TCEQ Interoffice Memorandum

To: Energy/Combustion Permit Staff

Thru: Daniel Menendez, Manager
Permit Support Section

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Subject: Air Quality Analysis Report – Compressor Station – Region 12

1. Project Identification Information

Air quality analyses (AQAs) were performed in support of the compressor station 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 1-hr NO_2 and annual $PM_{2.5}$ are reported for Harris County and for all other counties in TCEQ Region 12. Given the 1-hr NO_2 and annual $PM_{2.5}$ background concentrations for monitors located in Harris County, the 1-hr NO_2 and annual $PM_{2.5}$ modeling was based on three compressor engines for Harris County. The 1-hr NO_2 and annual $PM_{2.5}$ modeling for the other counties in TCEQ Region 12 was based on six compressor engines. See section 4 below for additional information on the compressor engines included in the modeling analyses.

Table 1. Modeling Results for State Property Line

Pollutant	Averaging Time	GLCmax (µg/m^3)	Standard (µg/m^3)
SO_2	1-hr	2.3	715

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	2.3	7.8
SO_2	3-hr	1.7	25
SO_2	24-hr	0.9	5
SO_2	Annual	0.2	1

Pollutant	Averaging Time	GLCmax (µg/m^3)	De Minimis (µg/m^3)
CO	1-hr	344	2000
CO	8-hr	319	500

The SO_2 and 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 (µg/m^3)	Background (µg/m^3)	Total Conc. = [Background + GLCmax] (µg/m^3)	Standard (µg/m^3)
PM_{10}	24-hr	8.4	110	118.4	150
$PM_{2.5}$	24-hr	5.8	23	28.8	35
$PM_{2.5}$ (Harris)	Annual	0.57	11.4	11.97	12
$PM_{2.5}$ (All other counties)	Annual	1.1	10.8	11.9	12
NO_2 (Harris)	1-hr	56.1	105	161.1	188
NO_2 (All other counties)	1-hr	95.9	87	182.9	188
NO_2	Annual	17.3	28	45.3	100

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 is the highest five-year average 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 GLCmax is the maximum predicted concentration 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 2014-2016 was used for the 24-hr value. 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 (2014-2016) 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 from areas in and near TCEQ Region 12 and it was selected

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

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 (2014-2016) of the annual concentrations was used for the annual value. 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. 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 482010024 located at 4510 ½ Aldine Mail Rd., Houston, Harris County. The three-year average (2014-2016) of the annual concentrations was used for the annual value. Except for the Clinton Dr. monitor 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.

For sites proposed to be located in Harris County, background concentrations for 1-hr NO_2 were obtained from the EPA AIRS monitor 482011052 located at 822 North Loop, Houston, Harris County. The two-year average (2015-2016) of the 98th percentile of the annual distribution of the maximum daily 1-hr concentrations was used for the 1-hr value. Though the data are based on two years, the value is greater than the highest three-year average of the 98th percentile of the annual distribution of the maximum daily 1-hr concentrations from the other monitors 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 1-hr NO_2 were obtained from the EPA AIRS monitor 482010026 located at 1405 Sheldon Rd., Channelview, Harris County. The three-year average (2014-2016) of the 98th percentile of the annual distribution of the maximum daily 1-hr concentrations was used for the 1-hr value. Except for monitors located in close proximity to downtown Houston, which would be overly conservative for the other counties of TCEQ Region 12, this value represents the highest three-year average of the 98th percentile of the annual distribution of the maximum daily 1-hr concentrations from areas in and near TCEQ Region 12 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 2014-2016 was used for the annual value. This value represents the highest annual 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)
Isobutane	1-hr	18171	23000
Isobutane	Annual	1765	7100
n-butane	1-hr	42037	66000
n-butane	Annual	4077	7100
Isopentane	1-hr	10066	59000
Isopentane	Annual	973	7100
n-pentane	1-hr	10640	59000
n-pentane	Annual	1028	7100
Mixed hexanes	1-hr	3988	6200
Mixed hexanes	Annual	189	200
Cyclohexane	1-hr	48	3400
Cyclohexane	Annual	4	340
Heptanes	1-hr	3994	10000

Pollutant	Averaging Time	GLCmax (µg/m³)	ESL (µg/m³)
Heptanes	Annual	388	1000
Methylcyclohexane	1-hr	1	16100
Methylcyclohexane	Annual	0.2	1610
Octanes	1-hr	1564	5600
Octanes	Annual	151	540
Nonanes	1-hr	297	4800
Nonanes	Annual	29	450
Decanes	1-hr	1	10000
Decanes	Annual	0.1	1000
Benzene	1-hr	141	170
Benzene	Annual	3.1	4.5
Toluene	1-hr	249	4500
Toluene	Annual	24	1200
Ethylbenzene	1-hr	13	26000
Ethylbenzene	Annual	1	570
Xylene	1-hr	111	2200
Xylene	Annual	11	180
2,2,4-trimethylpentane	1-hr	19	5600
2,2,4-trimethylpentane	Annual	2	540

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 25 meters from the modeled sources. Therefore, a setback distance of 25 meters from the facilities to the nearest property line will be needed. See section 3c below for additional information on the modeled receptor grid.

For the health effects analysis, a unit emission rate of 1 lb/hr was used to predict generic 1-hr and annual concentrations for each source. The generic concentrations were multiplied by the pollutant specific emission rates to calculate a maximum predicted concentration for each source. The maximum predicted concentration for each source was summed independent of time and space to get a total predicted concentration for each pollutant.

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 25 meters from the modeled sources. Receptors with a grid spacing of 25 meters extended from 25 meters out to 225 meters. Receptors with a grid spacing of 100 meters extended out to 1100 meters. Receptors with a grid spacing of 500 meters extended out to 5500 meters.

D. Building Wake Effects (Downwash)

BPIP-PRIME (version 04274) was used to develop the downwash parameters for the compressor engines. A cylindrical structure was used as the only downwash structure. The diameter of the structure was estimated using the maximum projected width from a typical compressor housing structure. The height of the cylindrical structure was based on an average height for a compressor housing structure. The compressor engine stack was located at the center of the structure so there would be no wind direction bias.

Building downwash was not included in the modeling analysis for the other modeled point sources. Typically, the other point sources are either located sufficiently far away from structures to not be impacted by downwash effects or are located near relatively small structures that will not significantly impede air flow.

4. Modeling Emissions Inventory

The compressor station 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 compressor station projects and selecting 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 ID ENG1: This modeled source represents the compressor engine stack. It was modeled as a point source using the parameters listed in Tables 5 and 6. The emissions listed in Table 6 represent the emissions associated with one compressor engine. As noted above, the 1-hr NO_2 and annual $PM_{2.5}$ modeling for Harris County included emissions for three compressor engines. All of other modeling for TCEQ Region 12 included emissions for six compressor engines.

Model ID HTR1: This modeled source represents the heater stack. It was modeled as a point source using the parameters listed in Tables 5 and 6.

Model ID FLARE: This modeled source represents the flare. It was modeled as a point source using the parameters listed in Tables 5 and 6. The exit diameter listed in Table 5 represents the smallest calculated effective stack diameter from the reviewed applications and it was selected to limit the amount of plume rise modeled from the flare.

In addition to the flare pilot emissions, emissions from other facilities/activities located at the site are routed to the flare. These include emissions from the dehydrator, compress engine blowdowns, and the oil tanks. The emissions listed in Table 6 for the flare represent the sum from all of these facilities/activities.

Model ID PRODWT: This modeled source represents the emissions from the produced water tank. It was modeled as a point source using the parameters listed in Tables 5 and 6.

Model ID TRKLD: This modeled source represents the emissions from the truck loadout activities. It was modeled as a point source using the parameters listed in Tables 5 and 6.

Model ID FUG: This modeled source represents fugitive emissions associated with piping components. 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 tank degassing and tank cleaning activities. It was modeled as a point source 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)
Compressor Engine	ENG1	30	992	107	1
Heater	HTR1	20	200	5.2	0.65
Flare	FLARE	25	1832	65.6	0.66
Produced Water Tank	PRODWT	10	Ambient	0.003	0.003
Truck Loadout	TRKLD	10	Ambient	0.003	0.003
Fugitive Piping	FUG	3	Ambient	0.003	0.003
MSS for Tank Degassing and Cleaning	MSS	10	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)
Compressor Engine	ENG1	NO_x	1.52	-
Compressor Engine	ENG1	CO	3.04	-
Compressor Engine	ENG1	SO_2	0.01	-
Compressor Engine	ENG1	PM_{10}	0.24	-
Compressor Engine	ENG1	$PM_{2.5}$	0.24	-
Heater	HTR1	NO_x	0.15	-
Heater	HTR1	CO	0.12	-
Heater	HTR1	SO_2	0.01	-
Heater	HTR1	PM_{10}	0.01	-
Heater	HTR1	$PM_{2.5}$	0.04	-
Flare	FLARE	NO_x	3.93	-
Flare	FLARE	CO	7.84	-
Flare	FLARE	SO_2	0.01	-
Flare	FLARE	Isobutane	1.75911	-
Flare	FLARE	n-butane	5.23577	-
Flare	FLARE	Isopentane	1.80233	-
Flare	FLARE	n-pentane	2.09986	-
Flare	FLARE	Mixed hexanes	1.05193	-
Flare	FLARE	Cyclohexane	0.24069	-
Flare	FLARE	Heptanes	0.39001	-
Flare	FLARE	Methylcyclohexane	0.05651	-
Flare	FLARE	Octanes	0.12294	-
Flare	FLARE	Nonanes	0.00678	-
Flare	FLARE	Decanes	0.00002	-
Flare	FLARE	Benzene	0.24584	-
Flare	FLARE	Toluene	0.16883	-
Flare	FLARE	Ethylbenzene	0.00781	-
Flare	FLARE	Xylene	0.03504	-
Flare	FLARE	2,2,4-trimethylpentane	0.0004	-
Produced Water Tank	PRODWT	Isobutane	0.094	-

Source	Model ID	Pollutant	Emission Rate (lb/hr)	Emission Rate (TPY)
Produced Water Tank	PRODWT	n-butane	0.251	-
Produced Water Tank	PRODWT	Isopentane	0.075	-
Produced Water Tank	PRODWT	n-pentane	0.084	-
Produced Water Tank	PRODWT	Mixed hexanes	0.036	-
Produced Water Tank	PRODWT	Heptanes	0.04	-
Produced Water Tank	PRODWT	Octanes	0.017	-
Produced Water Tank	PRODWT	Nonanes	0.003	-
Produced Water Tank	PRODWT	Decanes	0.000004	-
Produced Water Tank	PRODWT	Benzene	0.001	-
Produced Water Tank	PRODWT	Toluene	0.003	-
Produced Water Tank	PRODWT	Ethylbenzene	0.000004	-
Produced Water Tank	PRODWT	Xylene	0.001	-
Produced Water Tank	PRODWT	2,2,4-trimethylpentane	0.000004	-
Truck Loadout	TRKLD	Isobutane	3.21042	-
Truck Loadout	TRKLD	n-butane	7.36391	-
Truck Loadout	TRKLD	Isopentane	1.72855	-
Truck Loadout	TRKLD	n-pentane	1.81766	-
Truck Loadout	TRKLD	Mixed hexanes	0.66776	-
Truck Loadout	TRKLD	Heptanes	0.70014	-
Truck Loadout	TRKLD	Octanes	0.2681	-
Truck Loadout	TRKLD	Nonanes	0.05327	-
Truck Loadout	TRKLD	Decanes	0.00021	-
Truck Loadout	TRKLD	Benzene	0.02351	0.00266
Truck Loadout	TRKLD	Toluene	0.04246	-
Truck Loadout	TRKLD	Ethylbenzene	0.00218	-
Truck Loadout	TRKLD	Xylene	0.01944	-
Truck Loadout	TRKLD	2,2,4-trimethylpentane	0.00337	-

Source	Model ID	Pollutant	Emission Rate (lb/hr)	Emission Rate (TPY)
Fugitive Piping	FUG	Isobutane	0.0985	-
Fugitive Piping	FUG	n-butane	0.2896	-
Fugitive Piping	FUG	Isopentane	0.1051	-
Fugitive Piping	FUG	n-pentane	0.1203	-
Fugitive Piping	FUG	Mixed hexanes	0.0592	-
Fugitive Piping	FUG	Cyclohexane	0.01	-
Fugitive Piping	FUG	Heptanes	0.0209	-
Fugitive Piping	FUG	Octanes	0.0155	-
Fugitive Piping	FUG	Benzene	0.0013	-
Fugitive Piping	FUG	Toluene	0.0018	-
Fugitive Piping	FUG	Ethylbenzene	0.0001	-
Fugitive Piping	FUG	Xylene	0.0005	-
Tank Degassing	MSS	Isobutane	5.67763	-
Tank Degassing	MSS	n-butane	13.02308	-
Tank Degassing	MSS	Isopentane	3.05694	-
Tank Degassing	MSS	n-pentane	3.21454	-
Tank Degassing	MSS	Mixed hexanes	1.18093	0.00472
Tank Degassing	MSS	Heptanes	1.2382	-
Tank Degassing	MSS	Octanes	0.47413	-
Tank Degassing	MSS	Nonanes	0.09421	-
Tank Degassing	MSS	Decanes	0.00037	-
Tank Degassing	MSS	Benzene	0.04157	0.00017
Tank Degassing	MSS	Toluene	0.07508	-
Tank Degassing	MSS	Ethylbenzene	0.00386	-
Tank Degassing	MSS	Xylene	0.03438	-
Tank Degassing	MSS	2,2,4-trimethylpentane	0.00595	-
Tank Cleaning	MSS	Isobutane	1.4794	-
Tank Cleaning	MSS	n-butane	3.3933	-
Tank Cleaning	MSS	Isopentane	0.7965	-
Tank Cleaning	MSS	n-pentane	0.8376	-
Tank Cleaning	MSS	Mixed hexanes	0.3077	-
Tank Cleaning	MSS	Heptanes	0.3226	-
Tank Cleaning	MSS	Octanes	0.1235	-
Tank Cleaning	MSS	Nonanes	0.0245	-
Tank Cleaning	MSS	Decanes	0.0001	-

Source	Model ID	Pollutant	Emission Rate (lb/hr)	Emission Rate (TPY)
Tank Cleaning	MSS	Benzene	0.0108	-
Tank Cleaning	MSS	Toluene	0.0196	-
Tank Cleaning	MSS	Ethylbenzene	0.001	-
Tank Cleaning	MSS	Xylene	0.009	-
Tank Cleaning	MSS	2,2,4-trimethylpentane	0.0016	-

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

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 compressor engine blowdown (modeled from the flare, Model ID FLARE) were modeled with an annual average emission rate, consistent with EPA guidance for evaluating intermittent emissions. The annual average emission rate was added together with the routine emissions of other emissions emitted from the flare (pilot, dehydrator, and oil tank emissions), and the total emission rate was modeled. The annual average emission rate from the compressor engine blowdown is based on 12 hours per year for each engine.

For the annual benzene analysis, annual average emission rates were used for the truck loadout and tank degassing activities. For the annual mixed hexanes analysis, annual average emission rates were used for the tank degassing activities.