memo

ECT Environmental Consulting & Technology, Inc.

To: Manny Vizcaya, Air Engineering

From: John Shrock, ECT

CC: Rick Beringer
Ted Main, TRC

Date: June 15, 2016

Re: Middletown Technology Center
Refined Air Quality Modeling Analysis

A minor source air permit application has been submitted to the Delaware Department of Natural resources and Environmental Control (DNREC) for the Middletown Technology Center (MTC). The MTC is a 228,000 square foot technology center to be located in New Castle County, Delaware. The data center will have power generation capability through natural gas-fired reciprocating engine generator sets (gensets). There will be five 2.5 megawatt (MW) and five 10 MW generator sets. Nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOC), and hazardous air pollutants (HAPs) will be controlled with selective catalytic reduction (SCR) and oxidation catalyst emission control systems. The engines will also emit particulate matter less than or equal to 10 microns in aerodynamic diameter (PM_{10}), particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). Since the potential emissions at this facility will be below major new source review thresholds, the detailed air quality analyses required under Prevention of Significant Deterioration (PSD) rules were not required. However, TRC completed a refined air quality dispersion modeling analysis to assess the MTC's generator engine emissions' potential for modeled compliance with the National Ambient Air Quality Standards (NAAQS) (see memorandum from Ted Main dated June 14, 2016). Environmental Consulting & Technology, Inc. (ECT) was contracted to provide an independent third party review of the modeling study. ECT's review of the modeling methodology and results are provided below.

MODELED SOURCES

All ten gensets were modeled, both in steady state and startup conditions. The emission rates used in the modeling are shown below:

Generator Size	Pollutant	Short-term (grams/second)	Long-Term (grams/second)	Startup (grams/second)
10 MW	NO_x	0.168	0.063	0.903
	CO	0.194	N/A	0.733
	SO_2	0.142	0.053	N/A
	$PM_{2.5}$	0.144	0.054	N/A
	PM_{10}	0.144	N/A	N/A
2.5 MW	NO_x	0.0574	0.0216	0.304
	CO	0.1016	N/A	0.402
	SO_2	0.038	0.0142	N/A
	$PM_{2.5}$	0.036	0.0136	N/A
	PM_{10}	0.036	N/A	N/A

The modeled stack parameters for each of the individual gensets are shown below:

Parameter	10 MW Generator	2.5 MW Generator	Units
Stack Height	15.24	15.24	meters (m)
Stack Diameter	1.12	0.51	meters (m)
Exhaust Velocity	27.51	35.28	meters per second (m/s)
Exhaust Temperature	591	664	Kelvin (K)

The 10 MW generators exhaust through separate stacks, and the 2.5 MW generators exhaust through a common stack. The small cooling tower was not included in the modeling, but is not expected to contribute significantly to the modeling results since it is a relatively small source of PM_{10}/$PM_{2.5}$ emissions.

No off-site sources were included in the modeling, since no major sources were identified within 10 kilometers of the MTC facility. The contribution from any minor sources was assumed to be accounted for in the conservative background air quality estimates.

Model Selection

The latest version of U.S. Environmental Protection Agency's (EPA's) AERMOD model (Version 15181) was used in the analysis. AERMOD is a refined, steady state, multiple-source, Gaussian dispersion model. AERMOD is EPA's preferred model for nearfield analysis of industrial sources and is appropriate for this analysis. The model was run using the regulatory default options along with 5-years (2005-2009) of hourly meteorological data.

Meteorological Data

A representative meteorological data consisting of the years 2005 through 2009 derived from surface data observed at the Dover Air Force Base, Delaware meteorological station (WBAN #13707) and upper air data collected from Phillips Air Force Base (AFB), Maryland upper air sounding station (WBAN #13701) were used in the modeling. This data is considered representative for modeling the MTC sources, since the area in the vicinity of the MTC site is similar to the area where the surface data was collected, e.g., the terrain at both locations which is generally flat coastal plain at elevations of 50 to 100 feet above mean sea level. Also, the Dover AFB is only 40 kilometers southwest of the future MTC location.

Background Concentrations

The most recent complete years (i.e., 2013, 2014, and 2015) of ambient air quality data for the MTC study area (northern Delaware including New Castle County) was obtained from the EPA AirData web site (https://www3.epa.gov/airdata/). The PM_{10} air quality values were taken from the monitor in Glen Burnie, Maryland. All other background values were from monitors located in Delaware. Except for the NO_2 1-hour value, the background air quality was conservatively determined by selecting the highest of the recorded values from any of the three years. The NO_2 monitor recording the highest 1-hour values was not considered to be

representative of the MTC site, since it is in a more urban location that is affected by more NO_x sources. A reasonably representative NO_2 1-hour background concentration was estimated by averaging all of the highest 98th percentile concentrations measured in Delaware for 2013, 2014 and 2015. The resulting background values for all pollutants are shown below:

Pollutant	State	County	City	Site ID	Averaging Time	Value (ug/m^3)
NO_2	DE	New Castle New Castle Sussex	Wilmington (not in a city) Lewes	100032004 100031010 100051003	1-hr	66*
NO_2	DE	New Castle	Wilmington	100032004	Annual	23
CO	DE	New Castle	Delaware City	100031008	1-hr	2,519
CO	DE	New Castle	Wilmington	100032004	8-hr	1,489
SO_2	DE	New Castle	Wilmington	100032004	1-hr	39
PM_{10}	MD	Ann Arundel	Glen Burnie	240031003	24-hr	34
$PM_{2.5}$	DE	New Castle	Wilmington	100032004	24-hr	28**
$PM_{2.5}$	DE	New Castle	Wilmington	100032004	Annual	11

*NO_2 1-hour background is the average of the highest values recorded in all years for the listed monitoring sites.
**Average from four monitors at this location.

RECEPTOR GRID

AERMAP (Version 11103), was used to create a receptor grid to a minimum distance of 10 kilometers from the proposed facility. The elevations for each receptor were determined using 1/3 arc second National Elevation Dataset (NED) data obtained from the USGS. The receptor grid can be described as follows:

- Fence line receptors were spaced at 25 meters;
- Fine grid receptors (50 meter spacing) from the property line to 2 kilometers;
- Course grid receptors (250 meter spacing) from 2 kilometers to 5 kilometers;

- Course grid receptors (500 meter spacing) from 5 kilometers to 10 kilometers.

This receptor grid was sufficient to define the points of maximum concentrations to a resolution of 100 meters.

GEP Stack Height Analysis

Building downwash was accounted for in the model by inputting directional downwash parameters for each modeled stack. The latest version of the Building Profile Input Program BPIP-PRIME (version 04274) was utilized. The largest structure is the MTC building itself at 35 feet above grade. The formula GEP height at the facility is approximately 75 feet based upon the dimensions of the proposed building as calculated by BPIP PRIME, and the genset stacks are 50 feet high. Since all of the exhaust stacks are subject to downwash, the downwash parameters from the BPIP program were included in the AERMOD analysis.

Modeling Results

The modeling demonstrates that the worst-case operating scenarios, i.e., all ten engines operated in steady state mode or started in the same hour, will not endanger the NAAQS. During startup, emissions of NO_x and CO are higher, primarily due to the reduced effectiveness of the control systems and less efficient combustion at the lower loads. The emissions of other criteria pollutants of concern are lower during startup. Several pollutant/averaging time combinations had predicted impacts that were below significant impact levels (SILs), which have been defined to establish concentration levels below which a source is assumed to not be able to cause or contribute to an air quality violation. However, the total predicted impacts, i.e., the addition of MTC's contribution and background air quality, for all pollutants were compared to the NAAQS.

The background air quality was considered to be conservative, i.e., higher than the actual background expected to occur in the study area. It was determined that no major sources exist within the immediate study area, i.e., approximately 10 kilometers of the MTC site

location. Therefore, the background air quality value is sufficient to account for other source impacts in the study area.

The predicted ground level concentrations, along with comparisons to the SILs and NAAQS, resulting from the operation of all 10 engines in steady state mode are presented below. The NO_x concentrations have been adjusted in accordance with EPA's Tier 2 recommendation (i.e., NO_2 = 80% of NO_x). As shown, all predicted concentrations are below the applicable NAAQS. In addition, the annual concentrations are below the respective SILs. Also, CO 1-hour and 8-hour impacts, as well as the SO_2 3-hour impacts, are below the SILs. Except for $PM_{2.5}$, total predicted impacts are well below the NAAQS. However, it is believed that there is adequate margin to be protective of the $PM_{2.5}$ NAAQS.

	NO_2		CO		SO_2				PM_{10}	$PM_{2.5}$	
	1-hr	Ann	1-hr	8-hr	1-hr	3-hr	24-hr	Ann	24-hr	24-hr	Ann
	H8H	-	H2H	H2H	H4H	H2H	H2H	-	H2H	H4H	-
MTC Impact	23.4	0.34	28.9	22.6	20.2	18.3	14.6	0.28	14.8	5.5	0.24
SIL	7.5	1	2,000	500	7.8	25	5	1	5	1.2	0.3
>SIL	yes	no	no	no	yes	no	yes	no	yes	yes	yes
Bkgd AQ	66	23	1,489	1,374	39	39	10	3	33	28	11
MTC + Bkgd	89.4	23	1,517	1,397	59	57	25	3	48	33	11
NAAQS	188	100	40,000	10,000	196	1,300	365	80	150	35	12
> NAAQS	no	no	no	no	no	no	no	no	no	no	no
Percent of	48%	23%	4%	14%	30%	4%	7%	4%	32%	95%	90%

NAAQS											

Additionally, the modeling analysis examined the potential air quality impact of the startup emissions. The CO and NO_x control technologies take as long as a half an hour to become fully effective. Therefore NO_x and CO emissions are higher for a portion of the hour during the start. This was accounted for in the model by assuming uncontrolled emissions during the first 15 minutes followed by partial control for the next 15 minutes and steady state emissions for the remainder of the hour.

The maximum modeled NO_2 concentrations occur on the facility property line nearest the exhaust stacks. In addition, the maximum NO_2 concentrations rapidly decrease within a kilometer of the facility, falling to less than 10% of the maximum concentration at 2 kilometers from the facility, and below the SIL of 7.5 $\mu g/m^3$ at about 1.5 kilometers. As shown below, the combined concentrations of all gensets starting simultaneously and added to a representative background concentration would achieve the NO_2 and CO NAAQS with a large margin of safety.

	NO_2		CO	
	1-hr	1-hr	1-hr	1-hr
	H1H	H8H	H1H	H2H
Maximum Impact (Tier 1)	131.7	125.9	110.9	110.7
Maximum Impact (Tier 2)	105.3	100.7	-	-
SIL	7.5	1	2,000	500
>SIL	yes	yes	yes	yes
Bkgd AQ	-	66	-	1,489
MTC + Bkgd	-	166.7	-	1,397
NAAQS	-	188	-	40,000

>NAAQS	-	No	-	no
Percent of NAAQS	-	89%	-	14%

Conclusion

The modeling methodology used to assess the impacts of the 10 gensets is consistent with EPA's modeling guidelines for conducting a refined modeling analyses. Based on the results, there is reasonable assurance that the emissions from the 10 gensets during startup, or while operating in steady state conditions, will not cause or significantly contribute to any violation of the NAAQS.