	0.03883	136
GHG	-	3,397

¹ The CO₂ and CH₄ emission factors are from Table B-7 (weight of component per volume of gas).

² GHG Tons = SSM CO₂ Emissions + (SSM CH₄ Emissions x GWP of 25)