

Appendix G - Air Emissions Analyses

Appendix G-1 – Church Road Interconnects Construction Emissions Calculations

Appendix G-2 – Church Road Interconnects Operating Emissions Calculations

Appendix G-3 – Phased Project Construction Emissions Calculations

Appendix G-4 – Phase 1 Kidder Compressor Station Operating Emissions Calculations

Table G-1.1

PennEast Pipeline Company, LLC

Construction Emissions for Church Road Interconnects

All Emissions are in Units of Tons per Construction Period

Calculation of Total Project Construction Emissions

Values below for the Construction Project Elements are taken from Appendix G-1, Tables G-1.2 through G-1.6

Project Construction Elements	NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂ e	HAPs
Diesel Non-Road Construction Equipment	0.27	0.09	0.04	0.01	0.01	0.0012	129	0.003
Diesel and Gas On-Road Vehicles	0.14	0.55	0.07	0.01	0.01	0.0005	61	0.005
Roadway Travel Particulate Matter				5.92	1.45			
Construction Fugitive Dust from Land Disturbance				3.81	0.57			
Total Construction Emissions	0.41	0.65	0.11	9.76	2.04	0.0016	190	0.008

Table G-1.2 PennEast Pipeline Company, LLC
Construction Emissions - Off-road Engines - Church Road Interconnects Criteria Emissions

Description	Equipment category based on NONROAD classification	SCC ¹	Fuel Type	Equip-ment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Total Working Days	Hours per Day	Total	BSFC ²	Load Factor ²
											Working hrs	lb/hp-hr	
Air Compressors	Light Comm. Air Comp.	2270006015	Diesel	50	1	20	3	4	17	6	102	0.408	0.43
Pumps	Light Commercial Pumps	2270006010	Diesel	40	1	20	6	4	14	6	84	0.408	0.43
Welding Rigs	Light Commercial Welders	2270006025	Diesel	35	2	50	8	2	42	8	672	0.481	0.21
Hydro Mulcher/Seeder	Light Commercial Pumps	2270006010	Diesel	80	1	2	1	1	1	6	6	0.408	0.43
Trucks: Dump	Off-Highway Trucks	2270002051	Diesel	400	1	50	8	2	42	6	252	0.371	0.59
Loader	Rubber Tire Dozers	2270002063	Diesel	180	1	50	8	2	42	6	252	0.371	0.59
Crane	Tracked excavator	2270002036	Diesel	275	1	4	1	1	3	10	30	0.367	0.59
Grader	Rubber Tire Dozers	2270002063	Diesel	240	1	20	4	1	16	6	96	0.371	0.59
583 Sideboom, Pipe Benders	Tracked excavator	2270002036	Diesel	235	2	50	8	2	42	6	504	0.371	0.59
D8 Dozer	Tracked excavator	2270002036	Diesel	300	1	30	5	2	25	6	150	0.371	0.59
345 Backhoe	Tracked excavator	2270002036	Diesel	345	2	6	4	6	2	6	24	0.371	0.59

NOTES:

- Note 1: SCC code based on Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", July 2010, EPA-420-R-10-016.
- Note 2: Brake-specific fuel consumption, zero hour steady state emission factor (EFss; g/hp-hr), and load factor are from MOVES2014 . Year 2019 is used as the base year for EFs.
- Note 3: SO₂ Emissions are calculated using Equation 7 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", July 2010, EPA-420-R-10-018.
- SO₂ = (BSFC * 453.6 * (1- soxcnv) - HC_{adj EF}) * 0.01 * soxdsl * 2
- The correction factor is made to account for fuel sulfur variations; inputs specific to this calculation are noted below
- 0.02247 soxcnv (fraction of fuel sulfur converted to direct PM) for Base, T0, T1, T2, T3, T3B, T4A, T4B
- 0.30 soxcnv (fraction of fuel sulfur converted to direct PM) for Base, T4 and T4N
- 0.0015 soxdsl (weight percent of sulfur in diesel fuel as required per 40 CFR 80.510 for non-road diesel)
- 0.33 soxbas (default certification fuel sulfur weight percent, 0.33 is default)
- Note 4: CO₂ Emissions are calculated using Equation 6 from "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling-Compression-Ignition", July 2010, EPA-420-R-10-018.
- CO₂ = (BSFC * 453.6 - HC_{adj EF}) * 0.87 * 44/12

Table G-1.2

PennEast Pipeline Company, LLC																	
Construction Emissions - Off-road Engines - Church Road Interconnects												Criteria Emissions					
Description	2019 Emission Factors for Northampton Co.						N ₂ O EF ⁵ g/MMBtu	VOC ⁶ tons	CO ⁷ tons	PM ⁷ / PM ₁₀ ⁸ tons	PM _{2.5} ⁸ tons	SO ₂ ⁷ tons	NOx ⁷ tons	CO ₂ ⁷ tons	CH ₄ ⁹ tons	N ₂ O ¹⁰ tons	GHG ¹¹ tons of CO ₂ e
	EFss (g/hp-hr) ²																
	HC	CO	PM	NOx	SO ₂ ³	CO ₂ ⁴											
Air Compressors	0.16	0.42	0.07	3.30	0.005	589.9	0.6	0.00	0.00	0.00	0.00	0.00	0.01	1.43	0.000	0.000	1.43
Pumps	0.26	1.05	0.19	3.96	0.005	589.5	0.6	0.00	0.00	0.00	0.00	0.00	0.01	0.94	0.000	0.000	0.94
Welding Rigs	0.64	2.88	0.46	4.41	0.006	693.9	0.6	0.00	0.02	0.00	0.00	0.00	0.02	3.78	0.000	0.000	3.82
Hydro Mulcher/Seeder	0.40	1.95	0.34	3.48	0.005	589.1	0.6	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.000	0.000	0.13
Trucks: Dump	0.13	0.22	0.03	0.66	0.005	536.4	0.6	0.01	0.01	0.00	0.00	0.00	0.04	35.16	0.000	0.000	35.31
Loader	0.15	1.03	0.09	3.08	0.005	536.3	0.6	0.00	0.03	0.00	0.00	0.00	0.09	15.82	0.000	0.000	15.89
Crane	0.15	0.26	0.05	1.21	0.005	530.5	0.6	0.00	0.00	0.00	0.00	0.00	0.01	2.85	0.000	0.000	2.86
Grader	0.14	0.24	0.04	0.82	0.005	536.4	0.6	0.00	0.00	0.00	0.00	0.00	0.01	8.04	0.000	0.000	8.07
583 Sideboom, Pipe Benders	0.14	0.19	0.03	0.67	0.005	536.4	0.6	0.01	0.01	0.00	0.00	0.00	0.05	41.32	0.000	0.001	41.49
D8 Dozer	0.14	0.19	0.03	0.67	0.005	536.4	0.6	0.00	0.01	0.00	0.00	0.00	0.02	15.70	0.000	0.000	15.76
345 Backhoe	0.14	0.47	0.07	1.19	0.005	536.4	0.6	0.00	0.00	0.00	0.00	0.00	0.01	2.89	0.000	0.000	2.90
		Interconnects Construction TOTAL (Tons)						0.04	0.09	0.01	0.01	0.00	0.27	128.05	0.00	0.00	128.62

NOTES:

- Note 5: Emission factor for N2O from 40 CFR 98 Subpart C.
- Note 6: Annual VOC Emissions are calculated using the following calculation (1.053 * HC emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)
- 1.053 is the ratio of VOC to THC from "Conversion Factors for Hydrocarbon Emission Components", July 2010, EPA-420-R-10-015.
- Note 7: Annual CO, PM, SO₂, and NOx Emissions are calculated using the following calculation (Adj. emission factor (g/hp-hr) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)
- Note 8: For diesel engines all PM is considered to be PM₁₀, PM_{2.5} is 97% of PM/PM₁₀.
- Note 9: Annual CH4 emissions are calculated using the following calculation (Adj. HC emission factor (g/hp-hr) * (1-0.984) * horsepower * hours operated * load factor) / (2000 lb/ton * 453.6 g/lb)
- This equation is derived in part from subtracting methane from THC to calculate NMHC. THC - CH₄ = NMHC; THC - NMHC = CH₄; THC - (0.984 * THC) = CH₄; THC * (1-0.984) = CH₄
- 0.984 is the ratio of MNHC to THC from "Conversion Factors for Hydrocarbon Emission Components", July 2010, EPA-420-R-10-015.
- Note 10: Emissions estimate for N2O is based on a diesel higher heating value of 138,000 Btu/gallon and a density of 7.05 lb/gallon
- Note 11: Greenhouse gasses (GHG) are converted to carbon dioxide equivalents (CO2) using 40 CFR 98 Subpart A global warming potentials as follows:
- | | | | | | |
|-----|---|-----|----|-----|-----|
| CO2 | 1 | CH4 | 25 | N2O | 298 |
|-----|---|-----|----|-----|-----|

Table G-1.2.1

PennEast Pipeline Company, LLC

Construction Emissions - Off-road Engines - Church Road Interconnects

Description	Equipment category based on NONROAD classification	SCC ¹	Fuel Type	Construction Equipment Inventory - Durations							
				Equip- ment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Total Working Days	Hours per Day	Total Working hrs
Air Compressors	Light Comm. Air Comp.	2270006015	Diesel	50	1	20	3	4	17	6	102
Pumps	Light Commercial Pumps	2270006010	Diesel	40	1	20	6	4	14	6	84
Welding Rigs	Light Commercial Welders	2270006025	Diesel	35	2	50	8	2	42	8	672
Hydro Mulcher/Seeder	Light Commercial Pumps	2270006010	Diesel	80	1	2	1	1	1	6	6
Trucks: Dump	Off-Highway Trucks	2270002051	Diesel	400	1	50	8	2	42	6	252
Loader	Rubber Tire Dozers	2270002063	Diesel	180	1	50	8	2	42	6	252
Crane	Crane	2270002036	Diesel	275	1	4	1	1	3	10	30
Grader	Rubber Tire Dozers	2270002063	Diesel	240	1	20	4	1	16	6	96
583 Sideboom, Pipe Benders	Tracked excavator	2270002036	Diesel	235	2	50	8	2	42	6	504
D8 Dozer	Tracked excavator	2270002036	Diesel	300	1	30	5	2	25	6	150
345 Backhoe	Tracked excavator	2270002036	Diesel	345	2	6	4	6	2	6	24

Equipment Inventory Estimate subject to change based on contract award and construction contractor equipment selection

Table G-1.3 PennEast Pipeline Company, LLC
Construction Emissions - Off-road Engines - Church Road Intercor HAPS Emissions Estimates

Description	Equipment category based on NONROAD classification	SCC ¹	Fuel Type	Equipment HP	Number of Equipment	Total Days	Total Weeks	Total Months	Total Working Days	Hours per Day	Total Working hrs	BSFC ²	Load Factor ²
												lb/hp-hr	
Air Compressors	Light Comm. Air Comp.	2270006015	Diesel	50	1	20	3	4	17	6	102	0.408	0.43
Pumps	Light Commercial Pumps	2270006010	Diesel	40	1	20	6	4	14	6	84	0.408	0.43
Welding Rigs	Light Commercial Welders	2270006025	Diesel	35	2	50	8	2	42	8	672	0.481	0.21
Hydro Mulcher/Seeder	Light Commercial Pumps	2270006010	Diesel	80	1	2	1	1	1	6	6	0.408	0.43
Trucks: Dump	Off-Highway Trucks	2270002051	Diesel	400	1	50	8	2	42	6	252	0.371	0.59
Loader	Rubber Tire Dozers	2270002063	Diesel	180	1	50	8	2	42	6	252	0.371	0.59
Crane 50-70 Ton	Tracked excavator	2270002036	Diesel	275	1	4	1	1	3	10	30	0.367	0.59
Grader	Rubber Tire Dozers	2270002063	Diesel	240	1	20	4	1	16	6	96	0.371	0.59
583 Sideboom, Pipe Benders	Tracked excavator	2270002036	Diesel	235	2	50	8	2	42	6	504	0.371	0.59
D8 Dozer	Tracked excavator	2270002036	Diesel	300	1	30	5	2	25	6	150	0.371	0.59
345 Backhoe	Tracked excavator	2270002036	Diesel	345	2	6	4	6	2	6	24	0.371	0.59
										Interconnects Construction TOTAL (Tons)			

NOTES:
Note 1: SCC code based on Appendix A of "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling", April 2004, EPA-420-P-04-005.
Note 2: Brake-specific fuel consumption and load factor are from EPA's MOVES2014 model (Non-road sources run for 2019, Luzerne County, PA)
Note 3: Emission factors from AP-42 Section 3.3, Table 3.3-2 for engines ≤600 HP and AP-42 Section 3.4, Tables 3.4-3 and 3.4-4 for engines >600 HP.
Note 4: Emissions estimates are based on a higher heating value of 138,000 Btu/gallon and a density of 7.05 lb/gallon.

Table G-1.3

PennEast Pipeline Company, LLC

Construction Emissions - Off-road Engines - Church Road Interconnects

HAPS Emissions Estimates

Description	HAP Emissions (Tons) ⁴							
	Benzene	Toluene	Xylenes	Acrolein	PAHs	1,3-Butadiene	Formaldehyde	Acetaldehyde
Air Compressors	8.17E-06	3.58E-06	2.50E-06	8.10E-07	1.47E-06	3.42E-07	1.03E-05	6.72E-06
Pumps	5.38E-06	2.36E-06	1.64E-06	5.34E-07	9.69E-07	2.26E-07	6.81E-06	4.43E-06
Welding Rigs	2.17E-05	9.51E-06	6.63E-06	2.15E-06	3.91E-06	9.09E-07	2.74E-05	1.78E-05
Hydro Mulcher/Seeder	7.69E-07	3.37E-07	2.35E-07	7.62E-08	1.38E-07	3.22E-08	9.73E-07	6.32E-07
Trucks: Dump	2.01E-04	8.83E-05	6.15E-05	2.00E-05	3.63E-05	8.44E-06	2.55E-04	1.66E-04
Loader	9.07E-05	3.97E-05	2.77E-05	8.99E-06	1.63E-05	3.80E-06	1.15E-04	7.45E-05
Crane 50-70 Ton	1.63E-05	7.15E-06	4.98E-06	1.62E-06	2.94E-06	6.84E-07	2.06E-05	1.34E-05
Grader	4.61E-05	2.02E-05	1.41E-05	4.57E-06	8.29E-06	1.93E-06	5.82E-05	3.79E-05
583 Sideboom, Pipe Benders	2.37E-04	1.04E-04	7.23E-05	2.35E-05	4.26E-05	9.92E-06	2.99E-04	1.95E-04
D8 Dozer	8.99E-05	3.94E-05	2.75E-05	8.92E-06	1.62E-05	3.77E-06	1.14E-04	7.39E-05
345 Backhoe	1.66E-05	7.26E-06	5.06E-06	1.64E-06	2.98E-06	6.94E-07	2.09E-05	1.36E-05
	7.34E-04	3.22E-04	2.24E-04	7.27E-05	1.32E-04	3.08E-05	9.28E-04	6.03E-04
							Total All HAPS	0.003

Emission Factor ³	≤ 600 HP	> 600 HP
	lb/MMBtu	lb/MMBtu
Benzene	9.33E-04	7.76E-04
Toluene	4.09E-04	2.81E-04
Xylenes	2.85E-04	1.93E-04
Acrolein	9.25E-05	7.88E-06
PAHs	1.68E-04	2.12E-04
1,3-Butadiene	3.91E-05	
Formaldehyde	1.18E-03	7.89E-05
Acetaldehyde	7.67E-04	2.52E-05

Table G-1.4
PennEast Pipeline Company, LLC
Church Road Interconnects Construction Emissions - On-road Vehicles

Description	Category Based on MOVES2014 Classification	Number of Equipment	Total Days	Total Weeks	Total Months	Working Days	Miles per Day	Calc. VMT ¹
Gas Pickup Trucks	31 - Passenger Truck - Gas	6	180	26	6	156	50	46,800
Float, Lowboy, Tractor Trucks	52 - Single Unit Short-Haul Truck - Diesel	4	180	26	6	156	50	31,200
Diesel Parts Vans	32 - Light Commercial Truck - Diesel	1	180	26	6	156	50	7,800

Description	Category Based on MOVES2014 Classification	VOC ² g/VMT	CO ² g/VMT	PM ₁₀ ² g/VMT	PM _{2.5} ² g/VMT	SO ₂ ² g/VMT	NOx ² g/VMT	CO ₂ ² g/VMT	CH ₄ ² g/VMT	N ₂ O ² g/VMT	GHG ³ g CO ₂ e /VMT	HAPs ^{2,4} g/VMT
Gas Pickup Trucks	31 - Passenger Truck - Gas	1.03	9.19	0.05	0.02	0.00	1.09	460.66	0.03	0.03	470.46	0.05
Float, Lowboy, Tractor Trucks	52 - Single Unit Short-Haul Truck - Diesel	0.27	1.13	0.18	0.10	0.01	2.07	923.79	0.06	0.00	925.98	0.04
Diesel Parts Vans	32 - Light Commercial Truck - Diesel	0.64	4.69	0.13	0.09	0.01	2.01	616.86	0.07	0.002	619.37	0.09

Description	Category Based on MOVES2014 Classification	VOC ton/yr	CO ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	SO ₂ ton/yr	NOx ton/yr	CO ₂ ton/yr	CH ₄ ton/yr	N ₂ O ton/yr	GHG ton CO ₂ e /yr	HAPs ton/yr
Gas Pickup Trucks	31 - Passenger Truck - Gas	5.33E-02	4.74E-01	2.79E-03	1.29E-03	1.58E-04	5.61E-02	23.8	1.45E-03	1.57E-03	24.27	2.57E-03
Float, Lowboy, Tractor Trucks	52 - Single Unit Short-Haul Truck - Diesel	9.19E-03	3.89E-02	6.35E-03	3.59E-03	2.68E-04	7.11E-02	31.8	2.01E-03	8.42E-05	31.85	1.45E-03
Diesel Parts Vans	32 - Light Commercial Truck - Diesel	5.49E-03	4.04E-02	1.09E-03	7.79E-04	4.57E-05	1.73E-02	5.3	6.26E-04	1.98E-05	5.33	8.11E-04
Total		0.07	0.55	0.01	0.01	0.000	0.14	61	0.00	0.00	61	0.00

NOTES:

- Note 1: Vehicle Miles Traveled (VMT) = (Number of Equipment) * (Working Days) * (Miles per day)
- Note 2: Emissions estimates are based on EPA's MOVES2014 motor vehicle emissions estimation program. Year 2019 is used as the base year for EFs. Factors are based on county data.
- Note 3: Greenhouse gasses (GHG) are converted to carbon dioxide equivalents (CO2) using 40 CFR 98 Subpart A global warming potentials as follows:
CO₂ = 1, CH₄ = 25, N₂O = 298
- Note 4: HAPs are aggregated for benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein

Table G-1.4.1
PennEast Pipeline Company, LLC
 Onroad Vehicle Emission Factors used in February 2019 Amendment Application Appendix I Tables I-6.1 and I-7.1

Category Based on MOVES2014 Classification	County, State ¹	VOC ² g/VMT	CO ² g/VMT	PM ₁₀ ² g/VMT	PM _{2.5} ² g/VMT	SO ₂ ² g/VMT	NOx ² g/VMT	CO ₂ ² g/VMT	CH ₄ ² g/VMT	N ₂ O ² g/VMT	GHG ³ g CO ₂ e /VMT	HAPs ^{2,4} g/VMT
		VOC	CO	PM10	PM2.5	SO2	NOx	CO2	CH4	N2O	CO2e	HAPS
31 - Passenger Truck - Gas	Northampton County, PA	1.03	9.19	0.05	0.02	0.003	1.09	460.66	0.03	0.03	470.46	0.05
32 - Light Commercial Truck - Diesel	Northampton County, PA	0.64	4.69	0.13	0.09	0.01	2.01	616.86	0.07	0.002	619.37	0.09
52 - Single Unit Short-Haul Truck - Diesel	Northampton County, PA	0.27	1.13	0.18	0.10	0.01	2.07	923.79	0.06	0.002	925.98	0.04

Note 1: Factors are based on county data from the County and State as shown.

Note 2: Emissions estimates are based on EPA's MOVES2014 motor vehicle emissions estimation program. Year 2019 is used as the base year for EFs.

Note 3: Greenhouse gasses (GHG) are converted to carbon dioxide equivalents (CO2) using 40 CFR 98 Subpart A global warming potentials as follows:
 CO2 = 1, CH4 = 25, N2O = 298

Note 4: HAPs are aggregated for benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein

Table G-1.5
PennEast Pipeline Company, LLC
Construction Emissions - Fugitive Dust from Roadways

Vehicle Type - Spread	Daily Onsite Vehicular Traffic ^[1] (Vehicles)	Construction Days ^[1]	Average Daily Travel Distance per Vehicle ^[1] (VMT/vehicle/day)		Distance Traveled ^[2] (VMT)		Estimated Vehicle Weight		Estimated Emissions Fugitive Dust from Roadways					
									PM10			PM2.5		
			Paved	Unpaved	Paved	Unpaved	(lbs)	(tons)	Paved (tons)	Unpaved (tons)	Total (tons)	Paved (tons)	Unpaved (tons)	Total (tons)
Combined Pickup Trucks and Vans - Spread 3	7	156	50	0	54,600	0	5000	2.5	0.85	0.00	0.85	0.21	0.00	0.21
Float, Lowboy, Tractor Trucks - Spread 3	4	156	50	0	31,200	0	50000	25.0	5.07	0.00	5.07	1.25	0.00	1.25
TOTALS					85,800	0			5.92	0.00	5.92	1.45	0.00	1.45

Vehicle Type	Vehicle Wt.	PM10 Emission Factors (lb/VMT)			PM2.5 Emission Factors (lb/VMT)		
	(tons)	Paved ^[3]	Unpaved ^[4]	Unpaved w/ Control ^[5]	Paved ^[3]	Unpaved ^[4]	Unpaved w/ Control ^[5]
Combined Pickup Trucks and Vans	2.5	0.031	0.60	0.30	0.0076	0.060	0.030
Float, Lowboy, Tractor Trucks	25.0	0.325	1.68	0.84	0.0798	0.168	0.084

[1] See Table G-1.4. Trucks and Parts vans are combined in this table because they are the same estimated weight, and the emissions are based on vehicle weight.

[2] VMT = Vehicles x Construction Days x Daily Distance Traveled per Vehicle.

[3] The emission factor for paved roads was estimated using USEPA's AP-42 (1/11) Section 13.2.1 "Paved Roads" and the following:

- A. Emission factor (E) is calculated using Equation (2) in Section 13.2.1: $E = (k \times (sL)^{0.91} \times (W)^{1.02}) \times (1 - P/4N)$
- B. Table 13.2.1-1 specifies that for PM-10, k is 0.0022 lb/VMT and for PM-2.5, k is 0.00054 lb/VMT.
- C. Table 13.2.1-3 specifies that the typical mean silt loading value (sL) for a municipal solid waste landfill is 7.4 g/m², which is assumed to represent the construction site condition.
- D. Figure 13.2.1-2 estimates that days of precipitation >0.01 inch per year (P) is approximately 150; N is 365 days.

[4] The emission factor for unpaved roads was estimated using USEPA's AP-42 (11/06) Section 13.2.2 "Unpaved Roads" and the following:

- A. Emission factor (E) is calculated using Equations (1a) and (2) in Section 13.2.2: $E = (k \times (s/12)^a \times (W/3)^b) \times ((365-P)/365)$
- B. Table 13.2.2-1 specifies that the typical mean silt content value (s) for a construction site is 8.5%.
- C. Table 13.2.2-2 specifies that for PM-10, k is 1.5 lb/VMT, a is 0.9, and b is 0.45, and for PM-2.5, k is 0.15 lb/VMT, a is 0.9, and b is 0.45.
- D. Figure 13.2.2-1 estimates that days of precipitation >0.01 inch per year (P) is approximately 150.

[5] Dust suppression by water spray at construction site is conservatively assumed to have a control efficiency value of: 50%

Paved Equation Factors

k, PM10 = 0.0022
k, PM2.5 = 0.00054

Silt Paved loading = 7.4 g/m²
P= 150
N= 365

Unpaved Equation Factors

Silt Unpaved loading = 8.5 %

k, PM10 = 1.5 a = 0.9 b = 0.45
k, PM2.5 = 0.15 a = 0.9 b = 0.45
P= 150

Table G-1.6

PennEast Pipeline Company, LLC

Construction Emissions - Fugitive dust from construction activities of Church Road Interconnects

Modification Construction Activity	Area of Land Disturbance ¹ (acres):	Months of Construction Activity ² :	PM2.5 ton/period	PM10 ton/period
Church Road Interconnects	2.62	6	0.57	3.81
Total PM Emissions			0.57	3.81

Emission Factor Equations³PM10 Emission Factor = $0.42 \times (1 - CE) \times SAE \times SMA$

PM2.5 Emission Factor = PM10 Emission Factor x Ratio

Project Area Specific PM Emission Factors

Base PM10 Emission Factor (tons/acre-month)	0.42	tons/acre-month
Ratio of PM2.5 to PM10 (Ratio)	0.15	
Construction Dust Plan Control Efficiency Factor ⁴	50%	
Silt Adjustment Factor (SAF):	5.78	(SAF = Project Value/ 9%)
Basis (original Studies value, see Note 3)	9%	
Average Dry Silt Percent of Project Soils	52%	Washington Silt Loam, 0 to 3 percent slope

Soil Moisture Adjustment Factor (per Climate Divisions of Project Area)

Thornthwaite's Precipitation-Evaporation Index ⁵		Soil Moisture		Adjusted Emission Factors (tons/acre-month)	
Basis (Arid Southwest US)	See Note 3	24	Adjustment (SMA)	PM2.5	PM10
	Northampton	120	0.20	0.0364	0.2427

NOTES:

[1] The values for acres of the Area of Land Disturbance for the Church Road Interconnects are derived from GIS data of Project Workspaces. The sum of Temporary and Permenatly disturbed area is used here.

[2] The entire construction activity duration is expected to be 8 to 10 months; however, based on crew activity type and phasing, the emission causing Months of Heavy Construction Activity is used in the calculations here. Travel on unpaved roads for crews not using heavy equipment are accounted for in Off-Road travel.

[3] Estimating Particulate Matter Emissions From Construction Operations, Final Report, Eastern Research Group, Inc., September 30, 1999, EPA Contract 68-D7-0068, Section 5.6. It is assumed that the factor and methodology for adjusting the factor for Roadway Construction Emissions are similar in nature to the pipeline construction.

[4] Required and effective fugitive dust control measures will be determined at the site during construction activity. Application of water to mitigate fugitive dust will be used as one of the primary control measure. Mitigation of fugitive dust by the use of water application and other measures is reflected in the 50% control efficiency recommended in the referenced EPA Contract 68-D7-0068 Document.

[5] Thornthwaite's Precipitation-Evaporation Index values are taken from the map on page 5-12 of cited EPA Contract 68-D7-0068 Document.

Table G-2.1

PennEast Pipeline Company, LLC

Church Road Interconnects - Total Operational Emissions

Facility Operating Emission Sources	Criteria Pollutant Emissions					
	NO _x	VOC	CO	PM ₁₀	PM _{2.5}	SO ₂
Fugitive and Venting from Interconnection Piping		0.0039				
Pipeline Inspection Gauge (PIG) Retrieving		0.0001				
Indirect-fired Nat. Gas-fired Line Heaters	1.08	0.1076	1.11	0.14867	0.14867	0.01426
Diesel Emergency Generator	0.12	0.0275	0.11	0.00594	0.00594	0.00015
Total	1.20	0.1391	1.22	0.1546125	0.15461	0.014409
Largest Facility of Certified Project (Kidder)*	89.2	5.45	17.28	24.14	24.14	5.47
Church Road Interconnects Percent of Kidder	1.3%	2.6%	7.1%	0.6%	0.6%	0.3%
Times less that the CRI emissions are to Kidder	74	39	14	156	156	380

Facility Operating Equipment	Greenhouse Gas Emissions			
	CO ₂	Methane	N ₂ O	CO _{2e}
Fugitive and Venting from Interconnection Piping	0	5.963		149.1
Pipeline Inspection Gauge Retrieving Operation	0.00	0.031		0.8
Indirect-fired Nat. Gas-fired Line Heaters	2336.32	0.045	0.0430	2338.7
Diesel Emergency Generator	15.64	0.001	0.0001	15.7
Total	2352	6.040	0.0432	2504
Largest Facility of Certified Project (Kidder)*				190,529
Church Road Interconnects Percent of Kidder				1.3%
Times less that the CRI emissions are to Kidder				76

Facility Operating Equipment	Hazardous Air Pollutant Emissions			
	Benzene	Hexane	Formaldehyde	Total HAPs
Fugitive and Venting from Interconnection Piping				
Pipeline Inspection Gauge Retrieving Operation				
Indirect-fired Nat. Gas-fired Line Heaters	4.11E-05	3.52E-02	1.47E-03	3.69E-02
Diesel Emergency Generator	8.95E-05		1.13E-04	3.72E-04
Total	1.31E-04	3.52E-02	1.58E-03	3.73E-02
Largest Facility of Certified Project (Kidder)*				2.29
Church Road Interconnects Percent of Kidder				1.6%
Times less that the CRI emissions are to Kidder				61

*TABLE 4.10.1-9 , Project Operational Total PTE of the FEIS

Comparison of Church Road Interconnects Estimated Emissions to Exemption Criteria

Exemption Threshold Citation	Pollutant with an Exemption Threshold	Threshold Value	Threshold Units	Estimated Maximum Emissions (units as shown)	Percent of Threshold	Emission Source
------------------------------	---------------------------------------	-----------------	-----------------	--	----------------------	-----------------

PA DEP Document ID 275-2101-003, 38(c)v.	NOx	100	lbs/hr	0.49	0.5%	E-Gen
PA DEP Document ID 275-2101-003, 38(c)v.	NOx	1000	lb/day	11.88	1.2%	E-Gen
PA DEP Document ID 275-2101-003, 38(c)v.	NOx	6.6	TPY	0.12	1.9%	E-Gen
PA DEP Document ID 275-2101-003, 38(c)v.	NOx	2.75	T/Season	0.12	4.5%	E-Gen

PA DEP Document ID 275-2101-003, 38(c)iii.	Methane	200	TPY	5.963	3.0%	Fugitives
PA DEP Document ID 275-2101-003, 38(c)iii.	Methane	200	TPY	0.045	0.02%	Heaters
PA DEP Document ID 275-2101-003, 38(c)iii.	Methane	200	TPY	0.031	0.02%	Pigging
PA DEP Document ID 275-2101-003, 38(c)iii.	Methane	200	TPY	0.001	0.0003%	E-Gen

PA DEP Document ID 275-2101-003, 38(c)ii.	VOC	2.7	TPY	0.139	5.2%	Total, All
PA DEP Document ID 275-2101-003, 38(c)ii.	Total HAPs	1	TPY	0.037	3.7%	Total, All
Single HAP	Hexane	0.5	TPY	0.035	7.0%	Total, All

Table G-2.2
PennEast Pipeline Company, LLC
Church Road Interconnects - Fugitive Emissions from Interconnection Piping (Leaks from Valves, Flanges, etc.)

Equipment Type	Component Count ¹	CH4 Emission Factor ² (lb/hr/component)	VOC Emission Factor ² (lb/hr/component)	VOC Emission Rate (lb/hr)	VOC Emission Rate (tpy)	CH4 Emission Rate (lb/hr)	CH4 Emission Rate (TPY)	CO2e Emission Rate (lb/hr)	CO2e Emission Rate (TPY)
Connectors	50	4.24E-04	2.79E-07	1.39E-05	6.10E-05	2.12E-02	9.28E-02	5.30E-01	2.32E+00
Flanges	66	8.26E-04	5.43E-07	3.58E-05	1.57E-04	5.45E-02	2.39E-01	1.36E+00	5.97E+00
Open-Ended Lines	0	4.24E-03	2.79E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pump Seals	0	5.08E-03	3.34E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Valves	129	9.53E-03	6.27E-06	8.08E-04	3.54E-03	1.23E+00	5.39E+00	3.07E+01	1.35E+02
Other (Meters)	3	1.86E-02	1.23E-05	3.68E-05	1.61E-04	5.59E-02	2.45E-01	1.40E+00	6.12E+00
TOTAL =				0.001	0.004	1.36	5.96	34.04	149.08

Pneumatic Gas Control Venting and Bleed Emissions

Description	Qty	Exhaust Flow	Usage	Total Vent flow	CH ₄ ⁴	CO ₂ ⁴	CH ₄	CO ₂	CO ₂ e ⁵	VOC ⁶
		scf/stroke	strokes/yr	scf/yr	lb/yr	lb/yr	ton/yr	ton/yr	ton/yr	ton/yr
6"-600# Valve	1	6.5	2	13.0	0.54	-	0.0003	0.00000	0.01	8.75E-07
8"-600# Valve	1	6.5	2	13.0	0.54	-	0.0003	0.00000	0.01	8.75E-07
12"-600# Valve	1	6.5	2	13.0	0.54	-	0.0003	0.00000	0.01	8.75E-07
14"-600# Valve	2	6.5	2	26.0	1.08	-	0.0005	0.00000	0.01	1.75E-06
24"-600# Valve	2	6.5	2	26.0	1.08	-	0.0005	0.00000	0.01	1.75E-06

Description	Qty	Exhaust Flow	Bleed Rate	Total Bleed flow	CH ₄ ⁴	CO ₂ ⁴	CH ₄	CO ₂	CO ₂ e ⁵	VOC ⁶
		scf / h	hr/day	scf/yr	lb/yr	lb/yr	ton/yr	ton/yr	ton/yr	ton/yr
2"-Control Valves	1	55.0	24	481,800	19,945	-	10	-	249	3.24E-02
4"-Control Valves	4	55.0	24	1,927,200	79,781	-	40	-	997	1.30E-01
6"-Control Valves	4	55.0	24	1,927,200	79,781	-	40	-	997	1.30E-01
12"-Control Valves	6	55.0	24	2,890,800	119,672	-	60	-	1496	1.94E-01

Total of Fugitive Leaks, Venting, and Control Valves 3,889 4.90E-01

1. Counts and flow rates based on Preliminary Design Data from QPS April, 2015. To allow for estimated additional components in final design, 50 valves and 50 connectors have been added.
2. VOC and CH₄ emission factors are based on Gas Analysis and values from Table 2-4 of "Protocol for Equipment Leak Emission Estimates". EPA document 453/R-95-017
Gas analysis and calculation of the CH₄ and VOC emission factors are shown on Table L3-19
3. CH₄ and CO₂ emission rates based on volume fractions of natural gas analysis shown below as provided in the Gas Analysis Details Table
4. Conversion based on densities of GHG as provided in 40 CFR 98.233(v)
5. Based on 40 CFR 98 Subpart A Global Warming Potentials
6. Based on a 0.00325 ratio of VOC to methane as calculated from gas composition.

Volume fractions based on Gas Analysis from UGI Pipeline in Reading PA, April 2015
0.9780 CH₄
0.0000 CO₂
0.00325 mass fraction of VOC per methane (per gas analysis)

Densities per 40 CFR 98.233(v):
0.0192 kg/scf CH₄
0.0526 kg/scf CO₂

GWP per 40 CFR 98 Subpart A: 25 lb CO₂e/lb CH₄
Mass Units Conversion Factor: 2.20462 lb/kg

Table G-2.3
PennEast Pipeline Company, LLC
Fugitive Emissions from Pipeline PIG Launching and Retrieving Operations at Church Road Interconnects

Assumed PIG Gas Release	Emission Rate Estimates							
	CH ₄ ²	CO ₂ ²	CH ₄ ³	CO ₂ ³	CH ₄	CO ₂	CO ₂ e ⁴	VOC ⁵
scf/event	scf/event	scf/event	lb/event	lb/event	ton/event	ton/event	ton/event	ton/event
1,500	1,467	0.00	62.10	0.00	0.03	0.00E+00	0.78	1.01E-04

Maximum Case Annual Emissions Scenario		Total Emissions	ton/year	ton/year	ton/year	ton/year
Church Road		from Church Road				
Interconnects	1	Interconnects	0.03	0.00	0.78	0.00

Notes:

1. Based on typical volume (cubic feet) of a PIG receiver
2. CH₄ and CO₂ emission rates based on 97.8 vol% CH₄ and 0 vol% CO₂ on typical analyzed sample of natural gas in the region.
Gas analysis and calculation of the CH₄ and VOC emission factors are based on gas analysis results presented in the Certificate Application.
3. Conversion based on densities of GHG as provided in 40 CFR 98.233(v)
4. Based on 40 CFR 98 Subpart A Global Warming Potentials
5. Based on a typical 0.0325 ratio of VOC to methane as calculated from gas compositions

Volume fractions per Fugitive Split

0.9780 CH₄

0.0000 CO₂

0.00325 mass fraction of VOC per methane (per gas analysis)

Densities per 40 CFR 98.233(v):

0.0192 kg/scf

CH₄

0.0526 kg/scf

CO₂

GWP per 40 CFR 98 Subpart A:

25 lb CO₂e/lb CH₄

Table G-2.4

PennEast Pipeline Company, LLC

Page 1

Church Road Interconnects - Operating Emissions - Indirect-fired Nat. Gas-fired Line Heaters

Design Heat Input (Maximum): (per Heater, Interconnects will have two Heaters in redundant mode)	5.7	MMBtu/hr
Maximum Fuel Combustion rate (at assumed Gas Heat Content):	5582.8	scf/hr
Assumed Average Firing Rate:	80%	% of Design Input
Assumed Annual Operating Hours (Maximum):	8760	hr/yr
Estimated Annual Fuel Use:	39.12	MMscf/yr

Pollutant	Emission Factor		Emission Factor Reference	Emission Rate	
	lb/MMscf	lb/MMBtu		lb/hr	ton/yr
NO _x EPA AP-42 Default	55	0.054	150% of Manufacturer Quote	0.31	1.08
CO EPA AP-42 Default	57	0.056	150% of Manufacturer Quote	0.32	1.11
CO ₂		117.0	Table C-1 to Subpart C of Part 98	666.76	2336
Methane	2.3	0.0023	AP-42 Table 1.4-2 (7/98)	0.01	0.04
N ₂ O	2.2	0.0022	AP-42 Table 1.4-2 (7/98)	0.01	0.04
CO ₂ e		117.1	40 CFR 98 Subpart A, C	667	2,339
PM ₁₀	7.6	0.007	AP-42 Table 1.4-2 (7/98)	0.042	0.15
PM _{2.5}	7.6	0.007	AP-42 Table 1.4-2 (7/98)	0.042	0.15
VOC EPA Default	5.5	0.005	AP-42 Table 1.4-2 (7/98)	0.031	0.11
SO ₂ (Maximum Hourly)		0.0057	2 grains S / 100 scf	0.03	
SO ₂ (Average Annual)		0.000714	0.25 grains S / 100 scf		1.43E-02
Formaldehyde	0.075	0.000073	AP-42 Table 1.4-3 (7/98)	4.19E-04	1.47E-03
Benzene	0.002	0.0000021	AP-42 Table 1.4-3 (7/98)	1.17E-05	4.11E-05
Hexane	1.800	0.00176	AP-42 Table 1.4-3 (7/98)	1.00E-02	3.52E-02
Total HAPs	1.89	0.00185	AP-42 Table 1.4-3 & 4 (7/98)	1.05E-02	3.69E-02

Assumed Average Natural Gas Heat Content:

1021 Btu/scf

(See Table L3-17 and 18)

Manufacture Quote for a smaller heater at Kidder Station

Table G-2.4

PennEast Pipeline Company, LLC

Page 1

Church Road Interconnects - Operating Emissions - Indirect-fired Nat. Gas-fired Line Heaters

Table G-2.4

Nat. Gas-fired Line Heaters

1/0/1900

1/0/1900

Page 2

HAP Emission Factors		
HAPs	lb/MMscf	Source
Lead	0.0005	AP-42 Table 1.4-2 (7/98)
2-Methylnaphthalene	2.40E-05	AP-42 Table 1.4-3 (7/98)
3-Methylchloranthrene	1.80E-06	AP-42 Table 1.4-3 (7/98)
7,12-Dimethylbenz(a)anthracene	1.60E-05	AP-42 Table 1.4-3 (7/98)
Acenaphthene	1.80E-06	AP-42 Table 1.4-3 (7/98)
Acenaphthylene	1.80E-06	AP-42 Table 1.4-3 (7/98)
Anthracene	2.40E-06	AP-42 Table 1.4-3 (7/98)
Benz(a)anthracene	1.80E-06	AP-42 Table 1.4-3 (7/98)
Benzene	2.10E-03	AP-42 Table 1.4-3 (7/98)
Benzo(a)pyrene	1.20E-06	AP-42 Table 1.4-3 (7/98)
Benzo(b)fluoranthene	1.80E-06	AP-42 Table 1.4-3 (7/98)
Benzo(g,h,i)perylene	1.20E-06	AP-42 Table 1.4-3 (7/98)
Benzo(k)fluoranthene	1.80E-06	AP-42 Table 1.4-3 (7/98)
Chrysene	1.80E-06	AP-42 Table 1.4-3 (7/98)
Dibenzo(a,h)anthracene	1.20E-06	AP-42 Table 1.4-3 (7/98)
Dichlorobenzene	1.20E-03	AP-42 Table 1.4-3 (7/98)
Fluoranthene	3.00E-06	AP-42 Table 1.4-3 (7/98)
Fluorene	2.80E-06	AP-42 Table 1.4-3 (7/98)
Formaldehyde	7.50E-02	AP-42 Table 1.4-3 (7/98)
Hexane	1.80E+00	AP-42 Table 1.4-3 (7/98)
Indeno(1,2,3-cd)pyrene	1.80E-06	AP-42 Table 1.4-3 (7/98)
Naphthalene	6.10E-04	AP-42 Table 1.4-3 (7/98)
Phenanthrene	1.70E-05	AP-42 Table 1.4-3 (7/98)
Pyrene	5.00E-06	AP-42 Table 1.4-3 (7/98)
Toluene	3.40E-03	AP-42 Table 1.4-3 (7/98)
Arsenic	2.00E-04	AP-42 Table 1.4-4 (7/98)
Beryllium	1.20E-05	AP-42 Table 1.4-4 (7/98)
Cadmium	1.10E-03	AP-42 Table 1.4-4 (7/98)
Chromium	1.40E-03	AP-42 Table 1.4-4 (7/98)
Cobalt	8.40E-05	AP-42 Table 1.4-4 (7/98)
Manganese	3.80E-04	AP-42 Table 1.4-4 (7/98)
Mercury	2.60E-04	AP-42 Table 1.4-4 (7/98)
Nickel	2.10E-03	AP-42 Table 1.4-4 (7/98)
Selenium	2.40E-05	AP-42 Table 1.4-4 (7/98)
Total	1.8884582	

Table G-2.5
PennEast Pipeline Company, LLC
Church Road Interconnects - Operating Emissions - Diesel Emergency Generator

Exemption Criteria is item 38(c)v. of PA DEP Document ID 275-2101-003, August 8, 2018

Model	TBD	(Genrac SD030 used as an example for Emission Estimates)
EPA Rating	Tier 2, Emergency Engine	
Equipment Rating	30 kW	
Equipment Rating	49 hp	
Fuel Type	Diesel	
Max Fuel Consumption	2.80 Gal/hr at 100% Load, Standby Power	
Hours per Year (Estimate for Annual)	500 hours	0.7457 kW/hp
Estimated Potential Annual Fuel Use	1400 gallons/yr	83% Net Efficiency (HP to kW) of generator

Conversion Factors and Assumptions
453.6 grams/pound

Emission Factors and Emission Estimates			NOx	HC	PM	CO	VOC	SO2	CO2	Methane	NO2	CO2e	Formaldehyde	Benzene	Total HAPs
Emission Factors			4.58E+00	1.120392	0.220	4.1	1.02E+00	5.48E-03	22.34	9.06E-04	1.81E-04	22.41	1.18E-03	9.33E-04	3.88E-03
Proposed Emission Factor Units			g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr	lb/gallon	lb/gallon	lb/gallon	lb/gallon	lb/MMBtu	lb/MMBtu	lb/MMBtu
Source			Table 2 of 40 CFR 60 Subpart IIII Standard for NOx+NMHC minus VOC estimate(4)	VOC estimate divided by 91%	Table 2 of 40 CFR 60 Subpart IIII Standard for PM	Table 2 of 40 CFR 60 Subpart IIII Standard for CO	(1) 91% of TOC from AP 42 Table 3.3-1 Exhaust	Mass balance based on 15 ppm S	Table C-1 to Subpart C of Part 98, units converted with fuel heat content	Table C-2 to Subpart C of Part 98, units converted with fuel heat content	Table C-2 to Subpart C of Part 98, units converted with fuel heat content	40 CFR 98 Subpart C and A Emission Factors and GWP	AP-42 Table 3.3-2, E Rating	AP-42 Table 3.3-2, E Rating	AP-42 Table 3.3-2, E Rating
Exemption Criteria is item 38(c)v. of PA DEP Document ID 275-2101-003, August 8, 2018	Exemption Threshold (same units as row)	Percent of Threshold	This sub-section of the table considers NOx based permit exemption thresholds												
Estimated Maximum Hourly Emission Rate (lb/hr)	100	0.5%	0.5	0.12	2.38E-02	0.44	0.11	5.92E-04	62.55	2.54E-03	5.07E-04	62.76	4.53E-04	3.58E-04	1.49E-03
Estimated Maximum Daily NOx Emissions (lb/24-hr)	1000	1.2%	11.9												
Estimated Maximum NOx Emissions per Ozone Season (tons/season)	2.75	4.5%	0.12												
Estimated Potential to Emit (PTE) (tons/year)	6.6	1.9%	0.12	0.03	0.01	0.11	0.03	1.48E-04	15.64	6.34E-04	1.27E-04	15.69	1.13E-04	8.95E-05	3.72E-04

Notes

1. Per referenced table notes TOC (Total Organic Carbon) Emission Factor is 9% methane and 91% nonmethane, and nonmethane is assumed as VOC
2. Conversion Factors and Heat Content of Diesel taken from AP-42 Appendix, Available: <https://www3.epa.gov/ttnchie1/ap42/appendix/appa.pdf>
3. Emission factors for GHGs available: https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf
4. Table 2 of 40 CFR 60 Subpart IIII of Part 60—Emission Standards for 2008 Model Year and Later Emergency Stationary CI ICE <37 kW (50 HP) With a Displacement of <10 Liters per Cylinder, values in units of g/hp-hr from table row 3 for (25≤HP<50). https://www.ecfr.gov/cgi-bin/text-idx?rgn=div6&node=40%3A7.0.1.1.1.98%se40.8.60_14202

Table G-3.1

PennEast Pipeline Project
Construction Emissions

All Emissions are in Units of Tons per Construction Period

Revised: 01-30-020

Total Construction Emissions per Project Phase

Project Phase 1 Total Emissions	NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂ e	HAPs
Pipeline Diesel Non-Road Equipment Totals	95.5	31.1	13.3	5.0	4.9	0.41	44,319	1.80
Diesel and Gas On-Road	5.4	31.7	3.51	0.29	0.17	0.02	2,207	0.23
Pipeline Construction Activity Fugitive Dust				1,121	168			
Pipeline Roadway Fugitive Dust				178.2	27.9			
Pipeline Phase 1 Construction Sub-Total	101	63	17	1,305	201	0.42	46,526	2.03
Compressor Station Diesel Non-Road Equip.	3.0	1.5	0.5	0.2	0.2	0.0147	1602	0.04
Compressor Station Diesel and Gas On-Road	0.26	1.8	0.18	0.01	0.01	0.0007	106	0.010
Compressor Station Construction Fugitive Dust				23	3			
Compressor Station Roadway Fugitive Dust				5.7	0.6			
Comp. Station Construction Sub-Total	3	3	1	29	4.3	0.02	1,708	0.05
Project Phase 1 Total Construction Emissions	104.2	66.0	17.5	1,333	205	0.44	48,234	2.07
Project Phase 2 Total Emissions	NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂ e	HAPs
Pipeline Diesel Non-Road Equipment Totals	118.5	26.4	12.8	5.8	5.7	0.75	37,582	0.80
Diesel and Gas On-Road	1.8	6.5	0.72	0.15	0.08	0.01	876	0.06
Pipeline Construction Activity Fugitive Dust				773	118			
Pipeline Roadway Fugitive Dust				58.3	9.4			
Pipeline Construction Sub-Total	120.3	32.9	13.5	837	133	0.75	38,458	0.86
Project Total Construction Emissions	225	99	31	2171	339	1	86692	3

Project Emission Details

Non-Road Equipment Exhaust

Phase 1 Diesel Non-Road Equipment	NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂ e	HAPs
Pipeline Excavation Construction - Spread 1	26.4	9.9	4.1	1.4	1.4	0.13	14244	0.34
Pipeline HDD Construction - Spread 1 (Luzerne Co.)	2.6	0.8	0.2	0.1	0.1	0.01	547	0.79
Pipeline Excavation Construction - Spread 2	29.3	10.9	4.5	1.6	1.5	0.14	15807	0.37
Pipeline HDD Construction - Spread 2 (Carbon Co.)	18.5	2.4	1.5	0.9	0.8	0.03	3540	0.06
Pipeline Construction - Spread 3.1 (Phase 1)	18.9	7.0	2.9	1.0	1.0	0.09	10180	0.24
Phase 1 Pipeline Construction Sub-Total	95.5	31.1	13.3	5.0	4.9	0.41	44319	1.80
Compressor Station Construction Equip.	3.0	1.5	0.5	0.2	0.2	0.01	1602	0.04
Phase 1 Non-Road Equipment Construction Total	98.5	32.6	13.8	5.2	5.1	0.42	45921	1.84
Phase 2 Diesel Non-Road Equipment	NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂ e	HAPs
Pipeline Construction - Spread 3.2 (Phase 2) (Northampton)	10.8	4.0	1.7	0.6	0.6	0.05	5820	0.14
Pipeline HDD Construction - Spread 3.2 (Northampton Co.)	15.7	2.1	1.3	0.7	0.7	0.43	3031	0.05
Pipeline Construction - Spread 4	33.3	12.3	5.1	1.8	1.8	0.16	17754	0.42
Pipeline HDD Construction - Spread 4 (Bucks Co.)	6.1	0.8	0.5	0.3	0.3	0.01	1148	0.02
Pipeline HDD Construction - Spread 4 (Huntingdon Co.)	46.7	6.3	3.8	2.2	2.1	0.08	8595	0.16
Pipeline HDD Construction - Spread 4 (Mercer Co.)	5.9	0.9	0.5	0.3	0.3	0.01	1234	0.02
Phase 2 Non-Road Equipment Construction Total	118.5	26.4	12.8	5.8	5.7	0.75	37582	0.80
PennEast Project Total Phase 1 & 2 Non-Road Equip.	217.0	58.9	26.6	11.1	10.7	1.17	83503	2.64

Roadway Travel Particulate Matter

Phase 1 Pipeline Construction	PM ₁₀	PM _{2.5}
Combined Pickup Trucks and Vans - Spread 1	54.1	8.1
Float, Lowboy, Tractor Trucks Spread 1	6.0	1.3
Bus - Spread 1	3.8	0.7
Combined Pickup Trucks and Vans - Spread 2	60.0	9.0
Float, Lowboy, Tractor Trucks Spread 2	6.0	1.3
Bus - Spread 2	4.2	0.7
Combined Pickup Trucks and Vans - Spread 3.1	37.5	5.6
Float, Lowboy, Tractor Trucks Spread 3.1	3.9	0.8
Bus - Spread 3.1	2.7	0.5
Phase 1 Total Pipeline Construction Roadway PM	178.2	27.9
Compressor Station construction	PM ₁₀	PM _{2.5}
Gas Pickup Trucks - Supervisors/Inspectors	3.2	0.4
Gas Pickup Trucks - Operators	1.9	0.2
Diesel 1-Ton Trucks with Tools	0.5	0.1
Total Compressor Station Construction Roadway PM	5.7	0.63
Phase 1 Total Construction Roadway PM	183.9	28.6
Phase 2 Pipeline Construction	PM ₁₀	PM _{2.5}
Combined Pickup Trucks and Vans - Spread 3.2	21.4	3.2
Float, Lowboy, Tractor Trucks Spread 3.2	2.3	0.5
Bus - Spread 3.2	1.6	0.3
Combined Pickup Trucks and Vans - Spread 4	21.6	3.2
Float, Lowboy, Tractor Trucks Spread 4	6.9	1.4
Bus - Spread 4	4.8	0.9
Phase 2 Total Construction Roadway PM	58	9

Table G-3.1 page 2

Revised: 01-30-020

Total Project construction Emissions by Spread

Project Elements	NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂ e	HAPs
Spread 1								
Diesel Non-Road Equipment, Excavation Construction	26.4	9.9	4.1	1.4	1.4	0.130	14,244	0.34
Diesel Non-Road Equipment, HDD Construction	2.6	0.8	0.2	0.1	0.1	0.005	547	0.79
Diesel and Gas On-Road	2.02	12.5	1.43	0.10	0.06	0.006	794	0.094
Roadway Travel Particulate Matter				63.9	10.0			
Total construction Emissions Spread 1	30.9	23.2	5.8	65.6	11.6	0.14	15,584	1.22
County Breakdown for Spread 1:								
Luzerne County	30.9	23.2	5.8	65.6	11.6	0.1	15,584	1.22
Spread 2								
Diesel Non-Road Equipment, Excavation Construction	29.3	10.9	4.5	1.6	1.5	0.1	15,807	0.4
Diesel Non-Road Equipment, HDD Construction	18.5	2.4	1.5	0.9	0.8	0.0	3,540	0.06
Diesel and Gas On-Road	2.05	11.8	1.21	0.111	0.064	0.0062	854	0.08
Roadway Travel Particulate Matter				70.1	11.0			
Total construction Emissions Spread 2	49.8	25.1	7.2	72.7	13.4	0.18	20,201	0.51
County Breakdown for Spread 2:								
Luzerne	5.3	3.9	1.0	12.3	2.2	0.0	2,847	0.08
Carbon (100% of the HDD emissions are in Carbon County):	44.4	21.2	6.2	60.4	11.3	0.2	17,354	0.43
Spread 3.1								
Diesel Non-Road Equipment	18.9	7.0	2.9	1.0	1.0	0.1	10,180	0.24
Diesel and Gas On-Road	1.36	7.4	0.87	0.08	0.05	0.0041	560	0.05
Roadway Travel Particulate Matter				44.2	6.9			
Total construction Emissions Spread 3.1	20.3	14.4	3.8	45.3	8.0	0.10	10,740	0.30
County Breakdown for Spread 3.1:								
Carbon	3.1	2.2	0.6	6.9	1.2	0.0	1,629	0.04
Northampton	17.2	12.2	3.2	38.4	6.8	0.1	9,112	0.25
Spread 3.2								
Diesel Non-Road Equipment	10.8	4.0	1.7	0.6	0.6	0.1	5,820	0.14
Diesel Non-Road Equip., HDD Construction (Northampton)	15.7	2.1	1.3	0.7	0.7	0.4	3,031	0.05
Diesel and Gas On-Road	0.78	4.2	0.49	0.05	0.03	0.0023	320	0.03
Roadway Travel Particulate Matter				25.2	4.0			
Total construction Emissions Spread 3.2	27.3	10.3	3.4	26.6	5.3	0.48	9,171	0.22
County Breakdown for Spread 3.2:								
Northampton (includes 100% of HDD in Spread 3.2)	25.5	9.1	3.1	22.6	4.6	0.47	8,224	0.19
Bucks	1.7	1.2	0.3	3.9	0.7	0.01	923	0.03
Hunterdon	0.05	0.03	0.01	0.1	0.02	0.0002	24.5	0.001
Spread 4								
Diesel Non-Road Equipment	33.33	12.26	5.12	1.81	1.76	0.162	17,754	0.42
Diesel Non-Road Equipment, HDD Construction	58.65	7.98	4.74	2.70	2.62	0.106	10,977	0.20
Diesel and Gas On-Road	1.04	2.29	0.23	0.10	0.05	0.004	556	0.03
Roadway Travel Particulate Matter				33.03	5.49			
Total construction Emissions Spread 4	93.01	22.54	10.09	37.65	9.92	0.273	29,287	0.65
County Breakdown for Spread 4								
Bucks	6.1	0.8	0.5	0.3	0.3	0.0	1,148	0.02
Hunterdon	72.57	17.29	7.80	28.45	7.58	0.21	22,371	0.49
Mercer	14.38	4.45	1.82	8.93	2.07	0.05	5,768	0.13

Total Construction Emiss. by County/Phase	NO _x	CO	VOC	PM ₁₀	PM _{2.5}	SO ₂	CO ₂ e	HAPs
PHASE 1								
Luzerne Equipment Combustion and Roadway PM	36.3	27.1	6.7	78	14	0.17	18,431	1.30
Luzerne Construction Activity PM				320	48			
Luzerne County Emission Totals	36.3	27.1	6.7	397	61.7	0.2	18,431	1.30
Carbon Equipment Combustion and Roadway PM	50.8	26.7	7.5	95.9	16.7	0.19	20,691	0.53
Carbon Construction Activity PM				428	64			
Carbon County Emission Totals	50.8	26.7	7.5	524	81.0	0.2	20,691	0.53
Northampton Equipment Combustion and Roadway PM	17.18	12.23	3.23	38.41	6.76	0.08	9111.64	0.25
Northampton Construction Activity PM				373	56			
Northampton County Emission Totals	17.2	12.2	3.2	412	62.7	0.08	9,112	0.25
Total All Counties in Phase 1	104.2	66.0	17.46	1333.3	205.4	0.4	48234	2.1
PHASE 2								
Northampton Equipment Combustion and Roadway PM	25.5	9.1	3.1	22.6	4.6	0.5	8223.8	0.2
Northampton Construction Activity PM				198.8	29.8			
Northampton County Emission Totals	25.5	9.1	3.1	221.5	34.4	0.5	8223.8	0.2
Bucks Equipment Combustion and Roadway PM	7.8	2.0	0.8	4.2	1.0	0.0	2071	0.04
Bucks Construction Activity PM				14	4			
Bucks County Emission Totals	7.8	2.0	0.8	18	5.4	0.0	2,071	0.04
Hunterdon Equipment Combustion and Roadway PM	72.6	17.3	7.8	29	8	0.2	22,395	0.49
Hunterdon Construction Activity PM				389	58			
Hunterdon County Emission Totals	72.6	17.3	7.8	418	65.9	0.2	22,395	0.49
Mercer Equipment Combustion and Roadway PM	14.4	4.45	1.82	9	2	0.05	5,768	0.13
Mercer Construction Activity PM				171	26			
Mercer County Emission Totals	14.4	4.5	1.8	180	27.7	0.1	5,768	0.13
Total All Counties in Phase 2	120.3	33	14	837	133	1	38458	0.86

Table G-3.2
PennEast Pipeline Project

Fugitive Dust Emissions - Construction Activity/Land Disturbance

Updated 01-29-2020

Construction Emissions - Fugitive dust from Phase 1 Earth Disturbance Construction Activities

Source/Construction Activity	County	Area of Land Disturbance ¹ (acres):	Months of Construction Activity ² :	PM2.5 ton/period	PM10 ton/period
Total Pipeline Acres	Luzerne	336.6	6.5	40	268
Total Access Roads Acres	Luzerne	63.8	3	4	23
Pipeyards	Luzerne	39.7	3	2	15
Aboveground Facilities	Luzerne	13.0	6.5	2	10
Staging Areas	Luzerne	2.8	10	1	3
Total PM Emissions	Luzerne			48	320
Total Pipeline Acres	Carbon	373.5	6.5	51	337
Total Access Roads Acres	Carbon	44.8	3	3	19
Pipeyards	Carbon	50.4	3	3	21
Kidder Compressor Station	Carbon	27.3	6	3	23
Aboveground Facilities	Carbon	1.2	6.5	0	1
Staging Areas	Carbon	19.9	10	4	28
Total PM Emissions	Carbon			64	428
Total Pipeline Acres	Northampton	269.9	6.5	41	270
Total Access Roads Acres	Northampton	44.8	3	3	21
Pipeyards	Northampton	50.4	3	3	23
Aboveground Facilities	Northampton	28.4	6.5	4	28
Staging Areas	Northampton	19.9	10	5	31
Total PM Emissions	Northampton			56	373
Total ⁽¹⁾ Phase 1 Pipeline Only (Excludes Kidder Station)		1359.1		168	1121
Kidder Station Subtotal		27.3		3	23

Construction Emissions - Fugitive dust from Phase 2 Earth Disturbance Construction Activities

Total Pipeline Acres	Northampton	104.6	6.5	16	105
Total Access Roads Acres	Northampton	7.2	3	0	3
Pipeyards	Northampton	74.3	3	5	34
Aboveground Facilities	Northampton	6.9	6.5	1	7
Staging Areas	Northampton	12.7	10	3	20
Hellertown Lateral	Northampton	29.9	6.5	4	30
Total PM Emissions	Northampton			30	199
Total Pipeline Acres	Bucks	28.3	6.5	4	11
Total Access Roads Acres	Bucks	2.7	3	0	3
Total PM Emissions	Bucks			4	14
Total Pipeline Acres	Hunterdon	375.7	6.5	49	327
Total Access Roads Acres	Hunterdon	23.6	3	1	9
Pipeyards	Hunterdon	36.4	3	2	15
Aboveground Facilities	Hunterdon	16.7	6.5	2	15
Lambertville Lateral	Hunterdon	23.1	6.5	3	20
Gilbert Lateral	Hunterdon	3.6	6.5	0	3
Total PM Emissions	Hunterdon			58	389
Total Pipeline Acres	Mercer	151.4	6.5	23	152
Total Access Roads Acres	Mercer	6.0	3	0	3
Pipeyards	Mercer	26.3	3	2	12
Aboveground Facilities	Mercer	4.3	6.5	1	4
Total PM Emissions	Mercer			26	171
Total ⁽¹⁾ Phase 2		934.0		118	773

Table G-3.2

Table G-3.2

PennEast Pipeline Project

Fugitive Dust Emissions - Construction Activity/Land Disturbance

Fugitive Dust Emissions - Construction Activity/Land Disturbance

Updated 01-29-2020

Updated 01-29-2020

Emission Factor Equations³PM10 Emission Factor = $0.42 \times (1 - CE) \times SAE \times SMA$

PM2.5 Emission Factor = PM10 Emission Factor x Ratio

Project Area Specific PM Emission Factors

Base PM10 Emission Factor(tons/acre-month) 0.42

Ratio of PM2.5 to PM10 (Ratio) 0.15

Construction Dust Plan Control Efficiency Factor⁴ 50%

Silt Adjustment Factor (SAF): 3.67 (SAF = Project Value/ 9%)

Total 9%

Average Dry Silt Percent of Project Soils 33% Weighted Average by Area of Soil

Soil Moisture Adjustment Factor (per Climate Divisions of Project Area)

Thornthwaite's Precipitation-Evaporation Index⁵

Soil Moisture

Adjusted Emission Factors

Basis (Arid Southwest US)	See Note 3	24	Adjustment (SMA)	PM2.5	PM10
	Luzerne County	151	0.16	0.0184	0.1224
	Carbon County	133	0.18	0.0208	0.1389
	Northampton	120	0.20	0.0231	0.1540
	Bucks	120	0.20	0.0231	0.1540
	Hunterdon	138	0.17	0.0201	0.1339
	Mercer	120	0.20	0.0231	0.1540

NOTES:

[1] Acres per County are calculated from Project Details (From GIS Data), See Table L2-10.

[2] The entire construction activity duration is expected to be 8 to 10 months; however, based on crew activity type and phasing, the emission causing Months of Heavy Construction Activity is used in the emission calculations as shown above. Travel on unpaved roads for crews not using heavy equipment are accounted for in Off-Road travel.

[3] Estimating Particulate Matter Emissions From Construction Operations, Final Report, Eastern Research Group, Inc., September 30, 1999, EPA Contract 68-D7-0068, Section 5.6. It is assumed that the factor and methodology for adjusting the factor for Roadway Construction Emissions are similar in nature to the pipeline construction.

[4] Required and effective fugitive dust control measures will be determined at the site during construction activity. Application of water to mitigate fugitive dust will be used as one of the primary control measure. Mitigation of fugitive dust by the use of water application and other measures is reflected in the 50% control efficiency recommended in the referenced EPA Contract 68-D7-0068 Document.

[5] Thornthwaite's Precipitation-Evaporation Index values are taken from the map on page 5-12 of cited EPA Contract 68-D7-0068 Document.

Table G-3.3
PennEast Pipeline Project
Pipeline Construction Emissions - On-road Vehicles

Revised 01-29-2020

Description	Category Based on MOVES2014 Classification	Number of Equipment	Total Days	Total Weeks	Total Months	Working Days	Miles per Day	Calc. VMT ¹
Gas Pickup Trucks - Spread 1	31 - Passenger Truck - Gas	94	231	33	10	198	50	930,600
Gas Pickup Trucks - Spread 2	31 - Passenger Truck - Gas	105	231	33	10	198	50	1,039,500
Gas Pickup Trucks - Spread 3	31 - Passenger Truck - Gas	103	238	34	10	198	50	1,019,700
Gas Pickup Trucks - Spread 4	31 - Passenger Truck - Gas	104	252	36	10	72	50	374,400
Float, Lowboy, Tractor Trucks Spread 1	52 - Single Unit Short-Haul Truck - Diesel	21	231	33	10	198	50	207,900
Float, Lowboy, Tractor Trucks Spread 2	52 - Single Unit Short-Haul Truck - Diesel	21	231	33	10	198	50	207,900
Float, Lowboy, Tractor Trucks Spread 3	52 - Single Unit Short-Haul Truck - Diesel	21	238	34	10	204	50	214,200
Float, Lowboy, Tractor Trucks Spread 4	52 - Single Unit Short-Haul Truck - Diesel	22	252	36	10	216	50	237,600
Diesel Parts Vans - Spread 1	32 - Light Commercial Truck - Diesel	8	231	33	10	198	50	79,200
Diesel Parts Vans - Spread 2	32 - Light Commercial Truck - Diesel	8	231	33	10	198	50	79,200
Diesel Parts Vans - Spread 3	32 - Light Commercial Truck - Diesel	8	238	34	10	204	50	81,600
Diesel Parts Vans - Spread 4	32 - Light Commercial Truck - Diesel	8	252	36	10	216	50	86,400
Bus - Spread 1	32 - Light Commercial Truck - Diesel	10	231	33	10	198	50	99,000
Bus - Spread 2	32 - Light Commercial Truck - Diesel	11	231	33	10	198	50	108,900
Bus - Spread 3	32 - Light Commercial Truck - Diesel	11	238	34	10	204	50	112,200
Bus - Spread 4	32 - Light Commercial Truck - Diesel	11	252	36	10	216	50	118,800

Description	Category Based on MOVES2014 Classification	VOC ² g/VMT	CO ² g/VMT	PM ₁₀ ² g/VMT	PM _{2.5} ² g/VMT	SO ₂ ² g/VMT	NOx ² g/VMT	CO ₂ ² g/VMT	CH ₄ ² g/VMT	N ₂ O ² g/VMT	GHG ³ g CO ₂ e /VMT	HAPs ^{2,4} g/VMT
Gas Pickup Trucks - Spread 1	31 - Passenger Truck - Gas	1.22	11.07	0.05	0.03	0.00	1.19	454.32	0.04	0.03	465.45	0.06
Gas Pickup Trucks - Spread 2	31 - Passenger Truck - Gas	0.91	9.30	0.05	0.02	0.00	1.07	450.51	0.03	0.02	458.28	0.05
Gas Pickup Trucks - Spread 3	31 - Passenger Truck - Gas	1.03	9.19	0.05	0.02	0.00	1.09	460.66	0.03	0.03	470.46	0.05
Gas Pickup Trucks - Spread 4	31 - Passenger Truck - Gas	0.23	3.55	0.05	0.01	0.00	0.28	418.96	0.01	0.01	421.88	0.01
Float, Lowboy, Tractor Trucks Spread 1	52 - Single Unit Short-Haul Truck - Diesel	0.24	1.03	0.14	0.09	0.01	1.93	861.55	0.05	0.00	863.53	0.04
Float, Lowboy, Tractor Trucks Spread 2	52 - Single Unit Short-Haul Truck - Diesel	0.24	1.05	0.15	0.09	0.01	1.97	883.49	0.05	0.00	885.48	0.04
Float, Lowboy, Tractor Trucks Spread 3	52 - Single Unit Short-Haul Truck - Diesel	0.27	1.13	0.18	0.10	0.01	2.07	923.79	0.06	0.00	925.98	0.04
Float, Lowboy, Tractor Trucks Spread 4	52 - Single Unit Short-Haul Truck - Diesel	0.28	1.05	0.24	0.13	0.01	2.48	927.66	0.05	0.00	929.59	0.04
Diesel Parts Vans - Spread 1	32 - Light Commercial Truck - Diesel	0.65	4.63	0.10	0.07	0.01	1.83	598.23	0.11	0.002	601.57	0.10
Diesel Parts Vans - Spread 2	32 - Light Commercial Truck - Diesel	0.54	4.21	0.11	0.08	0.01	1.84	603.69	0.07	0.002	605.94	0.08
Diesel Parts Vans - Spread 3	32 - Light Commercial Truck - Diesel	0.64	4.69	0.13	0.09	0.01	2.01	616.86	0.07	0.002	619.37	0.09
Diesel Parts Vans - Spread 4	32 - Light Commercial Truck - Diesel	0.26	2.45	0.09	0.05	0.01	1.22	610.50	0.07	0.002	612.89	0.05
Bus - Spread 1	32 - Light Commercial Truck - Diesel	0.65	4.63	0.10	0.07	0.01	1.83	598.23	0.11	0.002	601.57	0.10
Bus - Spread 2	32 - Light Commercial Truck - Diesel	0.54	4.21	0.11	0.08	0.01	1.84	603.69	0.07	0.002	605.94	0.08
Bus - Spread 3	32 - Light Commercial Truck - Diesel	0.64	4.69	0.13	0.09	0.01	2.01	616.86	0.07	0.002	619.37	0.09
Bus - Spread 4	32 - Light Commercial Truck - Diesel	0.26	2.45	0.09	0.05	0.01	1.22	610.50	0.07	0.002	612.89	0.05

Table G-3.3
PennEast Pipeline Project
Pipeline Construction Emissions - On-road Vehicles

Revised 01-29-2020

Description	Category Based on MOVES2014 Classification	VOC ton/yr	CO ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	SO ₂ ton/yr	NOx ton/yr	CO ₂ ton/yr	CH ₄ ton/yr	N ₂ O ton/yr	GHG ton CO ₂ e /yr	HAPs ton/yr
Gas Pickup Trucks - Spread 1	31 - Passenger Truck - Gas	1.25E+00	1.14E+01	4.72E-02	2.81E-02	3.10E-03	1.22E+00	466.1	3.99E-02	3.49E-02	477.46	6.57E-02
Gas Pickup Trucks - Spread 2	31 - Passenger Truck - Gas	1.05E+00	1.07E+01	5.26E-02	2.58E-02	3.43E-03	1.22E+00	516.2	3.07E-02	2.73E-02	525.13	5.19E-02
Gas Pickup Trucks - Spread 3	31 - Passenger Truck - Gas	1.16E+00	1.03E+01	6.09E-02	2.81E-02	3.44E-03	1.22E+00	517.8	3.16E-02	3.43E-02	528.82	5.59E-02
Gas Pickup Trucks - Spread 4	31 - Passenger Truck - Gas	9.34E-02	1.46E+00	1.94E-02	5.06E-03	1.15E-03	1.15E-01	172.9	4.26E-03	3.70E-03	174.11	5.07E-03
Float, Lowboy, Tractor Trucks Spread 1	52 - Single Unit Short-Haul Truck - Diesel	5.45E-02	2.37E-01	3.28E-02	2.04E-02	1.67E-03	4.43E-01	197.4	1.24E-02	4.79E-04	197.90	8.65E-03
Float, Lowboy, Tractor Trucks Spread 2	52 - Single Unit Short-Haul Truck - Diesel	5.52E-02	2.40E-01	3.50E-02	2.11E-02	1.71E-03	4.51E-01	202.5	1.23E-02	4.98E-04	202.93	8.70E-03
Float, Lowboy, Tractor Trucks Spread 3	52 - Single Unit Short-Haul Truck - Diesel	6.31E-02	2.67E-01	4.36E-02	2.47E-02	1.84E-03	4.88E-01	218.1	1.38E-02	5.78E-04	218.64	9.95E-03
Float, Lowboy, Tractor Trucks Spread 4	52 - Single Unit Short-Haul Truck - Diesel	7.45E-02	2.76E-01	6.21E-02	3.39E-02	2.06E-03	6.49E-01	243.0	1.32E-02	5.87E-04	243.47	1.16E-02
Diesel Parts Vans - Spread 1	32 - Light Commercial Truck - Diesel	5.68E-02	4.04E-01	8.34E-03	6.32E-03	4.49E-04	1.60E-01	52.2	9.27E-03	2.03E-04	52.52	8.86E-03
Diesel Parts Vans - Spread 2	32 - Light Commercial Truck - Diesel	4.71E-02	3.68E-01	9.74E-03	7.16E-03	4.54E-04	1.61E-01	52.7	5.79E-03	1.74E-04	52.90	7.01E-03
Diesel Parts Vans - Spread 3	32 - Light Commercial Truck - Diesel	5.75E-02	4.22E-01	1.14E-02	8.14E-03	4.78E-04	1.81E-01	55.5	6.55E-03	2.08E-04	55.71	8.49E-03
Diesel Parts Vans - Spread 4	32 - Light Commercial Truck - Diesel	2.52E-02	2.33E-01	8.28E-03	4.51E-03	4.93E-04	1.16E-01	58.1	6.68E-03	2.06E-04	58.37	4.35E-03
Bus - Spread 1	32 - Light Commercial Truck - Diesel	7.09E-02	5.05E-01	1.04E-02	7.90E-03	5.61E-04	2.00E-01	65.3	1.16E-02	2.54E-04	65.65	1.11E-02
Bus - Spread 2	32 - Light Commercial Truck - Diesel	6.47E-02	5.06E-01	1.34E-02	9.85E-03	6.24E-04	2.21E-01	72.5	7.96E-03	2.39E-04	72.74	9.64E-03
Bus - Spread 3	32 - Light Commercial Truck - Diesel	7.90E-02	5.81E-01	1.57E-02	1.12E-02	6.57E-04	2.48E-01	76.3	9.00E-03	2.85E-04	76.60	1.17E-02
Bus - Spread 4	32 - Light Commercial Truck - Diesel	3.47E-02	3.21E-01	1.14E-02	6.20E-03	6.78E-04	1.59E-01	79.9	9.18E-03	2.83E-04	80.26	5.98E-03
Total		4.24	38.16	0.44	0.25	0.023	7.25	3047	0.22	0.10	3083	0.28

Project Element Subtotals	VOC ton/yr	CO ton/yr	PM ₁₀ ton/yr	PM _{2.5} ton/yr	SO ₂ ton/yr	NOx ton/yr	CO ₂ ton/yr	CH ₄ ton/yr	N ₂ O ton/yr	GHG ton CO ₂ e /yr	HAPs ton/yr
Pipeline Construction - Spread 1	1.434	12.504	0.099	0.063	0.006	2.02	781	0.073	0.036	794	0.094
Pipeline Construction - Spread 2	1.213	11.771	0.111	0.064	0.006	2.05	844	0.057	0.028	854	0.077
Pipeline Construction - Spread 3.1	0.866	7.379	0.084	0.046	0.004	1.36	552	0.039	0.023	560	0.055
Pipeline Construction - Spread 3.2	0.495	4.219	0.048	0.026	0.002	0.78	316	0.022	0.013	320	0.031
Pipeline Construction - Spread 4	0.228	2.293	0.101	0.050	0.004	1.04	554	0.033	0.005	556	0.027
Total Pipeline On-Road Emissions	4.24	38.16	0.44	0.25	0.023	7.25	3047	0.22	0.10	3083	0.28
Phase 1 Subtotal	3.51	31.65	0.29	0.17	0.016	5.44	2177	0.17	0.09	2207	0.23
Phase 2 Subtotal	0.72	6.51	0.15	0.08	0.007	1.82	870	0.06	0.02	876	0.06

NOTES:

- Note 1: Vehicle Miles Traveled (VMT) = (Number of Equipment) * (Working Days) * (Miles per day)
- Note 2: Emissions estimates are based on EPA's MOVES2014 motor vehicle emissions estimation program. Year 2019 is used as the base year for EFs. Factors are based on county data and pipeline miles per spread per county considerations as shown in Table L2-6.2 and 7.2.
- Note 3: Greenhouse gasses (GHG) are converted to carbon dioxide equivalents (CO2) using 40 CFR 98 Subpart A global warming potentials as follows:
CO₂ = 1, CH₄ = 25, N₂O = 298
- Note 4: HAPs are aggregated for benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein

Table G-3.4
Onroad Vehicle Emission Factors for 2019 used in Tables L2-6 and L2-7

Revised 01-30-2020

Category Based on MOVES2014 Classification	County, State	Spread Number that these Factors are used ¹	VOC ² g/VMT	CO ² g/VMT	PM ₁₀ ² g/VMT	PM _{2.5} ² g/VMT	SO ₂ ² g/VMT	NOx ² g/VMT	CO ₂ ² g/VMT	CH ₄ ² g/VMT	N ₂ O ² g/VMT	GHG ³ g CO ₂ e /VMT	HAPs ^{2,4} g/VMT
			VOC	CO	PM10	PM2.5	SO2	NOx	CO2	CH4	N2O	CO2e	HAPS
31 - Passenger Truck - Gas	Luzerne County, PA	100% Spread 1, 17% of Spread 2	1.22	11.07	0.05	0.03	0.003	1.19	454.32	0.04	0.03	465.45	0.06
32 - Light Commercial Truck - Diesel	Luzerne County, PA	100% Spread 1, 17% of Spread 2	0.65	4.63	0.10	0.07	0.01	1.83	598.23	0.11	0.002	601.57	0.10
52 - Single Unit Short-Haul Truck - Diesel	Luzerne County, PA	100% Spread 1, 17% of Spread 2	0.24	1.03	0.14	0.09	0.01	1.93	861.55	0.05	0.002	863.53	0.04
31 - Passenger Truck - Gas	Carbon County, PA	83% of Spread 2, 15% Spread 3	0.85	8.93	0.05	0.02	0.003	1.04	449.73	0.02	0.02	456.81	0.04
32 - Light Commercial Truck - Diesel	Carbon County, PA	83% of Spread 2, 15% Spread 3	0.52	4.13	0.11	0.08	0.01	1.84	604.81	0.06	0.002	606.84	0.08
52 - Single Unit Short-Haul Truck - Diesel	Carbon County, PA	83% of Spread 2, 15% Spread 3	0.24	1.05	0.15	0.09	0.01	1.98	888.01	0.05	0.002	890.00	0.04
31 - Passenger Truck - Gas	Luzerne/Carbon, PA	Average Spread 2	0.91	9.30	0.05	0.02	0.00	1.07	450.51	0.03	0.024	458.28	0.05
32 - Light Commercial Truck - Diesel	Luzerne/Carbon, PA	Average Spread 2	0.54	4.21	0.11	0.08	0.01	1.84	603.69	0.07	0.002	605.94	0.08
52 - Single Unit Short-Haul Truck - Diesel	Luzerne/Carbon, PA	Average Spread 2	0.24	1.05	0.15	0.09	0.01	1.97	883.49	0.05	0.002	885.48	0.04
31 - Passenger Truck - Gas	Northampton County, PA	Assumed 100% Spread 3	1.03	9.19	0.05	0.02	0.003	1.09	460.66	0.03	0.03	470.46	0.05
32 - Light Commercial Truck - Diesel	Northampton County, PA	Assumed 100% Spread 3	0.64	4.69	0.13	0.09	0.01	2.01	616.86	0.07	0.002	619.37	0.09
52 - Single Unit Short-Haul Truck - Diesel	Northampton County, PA	Assumed 100% Spread 3	0.27	1.13	0.18	0.10	0.01	2.07	923.79	0.06	0.002	925.98	0.04
31 - Passenger Truck - Gas	Bucks County, PA	% of Spread 3	0.64	7.31	0.04	0.02	0.003	0.82	438.62	0.02	0.024	446.13	0.03
32 - Light Commercial Truck - Diesel	Bucks County, PA	% of Spread 3	0.50	4.01	0.10	0.07	0.01	1.70	591.57	0.07	0.002	593.90	0.08
52 - Single Unit Short-Haul Truck - Diesel	Bucks County, PA	% of Spread 3	0.25	1.12	0.18	0.10	0.01	1.99	889.36	0.06	0.002	891.45	0.04
31 - Passenger Truck - Gas	Hunterdon County, NJ	75% of Spread 4	0.21	3.39	0.05	0.01	0.003	0.27	413.54	0.01	0.01	416.30	0.01
32 - Light Commercial Truck - Diesel	Hunterdon County, NJ	75% of Spread 4	0.26	2.36	0.09	0.05	0.01	1.19	603.57	0.07	0.002	605.87	0.04
52 - Single Unit Short-Haul Truck - Diesel	Hunterdon County, NJ	75% of Spread 4	0.26	0.99	0.21	0.12	0.01	2.31	863.61	0.05	0.002	865.38	0.04
31 - Passenger Truck - Gas	Mercer, NJ	25% of Spread 4	0.26	4.02	0.05	0.01	0.003	0.31	435.41	0.01	0.01	438.86	0.01
32 - Light Commercial Truck - Diesel	Mercer, NJ	25% of Spread 4	0.29	2.72	0.09	0.05	0.01	1.30	631.54	0.08	0.002	634.23	0.05
52 - Single Unit Short-Haul Truck - Diesel	Mercer, NJ	25% of Spread 4	0.35	1.23	0.31	0.16	0.01	2.97	1122.27	0.06	0.003	1124.67	0.05
31 - Passenger Truck - Gas	Hunterdon/Mercer NJ	Average Spread 4	0.23	3.55	0.05	0.01	0.003	0.28	418.96	0.01	0.01	421.88	0.01
32 - Light Commercial Truck - Diesel	Hunterdon/Mercer NJ	Average Spread 4	0.26	2.45	0.09	0.05	0.01	1.22	610.50	0.07	0.002	612.89	0.05
52 - Single Unit Short-Haul Truck - Diesel	Hunterdon/Mercer NJ	Average Spread 4	0.28	1.05	0.24	0.13	0.01	2.48	927.66	0.05	0.002	929.59	0.04

Note 1: For Spreads with multiple Counties, Weighted Average Emission Factors are used, except for Spread 3 which uses values for Northampton county. The percent of each county is based on miles of pipeline per county and calculated in Table G-3.5. **Bolded** values are used in Table G-3.3.

Note 2: Emissions estimates are based on EPA's MOVES2014 motor vehicle emissions estimation program. Year 2019 is used as the base year for EFs. Factors are based on county data from the County and State as shown. Model ID: MOVES2014a-20151201

Note 3: Greenhouse gasses (GHG) are converted to carbon dioxide equivalents (CO2) using 40 CFR 98 Subpart A global warming potentials as follows:
CO2 = 1, CH4 = 25, N2O = 298

Note 4: HAPs are aggregated for benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein

Table G-3.5

Updated 01-29-2020

PennEast Pipeline Project

Percentage⁽¹⁾ of Construction Spread Activity Per County

	Phase 1			Phase 2	
Construction Spreads> County	1	2	3.1	3.2	4
Luzerne	100%	17%			
Carbon		83%	15%		
Northampton			85%	85%	
Bucks				15%	
Hunterdon				0.4%	75%
Mercer					25%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Notes:

$$1. \text{ Percentage} = \frac{(\text{Total Main Line and Lateral of Construction in a County})}{(\text{Total Main Line and Laterals included in Construction Spread})}$$

2. Percentages calculated using GIS Data

PennEast Pipeline Project
Phase 1 Emission Estimation Tables

Table ID	Table Description
G-4.1	Kidder Compressor Station Total Annual Emissions - Estimate for Phase 1 Operating Emissions
G-4.2	Kidder Compressor Station - Estimate of Average Hourly Emission Rates - Based on Monthly Average Ambient Temperatures at 100% Load for One Combustion Turbine
G-4.3	Kidder Compressor Station - Compressor Start-up/Shutdown Emissions
G-4.4	Kidder Compressor Station - Speciated and Total HAPs from Compressor Turbines
G-4.5	Kidder Compressor Station - Natural Gas Engine Emissions for Auxiliary Power Unit
G-4.6	Kidder Compressor Station - Fugitive Emissions from Station Piping (Leaks from Valves, Flanges, etc.)
G-4.7	Kidder Compressor Station - Venting Emission Estimates
G-4.8	Kidder Compressor Station - Nat. Gas-Fired Heat Exchanger (Fuel Gas Heater) Emissions
G-4.9	Mars 100 Combustion Turbine Emission Specifications
G-4.10	Gas Analysis Details Used in Emission Estimates
G-4.11	Gas Analysis - Copy of Laboratory Analyses
G-4.12	Referenced Factors
G-4.13	Detailed Sulfur Dioxide Emission Rate Estimates

Table G-4.1

Revised:

1/29/2020

PennEast Pipeline Project

Kidder Compressor Station Total Annual Emissions - Estimate for Phase 1 Operating Emissions

Month	Hours in specified Month (each CT)	Monthly mean temperature °Fahrenheit (See Table B-2)	Average Station Load Percent (2 CTs combined) to deliver 17,700 Hp	NOx (Average lb/month)	CO (lb/month)	VOC (lb/month)	Average SO ₂ (lb/month)	Formaldehyde (Single HAP) (lb/month)	Total HAP (lb/month)	Total PM ₁₀ (lb/month)	Total PM _{2.5} (lb/month)	Total CO _{2e} (lb/month)
12	744	29.84	58%	5,959	604	346.0	371.6	131.7	141.0	1639.5	1639.5	12,906,780
1	744	19.22	57%	5,963	605	346.4	371.7	131.7	141.0	1640.0	1640.0	12,910,405
2	672	21.38	57%	5,384	546	312.7	335.7	119.0	127.4	1480.9	1480.9	11,658,080
3	744	28.94	58%	5,959	604	346.0	371.6	131.7	141.0	1639.4	1639.4	12,905,912
4	720	47.12	60%	5,784	586	335.4	361.2	128.0	137.0	1593.4	1593.4	12,544,032
5	744	59.36	62%	6,002	608	347.6	375.5	133.1	142.5	1656.6	1656.6	13,041,369
6	720	67.82	63%	5,831	591	337.4	365.4	129.5	138.6	1611.9	1611.9	12,689,614
7	744	70.52	64%	6,033	611	348.9	378.3	134.1	143.5	1668.8	1668.8	13,137,852
8	744	67.82	63%	6,025	610	348.6	377.5	133.8	143.2	1665.6	1665.6	13,112,601
9	720	62.24	63%	5,816	589	336.7	364.0	129.0	138.1	1606.0	1606.0	12,642,788
10	744	54.68	61%	5,991	607	347.2	374.5	132.7	142.1	1652.3	1652.3	13,007,547
11	720	42.62	60%	5,777	586	335.1	360.6	127.8	136.8	1590.8	1590.8	12,523,524
8760 < Total Hours per year												
Total of Two (2) Solar Mars 100 Turbines at Load Above (tpy)				35.26	3.57	2.04	2.20	0.78	0.84	9.72	9.72	76,540
Shutdown/Startup - Estimated 48 events (tpy)				0.07	6.54	0.07						42
Total Combined with Start/Stop for 2 Turbines (tpy)				35.34	10.12	2.12	2.20	0.78	0.84	9.72	9.72	76,583
Auxiliary Power Unit (tpy)				1.61	1.69	0.28	0.0097	0.15	0.21	0.03	0.03	333
Fuel Gas Heater (tpy)				0.05	0.05	0.01	0.0034	0.0001	0.002	0.01	0.01	115
Equipment Leaks (tpy)						0.004						150
Natural Gas Venting (tpy)						0.006						47
Total Combined Compressor Station Emission Sources (tpy)				37.00	11.9	2.42	2.22	0.93	1.04	9.8	9.8	77,229
Significance Thresholds in Carbon County, PA (tpy)				100	100	50	100	10	25	100	100	N/A
Title V (Major Source) Significance Threshold Exceeded?				NO	NO	NO	NO	NO	NO	NO	NO	N/A

Notes:

1

For all pollutants, except SO₂, the Annual CT Emissions are calculated by multiplying the hourly emission rates in Table G-4.2 x the hours per month x 2 x the Average Station Load.2 For SO₂, the Average Annual Emissions are estimated by multiplying the monthly average hourly fuel usage in Table G-4.B-2 times the average emission factor in Table G-4.12, times the hours per month, times 2, times the Average Station Load (for 2 CTs).

Table G-4.2

Revised: 1/29/2020

PennEast Pipeline Project

Kidder Compressor Station - Estimate of Average Hourly Emission Rates - Based on Monthly Average Ambient Temperatures at 100% Load for One Combustion Turbine

Month	Monthly mean temperature °Fahrenheit ¹	Variable Fuel Flow, 1 CT, 100% Load	NOx ² (lbm/hr)	CO ^{2,9} (lbm/hr)	UHC ^{2,9} (lbm/hr)	VOC ^{3,9} (lbm/hr)	Maximum SO ₂ ^{4,8} (lb/hr)	Formal- dehyde ^{5,8,9} (lb/hr)	Combined HAPs ^{5,9} (lb/hr)	PM ₁₀ ⁶ (lb/hr)	PM _{2.5} ⁶ (lb/hr)	CO ₂ e ⁷ (lb/hr)
		(MMBtu/hr) ²										
12	29.84	126.20	6.88	0.70	1.997	0.399	7.572	0.152	0.163	1.89	1.89	14,903
1	19.22	128.44	7.00	0.71	2.035	0.407	7.707	0.155	0.166	1.93	1.93	15,168
2	21.38	127.99	6.98	0.71	2.027	0.405	7.680	0.154	0.165	1.92	1.92	15,114
3	28.94	126.39	6.89	0.70	2.001	0.400	7.584	0.152	0.163	1.90	1.90	14,926
4	47.12	122.41	6.66	0.68	1.932	0.386	7.345	0.148	0.158	1.84	1.84	14,455
5	59.36	119.61	6.50	0.66	1.883	0.377	7.177	0.144	0.154	1.79	1.79	14,125
6	67.82	117.63	6.38	0.65	1.846	0.369	7.058	0.142	0.152	1.76	1.76	13,891
7	70.52	116.99	6.34	0.64	1.835	0.367	7.019	0.141	0.151	1.75	1.75	13,815
8	67.82	117.63	6.38	0.65	1.846	0.369	7.058	0.142	0.152	1.76	1.76	13,891
9	62.24	118.94	6.46	0.65	1.870	0.374	7.137	0.143	0.153	1.78	1.78	14,046
10	54.68	120.69	6.56	0.67	1.902	0.380	7.242	0.145	0.156	1.81	1.81	14,252
11	42.62	123.41	6.72	0.68	1.950	0.390	7.405	0.149	0.159	1.85	1.85	14,574
Maximum Monthly Average per turbine		128.44	7.00	0.71	2.03	0.41	7.71	0.15	0.17	1.93	1.93	15,168
Maximum per turbine (Inlet Temp = 0 degrees F)¹⁰		129.50	7.21	0.73	2.10	0.42	7.77	0.16	0.17	1.94	1.94	15,292
MAXIMUM combined (2) turbines		259.00	14.42	1.46	4.2	0.84	15.5	0.31	0.33	3.89	3.89	30,584
Modeled Average Annual Hourly Emission Rate (From Table B-1)			8.05	0.82		0.47	0.50			2.22	2.22	

Notes

- "Monthly Mean (Average) Temperature" (MNTM) Temperatures taken from NWS dataset for Carbon County PA, December 2012-November 2013 (12 month data set).
- Polynomial Regression used to extrapolate temperature dependent emission factors for from manufacturers' performance data @ 100% load. See Table G-4.9.
- Suggested 10-20% of UHC = VOCs for Solar Turbines burning natural gas, based on a ratio of total NMHC to total Organic Compounds as per PIL 168, Rev 5 "Volatile Organic Compound, Sulfur Dioxide and Formaldehyde Emission Estimates", 8 July 2015, by Solar Turbines Incorporated. This analysis assumes 20% of UHC is VOC, plus a 50% emission control reduction based on the Carbon Dioxide Catalyst, netting 10% of UHC. See Table G-4.12.
- For Maximum Hour, SO₂ Emission factor is of 0.060 lb SO₂/MMBtu (HHV) of Natural Gas as allowed by NSPS Subpart KKKK. Relates to Acid Rain Program definition of Natural Gas having 20 grains/dscf. See also Table G-4.12 and G-4.13
- AP42 Revised HAP Emission Factors for Stationary Combustion Turbines. Factor in lb/MMBtu HHV (95% Upper Confidence of Data - worst case) at > 90% load Based on HHV of Natural Gas. In addition a 50% emission reduction is attributed to the use of a Oxidation Catalyst.
- PM Factors taken from PIL 179 "Particulate Matter Emission Estimates", 6 May 2015, by Solar Turbines Incorporated, See Table G-4.12
- CO₂e Factor calculated from CO₂, N₂O and Methane factors in Table 3.1-2a "Emission Factors for Criteria Pollutants and Greenhouse Gases from Stationary Gas Turbines" AP-42 Chapter 3.1 and GWP values from ICCP.
- February 2016 Revision Note: The Emission Factors for SO₂ and Formaldehyde were cross referenced in prior versions of this table that were submitted to the FERC. This coding issue has been corrected in this version of Table G-4.2, and the related Tables G-4.1 reflect this revision.
- Oxidation Catalyst Efficiencies (% Reduction): CO = 90% UHC, VOC = 50% Formaldehyde, HAPs = 50%
- The Maximum Hourly Emissions are estimated at 0 degree F inlet temperature. These are the hourly rates presented in the Plan Approval.

Table G-4.3**PennEast Pipeline Project****Kidder Compressor Station - Compressor Start-up/Shutdown Emissions**

	<u>Operating Time</u>		NOx	CO	UHC	VOC	CO₂e² ton/yr
	Cycles	Hr/Yr					
Emissions per 10-minute Start-up (lbs) ¹			1.40	124	7.10	1.42	837
Emissions per 10-minute Shutdown (lbs) ¹			1.70	149	8.50	1.70	929
Total per combined Startup/Shutdown event (lbs)			3.10	273	15.60	3.12	1,766
Yearly Startup / Shutdown Emissions (tons per year)	48	16	0.07	6.54	0.37	0.07	42
Maximum Hourly Emission Rate at Full Load from B-2 (lbs/hr)			7.00	0.71	2.03	0.41	15,168
Equivalent Operating Hours at full load per Event (hours)			0.44	384	7.7	7.7	0.12
Equivalent Operating days at full load per Event (days)			0.02	16.0	0.32	0.32	0.005

At ISO conditions: 59F, 60% RH, se level, no losses, full load operation prior to shutdown, natural gas firing

1. Based on data from Solar PIL170 Revision 5, Table 3 of Solar Turbines Incorporated "Emission Estimates at Start-up, Shutdown, and Commissioning for SoLoNOx Combustion Products"

2. Emissions Converted from CO₂ to CO₂e by multiplying by 1.009 (ratio of CO₂e for CTs/CO₂ in Reference Factors, Table G-4.12)

Table G-4.4
PennEast Pipeline Project
Kidder Compressor Station - Speciated and Total HAPs from Compressor Turbines

	Speciated HAP Emission Factor ¹ (lb/MMBtu)	1,3- Butadiene	Acetal- dehyde	Acrolein	Benzene	Ethyl- benzene	Formal- dehyde	Naph- thalene	PAH	Propylene Oxide	Toluene	Xylenes		
		4.30E-07	4.00E-05	6.40E-06	1.20E-05	3.20E-05	7.10E-04	1.30E-06	2.20E-06	2.90E-05	1.30E-04	6.40E-05		
Month	Hours per specified month												Total HAPs lbs/month	Total HAPs tons/month
December	744	5.4E-05	5.0E-03	8.1E-04	1.5E-03	4.0E-03	9.0E-02	1.6E-04	2.8E-04	3.7E-03	1.6E-02	8.1E-03	93.7	4.7E-02
January	744	5.5E-05	5.1E-03	8.2E-04	1.5E-03	4.1E-03	9.1E-02	1.7E-04	2.8E-04	3.7E-03	1.7E-02	8.2E-03	95.4	4.8E-02
February	672	5.5E-05	5.1E-03	8.2E-04	1.5E-03	4.1E-03	9.1E-02	1.7E-04	2.8E-04	3.7E-03	1.7E-02	8.2E-03	85.8	4.3E-02
March	744	5.4E-05	5.1E-03	8.1E-04	1.5E-03	4.0E-03	9.0E-02	1.6E-04	2.8E-04	3.7E-03	1.6E-02	8.1E-03	93.8	4.7E-02
April	720	5.3E-05	4.9E-03	7.8E-04	1.5E-03	3.9E-03	8.7E-02	1.6E-04	2.7E-04	3.5E-03	1.6E-02	7.8E-03	87.9	4.4E-02
May	744	5.1E-05	4.8E-03	7.7E-04	1.4E-03	3.8E-03	8.5E-02	1.6E-04	2.6E-04	3.5E-03	1.6E-02	7.7E-03	88.8	4.4E-02
June	720	5.1E-05	4.7E-03	7.5E-04	1.4E-03	3.8E-03	8.4E-02	1.5E-04	2.6E-04	3.4E-03	1.5E-02	7.5E-03	84.5	4.2E-02
July	744	5.0E-05	4.7E-03	7.5E-04	1.4E-03	3.7E-03	8.3E-02	1.5E-04	2.6E-04	3.4E-03	1.5E-02	7.5E-03	86.9	4.3E-02
August	744	5.1E-05	4.7E-03	7.5E-04	1.4E-03	3.8E-03	8.4E-02	1.5E-04	2.6E-04	3.4E-03	1.5E-02	7.5E-03	87.3	4.4E-02
September	720	5.1E-05	4.8E-03	7.6E-04	1.4E-03	3.8E-03	8.4E-02	1.5E-04	2.6E-04	3.4E-03	1.5E-02	7.6E-03	85.5	4.3E-02
October	744	5.2E-05	4.8E-03	7.7E-04	1.4E-03	3.9E-03	8.6E-02	1.6E-04	2.7E-04	3.5E-03	1.6E-02	7.7E-03	89.6	4.5E-02
November	720	5.3E-05	4.9E-03	7.9E-04	1.5E-03	3.9E-03	8.8E-02	1.6E-04	2.7E-04	3.6E-03	1.6E-02	7.9E-03	88.7	4.4E-02
TPY Speciated HAPs per turbine													-	
													2.14E-02	3.42E-03
													6.42E-03	1.71E-02
													3.80E-01	6.96E-04
													1.18E-03	1.55E-02
													6.96E-02	3.42E-02
													Total HAPs tons per year per turbine	5.3E-01
													Total HAPs (tpy) for 2 turbines	1.07
													Total HAPs (tpy) for 3 turbines	1.60

Notes:

1 Emissions Factors taken from AP42 - Chapter 3.1: Stationary Gas Turbines

<http://www.epa.gov/ttnchie1/ap42/ch03/final/c03s01.pdf>

Table G-4.5
PennEast Pipeline Project
Kidder Compressor Station - Natural Gas Engine Emissions for Auxiliary Power Unit

Horsepower 1,462 hp
 Brake Specific Fuel Consumption 7,784 Btu/Bhp-hr
 Total Heat Input 11.38 MMBtu/hr
 Operating Hours 500 hr/yr
 Natural Gas Heat Content 1,021 Btu/scf
 Fuel Consumption 5.57 MMscf/yr
 11,146 scf/hr

Pollutant	Emission Factor		Emission Rate		Emission Factor Reference
	g/bhp-hr	lb/MMBtu	lb/hr	ton/yr	
NO _x	2.00		6.45	1.61	Vendor Data
CO	2.10		6.77	1.69	Vendor Data
CO ₂ e		117.1	1,333	333	40 CFR 98 Subpart C
PM ₁₀		0.010	0.11	0.03	AP-42 Table 3.2-2 (7/00) - 4SLB
PM _{2.5}		0.010	0.11	0.03	AP-42 Table 3.2-2 (7/00) - 4SLB
VOC	0.35		1.13	0.28	Vendor Data
SO ₂ (Maximum Hourly)		0.060	0.68		Based on 20 Grains/100 dscf
SO ₂ (Annual Average)		0.0034	0.04	0.010	Based on AP-42 and Vender data
Formaldehyde		0.05280	0.60	0.15	AP-42 Table 3.2-2 (7/00) - 4SLB
Total HAPs		0.07220	0.82	0.21	AP-42 Table 3.2-2 (7/00) - 4SLB

Table G-4.6
PennEast Pipeline Project
Kidder Compressor Station - Fugitive Emissions from Station Piping (Leaks from Valves, Flanges, etc.)

System Location: **Kidder Compressor Station**

Equipment Type	Component Count ¹	CH4 Emission Factor ^{2, 3} (lb/hr/component)	VOC Emission Factor ^{2, 3} (lb/hr/component)	VOC Emission Rate (lb/hr)	VOC Emission Rate (tpy)	CH4 Emission Rate (lb/hr)	CH4 Emission Rate (TPY)	CO2e Emission Rate ⁴ (lb/hr)	CO2e Emission Rate (TPY)
Connectors	50	4.24E-04	2.79E-07	1.39E-05	6.10E-05	2.12E-02	9.28E-02	5.30E-01	2.32E+00
Flanges	65	8.26E-04	5.43E-07	3.53E-05	1.55E-04	5.37E-02	2.35E-01	1.34E+00	5.88E+00
Open-Ended Lines	0	4.24E-03	2.79E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pump Seals	0	5.08E-03	3.34E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Valves	130	9.53E-03	6.27E-06	8.15E-04	3.57E-03	1.24E+00	5.43E+00	3.10E+01	1.36E+02
Other (Meters)	3	1.86E-02	1.23E-05	3.68E-05	1.61E-04	5.59E-02	2.45E-01	1.40E+00	6.12E+00
TOTAL =				0.001	0.004	1.37	6.00	34.25	150.03

1. Counts and flow rates based on Preliminary Design Data from QPS April, 2015. To allow for estimated additional components in final design, 50 valves and 50 connectors have been added to the preliminary design totals.
2. VOC and CH4 emission factors are based on Gas Analysis and values from Table 2-4 of "Protocol for Equipment Leak Emission Estimates".
EPA document 453/R-95-017
Gas analysis and calculation of the CH4 and VOC emission factors are shown on Table G-4.10
3. CH₄ and CO₂ emission rates based on volume fractions of natural gas analysis shown below as provided in the Gas Analysis Details Table G-4.10
4. Based on 40 CFR 98 Subpart A Global Warming Potentials

Volume fractions based on Gas Analysis from UGI Pipeline in Reading PA, April 2015

0.9780 CH₄

0.0000 CO₂

GWP per 40 CFR 98 Subpart A:

25 lb CO₂e/lb CH₄

Table G-4.7**PennEast Pipeline Project****Kidder Compressor Station - Venting Emission Estimates**

		Exhaust Flow (each)	Usage (each)	Total Flow/Year
Pneumatic Actuators	Quantity	scf	strokes/yr	scf/yr
Station Inlet Valve	1	91.2	2	182
Recycle Valve	1	48.9	12	587
Station Outlet Valve	1	91.2	2	182
Suction Blowdown valve	1	48.9	2	98
Discharge blowdown valve	1	48.9	2	98
Main Line Valve	1	91.2	2	182
After Cooler Valves	3	91.2	2	547
Compressor Inlet Valves	3	91.2	48	13,133
Compressor Outlet Valves	3	91.2	48	13,133
Anti-Surge Vents	3	91.2	8	2,189
Emergency Shut Down (ESD) Valves	1	6.5	4	26
Fuel Gas Valves	1	6.5	4	26
Station Bypass Valve	1	91.2	4	365
Filter Valves	6	91.2	8	4,378
Process Vents		Flow per event	Events per Year	
Pressure Safety Valves (PSV)	10	1	24	240
ESD Shutdown Panel Vent	1	25	1	25
Fuel Gas Shutdown Panel Vent	1	25	1	25
Turbine Lube Oil Tank Vent	1	10	365	3,650
Turbine Seal Vents	2	2	365	1,460
2" Fuel Gas Blowdown	1	500	1	500
Waste Water Storage	1	2	365	730
Emergency Shutdown (entire station)	1	50000	1	50,000
Total Annual Natural Gas Venting				91,756

Component	Emission Rate			
	CH₄	CO₂	CO₂e⁴	VOC⁶
Station Operation Vent flow from Above (scf/yr)	ton/yr	ton/yr	ton/yr	ton/yr
91,756	1.90	0.00	47.5	0.01
Intermittent During Startup/Shutdown	ton/yr	ton/yr	ton/yr	ton/yr
Pneumatic Starter (Total for number of units) ¹	0.00	0.00	0	0.00
Blowdowns (Total for number of units) ^{1,5}	0.00	0.00	0	0.00
	Total:		47.5	0.01

Notes for Table G-4.7:

1. Turbines will use DAC starters; therefore no Pneumatic Starter Emissions
2. CH₄ and CO₂ emission rates based on volume fractions of CH₄ and CO₂ below, per Gas Analysis Table G-4.10
3. Conversion based on densities of GHG as provided in 40 CFR 98.233(v)
4. Based on 40 CFR 98 Subpart A Global Warming Potentials
5. Conservative estimate based on 1 blowdown per shutdown. It is not expected that a blowdown will occur after each shutdown.
6. Based on a 0.0325 ratio of VOC to methane as calculated from gas composition

Volume fractions based on Gas Analysis from UGI Pipeline in Reading PA, April 2015

0.9780 CH₄

0.0000 CO₂

0.00325 mass fraction of VOC per methane (per gas analysis)

Densities per 40 CFR 98.233(v):

0.0192 kg/scf CH₄

0.0526 kg/scf CO₂

GWP per 40 CFR 98 Subpart A:

25 lb CO₂e/lb CH₄

2.20462 lb/kg

Table G-4.8
PennEast Pipeline Project
Kidder Compressor Station - Nat. Gas-Fired Heat Exchanger (Fuel Gas Heater) Emissions

Page 1

				Connection:	Tetco
Assumed Average Firing Rate: 225,000 average BTU/hr for the station total				80%	Percent of Max
Design Heat Input (for each unit - 2 units to be installed for reliability and maintenance reasons)				0.28	MMBtu/hr
Annual Operating Hours:				8760	hr/yr
Estimated Annual Fuel Use: 8760 hrs per year at average firing rate				1.93	MMscf/yr
Maximum Fuel Use (based on one unit at Design input rating):	Per Hour scf/hr	Per day Mscf/day (M=10 ³)	Per week Mscf/week	Per Year MMscf/yr (MM=10 ⁶)	
Values used on Form:	274	6.58	46.07	2.40	
Pollutant	Emission Factor		Emission Factor Reference	Emission Rate	
	lb/MMscf	lb/MMBtu		lb/hr (1 unit at design rating)	ton/yr
NO _x	55	0.054	150% of Manufacturer Quote	0.02	0.05
CO	57	0.056	150% of Manufacturer Quote	0.02	0.05
CO ₂ e		117.1	40 CFR 98 Subpart C	33	115
PM ₁₀	7.6	0.007	AP-42 Table 1.4-2 (7/98)	0.002	0.01
PM _{2.5}	7.6	0.007	AP-42 Table 1.4-2 (7/98)	0.002	0.01
VOC	5.5	0.005	AP-42 Table 1.4-2 (7/98)	0.002	0.01
SO ₂ (Maximum Hourly)		0.060	20 grains S / 100 scf	0.02	
SO ₂ (Average Annual)		0.0034	AP-42 and Vender data		0.003
Formaldehyde	0.075	0.00007	AP-42 Table 1.4-3 (7/98)	2.06E-05	0.0001
Hexane	1.800	0.00176	AP-42 Table 1.4-3 (7/98)	4.94E-04	0.002
Total HAPs	1.89	0.00185	AP-42 Table 1.4-3 & 4 (7/98)	5.18E-04	0.002

Assumed Average Natural Gas Heat Content: 1021 Btu/scf (See Table G10 and G11)

Table G-4.8

PennEast Pipeline Project

Kidder Compressor Station - Nat. Gas-Fired Heat Exchanger (Fuel Gas Heater) Emissions

HAP Emission Factors

HAPs	lb/MMscf	Source	Page 2
Lead	0.0005	AP-42 Table 1.4-2 (7/98)	
2-Methylnaphthalene	2.40E-05	AP-42 Table 1.4-3 (7/98)	
3-Methylchloranthrene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
7,12-Dimethylbenz(a)anthracene	1.60E-05	AP-42 Table 1.4-3 (7/98)	
Acenaphthene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
Acenaphthylene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
Anthracene	2.40E-06	AP-42 Table 1.4-3 (7/98)	
Benz(a)anthracene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
Benzene	2.10E-03	AP-42 Table 1.4-3 (7/98)	
Benzo(a)pyrene	1.20E-06	AP-42 Table 1.4-3 (7/98)	
Benzo(b)fluoranthene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
Benzo(g,h,i)perylene	1.20E-06	AP-42 Table 1.4-3 (7/98)	
Benzo(k)fluoranthene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
Chrysene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
Dibenzo(a,h)anthracene	1.20E-06	AP-42 Table 1.4-3 (7/98)	
Dichlorobenzene	1.20E-03	AP-42 Table 1.4-3 (7/98)	
Fluoranthene	3.00E-06	AP-42 Table 1.4-3 (7/98)	
Fluorene	2.80E-06	AP-42 Table 1.4-3 (7/98)	
Formaldehyde	7.50E-02	AP-42 Table 1.4-3 (7/98)	
Hexane	1.80E+00	AP-42 Table 1.4-3 (7/98)	
Indeno(1,2,3-cd)pyrene	1.80E-06	AP-42 Table 1.4-3 (7/98)	
Naphthalene	6.10E-04	AP-42 Table 1.4-3 (7/98)	
Phenanthrene	1.70E-05	AP-42 Table 1.4-3 (7/98)	
Pyrene	5.00E-06	AP-42 Table 1.4-3 (7/98)	
Toluene	3.40E-03	AP-42 Table 1.4-3 (7/98)	
Arsenic	2.00E-04	AP-42 Table 1.4-4 (7/98)	
Beryllium	1.20E-05	AP-42 Table 1.4-4 (7/98)	
Cadmium	1.10E-03	AP-42 Table 1.4-4 (7/98)	
Chromium	1.40E-03	AP-42 Table 1.4-4 (7/98)	
Cobalt	8.40E-05	AP-42 Table 1.4-4 (7/98)	
Manganese	3.80E-04	AP-42 Table 1.4-4 (7/98)	
Mercury	2.60E-04	AP-42 Table 1.4-4 (7/98)	
Nickel	2.10E-03	AP-42 Table 1.4-4 (7/98)	
Selenium	2.40E-05	AP-42 Table 1.4-4 (7/98)	
Total	1.8884582		

Table G-4.9

PennEast Pipeline Project

Kidder Compressor Station - Turbine Manufacturer's Emission Data

Revised: 1/29/2020

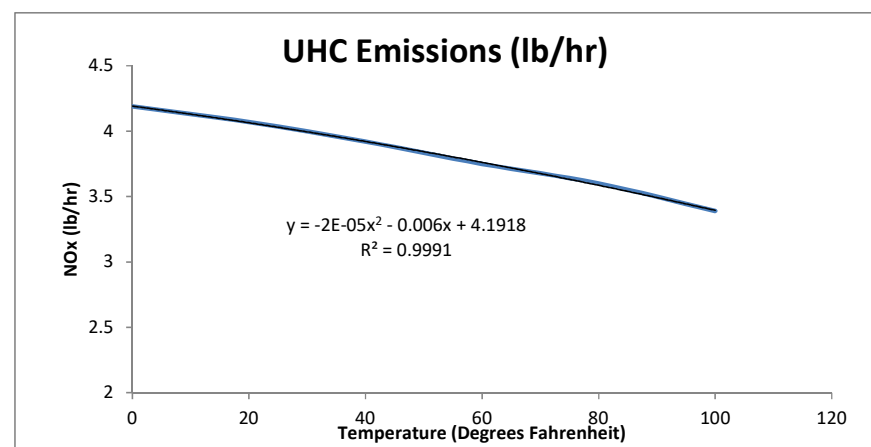
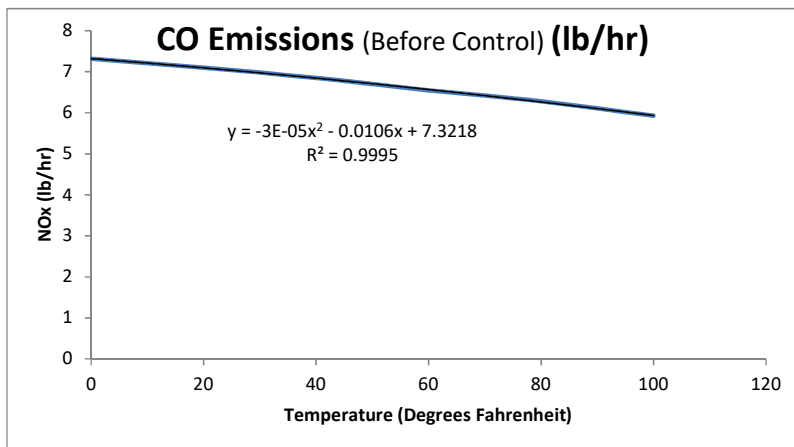
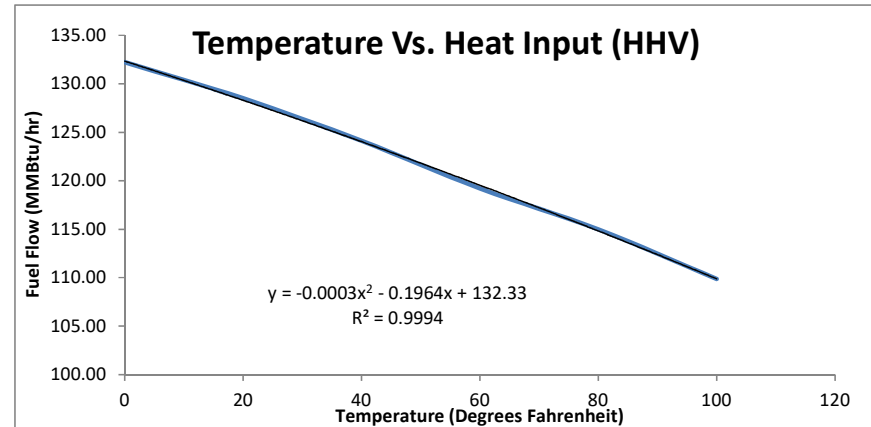
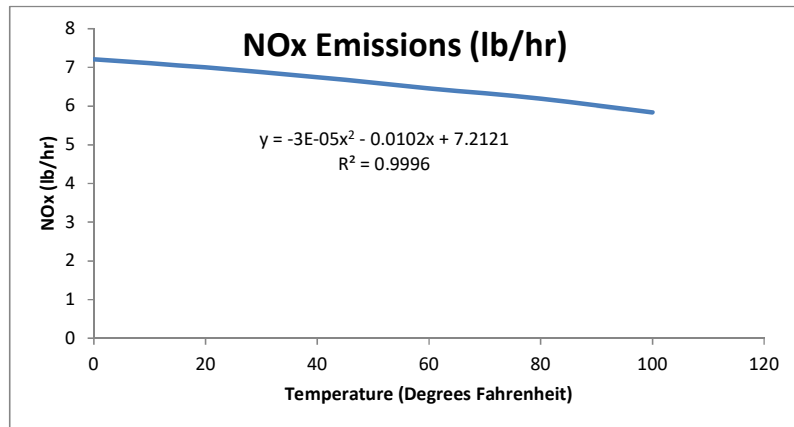
Temperature (Degrees Fahrenheit)	Nox (lbm/hr)	CO (Before Control) (lbm/hr)	UHC (lbm/hr)	Temperature (Degrees Fahrenheit)	MMBtu/hr (LHV)	MMBtu/hr (HHV)	MMscf/hr at 1021 BTU/scf	Data for:	Solar Turbines Mars 100-16000S
100	5.84	5.93	3.39	100	99.88	109.87	107.61	Engine Performance Code:	Rev. 4.15.1.17.10
80	6.19	6.28	3.6	80	104.53	114.98	112.62	Date Run:	30-Jun-15
60	6.46	6.55	3.75	60	108.37	119.21	116.76	ISO Rating	15,900
40	6.75	6.85	3.92	40	112.83	124.11	121.56	ISO Heat Rate	7395
20	7.00	7.10	4.07	20	116.81	128.49	125.85	Heat Input ISO (HHV)	117.6 MMBTU/hr
0	7.21	7.32	4.19	0	120.20	132.22	129.50	HHV values calculated based on LHV with HHV = LHV x	1.10

Data presented is for

100% Full Load Operation

HHV values calculated based on LHV with HHV = LHV x

1.10



Polynomial Coefficients

	X2	X1	X0
NOx	-3.00E-05	-0.0102	7.2121
CO	-3.00E-05	-0.0106	7.3218
UHC	-2.00E-05	-6.00E-03	4.1918
Fuel Flow	-0.0003	-0.1964	132.33
Station Load	9.00E-06	0.0005	0.5591

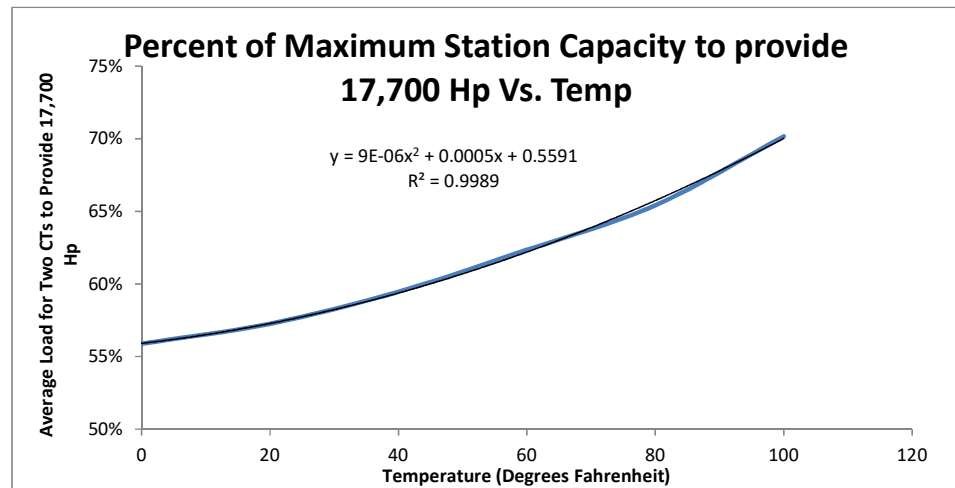


Table G-4.10
PennEast Pipeline Project
Gas Analysis Details Used in Emission Estimates

Gas Fractional Analysis			
Component	Mol Fraction	MW (g/mol)	Mass of 100 Moles
Methane	0.97800	16.04	15.68712
Ethane	0.01797	30.07	0.5403579
Propane	0.00050	44.09	0.022045
n-Butane	0.00001	58.12	0.0005812
Pentane	0.00000	72.15	0
Hexane+	0.00000	86.17	0
Nitrogen	0.00350	28.02	0.09807
Carbon Dioxide	0.00000	44.01	0
Oxygen	0.00000	32.00	0
TOC	0.99648		0
VOC ³	0.00051	100	0.051

Natural Gas Heat Content

1021	BTU/scf
Higher Heating Value (HHV)	

TOC Mol Wgt	16.31	
Gas Mol Wgt	16.35	
Density	0.0431	lb/cf

Project Specific Leak Emission Factors for Above Ground Process Piping Component based on Gas Properties per Gas Analysis

Equipment Type	TOC Emission Factor (kg/hr/component) ¹	VOC Emission Factor (kg/hr/component) ²	VOC Emission Factor (lb/hr/component)	CH4 Emission Factor (kg/hr/component)	CH4 Emission Factor (lb/hr/component)
Connectors	2.0E-04	2.79E-07	6.14E-07	1.93E-04	4.24E-04
Flanges	3.9E-04	5.43E-07	1.20E-06	3.76E-04	8.26E-04
Open-Ended Lines	2.0E-03	2.79E-06	6.14E-06	1.93E-03	4.24E-03
Pump Seals	2.4E-03	3.34E-06	7.37E-06	2.31E-03	5.08E-03
Valves	4.5E-03	6.27E-06	1.38E-05	4.33E-03	9.53E-03
Other	8.8E-03	1.23E-05	2.70E-05	8.47E-03	1.86E-02

Ratio of VOC mass per Mass of Methane used to estimate VOC³ emissions:

0.00325

Notes:

1. From Table 2-4 of "Protocol for Equipment Leak Emission Estimates". EPA document 453/R-95-017
2. VOC emissions speciated using approach specified in Section 2.4.1 of "Protocol for Equipment Leak Emission Estimates"
3. Molecular weight of unidentified VOC compounds are conservatively estimated at 100 g/mol in order to estimate the mass ratio to methane.

Table G-4.11

PennEast Pipeline Project



Gas Analysis Report

UGI Energy Services
 5665 Leesport Avenue
 Reading, PA 19605
 610-736-5591; E-mail: Dscholack@ugles.com
 Attn: Derek Scholack

AAL Number: 33279-1
 Received On: 15 July 14
 Report Date: 21 July 14
 PO Number: 0000001840

Sample ID.: Natural Gas # 1; Pre Odor Tap.
 Comments: 1 of 2 samples rec'd in 1, 1000 cc cust cyl # CM1019.

Sampled on: 15 July 14
 Location: Reading, PA

<u>Non-Condensable Gases</u>	<u>Result</u>	
	<u>% v/v</u>	<u>D.L.</u>
Nitrogen: -----	0.35	0.01
Oxygen: -----	nd	0.01
Carbon Dioxide: -----	nd	0.05
Carbon Monoxide: -----	nd	0.05
Hydrogen: -----	nd	0.05
Argon: -----	nd	0.01
Water Vapor: -----	--	0.001
Dew Point (°F @ 0 psig):-----	--	-77

<u>Hydrocarbons</u>	<u>% v/v</u>	<u>D.L.</u>
Methane: -----	97.80	0.01
Ethylene: -----	nd	0.001
Ethane: -----	1.797	0.001
Propylene: -----	nd	0.001
Propane: -----	0.050	0.001
Isobutane: -----	nd	0.001
n-Butane: -----	0.001	0.001
Butene: -----	nd	0.001
Isopentane: -----	nd	0.001
n-Pentane: -----	nd	0.001
Pentenenes: -----	nd	0.001
Hexanes+: -----	nd	0.001

Comments:

Total Sulfur (as H₂S):	<u>ppm v/v</u>	<u>D.L.</u>	<u>ppm w/w</u>	<u>D.L.</u>	<u>Grains/100ft³</u>	<u>D.L.</u>
	--	0.05	--	0.1	--	0.003

D.L. = Instrumental detection limit for the reported analyte. nd = Indicates the concentration is less than the accompanying report detection limit. -- = test not performed. % = parts per hundred (percent). ppm = parts per million. w/w = weight analyte/weight sample format. v/v = volume analyte/volume sample format (equivalent to mole fraction for normalized, ideal gas mixtures). **Conversions:** 0.0001% = 1 ppm.

Table G-4.11

PennEast Pipeline Project

Sample ID.: UGI Energy Services

AAL Number: 33279-1

GC/MS
C6+ Extended Range Results**Libr. Hit List¹ &/or
Target Analyte(s)****Result
% v/v**

Aliphatic Hydrocarbons (C ₆ range):	-----	nd 0.001
Aliphatic Hydrocarbons (C ₇ range):	-----	nd 0.001
Aliphatic Hydrocarbons (C ₈ range):	-----	nd 0.001
Aliphatic Hydrocarbons (C ₉ range):	-----	nd 0.001
Aliphatic Hydrocarbons (C ₁₀ range):	-----	nd 0.001
Aliphatic Hydrocarbons (C ₁₁ - C ₁₄ range):	-----	nd 0.001

Aromatic Hydrocarbons:**Peak ID/Scan No.****Result
ppm v/v**

Benzene	--/655	nd 0.1
Toluene	--/912	nd 0.1
Ethylbenzene	--/1159	nd 0.1
m+p Xylenes	--/1172	nd 0.1
o-Xylene	--/1250	nd 0.1

Peak ID, Category: **a** = computer library match >900, + retention time (t_r) match with a calibration std. **b1** = computer library match >900, not confirmed by a calibration std. **b2** = Computer library match between 800 - 900, not confirmed by a (t_r) match with a calibration std. **c** = Computer library match <800, potential structure + functional group information only.

D.L. = report detection limit. **nd** = indicates the concentration is less than the report detection limit. -- = test not performed.
L.T. = less than the amount specified. % = percent. **ppm** = parts per million. **ppb** = parts per billion. **v/v** = volume analyte/volume sample. **w/w** = weight analyte/weight sample. **[result]** indicates the result was obtained by the method listed within brackets. **Unit Conversions:** 1 ppm v/v = 1 µL/L = 1,000 ppb = 0.0001% v/v.

**Atlantic Analytical Laboratory, LLC**

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Table G-4.11

PennEast Pipeline Project

Sample ID.: UGI Energy Services

AAL Number: 33279-1

Elemental Composition (Normalized, % w/w)

Element	Result
Carbon Content (% C, w/w):	74.70
Hydrogen Content (% H, w/w):	24.70
Oxygen Content (% O, w/w):	0.00
Nitrogen Content (% N, w/w):	0.60

Heat of Combustion & Physical Properties (by ASTM D 3588-91)

I. @ ASTM Base Conditions: 14.696 psia, 60°F, dry gas format.	Result
Net Heat of Combustion (Lower Heating Value, Btu/ft. ³):	919
Gross Heat of Combustion (Higher Heating Value, Btu/ft. ³):	1,021
Gross Heat of Combustion (Water Saturated Gas Format, Btu/ft. ³):	1,003
Net Heat of Combustion (Lower Heating Value, Btu/lb.):	21,344
Gross Heat of Combustion (Higher Heating Value, Btu/lb.):	23,694
Molecular Weight:	16.35
Density (lb./ft. ³):	0.0431
Specific Gravity (vs. dry/normal air):	0.5646
Compressibility Factor (z):	0.9980

D.L. = instrumental detection limit for the reported analyte. nd = indicates the concentration is less than the accompanying report detection limit. -- = test not performed. % = parts per hundred (percent). ppm = parts per million. w/w = weight analyte/weight sample format. v/v = volume analyte/volume sample format (equivalent to mole fraction for normalized, ideal gas mixtures). Conversions: 0.0001% = 1 ppm.

Reviewed By,



Richard F. Frisch

Addendum: - Chromatograms on-file
Notebook data on-file

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Table G-4.12 **Referenced Factors**
PennEast Pipeline Project

Parameter	Emission Factor/ Formula	Units	Details
VOC	VOC = UHC x 0.20	lbm/hr	Manufacturer's recommendation VOCs = 20% UHC. Page 1 of PIL 168, "Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates" Revision 5, 8 July 2015, Solar Turbines Incorporated.
SO2 (Average)	0.00340	lb/MMBtu fuel input	AP-42 Table 3.1-2a, Note h, that indicates: If a value for Sulfur content is not available, use 3.4 E-03 lb/MMBtu for natural gas turbines it relates to about 1.2 grains per 100 scf. See table B-23 for calculations.
SO2 (Maximum)	0.060	lb/MMBtu fuel input	Value from NSPS Subpart KKKK, at 40 CFR 60.4365, limits fuel sulfur for Combustion Turbines to 20 grains of sulfur or less per 100 standard cubic feet, which meets the definition of "Natural gas" in the Acid Rain Program General Provisions (40 CFR 72.2).
Formaldehyde	0.00241	lb/MMBtu fuel input	Table 1, Page 2 of PIL 168, Revision 5, 8 July 2015, Solar Turbines Incorporated. Based on HHV, 95% Upper Confidence of data (conservative estimate) for engine loads greater than 90%
Combined HAPs	0.00258	lb/MMBtu fuel input	Table 1, Page 2 of PIL 168, Revision 5, 8 July 2015, Solar Turbines Incorporated. Based on HHV, 95% Upper Confidence of data (conservative estimate) for engine loads greater than 90%
PM10	0.015	lb/MMBtu fuel input	Recommended PM Emission Factors, Page 2, PIL 171 Rev 5, 6 May 2015, Solar Turbines Incorporated. Based on HHV of Natural Gas.
PM2.5	0.015	lb/MMBtu fuel input	Recommended PM Emission Factors, Page 2, PIL 171 Rev 5, 6 May 2015, Solar Turbines Incorporated. Based on HHV of Natural Gas.
HHV/LLV	1.1	unitless	
CO2e factor for Combustion Turbines	118.1	lb/MMBtu fuel input	Calculated from CO2, N2O, and Methane Emission/GWP Factors below
CO2e factor for for APU and Fuel Gas Heater	117.1	lb/MMBtu fuel input	Calculated from CO2, N2O, and Methane Emission/GWP Factors below
<u>GHG Emission Factors for Combustion Turbines</u>			
CO2	117.0	lb/MMBtu fuel input	40 CFR 98, Table C1 (Natural Gas Weighted US Average)
N2O	0.003	lb/MMBtu fuel input	Table 3.1-2a "Emission Factors for Criteria Air Pollutants and GHGs from Stationary Gas Turbines" AP42
Methane	0.0086	lb/MMBtu fuel input	
<u>GHG Emission Factors for Other Combustion Sources</u>			
CO2	117.0	lb/MMBtu fuel input	40 CFR 98, Table C1 (Natural Gas Weighted US Average)
N2O	0.00022	lb/MMBtu fuel input	40 CFR 98, Table C2
Methane	0.0022	lb/MMBtu fuel input	40 CFR 98, Table C2
<u>Global Warming Potentials for GHG</u>			
GWP Of CO2	1	100-yr, CO2 = 1	IPCC Fourth Assessment Report: Climate Change 2007, Table 2.14. Lifetimes, radiative efficiencies and direct (except for CH4) GWPs relative to CO2. ICPP/TEAP (2005).
GWP of N2O	298	100-yr, CO2 = 2	
GWP Methane	25	100-yr, CO2 = 3	

Table G-4.13
PennEast Pipeline Project
Detailed Sulfur Dioxide Emission Rate Estimates

NOTE: lb SO₂/Hp Value Used for Table 25, NOT used for Permit Hourly Rate

1.216 grains S per 100 cf	<This value is set so that the calculated value below equals the AP-42 emission factor.
0.01216 grains S per 1 cf	
1.19E-05 grains S per BTU	
11.91 grains S per MMBTU	
7000 grains per pound	
0.00170 lb S/MMBTU	
64.066 Molecular weight of SO ₂ lb/lb-mole	
32.065 Molecular weight of S lb/lb-mole	
0.00340 lb SO ₂ /MMBTU*	

Solar Turbines recommends using a value of 0.0034 lb SO₂/MMBTU
This also is recommended by EPA in AP-42, Table 3.1-2a, Note h, that indicates,
if natural gas sulfur content is is not available, use 3.4 E-03 lb/MMBtu.
Therefore, this value is used for Plan Approval Average Annual Rate Emission
Estimates for all sources.

For estimating "maximum hourly emissions" the 40 CFR §60.4365 NSPS Limit is:
0.06000 lb SO₂/MMBTU is used for Plan Approval Maximum Hourly Rates

From B-25b: 119.21 MMBTU (HHV)/hr (Mars 100 CT at 100% Load at Kidder, PA, 60 dF)

0.405 lb SO₂/hr (Mars 100 CT at 100% Load at Kidder, PA, 60 dF)

From B-25b: 15,900 Hp-hr/hr rating of a Mars 100-16000S, at ISO Conditions

0.0000255 lb SO₂/Hp < This Value is used in B-25b.