

TCEQ Interoffice Memorandum

To: Energy/Combustion Permit Staff

Thru: Daniel Menendez, Manager 
Permit Support Section

From: Dan Jamieson 
Permit Support Section

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Subject: Air Quality Analysis Report – Simple Cycle Turbine – Region 1

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 1 (Amarillo) and includes the counties of Armstrong, Briscoe, Carson, Castro, Childress, Collingsworth, Dallam, Deaf Smith, Donley, Gray, Hall, Hansford, Hartley, Hemphill, Hutchinson, Lipscomb, Moore, Ochiltree, Oldham, Parmer, Potter, Randall, Roberts, Sherman, Swisher, and Wheeler.

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.

Table 1. Modeling Results for State Property Line

Pollutant	Averaging Time	GLCmax ($\mu\text{g}/\text{m}^3$)	Standard ($\mu\text{g}/\text{m}^3$)
SO ₂	1-hr	21	1021
H ₂ SO ₄	1-hr	6.6	50
H ₂ SO ₄	24-hr	3.2	15

Table 2. Modeling Results for Minor NSR De Minimis

Pollutant	Averaging Time	GLCmax ($\mu\text{g}/\text{m}^3$)	De Minimis ($\mu\text{g}/\text{m}^3$)
SO ₂	3-hr	17	25
SO ₂	Annual	0.6	1

The 3-hr and annual SO₂ GLCmax are the maximum predicted concentrations associated with five years of meteorological data.

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

Pollutant	Averaging Time	GLCmax ($\mu\text{g}/\text{m}^3$)	Background ($\mu\text{g}/\text{m}^3$)	Total Conc. = [Background + GLCmax] ($\mu\text{g}/\text{m}^3$)	Standard ($\mu\text{g}/\text{m}^3$)
PM ₁₀	24-hr	5.9	114	119.9	150
PM _{2.5}	24-hr	4.5	28	32.5	35
PM _{2.5}	Annual	0.8	11.1	11.9	12
NO ₂	1-hr	65.5	113	178.5	188
NO ₂	Annual	4.8	27.8	32.6	100
SO ₂	1-hr	13.7	170	183.7	196
SO ₂	24-hr	10	92	102	365
CO	1-hr	2439	12483	14922	40000
CO	8-hr	678	3435	4113	10000

The 24-hr PM₁₀ 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 is the highest five-year average of the annual predicted concentrations determined for each receptor. The 1-hr NO₂ GLCmax is the highest five-year average of the 98th percentile, or H8H, predicted concentrations determined for each receptor. The 1-hr SO₂ GLCmax is based on the highest five-year average of the maximum predicted concentrations determined for each receptor. The annual NO₂, 24-hr SO₂, and 1-hr and 8-hr CO GLCmax are the maximum predicted concentrations associated with five years of meteorological data.

Background concentrations for PM₁₀ 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 PM₁₀), 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 481410044 located at 800 S San Marcial St., El Paso, El Paso County. The three-year average (2013-2015) of the 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 in the state and it was selected for a conservative analysis. Background concentrations for annual PM_{2.5} were obtained from the EPA AIRS monitor 482010024 located at 4510 ½ Aldine Mail Rd., Houston, Harris County. The three-year average (2013-2015) of the annual concentrations was used for the annual value. Except for the Clinton Dr. monitor located near the Houston ship channel, which would be overly conservative for TCEQ Region 1, this value represents the highest three-year average of the annual concentrations in the state and it was selected for a conservative analysis.

Background concentrations for 1-hr NO₂ 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 NO₂ 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 1-hr SO₂ were obtained from the EPA AIRS monitor 481830001 located at Gregg Co Airport, Longview, Gregg County. The highest 99th 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 99th 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 24-hr SO₂ were obtained from the EPA AIRS monitor 482450628 located in Port Arthur, Jefferson County. The highest 24-hr concentration from 2013-2015 was used for the 24-hr value. This value represents the highest 24-hr concentration in the state and it was selected for a conservative analysis.

Background concentrations for 1-hr CO were obtained from the EPA AIRS monitor 481410002 located at 222 S Campbell St., El Paso, El Paso County. The highest 1-hr concentration from 2013-2015 was used for the 1-hr value. This value represents the highest 1-hr concentration in the state and it was selected for a conservative analysis. Background concentrations for 8-hr 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 (µg/m ³)	ESL (µg/m ³)
Diesel	1-hr	24	1000
Diesel	Annual	0.4	100
Lube Oil	1-hr	245	1000
Lube Oil	Annual	4	100
Natural Gas	1-hr	202	3500
Natural Gas	Annual	3	350

3. Model Used and Modeling Techniques

AERMOD (Version 16216r) was used.

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 0.18, a calculated Bowen ratio of 0.65, and a calculated surface roughness length of 0.075 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 1 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 1 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: Amarillo, TX (Station #: 23047)
Upper Air Station and ID: Amarillo, TX (Station #: 23047)
Meteorological Dataset: 2011-2015
Profile Base Elevation: 1098.5 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
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	-

Source	Model ID	Pollutant	Emission Rate (lb/hr)	Emission Rate (TPY)
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 ₂ SO 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 ₂ SO 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 ₂ SO 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 ₂ SO ₄	0.0225	-
Lube Oil Vent 1	LOV1	PM ₁₀	0.05	-
Lube Oil Vent 1	LOV1	PM _{2.5}	0.05	-
Lube Oil Vent 1	LOV1	Lube Oil	0.05	-
Lube Oil Vent 2	LOV2	PM ₁₀	0.05	-
Lube Oil Vent 2	LOV2	PM _{2.5}	0.05	-
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 ₂ SO ₄	0.01	-
Emergency Engine	EGEN	NO _x	20.61	1.03

Source	Model ID	Pollutant	Emission Rate (lb/hr)	Emission Rate (TPY)
Emergency Engine	EGN	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 ₂ SO 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:

- NO₂ 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.
- SO₂ and H₂SO₄ - two turbines, two heaters, one fire water pump engine, and one emergency generator engine.
- PM₁₀ 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 NO₂, ARM2 was used in the model runs. This is consistent with EPA guidance for conducting a Tier 2 screening approach.

For the 1-hr NO₂ 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.

For the 24-hr PM_{2.5} and 24-hr PM₁₀ analyses, the modeled emission rates for the fire water pump and emergency generator engines are based on two hours of operation per day. 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 NO₂ and annual PM_{2.5} analyses, annual average emission rates were used for the fire water pump and emergency generator engines, as well as filter change-out and turbine washing activities.