TCEQ Interoffice Memorandum

To: Energy/Combustion Permit Staff

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Permit Support Section

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Subject: Air Quality Analysis Report – Simple Cycle Turbine – Region 12

1. Project Identification Information

Air quality analyses (AQAs) were performed in support of the simple cycle turbine readily available permit (RAP). AQAs were performed for each of the sixteen TCEQ regions. This AQA report summarizes the results for TCEQ Region 12 (Houston) and includes the counties of Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton.

2. Report Summary

Modeling was conducted for a number of pollutants for comparison with the National Ambient Air Quality Standards (NAAQS), state property line standards, and Effects Screening Levels (ESLs). The results are summarized below.

The results presented below in Table 3 for annual $PM_{2.5}$ are reported for Harris County and for all other counties in TCEQ Region 12. Given the annual $PM_{2.5}$ background concentrations for two monitors located in Harris County (the Clinton Dr. and Aldine monitors), modeling results were evaluated to determine when annual $PM_{2.5}$ predictions together with background concentrations are less than the annual $PM_{2.5}$ NAAQS (12 µg/m^3). Based on the evaluation, a setback distance of 420 meters from the facilities to the nearest property line will be needed for sites proposed to be located in Harris County. See section 3 below for additional information on the setback distance for the remaining counties in TCEQ Region 12.

Table 1. Modeling Results for State Property Line

Pollutant	Averaging Time	GLCmax (µg/m^3)	Standard (µg/m^3)
SO_2	1-hr	14	715
H_2SO_4	1-hr	4.5	50
H_2SO_4	24-hr	1.3	15

Table 2. Modeling Results for Minor NSR De Minimis

Pollutant	Averaging Time	GLCmax (µg/m^3)	De Minimis (µg/m^3)
SO_2	1-hr	7.1	7.8
SO_2	3-hr	7.1	25

Pollutant	Averaging Time	GLCmax ($\mu g/m^3$)	De Minimis ($\mu g/m^3$)
SO_2	24-hr	2.6	5
SO_2	Annual	0.7	1
CO	1-hr	1642	2000

The 1-hr SO_2 GLCmax is based on the highest five-year average of the maximum predicted concentrations determined for each receptor. The 3-hr, 24-hr, and annual SO_2 and 1-hr CO GLCmax are the maximum predicted concentrations associated with five years of meteorological data.

The justification for selecting the EPA's interim 1-hr SO_2 De Minimis level was based on the assumptions underlying EPA's development of the 1-hr SO_2 De Minimis level. As explained in EPA guidance memoranda[1], the EPA believes it is reasonable as an interim approach to use a De Minimis level that represents 4% of the 1-hr SO_2 NAAQS.

Table 3. Total Concentrations for Minor NSR NAAQS (Concentrations > De Minimis)

Pollutant	Averaging Time	GLCmax ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Conc. = [Background + GLCmax] ($\mu g/m^3$)	Standard ($\mu g/m^3$)
PM_{10}	24-hr	11.3	114	125.3	150
$PM_{2.5}$	24-hr	9.8	23.7	33.5	35
$PM_{2.5}$ (Harris)	Annual	0.48	11.5	11.98	12
$PM_{2.5}$ (All other counties)	Annual	1	10.4	11.4	12
NO_2	1-hr	48.6	113	161.6	188
NO_2	Annual	6.4	27.8	34.2	100
CO	8-hr	657	3435	4092	10000

The 24-hr PM_{10} GLCmax is based on the maximum high, sixth high (H6H) predicted concentration over a five year period. The 24-hr $PM_{2.5}$ GLCmax is based on the highest five-year average of the 98th percentile, or high, eighth high (H8H), predicted concentrations determined for each receptor. The annual $PM_{2.5}$ GLCmax are the highest five-year averages of the annual predicted concentrations determined for each receptor. The 1-hr NO_2 GLCmax is the highest five-year average of the 98th percentile, or H8H, predicted concentrations determined for each receptor. The annual NO_2 and 8-hr CO GLCmax are the maximum predicted concentrations associated with five years of meteorological data.

Background concentrations for PM_{10} were obtained from the EPA AIRS monitor 482011035 located at 9525 ½ Clinton Dr., Houston, Harris County. The high, fourth high (H4H) 24-hr concentration from 2013-2015 was used for the 24-hr value. Except for two monitors located in El Paso (non-attainment for PM_{10}), this value represents the highest H4H 24-hr concentration in the state and it was selected for a conservative analysis.

Background concentrations for 24-hr $PM_{2.5}$ were obtained from the EPA AIRS monitor 482011039 located at 4514 ½ Durant St., Deer Park, Harris County. The three-year average (2013-2015) of the

[1] www.epa.gov/sites/production/files/2015-07/documents/appwso2.pdf

98th percentile of the annual distribution of the 24-hr concentrations was used for the 24-hr value. This value represents the highest three-year average of the 98th percentile of the annual distribution of the 24-hr concentrations from areas in and near TCEQ Region 12 and it was selected for a conservative analysis. For sites proposed to be located in Harris County, background concentrations for annual $PM_{2.5}$ were obtained from the EPA AIRS monitor 482011035 located at 9525 ½ Clinton Dr., Houston, Harris County. The three-year average (2013-2015) of the annual concentrations was used for the annual value. This value represents the highest three-year average of the annual concentrations in and near TCEQ Region 12 and it was selected for a conservative analysis. For sites proposed to be located in one of the other counties of TCEQ Region 12, background concentrations for annual $PM_{2.5}$ were obtained from the EPA AIRS monitor 482011034 located at 1262 ½ Mae Dr., Houston, Harris County. The three-year average (2013-2015) of the annual concentrations was used for the annual value. Except for two monitors located in Harris County, which would be overly conservative for the other counties of TCEQ Region 12, this value represents the highest three-year average of the annual concentrations from areas in and near TCEQ Region 12 and it was selected for a conservative analysis.

Background concentrations for 1-hr NO_2 were obtained from the EPA AIRS monitor 481410044 located at 800 S San Marcial St., El Paso, El Paso County. The highest 98th percentile of the annual distribution of the maximum daily 1-hr concentrations from 2013-2015 was used for the 1-hr value. This value represents the highest 98th percentile of the annual distribution of the maximum daily 1-hr concentrations in the state and it was selected for a conservative analysis. Background concentrations for annual NO_2 were obtained from the EPA AIRS monitor 484531068 located at 8912 N IH 35 Svrd Sb, Austin, Travis County. The highest annual concentration from 2013-2015 was used for the annual value. This value represents the highest annual concentration in the state and it was selected for a conservative analysis.

Background concentrations for CO were obtained from the EPA AIRS monitor 481410055 located at 650 R E Thomason Loop, El Paso, El Paso County. The highest 8-hr concentration from 2013-2015 was used for the 8-hr value. This value represents the highest 8-hr concentration in the state and it was selected for a conservative analysis.

Table 4. Modeling Results for Health Effects

Pollutant	Averaging Time	GLCmax ($\mu g/m^3$)	ESL ($\mu g/m^3$)
Diesel	1-hr	21	1000
Diesel	Annual	1	100
Lube Oil	1-hr	213	1000
Lube Oil	Annual	9	100
Natural Gas	1-hr	174	3500
Natural Gas	Annual	7	350

3. Model Used and Modeling Techniques

AERMOD (Version 16216r) was used.

As noted above, a setback distance of 420 meters from the facilities to the nearest property line will be needed for sites proposed to be located in Harris County (related to the annual $PM_{2.5}$ background concentrations for two monitors located in Harris County and the distance needed for modeling results to be less than 12 $\mu g/m^3$). For the remaining counties in TCEQ Region 12, the modeling was conducted using a receptor grid that started at a distance of approximately 150 meters from the modeled sources. Therefore, a setback distance of 150 meters from the facilities to the nearest property line will be needed. See section 3c below for additional information on the modeled receptor grid.

A. Land Use

A land use/land cover analysis was performed using AERSURFACE consistent with guidance given in the AERMOD Implementation Guide (August 3, 2015). The recommended input data, the National Land Cover Data 1992 archives (NLCD92), were used for this analysis.

The AERSURFACE analysis resulted in a calculated albedo of 0.16, a calculated Bowen ratio of 0.77, and a calculated surface roughness length of 0.11 meters. These values were used to develop the meteorological data set for this analysis.

Flat terrain was used in the modeling analysis. Using flat terrain is reasonable for TCEQ Region 12 and given that the maximum modeled predictions occur near the modeled sources.

B. Meteorological Data

Meteorological data for years 2011-2015 from stations representative for TCEQ Region 12 were used in the analysis. Raw surface and upper air meteorological data were processed using AERMET (Version 16216). The ADJ_U* option was used in the AERMET meteorological data processing.

Surface Station and ID: Houston, TX (Station #: 12960)
Upper Air Station and ID: Lake Charles, LA (Station #: 3937)
Meteorological Dataset: 2011-2015
Profile Base Elevation: 32 meters

C. Receptor Grid

The modeling was conducted using a receptor grid that started at a distance of approximately 150 meters from the modeled sources. Receptors with a grid spacing of 25 meters extended from 150 meters out to 350 meters. Receptors with a grid spacing of 100 meters extended out to 1200 meters. Receptors with a grid spacing of 500 meters extended out to 5500 meters.

D. Building Wake Effects (Downwash)

Building downwash was not included in the modeling analysis. This approach is reasonable for the simple cycle turbines since building downwash effects are not expected to impact the emissions from the turbine stacks given the modeled release height (80 feet) and the plume rise from the momentum flux of the exit gases. Not including building downwash is reasonable for the other ancillary equipment at the site given the low release heights and expected location of maximum predictions. Maximum predictions from the ancillary equipment occur at the beginning edge of the receptor grid near the modeled sources; including building downwash effects would act to enhance dispersion for these sources and lead to lower model predictions. Therefore, not including building downwash is conservative for these sources.

4. Modeling Emissions Inventory

The simple cycle turbine facilities have emissions from stacks and emissions that are fugitive in nature. The determination of the modeled source parameters and emission rates was based on a review of previously submitted permit applications for simple cycle turbine projects and selecting high emission rates and source parameters to minimize plume rise in order to estimate conservative impacts. Each modeled source is further described below, and the modeled source parameters and emission rates are summarized in Tables 5 and 6.

Model IDs WC1 and WC2: These modeled sources represent the simple cycle turbine stacks. They were modeled as point sources using the parameters listed in Tables 5 and 6. In determining the modeled source parameters and emission rates, different turbine models, operating loads, as well as start-up/shutdown operations were considered.

Model IDs HTR1 and HTR2: These modeled sources represent the heater stacks. They were modeled as point sources using the parameters listed in Tables 5 and 6.

Model IDs LOV1 and LOV2: These modeled sources represent the lube oil vent stacks. They were modeled as point sources using the parameters listed in Tables 5 and 6.

Model ID FWP: This modeled source represents the fire water pump engine stack. It was modeled as a point source using the parameters listed in Tables 5 and 6.

Model ID EGEN: This modeled source represents the emergency generator engine stack. It was modeled as a point source using the parameters listed in Tables 5 and 6.

Model ID CEMS: This modeled source represents planned MSS emissions associated with CEMS calibration. It was modeled as a point source using the parameters listed in Tables 5 and 6.

Model ID MSS: This modeled source represents planned MSS emissions associated with filter change-outs and turbine washing. It was modeled as a point source using the parameters listed in Tables 5 and 6.

Model IDs NGFUG and LOFUG: These modeled sources represent fugitive emissions from natural gas piping (NGFUG) and lube oil piping (LOFUG). They were modeled as point sources using the parameters listed in Tables 5 and 6.

Model IDs LOTK and DTK: These modeled sources represent the emissions from the lube oil tank (LOTK) and the diesel tank (DTK). They were modeled as point sources using the parameters listed in Tables 5 and 6.

Table 5. Point Source Parameter Information

Source	Model ID	Release Height (ft)	Exit Temperature (°F)	Exit Velocity (ft/sec)	Exit Diameter (ft)
Turbine 1	WC1	80	756	52.4	15
Turbine 2	WC2	80	756	52.4	15
Heater 1	HTR1	20	700	40	0.67
Heater 2	HTR2	20	700	40	0.67
Lube Oil Vent 1	LOV1	20	Ambient	0.003	0.003
Lube Oil Vent 2	LOV2	20	Ambient	0.003	0.003
Fire Water Pump	FWP	7	821	90	0.33
Emergency Engine	EGEN	10	859	73.5	0.32
MSS for CEMS	CEMS	15	Ambient	0.003	0.003
MSS for Filter/Washing	MSS	15	Ambient	0.003	0.003
Fugitive Piping	NGFUG/LOFUG	3	Ambient	0.003	0.003

Source	Model ID	Release Height (ft)	Exit Temperature (°F)	Exit Velocity (ft/sec)	Exit Diameter (ft)
Tanks	LOTK/DTK	3	Ambient	0.003	0.003

All of the modeled sources were co-located at the center of the site. This technique will provide conservative results since the cumulative impact of all sources is maximized.

Table 6. Point Source Emission Rate Information

Source	Model ID	Pollutant	Emission Rate (lb/hr)	Emission Rate (TPY)
Turbine 1	WC1	NO_x	203	-
Turbine 1	WC1	CO	2100	-
Turbine 1	WC1	SO_2	18	-
Turbine 1	WC1	PM_{10}	22.24	-
Turbine 1	WC1	$PM_{2.5}$	22.24	-
Turbine 1	WC1	H_2SO_4	5.68	-
Turbine 2	WC2	NO_x	203	-
Turbine 2	WC2	CO	2100	-
Turbine 2	WC2	SO_2	18	-
Turbine 2	WC2	PM_{10}	22.24	-
Turbine 2	WC2	$PM_{2.5}$	22.24	-
Turbine 2	WC2	H_2SO_4	5.68	-
Heater 1	HTR1	NO_x	0.5	-
Heater 1	HTR1	CO	1.53	-
Heater 1	HTR1	SO_2	0.05	-
Heater 1	HTR1	PM_{10}	0.04	-
Heater 1	HTR1	$PM_{2.5}$	0.04	-
Heater 1	HTR1	H_2SO_4	0.0225	-
Heater 2	HTR2	NO_x	0.5	-
Heater 2	HTR2	CO	1.53	-
Heater 2	HTR2	SO_2	0.05	-
Heater 2	HTR2	PM_{10}	0.04	-
Heater 2	HTR2	$PM_{2.5}$	0.04	-
Heater 2	HTR2	H_2SO_4	0.0225	-
Lube Oil Vent 1	LOV1	PM_{10}	0.05	-
Lube Oil Vent 1	LOV1	$PM_{2.5}$	0.05	0.1
Lube Oil Vent 1	LOV1	Lube Oil	0.05	-
Lube Oil Vent 2	LOV2	PM_{10}	0.05	-

Source	Model ID	Pollutant	Emission Rate (lb/hr)	Emission Rate (TPY)
Lube Oil Vent 2	LOV2	$PM_{2.5}$	0.05	0.1
Lube Oil Vent 2	LOV2	Lube Oil	0.05	-
Fire Water Pump	FWP	NO_x	1.852	0.093
Fire Water Pump	FWP	CO	2.004	-
Fire Water Pump	FWP	SO_2	0.01	-
Fire Water Pump	FWP	PM_{10}	0.0992	-
Fire Water Pump	FWP	$PM_{2.5}$	0.0992	0.01
Fire Water Pump	FWP	H_2SO_4	0.01	-
Emergency Engine	EGEN	NO_x	20.61	1.03
Emergency Engine	EGEN	CO	9.56	-
Emergency Engine	EGEN	SO_2	0.02	-
Emergency Engine	EGEN	PM_{10}	1.0847	-
Emergency Engine	EGEN	$PM_{2.5}$	1.0847	0.0542
Emergency Engine	EGEN	H_2SO_4	0.01	-
MSS for CEMS	CEMS	NO_x	0.00717	-
MSS for CEMS	CEMS	CO	0.00436	-
MSS for Filter/Washing	MSS	PM_{10}	0.14	-
MSS for Filter/Washing	MSS	$PM_{2.5}$	0.14	0.0108
Fugitive Piping	NGFUG	Natural Gas	0.5	-
Fugitive Piping	LOFUG	Lube Oil	0.5	-
Tanks	LOTK	Lube Oil	0.06	-
Tanks	DTK	Diesel	0.06	-

For each pollutant, all applicable sources that emit the pollutant were modeled together:

- NO_2 and CO - two turbines, two heaters, one fire water pump engine, one emergency generator engine, and planned MSS activities associated with CEMS calibration for two turbines.
- SO_2 and H_2SO_4 - two turbines, two heaters, one fire water pump engine, and one emergency generator engine.
- PM_{10} and $PM_{2.5}$ - two turbines, two heaters, two lube oil vents, one fire water pump engine, one emergency generator engine, and planned MSS activities associated with filter change-outs and turbine washing for one turbine.
- Diesel – diesel storage tank.

- Natural Gas – fugitive piping.
- Lube Oil – two lube oil vents, lube oil storage tank, and fugitive piping.

To account for conversion of NO_x to NO_2, ARM2 was used in the model runs. This is consistent with EPA guidance for conducting a Tier 2 screening approach.

For the 1-hr NO_2 NAAQS analysis, emissions from the fire water pump and emergency generator engines (Model IDs FWP and EGEN) were modeled with an annual average emission rate, consistent with EPA guidance for evaluating intermittent emissions. The modeled emissions from each engine are based on 100 hours of testing per year. Since many of the counties in TCEQ Region 12 are located in the Houston/Galveston/Brazoria ozone nonattainment area, the emergency engines cannot be tested between the hours of 6 am and 12 pm (Title 30 of the Texas Administrative Code Chapter § 117.2030(c)). This operational limitation was considered in the determination of the annual average emission rates.

For the 24-hr $PM_{2.5}$ and 24-hr PM_{10} analyses, the modeled emission rates for the fire water pump and emergency generator engines are based on two hours of operation per day (where a day represents eighteen hours to reflect the operational restrictions noted above for the ozone nonattainment area). Additionally, the modeled emission rates for the filter change-out and turbine washing MSS activities are based on twelve hours of operation per day.

For the annual NO_2 and annual $PM_{2.5}$ analyses, annual average emission rates were used for the fire water pump and emergency generator engines, the filter change-out and turbine washing activities, and the lube oil vents.