01573

AECOM

Memorandum

To	Edward Wiener (Philadelphia Air Management Services)	Page	1
CC	Richard Harris (SEPTA)		
Subject	**Midvale Bus Facility Air Dispersion Modeling for Proposed Combined Heat and Power Plant**		
From	Kevin Voit (AECOM)		
Date	October 23, 2017		

AECOM conducted an air quality dispersion modeling analysis for the proposed combined heat and power (CHP) plant at the Midvale Bus Facility (the Facility). Modeling was performed with two (2) new GE engines with stacks of 50 feet. The maximum predicted impacts (in the form of the standard) were combined with a background concentration and then compared to the National Ambient Air Quality Standards (NAAQS). This modeling follows procedures and guidance specified by the United States Environmental Protection Agency (USEPA); however, reasonable assumptions were incorporated in the modeling whenever source and building data was not readily available.

The air dispersion model inputs and results are presented in Tables 1 through 4 as follows:

- Stack parameters for the new engines are provided in Table 1;
- Modeled emission rates for the new engines are provided in Table 2;
- Model results combined with background concentrations and compared to the NAAQS are provided in Table 3; and
- Summary of HAP emissions are provided in Table 4.

Air dispersion modeling was performed using the latest version (version 16216r) of AERMOD, the most advanced sequential Gaussian plume model sanctioned by the USEPA. Surface meteorological data for the five-year period of 2012–2016 was taken from the Philadelphia International Airport (PHL), which is located in the southeastern portion of Pennsylvania, approximately 16 kilometers (km) southwest of the Facility. Upper air data was taken from the Sterling (Washington Dulles) Airport (IAD), which is located in northern Virginia, approximately 229 km southwest of the Facility.

This meteorological data was processed through the AERMOD meteorological preprocessor (AERMET), whose purpose is to compute boundary layer parameters used to estimate profiles of wind, turbulence, and temperature. AERMINUTE, a preprocessor program within AERMET, was used to process 1-minute Automated Surface Observing Systems (ASOS) wind data available from the National Climatic Data Center (NCDC) to generate hourly-averaged wind speed and wind direction observations or values to supplement the standard hourly ASOS observations. This step greatly reduces the amount of hourly calms within the meteorological database. Since AERMOD does not produce output on hours that are designated calm within the database, this process helps to increase the robustness of the AERMOD predicted impacts.

1023176003

AERMAP, AERMOD's terrain processor, was used to create model impact receptors with elevations consistent with the terrain surrounding the depot. A nested Cartesian receptor grid with five tiers centered on the approximate center point of the Facility was created to evaluate the impacts at the site. The five tiers were structured as follows:

- 50-m receptor spacing out to 0.5 km;
- 100-m receptor spacing out to 1.5 km;
- 250-m receptor spacing out to 3.0 km;
- 500-m receptor spacing out to 5.0 km; and
- 1,000-m receptor spacing out to 10.0 km.

Receptors were also placed around the fenceline of the site location in 25-m intervals.

Structures can influence modeling results due to building-induced downwash which can increase predicted concentrations at receptors in close proximity to the stacks (e.g., fenceline receptors). The dimensions, proximity and orientation of structures relative to stacks can significantly influence modeling results. Existing and new building locations and building heights were estimated through Google Earth™ and from dimensions and locations provided by NORESCO / SEPTA. AERMOD's Building Profile Input Program (BPIP) was used to simulate the influence of downwash effects from structures near the Project site. The modeling was performed with stack heights of 50 feet.

Modeled emissions of NO_2 and CO were derived based on vendor data assuming that the engines will be equipped with selective catalytic reduction (SCR) and an oxidation catalyst for control of NO_2 and CO emissions respectively. Emissions of $PM_{10}/PM_{2.5}$ and SO_2 are based on the USEPA AP-42 emission factors. Emissions of CH_2O are based on vendor data assuming the engines will be equipped with selective catalytic reduction (SCR) for control of CH_2O. Emissions of the remainder of the HAPs are based on AP-42 emission factors for 4-stroke, lean-burn engines with an average 62.5% control based on the vendor guarantee for VOC. Emissions are based on operation of 8,068 hours per year for each engine based on the submitted plan approval application

Overall Impacts

Overall impacts were evaluated by summing the impacts of the new emission units at the Facility with a representative background concentration. These simple sums (not concurrent in time or space) are compared to the NAAQS in Table 3.

Modeling of NO_2 impacts was performed using the Tier 2 method, in which NO_2 impacts are assumed to equal 80% of the total modeled NO_2 emissions impacts. Application of the Tier 2 method is permitted without approval from the USEPA.

Because of the urban nature of the Midvale Bus facility location, ambient monitors are proximate to the facility (distances range from 6 to 8 km). Predicted impacts plus monitored background concentrations are below the NAAQS for all pollutants at the 50-foot stack height. Comparison with the NAAQS is the key metric for modeling associated with non-PSD applications.

Conclusion

Dispersion modeling was conducted to assess the impact of the Project emissions on ambient concentrations of NO_2, CO, PM_{10}/$PM_{2.5}$ and SO_2. Modeling indicates that if the Project were constructed with a 50 foot stack height, the emission impacts combined with the background concentrations would not result in an exceedance of the NAAQS for any of the pollutants.

NORESCO / SEPTA
Midvale Bus Facility
Table 1 - *Stack parameters for modeling Project impacts at Midvale*

Emission Point	ID	Stack Diameter		Temperature		Exit Velocity/Flow		
		ft	m	°F	K	ft/s	m/s	ACFM
New Emission Sources								
New GE Engine #1	E01	2.46	0.75	675.00	630.37	90.25	27.51	25,704
New GE Engine #2	E02	2.46	0.75	675.00	630.37	90.25	27.51	25,704

CS = compressor station
ft = feet
m = meters
F = Fahrenheit

ACFM = actual cubic feet per minute
ft/s = feet per second
m/s = meters per second
K = Kelvin

NORESCO / SEPTA
Midvale Bus Facility
Table 2 - Emission rates for modeling Project Impacts at Midvale

Emission Point	ID	Scenario	CO		NO_2		PM_{10}		$PM_{2.5}$		SO_2	
			lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
New Emission Sources												
New GE Engine #1	E01	Short Term	3.37	0.425	2.70	0.340	0.01	0.001	0.01	8.50E-04	0.02	0.003
		Long Term	nm	nm	2.48	0.313	0.01	0.001	0.01	7.83E-04	0.02	0.002
New GE Engine #2	E02	Short Term	3.37	0.425	2.70	0.340	0.01	0.001	0.01	8.50E-04	0.02	0.003
		Long Term	nm	nm	2.48	0.313	0.01	0.001	0.01	7.83E-04	0.02	0.002

Notes(s):

CS = compressor station
CO = carbon monoxide
NO_2 = nitrogen dioxide
SO_2 = sulfur dioxide
nm = not modeled

g/s = grams per second
lb/hr = pounds per hour
PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns
$PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 microns

NORESCO / SEPTA
Modeling of New GE Engines
Table 3 - Comparison of the Midvale Facility Ambient Air Impacts to NAAQS

Pollutant	Averaging Period	Project Impact Based on Stack Height (Hs) Hs = 50 ft (µg/m³)	Background[1] (µg/m³)	Total Impacts Hs = 50 ft (µg/m³)	NAAQS (µg/m³)	Percent of NAAQS Hs = 50 ft (%)
NO_2[2]	1-hour (Tier 1)	17.60	109.1	126.7	n/a	n/a
	1-hour (Tier 2)	14.08	109.1	123.1	188	65.5%
	Annual (Tier 1)	0.53	32.6	33.1	n/a	n/a
	Annual (Tier 2)	0.40	32.6	33.0	100	33.0%
CO	1-hour	50.83	2,633	2,684	40,000	6.7%
	8-hour	19.86	1,946	1,966	10,000	19.7%
PM_{10}	24-hour	0.05	64.0	64.0	150	42.7%
	Annual	2.55E-03	n/a	n/a	n/a	n/a
$PM_{2.5}$[2]	24-hour	0.02	29.3	29.4	35	83.9%
	Annual	1.56E-03	9.8	9.8	12	81.4%
SO_2[3]	1-hour	0.17	28.8	29.0	196	14.8%
	3-hour	0.16	28.8	29.0	1,300	2.2%
	24-hour	0.10	14.9	15.0	365	4.1%
	Annual	3.41E-03	n/a	n/a	n/a	n/a

Notes:

(1) Background data for CO, NO_2, and $PM_{2.5}$ came from the E. Lycoming St., Philadelphia, PA monitor located approximately 6 km ESE from the Midvale Bus Background data for SO_2 and PM_{10} came from the Lewis St., Philadelphia, PA monitor located approximately 8 km SE from the Midvale Bus Facility.

(2) NO_2 impacts presented on this table are based upon the USEPA's Tier 1 procedure (100% conversion of NO_x to NO_2) and Tier 2 procedure (80% convers 1-hour impacts and 75% conversion for annual impacts).

(3) 3-hour SO_2 background concentrations were not available from either the USEPA or AMS and were conservatively estimated as equal to the 1-hour SO_2 t

NAAQS = National Ambient Air Quality Standard
USEPA = U.S. Environmental Protection Agency
CO = carbon monoxide
NO_2 = nitrogen dioxide
SO_2 = sulfur dioxide
n/a = not applicable

µg/m³ = micrograms per cubic meter
DEP = Department of Environmental Protection
PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 mi
$PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 m