Consolidated Asset Management Services

February 28, 2014

Mr. Daniel Menendez *via email*
Air Dispersion Modeling Team (ADMT), MC 163
Texas Commission on Environmental Quality
12100 Park 35 Circle, Building C, Third Floor
Austin, Texas 78753

RE: Air Quality Analysis Protocol
Lon C. Hill Power Station
Corpus Christi, Nueces County
Permit Numbers 114911 and PSD-TX-1380
CN602656688; RN100215979

Dear Mr. Menendez,

On behalf of Lon C. Hill, LP (LCH), CAMS eSPARC is submitting this revised air quality analysis protocol in support of a new Prevention of Significant Deterioration (PSD) Air Quality Permit for the redevelopment of Lon C. Hill Power Station. This revised protocol addresses the comments provided in the air quality analysis protocol review dated January 23, 2014 and as a result, sections 2.1, 2.2, 4.1, 4.2, 4.3, 5.5, 5.6, 5.7, 6.5, 7.5 and 7.7 have been revised. Additionally, LCH has revised the cooling tower system initially proposed and a second cooling tower is being proposed as detailed in Section 5.3, Table 13.

By way of this letter and the revised protocol, LCH is responding to each of your specific requests. Relevant text from each item in your letter is provided in bold, followed by LCH response in blue font.

2.1 Type of Permit Review

The protocol notes that sulfuric acid will be evaluated in a PSD NAAQS analysis. Even though sulfuric acid is a regulated pollutant, there are no NAAQS established for sulfuric acid. However, there is a state property line standard for sulfuric acid. Please see section 7.5 below for additional guidance.

Sulfuric acid will be evaluated in a State Property Line Analysis as indicated in revised Section 2.1 and Section 7.5, not in a PSD NAAQS analysis.

The protocol did not address the pre-application analyses for ozone and sulfuric acid. Even though there are no significant monitoring concentrations (SMCs) for either pollutant, a preconstruction monitoring analysis must be provided in the AQA. Please note that existing ambient monitoring data and site-wide modeling for the state property line standard analysis can be used for the ozone and sulfuric acid preconstruction monitoring analyses, respectively.

A pre-construction monitoring analysis for ozone and sulfuric acid will be provided in the AQA. Existing ambient monitoring data and site-wide modeling for the state property line standard analysis will be used for the ozone and sulfuric acid preconstruction monitoring analysis, respectively. Refer to revised Section 4.3.

The protocol notes that SO_2 will be evaluated in a PSD NAAQS analysis. However, other parts of the protocol note that SO_2 will be evaluated for a minor new source review (NSR) NAAQS analysis. The AQA needs to be clear on the documentation of analyses.

SO_2 will be evaluated in a State NAAQS and State Property Line Analyses. The AQA will clearly identify the analyses performed for each pollutant.

2.2 Constituents Evaluated

Table 2 of the protocol does not list the annual PM10 significant impact level (SIL). Please note that this value is still used for purposes of conducting the annual PM10 increment analysis. Table 2 of the protocol lists the significant monitoring concentration (SMC) for PM2.5. It should be noted that the SMC for PM2.5 has been vacated and should be removed from Table 2.

Table 2 has been updated accordingly. The annual PM_{10} SIL will be used for the increment analysis.

Based on the information provided with the protocol, the monitor proposed to be used to justify the use of the $PM_{2.5}$ SILs may be appropriate, but additional information is required. See section 4.1 below for more detail.

A new $PM_{2.5}$ monitor is being proposed; refer to Section 4.1 for information.

3.0 Area Map and Plot Plan

Provide a plot plan with the AQA (electronic format preferred) that depicts the entire site. The plot plan should be independent of modeling software and include the site property line, fence line, locations of production activities, locations of emission sources represented in the AQA, and the locations of any buildings or structures represented in the AQA. The plot plan provided with the protocol did not depict the location of the area source. Be sure to label the buildings or structures on the plot plan provided with the AQA.

A plot plan containing all the information requested will be provided with the AQA.

3.1 Class I Areas

The protocol notes that the nearest Class I area is Big Bend National Park, which is located more than 500 kilometers (km) northwest of the project site. The TCEQ follows 40 Code of Federal Regulations § 52.21(p) which requires the TCEQ to provide written notice of any permit application for a proposed major stationary source which may affect a Class I area to the Federal land manager and the Federal official charged with direct responsibility for management of any lands within any such area. The EPA, through applicable guidance, has interpreted the meaning of the term "may affect" to include all

major source or major modifications which propose to locate within 100 km of a Class I area. As noted, the proposed site is located beyond 100 km from the nearest Class I area and would not require a Class I analysis. However, the applicant may contact the applicable Federal land manager to discuss any potential Class I analyses.

LCH reserves the right to contact the Federal land manager.

4.0 Ambient Monitoring Stations and Concentration Data

The protocol notes that for state NAAQS evaluations, only the site-wide sources are modeled. It should be noted that if the model predictions associated with the minor NSR NAAQS analysis are greater than or equal to the SILs, then off-property sources must be evaluated.

If the model predictions associated with the minor NSR NAAQS analysis are greater than or equal to the SILs, the off-property sources will be evaluated.

4.1 Representative Monitoring Stations

The selection of these monitors appears to be reasonable based on information reviewed by the ADMT; however, sufficient documentation to justify the use of these monitors was not provided with the protocol for determining representativeness of the monitoring data. The protocol notes that county-wide emissions comparisons derived from 2008 NEI data will be used to justify the representativeness of the proposed monitor stations. Please note that 2011 NEI data are available. In addition, relying solely on county-wide emissions comparisons are no longer sufficient. Technical justification should include a quantitative demonstration that shows emissions near the monitor are similar to or greater than the emissions near the project site. Also, for pollutants with multiple monitors located in the same county as the project site, technical justification must address why the proposed monitor is the most appropriate.

Section 4.1 has been updated to include data from the 2011 NEI, a quantitative demonstration comparing emissions near the proposed monitors and the project site, and technical justification for the cases when multiple monitors for a pollutant are located in the same county as the project site.

The protocol states that the Baytown monitor (EPA AIRS monitor 482010058) will be used for the 24-hr and annual $PM_{2.5}$ PSD NAAQS analysis and to justify the use of the $PM_{2.5}$ SILs since the $PM_{2.5}$ monitors in Nueces County have incomplete data. Even though the Nueces County monitors have incomplete data, the data may be valid if the applicant can demonstrate the validity of the design value by performing a substitution test outlined in 40 CFR Appendix N to Part 50. The applicant should provide this demonstration in the revised protocol.

Demonstration of the tests outlined in Appendix N to 40 CFR Part 50 is provided in Attachment D. Sections 4.1 and 4.2 have been updated based on the results from the substitution test.

4.2 Ambient Background Concentration Data

The protocol states that the background concentration for PM_{10} is the high, second high (H2H) value from 2012 (45 µg/m^3). Please note that data for this monitor indicates that a higher H2H value (53 µg/m^3) should be used.

Section 4.2 has been updated accordingly.

4.3 Preconstruction Monitoring Requirements

As noted in section 2.2, the significant monitoring concentration for $PM_{2.5}$ has been vacated. Representative monitoring should be provided to satisfy the pre-application analysis requirement. As discussed in section 4.1, the applicant should consider demonstrating the validity of the design value at one of the Nueces County monitors by performing a substitution test outlined in 40 CFR Appendix N to Part 50.

Demonstration of the tests outlined in Appendix N to 40 CFR Part 50 is provided in Attachment D. Sections 4.1 and 4.2 have been updated based on the results from the substitution test.

For all other pollutants, the AQA must include clear documentation on how the pre-construction monitoring requirement is being met. It may be appropriate to use the background concentrations reported in section 4.2 of the protocol. As noted above in section 4.1, additional technical justification may be required to support the use of the proposed monitors in order to meet the pre-construction monitoring requirement.

The AQA will include the documentation on how the pre-construction monitoring requirements are being met. Section 4.1 has been updated to include the requested technical justification.

5.1 On-Property Sources

Provide a copy of the completed Table 1(a) that was submitted with the permit application with the AQA. Identify special source types such as covered stacks, horizontal exhausts, fugitive sources, area sources, open pit sources, volume sources, roads, stockpiles, and flares. Provide sufficient documentation to justify all the source characterizations used for modeling, as well as the supporting technical justification for the associated source parameters.

A copy of the completed Table 1(a) and the requested documentation will be provided with the AQA.

5.2 Off-Property Sources

The protocol notes that a retrieval from the TCEQ Air Permits Allowable Database (APAD) will be obtained for NAAQS pollutants that exceed the applicable SIL. Attached is a spreadsheet that contains the regulated entity numbers (RNs) of sites that are within 50 km of the project site to help verify that off-property sources are addressed. In addition, if the applicant is aware of data not contained in the retrieval, such as recently issued permitted facilities, the data should be included as applicable. Any changes to data or exclusion of sources must be clearly documented and justified. Be sure to provide

all supporting materials with the AQA. The protocol notes that sources with negative emission rates will be removed from the APAD inventory. It should be noted that APAD inventories do not include negative emission rates.

Be sure to provide the basis for any assumed source parameters that cannot be verified from a Table 1(a) or exhaust descriptions within the TCEQ public files. For point sources where the height cannot be verified, the ADMT recommends evaluating the source with a height of 1 meter. For flares where the diameter and height cannot be verified, the ADMT recommends evaluating the source with a diameter of 0.001 meters and a height of 1 meter.

The APAD retrieval will be verified against the provided list of sites within 50 km of the project site and the retrieval will be supplemented if other sources are known to exist. Supporting documentation for any assumed source parameters will be included in the AQA.

5.3 Source Characterization and Justification

The protocol states that fugitive emissions from piping components will be modeled as area sources. However, the protocol does not provide sufficient justification for the area source characterization. Some items to address in the AQA include the horizontal and vertical scale of emissions associated with the activity, the locations of the activity throughout the site, and if the activity represents smaller areas of emissions that operate simultaneously.

The AQA will address the technical justification of the area sources, including the horizontal and vertical scale of emissions associated with the activity, the locations of the activity throughout the site, and if the activity represents smaller areas of emissions that operate simultaneously.

5.4 Startup/Shutdown/Maintenance Emissions

The protocol notes that the frequency of exceedance analysis used in the health effects review will be scaled according to the proposed time required for planned MSS activities. The predicted hours of exceedance may be refined to the operating hours of the source or sources causing the ESL exceedances. Any refinements made to the predicted frequencies of exceedance must be technically justified.

Refinements made to the predicted frequencies of exceedance will be technically justified in the AQA.

5.5 NOx to NO2 Conversion

The protocol notes that the plume volume molar ratio method (PVMRM) model option will be used to conduct the NO_2 analyses. The protocol includes a proposal to use a non-default in-stack NO_2/NO_x ratio of 0.091 for the combined cycle units (EPNs STK-101 and STK-102) and 0.10 for the auxiliary boiler (EPN ABLSTK-100). The protocol notes that the in-stack NO_2/NO_x ratios are industry recommended values. Please provide copies of the studies used to determine the in-stack NO_2/NO_x ratios with the AQA. Technical justification for the use of these values should be submitted and approved by the permit reviewer prior to using this model option.

The source of the proposed in-stack NO_2/NO_x ratios, as referenced in the section footnotes, is included in Attachment E. Approval from the permit reviewer will be obtained prior to using the PVMRM model option.

The protocol notes that ozone concentrations from the Tuloso monitor (EPA AIRS monitor 483550026) will be used with the PVMRM model option. This approach is reasonable; however, additional information is needed to determine how the ozone data will be used, as well as how missing hourly ozone data will be modeled if ozone data is used on an hour-by-hour basis. Please provide this information in a revised protocol.

Hourly ozone data will be used with the PVMRM model option. Please refer to Section 5.5 for details on how the missing hourly ozone data will be modeled.

5.6 Secondary PM Formation

The protocol notes that the proposed emissions are less than the 40 tons per year significant emission rate; therefore, SO_2 is not expected to result in significant secondary $PM_{2.5}$ formation. This approach is reasonable. Be sure to include this in the AQA as part of the secondary $PM_{2.5}$ analysis. Additional information must be provided to determine the appropriateness of the proposed approach to evaluate secondary formation of $PM_{2.5}$ due to the project NO_x emissions. The protocol states that a qualitative analysis will account for how secondary formation occurs and that representative background concentrations will be used to demonstrate that the modeling analysis adequately addresses secondary $PM_{2.5}$ formation. The model predictions of NO_2 and direct $PM_{2.5}$ emissions may also be used in the analysis to determine if the project would result in significant secondary formation of $PM_{2.5}$. This must be addressed in a revised protocol before the AQA is submitted.

The model predictions of NO_2 and direct $PM_{2.5}$ emissions will be used in the analysis to determine if the project would result in significant secondary formation of $PM_{2.5}$, as indicated in the revised Section 5.6.

5.7 Ozone Analysis

The proposed ozone analysis is generally acceptable. It is not clear from the protocol if the NO_x to NO_2 conversion factor of 0.9 will be used along with the PVMRM model option. Please note that only one of these options can be used for the ozone analysis. This information should be provided prior to submitting the AQA.

The NO_x to NO_2 conversion from the PVMRM model option will be used as indicated in revised Section 5.7.

In addition, the protocol notes that 3.1 $\mu g/m^3$ of ozone per $\mu g/m^3$ of NO_2 will be assumed. Additional clarification is needed to determine how the proposed value will be used in the modeling demonstration. Please provide this information prior to submitting the AQA.

The 3.1 µg/m^3 of ozone per µg/m^3 of NO_2 is the equivalent of 3 ppb of ozone per ppb of NO_2, the EPA recommended ozone yield. The estimated potential impact calculated from the maximum predicted project 8-hour NO_2 concentration and the 3 ppb of ozone per ppb of NO_2 ozone yield will be added to the 8-hour background ozone concentration, as indicated in revised Section 5.7.

6.2 Building Wake Effects

Provide all structure heights used in the downwash analysis and any computer assisted drawing files with the AQA. Ensure that all GEP heights used in BPIP PRIME are justified according to Guideline for Determination of Good Engineering Practice Stack Height: http://www.epa.gov/scram001/guidance/guide/gep.pdf

For structures not included in the downwash analysis or for air quality analyses conducted without consideration of downwash, please provide technical justification for supporting this approach.

The requested data will be provided in the AQA.

6.5 Meteorological Data

Please note that revised preprocessed meteorological data sets (2008-2012) are now available on the TCEQ's website and that the revised data are recommended for use. Note that year 2012 will be the recommended data set to use for the minor NSR modeling.

The revised preprocessed 2008-2012 meteorological data sets will be used in the modeling analyses. Section 6.5 has been updated accordingly.

Be sure to provide the AERSURFACE files with the AQA associated with the modeling analysis.

The AERSURFACE files will be provided in the AQA.

7.1 AOI Analysis

In general, report the predicted high, first high (H1H) concentration for each pollutant. The results of the modeling for the $PM_{2.5}$ and 1-hr NO_2 NAAQS analyses should be presented as the highest five-year average of the maximum modeled $PM_{2.5}$ and 1-hr NO_2 concentrations predicted each year at each receptor, consistent with EPA guidance.

The concentrations recommended above will be reported and used for the AOI analysis.

7.3 NAAQS Analysis

The protocol notes that the MAXDCONT feature may be used to evaluate predicted exceedances of the NAAQS and Increments. Before conducting this analysis, review and evaluate the assumptions made in the modeling analysis prior to conducting any other approaches. Please contact the ADMT for further guidance.

The ADMT will be contacted prior to using the MAXDCONT or any other approach.

Table 13 of the protocol notes that the H1H will be reported for the 24-hr $PM_{2.5}$ PSD NAAQS analysis. However, section 7.3 of the protocol cites drafts EPA guidance that allows applicants to report the modeled design value in conjunction with the three-year average of the 98th percentile of the annual distribution of the 24-hr monitored background concentrations for comparison to the NAAQS if a sufficient demonstration of the potential impacts associated with secondary $PM_{2.5}$ formation is provided. The AQA should clearly document the approach used for the 24-hr $PM_{2.5}$ PSD NAAQS analysis.

The AQA will clearly document the approach used for the 24-hr $PM_{2.5}$ PSD NAAQS analysis. Table 13, corresponding to Table 15 in the revised protocol, has been updated to indicate the use modeled design value.

7.4 PSD Increment Analysis

If the predicted concentrations associated with the proposed project emissions of $PM_{2.5}$ result in a significant impact, the applicant will need to search and identify all major sources of $PM_{2.5}$ that have increment consuming emissions (related to the $PM_{2.5}$ major source baseline date [October 20, 2010]), as well as minor sources that have increment consuming emissions (related to the minor source baseline date for Nueces County [March, 1 2013]). Be sure to document how this information was obtained in the AQA.

If the predicted concentrations associated with the proposed project emissions of PM2.5 result in a significant impact, the source of the information used to identify all major sources of PM2.5 that have increment consuming emissions will be included in the AQA.

7.5 State Property-Line Analysis

If hourly average emission rates are used for any sources (i.e. following EPA's intermittent guidance), be aware that this guidance only applies to the 1-hr NO_2 and 1-hr SO_2 NAAQS analyses. The hourly average emission rates should not be used for any other short-term averaging times and pollutants, including the SO_2 State Property Line analysis.

Average emission rates for intermittent sources will only be used for the applicable pollutants and averaging periods. In addition, the emission rates used will be included in the input files to be submitted with the AQA.

The protocol notes that a state property line analysis will be conducted for the 1-hr and annual H_2SO_4 averaging periods. Please note that the annual averaging period is not applicable to H_2SO_4. The H_2SO_4 modeling analysis should evaluate the 1-hr and 24-hr averaging periods.

The H_2SO_4 modeling analysis will evaluate the 1-hr and 24-hr averaging periods as indicated in revised Section 7.5.

7.7 Additional Impacts Analysis

The AQA should explain in detail how the project will affect the area in terms of a growth analysis, soil and vegetation analysis, and a Class II visibility impairment analysis.

The AQA will explain in detail how the project will affect the area in terms of a growth analysis, soil and vegetation analysis, and a Class II visibility impairment analysis.

In addition, the protocol notes that a visibility analysis is not required because the proposed project will comply with the visibility and opacity requirements in 30 TAC Chapter 111. It is incorrect to state that a visibility analysis is not required. The visibility analysis is required; however, the applicant can meet the requirement by acknowledging compliance with the visibility and opacity requirements in 30 TAC Chapter 111.

Section 7.7 has been updated to state the visibility analysis requirement will be met by complying with the visibility and opacity requirements in 30 TAC Chapter 111.

Please contact me at (281) 333-3339 x201 or via email at mjohnson@camsesparc.com, if you have any questions or need additional information.

Sincerely,

Mona Caesar Johnson, P.E.
CAMS eSPARC, LLC

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Lon C. Hill Power Station
Air Quality Analysis Protocol

Submitted by
Lon C. Hill, LP
Corpus Christi, Nueces County, Texas
RN100215979
CN602656688

Prepared by
CAMS eSPARC, LLC
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February 2014

Lon C. Hill Power Station
Air Quality Analysis Protocol

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Attachments

Attachment A

Table 1(a)

Attachment B

AERSURFACE Output

Attachment C

Seabrook-Baytown-Clinton Land Area

Attachment D

Appendix N to 40 CFR Part 50: Substitution Test Demonstration

Attachment E

NO_2/NO_x In-Stack Ratio Source

Section 1
Project Overview

Lon C. Hill, LP (LCH) is proposing to construct, own and operate a new 2x1 combined cycle power plant west of Corpus Christi, TX, which will be referred to as the Lon C. Hill Power Station. The new plant will have a nominal capacity of approximately 740 megawatts (MW). Construction of the new plant is proposed to begin in May 2015, with commercial operation proposed for April 2017.

The site previously consisted of a four unit generation facility that ceased operations in 2002 and was subsequently demolished down to the equipment foundations. All associated air permits (NSR and Federal Operating Permit) were voided.

The proposed new facility will consist of two natural gas-fired combustion turbines (GTs), two heat recovery steam generators (HRSGs) with natural gas-fired duct burners and one steam turbine (ST) generator (2x1 configuration). Proposed ancillary equipment may include a natural gas fuel supply system, an auxiliary natural gas-fired boiler, a diesel-fired emergency generator, a fire protection system, an water-cooled condenser with a cooling tower, an oil/water separator, two diesel storage tanks, an aqueous ammonia storage tank, and storage and dispensing of gasoline from a small gasoline storage tank. Other equipment may include an evaporative cooling system or gas turbine inlet chilling with the associated cooling tower and chilled water storage.

The combined cycle units will exclusively fire natural gas. Dry low-NOx (DLN) combustors will be used to reduce the nitrogen oxides (NOx) emissions at the turbine exhaust. The duct burners in the HRSGs will be equipped with low-NOx burners. Stack exhaust NOx emissions will be reduced using selective catalytic reduction (SCR) with aqueous ammonia (NH_3). Stack exhaust carbon monoxide (CO) emissions will be reduced using a CO catalyst.

Contact and administrative information for this protocol is summarized below:

Applicant:	Lon C. Hill, LP
Facility:	Lon C. Hill Power Station
Contact:	Mr. Mathew Lindsey Sr. ESH Specialist Consolidated Asset Management Services Phone: (713) 358-9736 Email: mlindsey@camstex.com
Permit Application Number:	114911
Air Quality Account Number	NE-0025-C
TCEQ Regulated Entity Reference Number (RN):	RN100215979
Nearest City and County	Corpus Christi, Nueces County

Applicant’s Modeling Prepared by:	CAMS eSPARC, LLC 1110 Nasa Pkwy, Suite 212 Houston, TX 77058 Attn: Mona Caesar Johnson, P.E. (281) 333-3339 x201 mjohnson@camsesparc.com

This report is organized as follows:

- Section 2 provides the modeling overview.
- Section 3 provides the area maps and plot plan.
- Section 4 describes the proposed ambient monitoring stations and concentration data.
- Section 5 discusses modeling the emissions inventory.
- Section 6 describes the proposed models and the modeling techniques.
- Section 7 describes the proposed method for presentation of modeling results.

Section 2
Modeling Overview

2.1 Type of Permit Review

LCH is proposing to construct, own and operate a new 2x1 combined cycle power plant in Nueces County, an area that is classified by the United States Environmental Protection Agency (US EPA) as attainment with the National Ambient Air Quality Standards (NAAQS). The proposed plant will be a major stationary source of nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter 10 microns or less (PM_{10}) and particulate matter 2.5 microns or less ($PM_{2.5}$). To support the proposed permit application, the following analyses will be performed:

- NAAQS Significance Impact Level (SIL) and Area of Impact (AOI) analyses for nitrogen dioxide (NO_2), CO, PM_{10}, $PM_{2.5}$, and sulfur dioxide (SO_2) emissions, to predict whether the proposed sources could make a significant impact on existing air quality;
- PSD preconstruction monitoring analysis for NO_2, CO, H_2SO_4, Ozone, PM_{10} and $PM_{2.5}$ emissions, to determine whether preconstruction monitoring may be required to evaluate existing air quality;
- PSD NAAQS analysis for NO_2, CO, PM_{10}, and $PM_{2.5}$ emissions, as applicable based on the SIL and AOI analyses, to demonstrate that the proposed project will not cause nor contribute to an exceedance of the NAAQS;
- PSD Increment analysis for NO_2, PM_{10} and $PM_{2.5}$ emissions, to demonstrate that the proposed project will not cause nor contribute to an exceedance of an increment;
- State NAAQS analysis for SO_2 emissions, as applicable based on the SIL and AOI analyses, to demonstrate that the proposed project will not cause nor contribute to an exceedance of the State NAAQS;
- State Property Line analysis, to demonstrate that the emissions from the proposed project comply with State standards for net ground-level concentrations of SO_2 and sulfuric acid (H_2SO_4); and
- State Health Effects analysis, to demonstrate that ammonia (NH_3) and formaldehyde (HCHO) emissions from the proposed project will not exceed the Texas Commission on Environmental Quality (TCEQ) Effects Screening Levels (ESLs).

The proposed analyses will incorporate emission rates from routine operations, as well as planned maintenance, startup and shutdown (MSS).

2.2 Constituents to Be Evaluated

Table 1 summarizes the constituents to be evaluated to support the proposed project.

Table 1 – Constituents to be Evaluated

Constituent	PSD/State NAAQS Analysis	PSD Increment Analysis	State Property Line Analysis	State Health Effects Analysis
Nitrogen Dioxide (NO_2)	Yes	Yes	-	-
Carbon Monoxide (CO)	Yes	-	-	-
Particulate Matter (PM_{10})	Yes	Yes	-	-
Particulate Matter ($PM_{2.5}$)	Yes	Yes	-	-
Sulfur Dioxide (SO_2)	Yes	-	Yes	-
Sulfuric Acid (H_2SO_4)	-	-	Yes	-
Ammonia (NH_3)	-	-	-	Yes
Formaldehyde (HCHO)	-	-	-	Yes

Table 2 summarizes the standards to which the modeled concentrations of the criteria pollutants will be compared for each analysis. These include:

- **Significant Impact Levels** (SILs), also called *de minimis* impact levels, are values set by US EPA or TCEQ. An air quality impact that is less than *de minimis* is considered an insignificant air quality impact and requires no further evaluation. The terms *de minimis* and SIL may be used interchangeably throughout this document.
- **Preconstruction Monitoring Significance Levels**, which determine if preconstruction monitoring data are required for the proposed project. These standards are set by US EPA (40 CFR 51.166 and 40 CFR 52.21).
- **PSD Increment**, is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant. PSD Increment analysis is required for NO_2, PM_{10} and $PM_{2.5}$. These standards are set by 40 CFR 51.166 and 40 CFR 52.21.
- **NAAQS** are set by US EPA (40 CFR Part 50) and provide public health protection, including the health of sensitive populations and public welfare from criteria pollutants.
- **State Property Line Standards** are set by 30 Texas Administrative Code (TAC) Chapter 112. These standards set limits to protect public health, including the health of sensitive populations, and public welfare from any known or anticipated adverse effects of a pollutant.

Table 2 – Criteria Pollutant Concentration Standards

Constituents	Regulation	Averaging Period	Significant Impact Level (SIL)(1) $\mu g/m^3$	Preconstruction Monitoring Significance Level (2)(3) $\mu g/m^3$	PSD Increment (2)(3) $\mu g/m^3$	NAAQS/State Property Line Standard (4) $\mu g/m^3$
NO_2	NAAQS	1-hour	7.5	-	-	188
		Annual	1	14	25	100
CO	NAAQS	1-hour	2,000	-	-	40,000
		8-hour	500	575	-	10,000
PM_{10}	NAAQS	24-hour	5	10	30	150
		Annual	1	-	17	-
$PM_{2.5}$	NAAQS	24-hour	1.2	-	9	35
		Annual	0.3	-	4	12
SO_2	30 TAC 112	30 min(5)	20.4	-	-	1,021
	NAAQS	1-hour	7.8	-	-	196
		3-hour	25	-	-	1,300
		24-hour	5	-	-	365
		Annual	1	-	-	80
H_2SO_4	30 TAC 112	1-hour	1	-	-	50
		24-hour	0.3	-	-	15

(1) 40 CFR 51.165 and as discussed in Section 2.2

(2) The project is only subject to PSD modeling for NOx, CO, PM_{10}, and $PM_{2.5}$, therefore only the applicable PSD standards are presented in the table.

(3) 40 CFR 51.166 and 40 CFR 52.21

(4) 40 CFR 50 and 30 TAC 112

(5) The EPA AERMOD model calculates concentrations for a minimum time interval of 1-hour. According to *TCEQ Air Quality Modeling Guidelines (AQMG)* (Revised, February 1999, RG-25) guidance, the model-predicted 1-hour concentration is compared to the 30-minute standard.

The SIL used for the 1-hour NO_2 NAAQS demonstration is based on the EPA's Interim guidance memorandum "*General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level*", by Anna Marie Wood (June 28, 2010). The value is equal to 4% of the full NAAQS. Technical discussions in the memo are presented as justifications for using the SIL in this modeling analysis.

The SIL used for the 1-hour SO_2 NAAQS demonstration is based on the EPA's Interim guidance memorandum "*General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level*", by Anna Marie Wood (August 23, 2010). The value is equal to 4% of the full NAAQS. Technical discussions in the memo are used as justifications for using the SIL in this modeling analysis.

The United States Court of Appeals for the District of Columbia Circuit recently vacated the $PM_{2.5}$ SILs, however, on March 4, 2013, the EPA issued "Draft Guidance for $PM_{2.5}$ Permit Modeling" indicating that the continued use of the vacated SILs is acceptable with sufficient justification. In the guidance document, the EPA suggests that if the difference between the $PM_{2.5}$ NAAQS and the monitored $PM_{2.5}$ background concentration is greater than the EPA's vacated $PM_{2.5}$ SILs, then it is sufficient in most cases for permitting authorities to conclude that a proposed source with a $PM_{2.5}$ impact below the vacated $PM_{2.5}$ SILs will not cause or contribute to a violation of the $PM_{2.5}$ NAAQS and to forego a more comprehensive cumulative modeling analysis for $PM_{2.5}$. The difference between the proposed 24-hour and annual $PM_{2.5}$ ambient monitor data (refer to Section 4.2) and the NAAQS is summarized below:

24-hr $PM_{2.5}$ NAAQS minus 24-hour $PM_{2.5}$ ambient monitor[1] =
$35.0 – 21.3 = 13.7\ \mu g/m^3 > \text{SIL of } 1.2\ \mu g/m^3$

Annual $PM_{2.5}$ NAAQS minus annual $PM_{2.5}$ ambient monitor[1] =
$12.0 – 11.1 = 0.9\ \mu g/m^3 > \text{SIL of } 0.3\ \mu g/m^3$

Since the NAAQS concentrations minus the representative background concentrations are greater than the vacated SILs, the vacated 24-hour and annual $PM_{2.5}$ SILs are proposed for use in the significant impact analysis.

While there are no SILs for the State Property Line standards for SO_2 and H_2SO_4, the TCEQ has generally accepted that 2% of the standard represents an insignificant air quality impact. LCH proposes to use 2% of the full State Property Line standard as the *de minimis* levels to determine if the project has a significant impact warranting further monitoring.

Modeling for the non-criteria pollutants or State Health Effects evaluation will be conducted following the TCEQ's Modeling Effects Review and Applicability (MERA) guidance document (APDG 5874v3, 2009). The ESLs shown on Table 3 were obtained from the most recent published TCEQ ESL list dated February 1, 2013.

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[1] Baytown monitor (EPA ID: 48-201-0058). Refer to Section for 4.1 for details.

Table 3 – Non-Criteria Pollutant ESLs

Constituents	CAS Number	Name Used in Model	Averaging Period	ESL[(1)] μg/m^3
Ammonia	7664-41-7	NH3	1-hour	170
		NH3_LT	Annual	17
Formaldehyde	50-00-0	HCHO	1-hour	15
		HCHO_LT	Annual	3.3

1 - The ESLs obtained from the TCEQ's ESL list dated February 1, 2013.

Section 3
Area Map and Plot Plan

The Lon C. Hill Power Station will be located within TCEQ Region 14, Corpus Christi, Texas. An area map is provided in Figure 1, which details the property line, 3000 foot distance marking, 1 mile distance marking and 3 kilometer distance marking. Calallen East Elementary School is within 3,000 feet of the site. Other schools within 3 kilometers of the site are:

1. Annaville Elementary School
2. Calallen High School
3. Calallen Middle School
4. Calallen Independent School District
5. Wilma Magee School

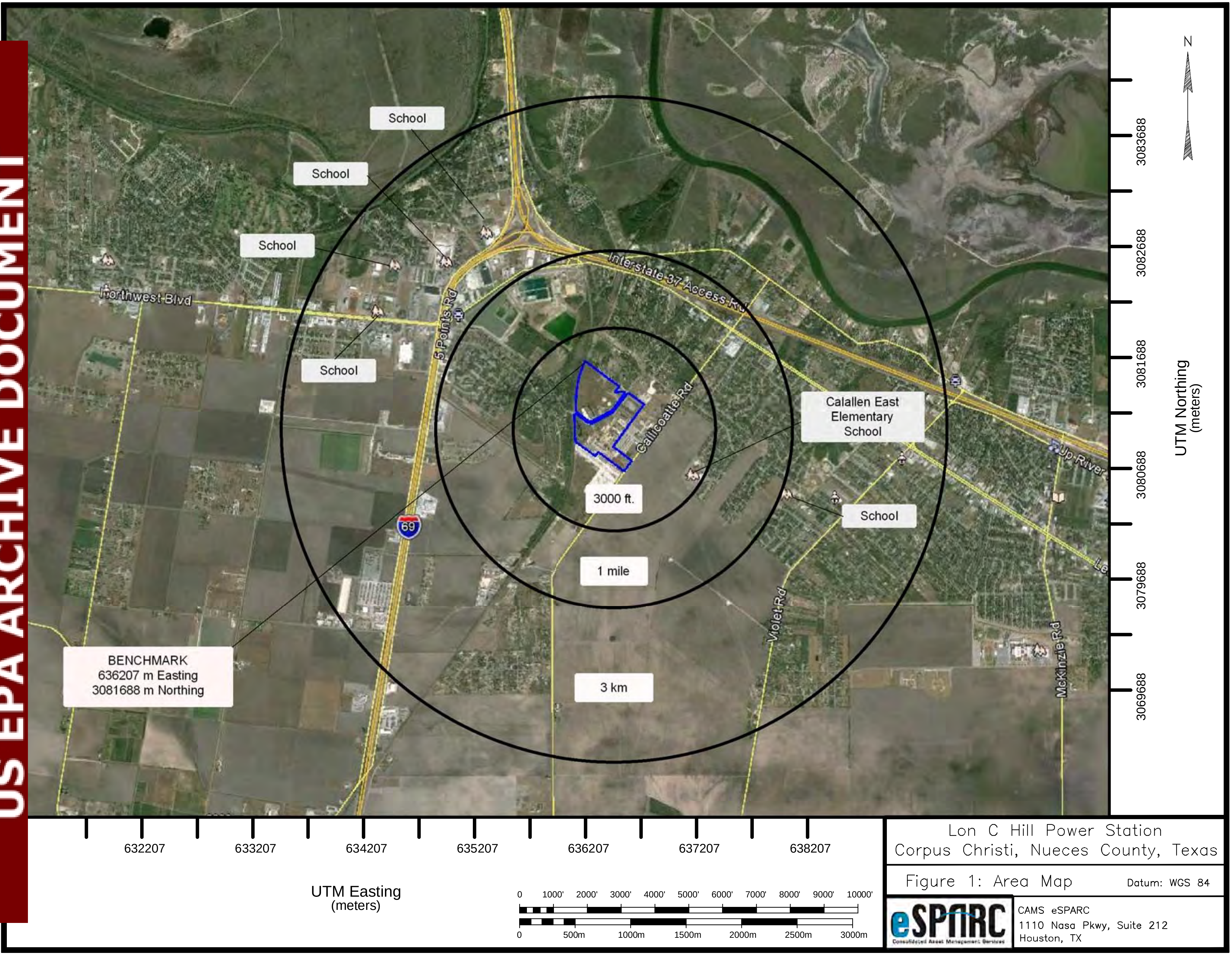
A plot plan of the Lon C. Hill Power Station is provided in Figure 2. The plot plan details the location of major equipment and facilities, and the emission points at the site that are included in the permit application. The layout and location of equipment and emissions point illustrated in the plot plan are a preliminary estimate pending structural analysis of the soils.

3.1 Class I Areas

The nearest Class I area to the proposed power station is Big Bend National Park, located 356 miles (588 km) northwest of the project site. The distances from the site to other Class I areas are shown in Table 4. Because the nearest Class I area is located at a distance greater than 100 km from the proposed site, a Class I Area Impact Analysis is not required.

Table 4 – PSD Class I Areas, Lon C. Hill Power Station

Class 1 Area	State	Km to Site	Miles to Site
Big Bend National Park	Texas	588	356
Wichita Mountains National Wilderness Area	Oklahoma	744	477
Caney Creek Wilderness Area	Arkansas	781	498
Carlsbad Caverns National Park	New Mexico	818	507
Guadalupe Mountain National Park	New Mexico	829	517
Breton National Wildlife Refuge	Louisiana	888	548
Salt Creek Wilderness Area	New Mexico	911	566



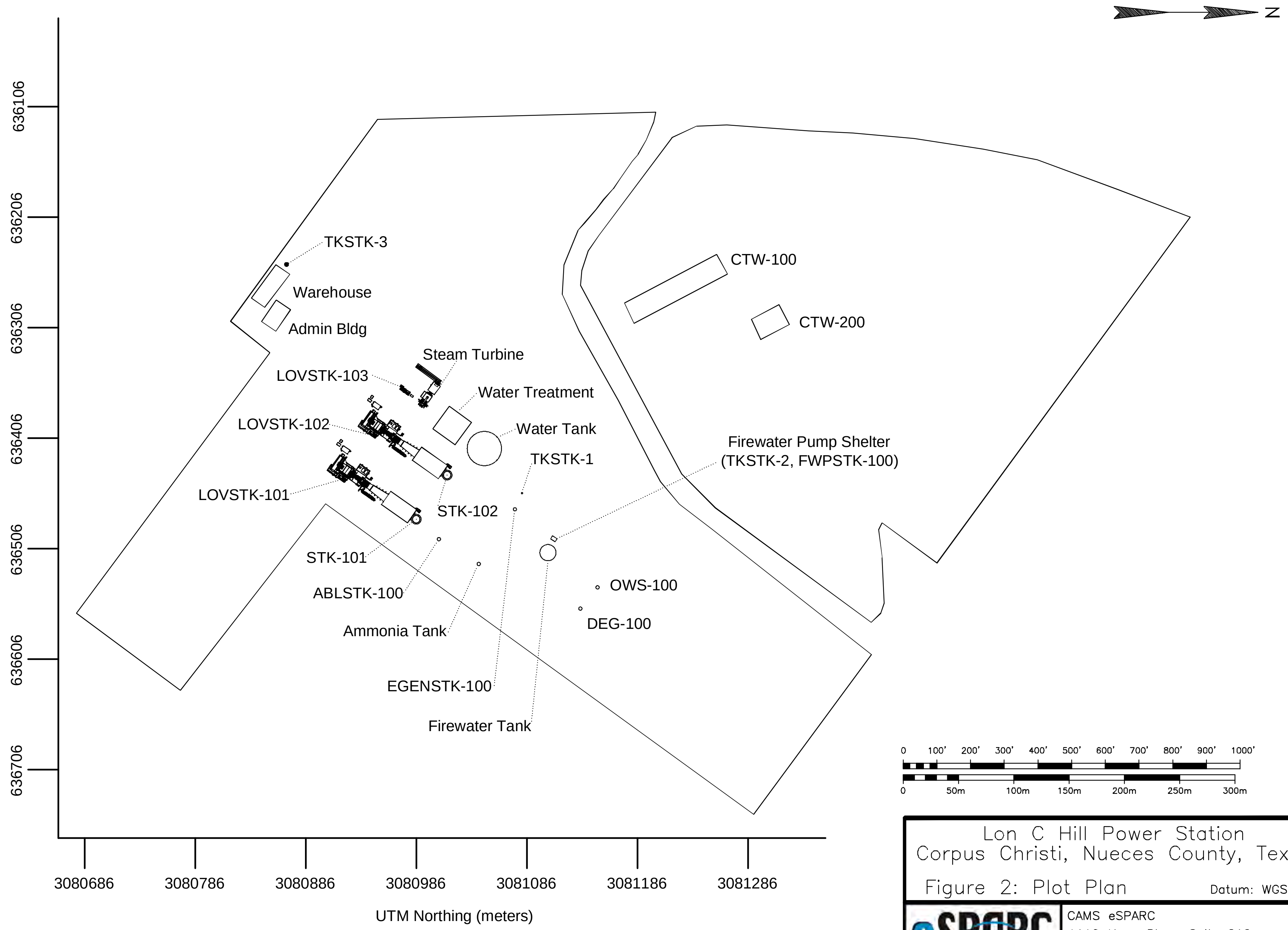
Lon C Hill Power Station
Corpus Christi, Nueces County, Texas

Figure 1: Area Map

Datum: WGS 84

eSPARC
Consolidated Asset Management Services

CAMS eSPARC
1110 Nasa Pkwy, Suite 212
Houston, TX



Lon C Hill Power Station
Corpus Christi, Nueces County, Texas

Figure 2: Plot Plan

Datum: WGS 84

CAMS eSPARC
1110 Nasa Pkwy, Suite 212
Houston, TX

Section 4
Ambient Monitoring Stations and Concentration Data

Actual ambient monitoring data must be collected for all pollutants, unless the modeled ambient air concentrations fall below the state *de minimis* level or EPA's promulgated (or interim) SIL. The ambient monitoring data is used in the NAAQS analyses to represent the contribution of emissions sources that are not included in the modeling to the overall air quality impact.

Depending on the type of NAAQS Analysis, PSD or State NAAQS, the appropriate location for the ambient monitor could differ. For PSD evaluations, other nearby industrial sources will be included in the modeling analysis; therefore a monitor located away from industrial sources will be more representative of the emissions that will not be included in the modeling. For State NAAQS evaluations, only the site-wide sources are modeled; therefore the monitor location needs to be in an area similar to the Lon C. Hill Power Station site.

LCH proposes to use existing representative ambient monitoring data (Refer to Table 11 in Section 4.2 of this document) to demonstrate that there is no threat to the $PM_{2.5}$ NAAQS and justify the use of the recently vacated $PM_{2.5}$ SILs, as discussed in Section 2.2, and to address secondary PM formation. As detailed in Section 0, for constituents for which the GLCmax is above the preconstruction ambient monitoring thresholds, LCH proposes to use the existing representative ambient monitoring data discussed in Section 4.2 in lieu of performing preconstruction monitoring.

The background concentrations presented in Tables 5 through 10 (Section 4.2) were obtained using the procedures outlined in the following modeling guidance documents:

- "Background Concentration Determination for Use in NAAQS Analyses" TCEQ memorandum from Dom Ruggeri [Air Dispersion Modeling Team (ADMT), Team Leader] to the New Source Review Permits Division (NSRPD) Technical Staff (September 2, 1998); and
- "Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS" US EPA memorandum from Stephen D. Page, Director, EPA Office of Air Quality Planning and Standards (March 23, 2010).

4.1 Representative Monitoring Stations

Representative ambient monitoring stations were identified using the EPA air monitoring sites website[2]. Those monitoring stations located within Nueces County that met EPA's completeness requirements for each pollutant and averaging period (each quarterly data set must be at least 75% complete) were selected for use in the analysis. For those pollutants for which an acceptable ambient monitor was not available within Nueces County, monitoring stations located close to heavily industrialized areas preferably within coastal areas were selected as a conservative alternative. If further refinement is

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[2] http://www.epa.gov/airquality/airdata/ad_maps.html

necessary during the modeling process, representative monitors located in coastal areas away from industrial sources and with similar non-industrial emissions to Nueces County may be proposed.

NO_2 Proposed Monitoring Station

There is no NO_2 ambient air monitor in Nueces County. Therefore, representative ambient monitoring data collected in another county is proposed for use in the 1-hour and annual NO_2 NAAQS Analysis. The Nederland High School monitor (EPA ID: 48-245-1035) in Jefferson County was selected for the NO_2 ambient monitoring data. This monitor is located in proximity to industrial activity near the Port of Beaumont and the Beaumont-Port Arthur Channel. The 2011 EPA NEI data show higher NO_X emissions for Jefferson County (22,756 tpy) than for Nueces County (18,037 tpy). NO_X emissions in a 10 kilometer radius around the monitor are greater than for the same radius around the proposed LCH site, based on the 2012 Emissions Inventory (EI). While the census data show a smaller population for Jefferson County (252,273) than for Nueces County (340,223), the census data shows that the population in the Metro Statistical Areas (MSA) on which the monitor is located is comparable to that of the MSA on which the proposed site will be located. Table 5 details the technical justification data for the proposed NO_2 monitor.

Table 5 – NO_2 Monitor Justification

Population[1]		County-Wide Emissions (tpy)		Area Emissions - 10 km radius (tpy)	
Beaumont - Port Arthur MSA	Corpus Christi MSA	Jefferson County	Nueces County	Nederland Monitor	LCH
403,190	428,185	419,464	47,054	2,293	860

(1) Per U.S. Census Bureau, 2010 Census at http://www.census.gov/population/www/cen2010/cph-t/CPH-T-5.pdf

Given that total NO_x emissions from the area surrounding the monitor are much higher than those from Nueces County and that the population in both MSAs are comparable, the use of this monitor provides a conservative representation of the ambient background around the site. In addition, the coastal influences affecting NO_2 concentrations in the Beaumont-Port Arthur, Jefferson County area are also very similar to the coastal influences affecting NO_2 concentrations in Nueces County. The applied ambient concentrations are: 54.5 $\mu g/m^3$ for 1-hour NO_2 and 7.9 $\mu g/m^3$ for annual NO_2.

CO Proposed Monitoring Station

There is no CO ambient monitor in Nueces County. Therefore, the Clinton monitor (EPA ID: 48-201-1035) in Harris County is proposed for use in the 1-hour and 8-hour CO NAAQS Analysis. The Clinton monitor provides a conservative estimate of CO levels that would be expected near the proposed Lon C. Hill Power Station site since it is in close proximity to industrial activity near the Houston Ship Channel. The amount of industry near this monitor is greater than the amount of industry that surrounds the Lon C. Hill Power Station site. CO emissions in a 10 kilometer radius around the monitor are greater than for the same radius around the proposed LCH site, based on the 2012 Emissions Inventory (EI). In addition, 2011 EPA NEI data show higher CO emissions for Harris County than for Nueces County. Given that

Harris County has approximately twice the land area of Nueces County (roughly 1,700 square miles compared to approximately 840 square miles); a land area equivalent to the size of Nueces County and surrounding the monitor location was analyzed for population. Table 16 in Attachment C details the equivalent land area used in the analysis. Census data show a higher population for the equivalent Harris County land area (2,628,194) than for Nueces County (340,223). Table 6 details the technical justification data for the proposed CO monitor.

Table 6 – CO Monitor Justification

Population		County-Wide Emissions (tpy)		Area Emissions - 10 km radius (tpy)	
Equivalent Land Area	Nueces County	Harris County	Nueces County	Clinton Monitor	LCH
2,628,194	340,223	419,464	47,054	2,293	860

The coastal influences affecting CO concentrations in the Clinton, Harris County area are also very similar to the coastal influences affecting CO concentrations in Nueces County. The applied ambient concentrations are: 1596 μg/m^3 for 1-hour CO and 1254 μg/m^3 for 8-hour CO.

PM_{10} Proposed Monitoring Station

The Dona Park monitor (EPA ID: 48-355-0034) in Nueces County is proposed for use in the 24-hour PM_{10} NAAQS Analysis. The highest-second-high (H2H) concentration from 2012 will be used for the 24-hour PM_{10} background concentrations. The Dona Park monitor is the only active PM_{10} monitor in Nueces County. PM_{10} emissions in a 10 kilometer radius around the monitor are greater (1,694 tpy) than for the same radius around the proposed LCH site (680 tpy), based on the 2012 EI. This monitor is located approximately 9.5 miles away from the proposed Lon C. Hill Power Station; therefore, the monitor provides a representative estimate of the PM_{10} levels near the proposed site. The applied ambient concentration for 24-hour PM_{10} is 45 μg/m^3.

$PM_{2.5}$ Proposed Monitoring Station

The 2010-2012 datasets from the three $PM_{2.5}$ monitors located in Nueces County (Corpus Christi Huisache 1 & 2, and Dona Park) do not meet EPA's completeness requirements of at least 75% of data completeness for each quarter. The applicable substitution test outlined in Appendix N to 40 CFR Part 50 was performed on the Corpus Christi Huisache and Dona Park monitors. The Huisache 2 monitor did not meet the minimum data capture requirement required to perform the substitution test. The annual $PM_{2.5}$ DV for the Huisache 1 monitor could not be validated. Both the 24-hour and annual $PM_{2.5}$ DVs from the Dona Park monitor were validated by the substitution test. Refer to Attachment D for the substitution test demonstration.

Consequently, the Dona Park monitor (EPA ID: 48-355-0034) in Nueces County is proposed for use in the analyses. $PM_{2.5}$ emissions in a 10 kilometer radius around the monitor are greater (1,293 tpy) than for the same radius around the proposed LCH site (679 tpy), based on the 2012 EI. This monitor is located approximately 9.5 miles away from the proposed Lon C. Hill Power Station; therefore, the monitor provides a representative estimate of the $PM_{2.5}$ levels near the proposed site. The applied ambient concentrations are: 23.7 µg/m^3 for 24-hour $PM_{2.5}$ and 9.4 µg/m^3 for annual $PM_{2.5}$.

SO_2 Proposed Monitoring Station

Though it is not expected that the proposed project will exceed the SO_2 SIL given that the power plant will be natural gas fired with inherently low SO_2 emissions, an SO_2 monitoring station has been identified. The Corpus Christi Tuloso monitor (EPA ID: 48-355-0026) in Nueces County is being proposed for ambient monitoring data. SO_2 emissions in a 10 kilometer radius around the monitor are greater (534 tpy) than for the same radius around the proposed LCH site (111 tpy), based on the 2012 EI. The monitor, located approximately 3.6 miles away from the proposed Lon C. Hill Power Station, is the closest SO_2 monitor in Nueces County to the proposed site; therefore, the monitor will provide a representative estimate of the SO_2 levels near the proposed site.

Ozone Proposed Monitoring Station

The proposed NO_x emission rate for the Lon C. Hill Power Station redevelopment will be greater than 100 tpy, consequently an ozone screening analysis will be required (Refer to Section 5.7). A screening approach based on the project 8-hour NO_x modeling result concentration will be used to estimate the potential impact of the project on the ozone concentration at a distance of 10-to-11 km downwind of the project site.

For the ozone ambient monitoring data, the Corpus Christi Tuloso monitor (EPA ID: 48-355-0026) in Nueces County is proposed. Since ozone is not directly emitted, NO_x and VOC emissions are being used as a surrogate to evaluate emissions near the monitor and the project site. The NO_x and VOC emissions in a 10 kilometer radius around the monitor are greater (4,709 tpy of NO_x and 2,114 tpy of VOC) than for the same radius around the proposed LCH site (2,677 tpy of NO_x and 715 tpy of VOC), based on the 2012 EI. The monitor, located approximately 3.6 miles away from the proposed Lon C. Hill Power Station, is the closest ozone monitor in Nueces County to the proposed site; therefore, the monitor provides a representative estimate of the ozone levels near the proposed site. The applied ambient concentration for 8-hour ozone is 140.6 µg/m^3 (72 ppb vs. 75 ppb standard)

4.2 Ambient Background Concentration Data

This section summarizes the background concentrations proposed to be used in the PSD NAAQS analysis, the $PM_{2.5}$ background concentrations calculated for use in the justification of the SILs and secondary PM formation, as discussed in Sections 2.2 and 5.6 respectively, and the ozone background concentration to be used in the ozone screening analysis, as discussed in Section 5.7.

Raw and statistic ambient monitoring data were obtained from the following sources:

- **NO_2**: TCEQ's Texas Air Monitoring Information System (TAMIS) website at the following web address: http://www5.tceq.state.tx.us/tamis/.

- **NO_2, Ozone, CO PM_{10} and $PM_{2.5}$**: EPA's AirData website at the following web address: www.epa.gov/airdata/ad_rep_mon.html.

The values calculated from ambient monitoring data obtained in parts per billion by volume (ppb) and parts per million by volume (ppm) was converted to micrograms per cubic meter (µg/m^3) using the following formulae, and standard conditions of 1 atmosphere and 25°C:

- $\frac{\mu g}{m^3} = ppb \times 12.187 \ \times MW/T$
- $\frac{\mu g}{m^3} = ppm \times 12.187 \ \times MW/T \ \times 1000$

  - ppm= constituent concentration
  - 12.187= Universal Gas Law constant, in (mol-K)/(atm-L)
  - MW- molecular weight of constituent
  - T= Temperature in kelvins (K), K=273.15 + °C

NO_2 Background Concentration

The NO_2 background concentrations measured at the Nederland High School monitor (EPA ID: 48-245-1035) was manually calculated using the procedures outlined in Appendix S to 40 CFR Part 50. The 1-hour background concentration is the 3-year average of the 98th percentile of the daily maximum 1-hour NO_2 values for 2010 through 2012. The annual background concentration is the arithmetic average of all the 1- hour NO_2 values observed at the monitoring site during the 2012 calendar year. Table 7 presents the 1-hour NO_2 background concentration and Table 8 presents the annual NO_2 background concentration.

Table 7 – 1-Hour NO_2 Background Concentrations

Monitor ID	Monitor Name	Year	Valid Days[1]	Number of Observations	98th Percentile (ppb)
482451035	Nederland High School	2010	346	8241	34
		2011	327	7856	25
		2012	349	8293	28
Calculated Three Year Average (ppb)					**29**
Calculated Three Year Average (µg/m^3)					**54.5**

(1) Number of days with at least 75% of observations reported.

Table 8 – Annual NO_2 Background Concentrations

Monitor ID	Monitor Name	Year	Number of Observations	Annual Average (ppb)	Annual Average ($\mu g/m^3$)
482451035	Nederland High School	2012	8293	4	7.9

CO Background Concentration

The CO background concentrations proposed are measured at the Clinton monitor (EPA ID: 48-201-1035). The CO background concentrations are the highest-second-high (H2H) 1-hour and 8-hour CO ground level concentrations observed at the proposed monitoring site for the 2012 calendar year, as outlined in 40 CFR 50.8. Table 9 summarizes the proposed CO background concentrations.

Table 9 – 1-Hour and 8-Hour CO Background Concentrations

Monitor ID	Monitor Name	Year	Averaging Period	Number of Observations(1)	H2H (ppm)	H2H ($\mu g/m^3$)
482011035	Clinton	2012	1-Hour Average	8597	1.4	1596
			8-Hour Average	8687	1.1	1254

(1) Observations represent the number of 1-hour values reported for the year. The 1-hour values are used to compute rolling 8-hour averages. The reported values come directly from EPA's AirData website: www.epa.gov/airdata/ad_rep_mon.html

PM_{10} Background Concentration

The PM_{10} background concentration proposed is the highest-second-high (H2H) 24-hour PM_{10} ground level concentration observed at the Dona Park monitor (EPA ID: 48-355-0034) for the 2012 year, as outlined in 40 CFR 50.6 and Appendix K to 40 CFR Part 50. Table 10 summarizes the proposed PM_{10} background concentration.

Table 10 – 24-Hour PM_{10} Background Concentration

Monitor ID	Monitor Name	Year	Number of Observations	H2H ($\mu g/m^3$)
483550034	Dona Park	2012	58	53

$PM_{2.5}$ Background Concentration

The $PM_{2.5}$ background concentrations proposed are measured at the Dona Park monitor (EPA ID: 48-355-0034). As outlined in Appendix N to 40 CFR Part 50, the $PM_{2.5}$ ground level concentration for the annual averaging period is based on the 3-year average of the annual average $PM_{2.5}$ concentrations; for the 24-hour averaging period, the ground level concentration is based on the 3-year average of the 98th percentile 24-hour average $PM_{2.5}$ concentrations for the daily standard. Proposed values are summarized in Table 11.

Table 11 –Annual and 24-Hour $PM_{2.5}$ Background Concentrations

Monitor ID	Monitor Name	Year	Number of Observations	98th Percentile 24-hour Average (µg/m^3)	Annual Average (µg/m^3)
483550034	Dona Park	2010	52	20	9.3
		2011	44	26	9.3
		2012	55	25	9.6
Calculated Three Year Average (µg/m^3)				**23.7**	**9.4**

SO_2 Background Concentration

An SO_2 background concentration is not being proposed at this time, as it is unlikely the proposed project will exceed the SIL. However, should that be the case, SO_2 background concentration will be obtained from the Corpus Christi Tuloso monitor (EPA ID: 48-355-0026) in Nueces County, as detailed in Section 4.1. The background concentrations would be calculated as outlined in 40 CFR 50.5 and Appendix T to 40 CFR Part 50.

Ozone Background Concentration

The ozone background concentrations are measured at the Corpus Christi Tuloso monitor (EPA ID: 48-355-0026). The 8-hour background concentration is the three year arithmetic average of the annual highest-fourth-high daily maximum 8-hour ozone concentrations for 2010 through 2012, as outlined in Appendix P to 40 CFR Part 50. Table 12 summarizes the ozone background concentration.

Table 12 – 8-Hour Ozone Background Concentration

Monitor ID	Monitor Name	Year	Percent Valid Days	H4H 8-hour Concentration (ppb)
483550026	Corpus Christi Tuloso	2010	95	72
		2011	98	78
		2012	99	65
Calculated Three Year Average (ppb)				**72**
Calculated Three Year Average (µg/m^3)				**140.6**

4.3 Preconstruction Monitoring Requirements

In the event that the modeling analysis predicts project impacts above the applicable preconstruction monitoring significance levels, LCH requests to use the ambient background concentrations summarized in Section 4.2 in lieu of performing preconstruction monitoring. Preconstruction monitoring significance levels have not been established for ozone and sulfuric acid. Existing ambient monitoring data and site-wide modeling for the state property line standard analysis will be used for the ozone and sulfuric acid preconstruction monitoring analysis, respectively.

As described in the TCEQ Air Quality Modeling Guidelines, the requirement for preconstruction monitoring may be waived if data are available to demonstrate NAAQS compliance. Since background monitoring information is available and representative as described in Section 4.1 of this protocol, and site-wide modeling for sulfuric acid will performed as described in Section 7.5, LCH requests that the preconstruction monitoring requirements for the Lon C. Hill Power Station be waived.

Section 5
Modeling Emissions Inventory

This section describes the emission sources and procedures for developing the representative emission rates and stack parameters for the air dispersion modeling analysis.

5.1 On-Property Sources

A current TCEQ Table 1(a) showing all of the emission sources in the permit application is included in Attachment A. Detailed modeling parameters including location, stack height, emission rate, exhaust flow, and exhaust temperature for all sources in the permit application will be provided in the Air Quality Analysis (AQA) report.

5.2 Off-Property Sources

If any of the criteria pollutant SILs is exceeded, compliance with the applicable pollutant and averaging period specific NAAQS standard will be demonstrated by completing a cumulative impact assessment to account for the combined impact of the on-property emission sources, emissions from other nearby sources (off-property), and the representative background levels as described in Section 4.2 of this protocol.

The off-property sources will be obtained from the TCEQ by requesting a retrieval of the Air Permits Allowable Database (APAD). The retrievals will be based on the maximum observed Radius of Impact (ROI) plus 50 km. The AOI will be defined by the receptors where the project- source modeling predicts concentrations above the relevant SILs. The ROI is the maximum distance from the property line to the point of any given SIL exceedance. A file of the APQD retrievals used in the modeling analysis will be included in the final AQA report. The following changes will be made to the TCEQ retrievals to prepare them for use in the model:

- Surface-based releases will be modeled at a release height of 1 meter;
- Stack diameters less than 0.001 m will be set to 0.001 m;
- Stack velocities less than 0.001 m/s will be set to 0.001 m/s; and

The APAD sources will be reviewed for completeness. If other sources are known to exist, they will be included in the modeling analysis. Stack parameters and emission rates for these sources not included in the retrieval data set will be determined by reviewing the TCEQ permitting files.

5.3 Source Characterization and Justification

Table 13 summarizes the site sources with the respective characterizations.

Table 13 – Lon C. Hill Site Sources

Source	EPN	Characterization
Unit 1 Combined Cycle (GT+HRSG)	STK-101	Point Source
Unit 2 Combined Cycle (GT+HRSG)	STK-102	Point Source
Unit 1 GT Lube Oil Vent	LOVSTK-101	Pseudo-Point Source
Unit 2 GT Lube Oil Vent	LOVSTK-102	Pseudo-Point Source
ST Lube Oil Vent	LOVSTK-103	Pseudo-Point Source
Auxiliary Boiler	ABLSTK-100	Point Source
Emergency Generator	EGENSTK-100	Point Source
Firewater Pump	FWPSTK-100	Point Source
Cooling Tower 1	CTW-100	Point Source
Cooling Tower 2	CTW-200	Point Source
Site Fugitive Ammonia Service	FUGSCR-100	Area Source

Point sources will be modeled with the best available stack parameter information, as detailed in Table 1(a). The two cooling tower are listed as individual EPNs on the Table 1(a); however, for the modeling purposes, each of the cells will be modeled as a separate stack and the total emission rate will be divided equally over the cells for each cooling tower.

Sources that do not have vertical stacks will be modeled as pseudo-point sources. The use of pseudo-point source parameters for these sources is appropriate because they have no plume rise. Pseudo-point sources will be modeled with the following parameters: a stack exit diameter of 0.001 meter, stack velocity of 0.001 meter per second, and an exhaust temperature of zero Kelvin, as required by TCEQ. An emission point with a temperature set to zero Kelvin instructs the model to vary the temperature of the source with the ambient temperature from the meteorological data. Fugitive emissions from piping components will be modeled as square area sources.

5.4 Startup/Shutdown/Maintenance Emissions

The final AQA will include the emissions associated with the maintenance, startup, and shutdown (MSS) activities which are identified in Table 14.

Table 14 – MSS Source Groups

Source	EPN	Group
Unit 1 Combined Cycle (GT+HRSG) Startup/Shutdown	STK-101	CC-2 SU-SD
Unit 2 Combined Cycle (GT+HRSG) Startup/Shutdown	STK-102	CC-2 SU-SD
Auxiliary Boiler Startup/Shutdown	ABLSTK-100	Aux Boiler SU-SD
MSS Soldering, Welding, Brazing	WELD	Routine Maintenance

For each constituent, impacts from the MSS emissions will be determined using source groups in the modeling. Each source group will be determined by only including the set of sources that could operate simultaneously. The proposed analysis for planned MSS activities will differ from the routine emissions as follows:

- For activities with a duration less than 1-hour, the analysis will evaluate the sustained emission rate over a 1-hour period due to constraints inherent in dispersion models;
- For averaging periods greater than 1-hour in duration, the analysis will evaluate the sustained emission rate over the appropriate averaging period;
- The analysis will consider MSS emissions separately from routine emissions since MSS conditions typically occur independently of process operations; and
- If the model predicts a concentration greater than an applicable ESL, LCH will scale the estimated hours of exceedance by the proposed time required for planned MSS activities.
- Off-property sources will only be modeled at their routine emission rates. MSS emission rates will not be included, as it is extremely unlikely that MSS for on-property and off-property sources will occur simultaneously.

5.5 NOx to NO_2 Conversion

As outlined in the EPA's Memorandum, Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, March 1, 2011, a Tier 3 approach may be used to convert 1-hour and annual NO_X emission rates in order to obtain the NO_2 emission rates for input into the modeling for NAAQS analysis. A Tier 3 approach allows detailed screening techniques to be used on a case-by-case basis. The use of the Plume Volume Molar Ratio Method (PVMRM) implemented in AERMOD is being proposed. The PVMRM is currently implemented as non-regulatory-default within the AERMOD dispersion model. Therefore, approval to use the PVMRM is requested, pursuant to Sections 3.1.2.c, 3.2.2.a, and A.1.a(2) of Appendix W.

The request to use PVMRM for predicting the NO_2 concentrations is based on the following reasons:

- EPA's Guideline on Air Quality Models (GAQM) (Appendix W, 40 CFR 51) recommends the use of a multi-tiered approach to estimate NO_2 concentration;
- PVMRM is already implemented in AERMOD, which is approved by EPA for assessing impacts within 50 kilometers of a source;
- Based on studies and the science, the PVMRM chemistry appears to be more realistic in treating the conversion of nitric oxide (NO) to NO_2 and limiting the conversion as it considers the situation within the plume itself; and
- PVMRM has been approved for use by EPA and is used in the air modeling community outside of the U.S.

In general, maximum NO_2 concentrations estimated using Tier 1 (total conversion) or Tier 2 (default equilibrium NO_2/NO_x ratio of 0.75) provide conservative estimates of NO_2 concentrations when assessing compliance with the annual standard of 100 $\mu g/m^3$. For stationary sources with NO_x emission controls, such as the current project, the NO_2 impacts are predicted to be well below the annual NAAQS and, in many cases, less than the annual significant impact level. However, for the 1-hour average concentrations, which are greatly affected by the widely varying meteorological conditions, modeling of the emission sources, such as those for this project, can show 1-hour average NO_2 concentrations to be high relative to the 1-hour NAAQS of 188 $\mu g/m^3$ using the Tier 1 or the Tier 2 approach. There is a clear need to perform a more detailed screening analysis, using less conservative assumptions and more realistic methods, to account for NO_2 formation when assessing NO_2 concentrations from a source, such as the PVMRM method that is being proposed.

For the combined cycle units (EPNs STK-101 and STK-102), the industry recommended NO_2/NO_x in-stack ratio of .091[3] is proposed as input to the PVMRM. For the auxiliary boiler (EPN ABLSTK-100), the default recommended NO_2/NO_x in-stack ratio of 0.10[4] is proposed as input to the PVMRM. Hourly ozone background concentrations from the Corpus Christi Tuloso monitor (EPA ID: 48-355-0026) proposed in Section 4.1 for the time period corresponding to the meteorological data sets proposed in Section 6.5 will be used as inputs to the PVMRM. Missing hourly ozone data will be modeled by substituting the missing data with the maximum annual average hourly concentration. The maximum annual average hourly concentration will be calculated by determining the maximum hourly concentration for each year and taking the average of all the annual maximum hourly concentrations.

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[3] Refer to Attachment E- CAPCOA Engineering Managers, CAPCOA, "Modeling Compliance of The Federal 1-Hour NO2 NAAQS" October 2011, Appendix C, Page 58

[4] Refer to Attachment E- CAPCOA Engineering Managers, CAPCOA, "Modeling Compliance of The Federal 1-Hour NO2 NAAQS" October 2011, Appendix C, Page 57

5.6 Secondary PM Formation

$PM_{2.5}$ is either directly emitted from a source (primary emissions) or formed through chemical reactions with SO_2 and NO_X already in the atmosphere (secondary formation).

Secondary $PM_{2.5}$ formation due to chemical transformations occurs slowly, often over hours or even days, depending on atmospheric conditions and other variables. As the SO_2 and NO_x plume travels, it becomes increasingly diffuse. Thus, the secondary $PM_{2.5}$ ground-level impacts typically occur at some distance from associated precursor gaseous emission sources. Any ground-level impacts are expected to be considerably smaller than the impacts associated with directly emitted $PM_{2.5}$ and are unlikely to overlap with nearby maximum primary $PM_{2.5}$ impacts.

EPA has not recommended a near-field model that includes the necessary chemistry algorithms to estimate secondary impacts in an ambient air analysis. On March 4, 2013, EPA issued a Draft Guidance *for $PM_{2.5}$ Permit Modeling* (Stephen D. Page, memorandum) that outlines approaches for addressing secondary $PM_{2.5}$ formation. Based on this guidance, the Lon C. Hill project falls into "Case 3: Primary and Secondary Air Quality Impacts Only" category due to the direct $PM_{2.5}$ emissions being higher than the 10 tpy Significant Emission Rate (SER) and the NOx emissions being higher than the 40 tpy SER.

The Lon C. Hill Power Station proposed annual SO_2 emission rate is 23.0 tpy which is less than the SO_2 SER of 40 tpy, and would not be expected to result in significant secondary $PM_{2.5}$. The Lon C. Hill Power Station proposed annual NO_X emission rate is approximately 213.4 tpy, exceeding the SER of 40 tpy. According to EPA's draft guidance, for Case 3 category sources, a qualitative analysis is allowed and will be presented in the final AQA. The qualitative analysis will account for how secondary formation occurs and use representative background concentrations to demonstrate that the modeling analysis adequately addresses secondary $PM_{2.5}$. In conjunction with the representative background concentrations, the modeled predictions of NO_2 and direct $PM_{2.5}$ emissions will be used in comparison with the applicable SIL, if appropriate, to determine if the project would result in significant secondary formation of $PM_{2.5}$.

5.7 Ozone Analysis

The three-year average of the highest-fourth-high (H4H) daily maximum 8-hour ozone concentrations from the Corpus Christi Tuloso ozone monitor (EPA ID: 48-355-0026) for 2010 through 2012 is 72 ppb, as discussed in Section 4.2. This value is below the 8-hour ozone NAAQS of 75 ppb. For the proposed project, the total annual NO_X emission rate of approximately 213.4 tpy. Because the proposed NO_X emission rate is greater than 100 tpy, an ozone screening analysis is required.

A screening approach based on the project 8-hour NO_X modeling result concentration will be used to estimate the potential impact of the project on the ozone concentration at a distance of 10-to-11 km downwind of the project site. The maximum predicted project 8-hour NO_2 concentration using five individual years of meteorological data at a downwind distance of 10 to 11 km (in any direction) from the project will be determined using the NO_X to NO_2 conversion from the PVMRM model option discussed in Section 5.5. It will be assumed that one molecule of NO_2 would produce three molecules of ozone at the 10 to 11 km downwind distance, so that 3 ppb of ozone per ppb of NO_2 (which equals 3.1 $\mu g/m^3$ of ozone per $\mu g/m^3$ of NO_2) will be produced. The estimated potential impact calculated from the maximum predicted project 8-hour NO_2 concentration and the 3 ppb of ozone per ppb of NO_2 ozone yield will be added to the 8-hour background ozone concentration for comparison with the NAAQS ozone standard of 75 ppb. This approach is based on EPA's memorandum "*Summit Texas Clean Energy, Ector County, Texas-Prevention of Significant Deterioration (PSD) Permit No. PSDTX1218*", by Jeff Robinson (November 19, 2010).

Section 6
Models Proposed and Modeling Techniques

Modeling methodology will follow the procedures outlined in the applicable EPA and TCEQ guidance documents, including the following: EPA's Guideline on Air Quality Models (GAQM) (Appendix W, 40 CFR 51)*, TCEQ Air Quality Modeling Guidelines (AQMG)* (Revised, February 1999, RG-25), *Modeling and Effects Review Applicability: How to Determine the Scope of Modeling and Effects Review for Air Permits* (August 2008, APDG 5874v3), and written TCEQ and EPA memorandums.

Meteorological data and receptor grid selection are discussed in Sections 6.4 and 6.5. The recommended "regulatory default option" will be applied for other inputs. This includes the use of stack-tip downwash, the effects of elevated terrain, and calms and missing data processing routines.

6.1 AERMOD

The air dispersion modeling analyses will be performed using the **A**MS/**E**PA **R**egulatory **MOD**el (AERMOD) (version number 12345). The AERMOD model was selected because it is approved by the EPA as a Preferred/ Recommended model and is also approved by the TCEQ modeling staff.

AERMOD is a steady-state plume dispersion model for assessment of pollutant concentrations from a variety of sources. AERMOD estimates ground-level pollutant concentrations due to multiple point, area, or volume sources based on an up-to-date characterization of the atmospheric boundary layer. The model employs hourly sequential preprocessed (AERMET) meteorological data. The AERMOD model is applicable to receptors on all types of terrain, including flat terrain, simple elevated terrain (below height of stack), intermediate terrain (between height of stack and plume height), and complex terrain (above plume height). In addition, AERMOD provides a smooth transition of algorithms across these different terrains. Therefore, AERMOD was selected as the most appropriate model for the air quality impact analysis for the proposed facility. The Oris Solutions, LLC software program, "BEEST for Windows", will be used as the interface to set up the model inputs and perform the model runs.

6.2 Building Wake Effects

Building wake effects occur when the air flow around buildings influences the dispersion of pollutants. A building wake (downwash) analysis will be performed to determine appropriate downwash parameters for the major structures at the facility. Downwash parameters will be calculated using the BPIP-PRIME (version number: 04274) Program. Approximate rectangles will be used to assess the building wakes effects of irregularly shaped structures. Only structures that are solid all the way to ground level or significantly obstruct air flow will be included in the downwash analysis. The downwash structure heights and the BPIP-PRIME input and output files will be included with the final AQA.

6.3 Terrain

The terrain height difference between the modeled source and each receptor may vary. For each source/receptor combination, the relationship may be characterized as flat terrain, simple terrain, intermediate, or complex terrain. This variation affects the dispersion and the relative plume height of modeled sources.

The terrain surrounding the proposed Lon C. Hill facility is generally flat with some minor elevation changes. The receptor, source, building base, and controlling hill elevations will be obtained from USGS National Elevation Dataset (NED) files and the AERMAP processing program. AERMAP is a preprocessor program which processes the terrain information to provide inputs to AERMOD. The output from AERMAP provides not only base elevations for the receptors, but also an effective "hill height" that enables AERMOD to make more realistic simple to complex terrain concentration calculations. The AERMAP processing files will be included with the final AQA.

6.4 Receptor Grid

The receptor grid defines the locations at which the concentrations are calculated based on the dispersion of the emissions from the sources in the model input. A Cartesian receptor grid that extends 11-kilometers in all directions from the property boundary will be used for the initial AOI Analysis. This grid will start at the fenceline that restricts public access to the plant. At this time the general location of all emission sources is known. However, the exact final placement of the new units cannot be confirmed until after engineering assessments of the soils in the plant area are complete. Therefore, to ensure that the modeling results will be representative even in the case of small changes in plant location, an extended 25 meter grid will be incorporated. The receptor spacing will vary with distance from the facility fenceline as follows:

- Along the fenceline and extending 200-meters beyond the property line 25-meter spacing will be applied;
- From 200-meters to 2,000 meters, 100-meter spacing will be applied;
- From 2,000 m to 6,000 m (6 km), 500-meter spacing will be applied; and
- From 6 km to 11 KM, 1,000-meter spacing will be applied.

6.5 Meteorological Data

The meteorological data to be used in the model include hourly wind speed, wind direction, temperature and numerous other parameters. These data are used, along with other inputs, by the model to determine the dispersion of the emissions from sources in the model input.

AERMOD requires input from a preprocessor (AERMET) that organizes and processes meteorological data and estimates the necessary boundary layer parameters for dispersion calculations. Several parameters are used to describe the character of the modeled domain, including surface roughness length, albedo and Bowen ratio. These parameters are incorporated into the surface meteorological data used by AERMOD. TCEQ has developed three separate AERMOD-ready meteorological data sets for each county in the state. The different data sets correspond to three categories of surface roughness length:

- **Category 1 – LOW**: Appropriate for flat areas with surface roughness lengths of 0.001 m - 0.1 m
- **Category 2 – MEDIUM**: Appropriate for rural/suburban areas with surface roughness lengths of 0.1 m – 0.7 m
- **Category 3 – HIGH**: Appropriate for urban/industrial areas with surface roughness lengths of 0.7 m - 1.5 m

To determine which land use category is appropriate, the AERSURFACE preprocessor was used. As discussed in the EPA's AERSURFACE User's Guide (EPA-454/B-08-001), the surface roughness length is related to the height of obstacles to the wind flow and is, in principle, the height at which the mean horizontal wind speed is zero based on a logarithmic profile. The surface roughness length influences the surface shear stress and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. AERSURFACE utilizes land use data available from the 1992 National Land Cover Data (NLCD). A default 1 km radius was used to determine the appropriate surface roughness value. The AERSURFACE output is included in Attachment B.

Given that the surface roughness calculated from AERSURFACE (Zo = 0.201 m) is within the TCEQ's medium roughness range (0.1 m to 0.7 m), the pre-processed TCEQ AERMET data corresponding to medium roughness for Nueces County will be used.

Pre-processed (via AERMET) meteorological data sets for 2008, 2009, 2010, 2011 and 2012 were obtained from the TCEQ. This represents the five most recent years of approved data available. The surface station and the upper air station is Corpus Christi (CRP, ID #12924). The data sets will be applied for each analysis as summarized in Table 15.

Table 15 – Meteorological Data Sets

Pollutant	Averaging Period	Applicable Analysis	Met Data Set	Concentration Rank Applied
NO_2	1-hr	PSD NAAQS	5-yr, Concatenated	H8H
	Annual	PSD NAAQS, PSD Increment	5-yr, Individual	H1H
CO	1-hr	PSD NAAQS	5-yr, Individual	H2H
	8-hr			
PM_{10}	24-hour	PSD NAAQS	5-yr, Individual	H6H
		PSD Increment		H2H
	Annual	PSD Increment	5-yr, Individual	H1H
$PM_{2.5}$	24-hour	PSD NAAQS	5-yr, Concatenated	H8H*
		PSD Increment	5-yr, Individual	H2H
	Annual	PSD NAAQS	5-yr, Concatenated	H1H
		PSD Increment	5-yr, Individual	
SO_2	30- min	State Property Line	5-yr, Individual	H1H
	1-hour	State NAAQS	5-yr, Concatenated	H4H
	3-hour	State NAAQS	5-yr, Individual	H2H
	24-hour	State NAAQS	5-yr, Individual	H2H
	Annual	State NAAQS	5-yr, Individual	H1H
H_2SO_4	1-hr	State Property Line	2012 data file	H1H
	Annual			
NH_3	1-hr	Health Effects	2012 data file	H1H
	Annual			
HCHO	1-hr	Health Effects	2012 data file	H1H
	Annual			

*** Modeled Design Value**

Section 7
Modeling Results

This section explains how the modeling results will be presented relative to all applicable standards. The modeling results tables will list the maximum concentration for each constituent and averaging time, and the applicable SIL, NAAQS, PSD increment, or TCEQ property line standard. A Flash drive containing all the modeling input and output files will be included in the final AQA.

In the modeling analysis, several conservative assumptions may be incorporated. If TCEQ requests additional modeling to demonstrate compliance, these conservative assumptions could be refined in any future modeling analysis.

7.1 AOI Analysis

Modeling for the permit will begin with modeling the on-property (project) emission sources discussed in Section 5.1 and listed in Attachment A. The resulting modeled ground level concentrations due to operation of the project will be compared to the air quality SILs, as defined by EPA and shown on Table 2. Separate runs will be carried out for the MSS emissions, as detailed in Section 5.4. If maximum off-property pollutant concentrations for any specific pollutant and averaging period are below these levels, the project will not cause nor contribute to a significant air quality impact, and no further modeling related to that specific standard will be performed.

In general, the high, first high (H1H) concentration for each pollutant will be compared to the SIL. The results of the modeling for the $PM_{2.5}$ and 1-hr NO_2 NAAQS analyses will be presented as the highest five-year average of the maximum modeled $PM_{2.5}$ and 1-hr NO_2 concentrations predicted each year at each receptor, consistent with EPA guidance.

However, if there is an exceedance of the SIL for a specific standard, an AOI will be defined for that pollutant and averaging time. The AOI will include each receptor at which the predicted ambient concentration for the project is above the corresponding SIL. The receptor locations and time periods where the project has a significant impact constitute significant events. The radius of significant impact (ROI) is defined as the furthest distance to a significant event. For pollutants having multiple short-term SILs exceedances, the short-term ROI will be defined as the greatest distance to any short-term significant event.

7.2 PSD Monitoring Analysis

The purpose of the PSD monitoring analysis is to determine whether preconstruction monitoring may be required to evaluate existing air quality before the permit is issued. To evaluate whether preconstruction monitoring is required, the pollutant concentrations obtained from the AOI analysis modeling described in Section 7.1 will be compared to the preconstruction monitoring significance level for each applicable pollutant, as defined by EPA and shown on Table 2. If the maximum concentration for any specific pollutant does not exceed the preconstruction monitoring significance level, preconstruction monitoring will not be required.

However, if the maximum concentration for any specific pollutant is above the applicable preconstruction monitoring significance levels, LCH requests to use the ambient background concentrations summarized in Section 4.2 in lieu of performing preconstruction monitoring, as proposed in Section 0.

7.3 NAAQS Analysis

The purpose of NAAQS Analysis is to show that the proposed project (maximum modeled impact concentrations plus background concentrations) does not cause nor contribute to a NAAQS violation or exceed a PSD Increment. The project will not be considered to cause or contribute to a NAAQS violation unless impacts from the project itself exceed the NAAQS or the project has a significant impact at the same location and time as a predicted NAAQS violation. The following approach is proposed for performing the NAAQS and PSD Increment analyses:

1. A receptor grid will be developed for each pollutant, averaging period and meteorological data year by analyzing the maximum concentration at each receptor from the AOI analysis. Only those receptors from the AOI analysis which had at least one predicted significant event will be included in the analyses. The analyses will result in different receptor grids for each pollutant, averaging period and meteorological data year (Refer to Table 15). For example, for the 1-hour NO_2, 1-hour SO_2, and 24-hour and annual $PM_{2.5}$ NAAQS analysis, the significant receptors will be determined by averaging the modeled results from the meteorological data years using the 5-year concatenated meteorological data file and the appropriate averaging time.
2. Short-term and annual modeling will be performed using AERMOD for both the on-property and off-property sources. Annual modeling will be performed using the “ANNUAL” option. Both short-term and annual analyses will be run using the 5 years of meteorological data, either concatenated or individual files as required by Appendix W to 40 CFR Part 51 and as specified in Table 15. If the predicted concentrations plus background concentrations do not exceed the NAAQS, NAAQS compliance is demonstrated and no further modeling is necessary.
3. In the event that potential NAAQS exceedances are modeled, the specific receptors will be analyzed to determine if the permitted sources are predicted to make a significant impact at the same time and location as the NAAQS exceedance. If the permitted sources do not have a significant impact at these times, then compliance with the applicable NAAQS and/or Increment is demonstrated and no further modeling for that standard is necessary.

If potential exceedances of the standards are observed at receptor(s) that reside within another facility, a special receptor grid will be made with the receptors on the off-property sources property. The modeling will be performed at those receptors without those specific off-property sources included in the modeling run. If the impacts due to the permitted sources and other off-property sources do not have a significant impact at these times, then compliance with the applicable NAAQS and/or Increment is demonstrated and no further modeling for that standard is necessary.

In the case that the receptor(s) is not located on an off-property sources' property, the receptor(s) will be extracted from the original receptor grid and analyzed separately from the other receptors. The model will be re-run for only those averaging periods that the project sources exceeded the applicable significance level. The "MAXDCONT" function may be used to identify the sources that have the largest contribution to a modeled impact for further evaluation. This function may be used, as necessary to evaluate 1-hour SO_2, 1-hour NO_2, and 24-hour $PM_{2.5}$ impacts, as detailed in the AERMOD User Guide Addendum[5].

The EPA has recently published guidance[6] that it is now acceptable to combine the modeled concentrations of $PM_{2.5}$, from dispersion model estimates based on the project's and other nearby source's direct $PM_{2.5}$ emissions, with the monitored concentrations of $PM_{2.5}$ for comparison to the $PM_{2.5}$ NAAQS standard. This guidance will be used for the $PM_{2.5}$ NAAQS modeling demonstration.

7.4 PSD Increment Analysis

The purpose of the PSD increment analysis is to demonstrate that emissions of criteria pollutants from a new major source or major modification of an existing major source will not cause or contribute to an exceedance of an increment. The PSD increment is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant. The following approach is proposed for performing the PSD Increment analysis:

1. For those constituents for which the respective SIL is exceeded, the modeled maximum predicted concentration (excluding background concentration) will be compared to the applicable increment. If the modeled concentration is below the applicable increment, the demonstration is complete. The maximum predicted concentration will be the same one obtained in the PSD NAAQS analysis, except for those constituents with NAAQS that are statistically-based.
2. For constituents with modeled concentration above the applicable increment, an AOI will be determined for each constituent and averaging period subject to the PSD increment analysis. The AOI will be the same one used in the PSD NAAQS analysis, except for those criteria pollutants with NAAQS that are statistically-based. For criteria pollutants with

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[5] *Addendum - User's Guide for the AMS/EPA Regulatory Model (AERMOD) (EPA-454/B-03-001, September 2004)*, December 2012

[6] *Draft Guidance for $PM_{2.5}$ Permit Modeling*, Stephen D. Page, March 4th, 2013

NAAQS that are statistically-based, determine the AOI following the convention of exceedance-based NAAQS (i.e., maximum predicted concentration).

3. A listing of all increment-affecting sources and associated parameters will be obtained from the TCEQ to include in the air dispersion modeling. The emission inventory will be adjusted to omit any source from the inventory that has a negative emission rate, unless the source existed and was in operation at the applicable minor source baseline date. A source must have existed and been in operation on or before the applicable minor source baseline date to be considered for increment expansion. Also, any source permitted after the applicable minor source baseline date that has shut down will be omitted. A source that did not exist or was not operating on the applicable minor source baseline date would not have contributed to the air quality at that time, and there would be no need to model the source with an emission rate of zero.
4. A modeling demonstration following the tiered approach outlined in the *TCEQ Air Quality Modeling Guidelines (AQMG)* (Revised, February 1999, RG-25), as applicable, will be performed.

7.5 State Property Line Analyses

State property line analyses will be conducted for the 30-minute SO_2, and the 1-hour and 24-hour H_2SO_4 averaging periods. For these analyses, the maximum off-property concentration as a result of the project will be compared to 2% of the TCEQ Chapter 112 standards. If the maximum off-property concentration is less than 2% of 30 TAC Chapter 112 standard, then the project is considered insignificant and no further analysis will be performed. If further analysis is required, the maximum off-property concentrations from the site will be compared to 30 TAC Chapter 112 standards.

7.6 Effects Screening Levels

Modeling for the non-criteria pollutants or State Health Effects evaluation will be conducted following the MERA Flowchart[7]. ESLs are TCEQ guideline concentrations used to evaluate the health effects anticipated from modeled concentrations of a project or site. Health-based ESLs are set at levels far below those levels which have been shown to cause adverse health effects in humans or laboratory animals. Thus, an ESL is a conservative screening tool to help in the assessment of whether the pollutant concentrations will be protective of public health. It is a guideline to separate constituents which would not be expected to cause adverse health and welfare effects (below the ESL) from those where additional review is more appropriate (above the ESL). The ESLs will be evaluated for ammonia and formaldehyde, as listed in Table 3.

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[7] TCEQ *Modeling and Effects Review Applicability: How to Determine the Scope of Modeling and Effects Review for Air Permits* (August 2008, APDG 5874v3)

The TCEQ uses a three-tiered approach to assess public health and welfare effects from non-criteria pollutants. The tiers listed below represent a progressively more complex review process of routine emissions, each requiring increasingly detailed information.

- **Tier I** – The off-property short-term and long-term (as applicable) concentrations are compared to the applicable ESLs. If the modeled concentrations are less than the ESLs, then the impacts are considered protective of public health and no further review is performed.
- **Tier II** – The type of receptor where the ESL exceedance is predicted to occur is evaluated. There are two types of receptors: industrial and non-industrial. If the maximum predicted concentration at an industrial receptor is less than twice the ESL and the maximum concentration at a non-industrial receptor is less the ESL, then the impacts are considered protective of public health and no further review occurs.
- **Tier III** – Additional case-specific factors that have a bearing on the predicted concentration are analyzed. The following factors are among those that are considered:
    - Surrounding land use;
    - Magnitude of the concentration exceeding the ESL;
    - Frequency of ESL exceedances;
    - Degree of conservatism in the emission calculations; and
    - Degree of conservatism in the modeling parameters or scenario modeled.

For the Tier III analysis, TCEQ guidance provides for the evaluation of a number of various combinations of magnitude over the ESL and the frequency of exceeding the ESL. The frequency of exceeding the ESL is determined for various multiples of the ESL (e.g., 2x, 4x, and 10x). If the combination of receptor, magnitude and frequency would not be expected to have an adverse effect on public health, then the concentration is deemed acceptable.

7.7 Additional Impacts Analysis

The proposed facility's impacts on growth, soils, vegetation, and visibility will be discussed in the final modeling report. The modeling results will be used to make a judgment on the soils and vegetation impacts. The NAAQS secondary standards were set by EPA to provide protection to most soils and vegetation from the adverse effects of air pollution. If the model results demonstrate that the impacts from all constituents are less than the NAAQS secondary standards, it will be concluded that the project will not have an adverse effect on soils and vegetation.

As discussed in Section 3, the facility is located at a distance greater than 100km from the nearest Class I area; therefore, per TCEQ guidance, no PSD Class I visibility impairment analysis is required. Per the TCEQ modeling guidance, the proposed project will meet the visibility analysis requirement by complying with the visibility and opacity requirements in 30 TAC Chapter 111.

Attachment A

Table 1(a)

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary (Worst Case)

Date:	February 28, 2014	**Permit No.:**	114911 - PSDTX1380	**Regulated Entity No.:**	RN100215979
Area Name:	Lon C Hill Power Station			**Customer Reference No.:**	CN602656688

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

AIR CONTAMINANT DATA					
1. Emission Point			**2. Component or Air Contaminant Name**	**3. Air Contaminant Emission Rate**	
(A) EPN	**(B) FIN**	**(C) NAME**		**(A) LB/HR**	**(B) TPY**
STK-101	CC-101	Unit 101 Combined Cycle (GT+HRSG)	NOx	32.7	
			NOx (startup/shutdown)	206.8	
			CO	11.7	
			CO (startup/shutdown)	3,137.2	
			VOC	6.5	
			VOC (startup/shutdown)	359.7	
			SO_2	35.9	
			$PM_{10}/PM_{2.5}$	29.7	
			H_2SO_4	5.5	
			NH_3	24.2	
			NH_3 (startup/shutdown)	34.0	
STK-102	CC-102	Unit 102 Combined Cycle (GT+HRSG)	NOx	32.7	
			NOx (startup/shutdown)	206.8	
			CO	11.7	
			CO (startup/shutdown)	3,137.2	
			VOC	6.5	
			VOC (startup/shutdown)	359.7	
			SO_2	35.9	
			$PM_{10}/PM_{2.5}$	29.7	
			H_2SO_4	5.5	
			NH_3	24.2	
			NH_3 (startup/shutdown)	34.0	
STK-101 & STK-102	CC-101 & CC-102	Unit 101 Combined Cycle (GT+HRSG) Unit 102 Combined Cycle (GT+HRSG)	NOx		208.7
			NOx (startup/shutdown)		
			CO		846.4
			CO (startup/shutdown)		
			VOC		142.9
			VOC (startup/shutdown)		
			SO_2		11.7
			$PM_{10}/PM_{2.5}$		109.5
			H_2SO_4		1.8
			NH_3		199.7
			NH_3 (startup/shutdown)		
LOVSTK-101	CC-101	Unit 101 GT Lube Oil Vent	$PM_{10}/PM_{2.5}$	0.003	0.01
LOVSTK-102	CC-102	Unit 102 GT Lube Oil Vent	$PM_{10}/PM_{2.5}$	0.003	0.01
LOVSTK-103	ST-103	ST Lube Oil Vent	$PM_{10}/PM_{2.5}$	0.01	0.05

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary (Worst Case)

Date:	February 28, 2014	**Permit No.:**	114911 - PSDTX1380	**Regulated Entity No.:**	RN100215979
Area Name:	Lon C Hill Power Station			**Customer Reference No.:**	CN602656688

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

AIR CONTAMINANT DATA

1. Emission Point			2. Component or Air Contaminant Name	3. Air Contaminant Emission Rate	
(A) EPN	(B) FIN	(C) NAME		(A) LB/HR	(B) TPY
ABLSTK-100	ABL-100	Auxiliary Boiler	NOx	1.7	2.8
			NOx (startup/shutdown)	4.8	
			CO	1.8	5.1
			CO (startup/shutdown)	17.9	
			VOC	0.3	0.3
			SO$_2$	0.03	0.03
			PM$_{10}$/PM$_{2.5}$	0.4	0.4
EGENSTK-100	EGEN-100	Emergency Generator	NOx	20.3	1.0
			CO	25.1	1.3
			VOC	2.9	0.14
			SO$_2$	2.7	0.1
			PM$_{10}$/PM$_{2.5}$	1.19	0.06
FWPSTK-100	FWP-100	Firewater Pump	NOx	10.7	0.5
			CO	3.6	0.2
			VOC	10.7	0.5
			SO$_2$	1.3	0.1
			PM$_{10}$/PM$_{2.5}$	0.5	0.03
CTW-100	CTW-100	Cooling Tower 1	PM$_{10}$	0.8	2.3
			PM$_{2.5}$	0.003	0.01
CTW-200	CTW-200	Cooling Tower 2	PM$_{10}$	0.05	0.24
			PM$_{2.5}$	0.0002	0.001
OWS-100	OWS-100	Oil Water Separator	VOC	1.0	0.2
TKSTK-101	TK-101	Diesel Tank (Emergency Generator)	VOC	0.03	0.0001
TKSTK-102	TK-102	Diesel Tank (Firewater Pump)	VOC	0.01	0.0001
TKSTK-103	TK-103	Gasoline Tank	VOC	2.89	0.01
FUGNG-100	FUGNG-100	Fugitive Natural Gas Service	VOC	0.1	0.4
FUGSCR-100	FUGSCR-100	Fugitive Ammonia Service	NH$_3$	0.01	0.04
FUGDS-100	FUGDS-100	Fugitive Diesel Service	VOC	0.05	0.24
PURG-100	PURG-100	MSS Fuel Purging Emissions	VOC	0.01	0.004
OFFWASH-100	CC-101 and CC-102	MSS Offline Turbine Washing	VOC	1.3	0.003
WELD	WELD	MSS Soldering, Welding, Brazing	PM$_{10}$/PM$_{2.5}$	0.1	0.04

EPN = Emission Point Number

FIN = Facility Identification Number

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	February 28, 2014	**Permit No.:**	114911 - PSDTX1380	**Regulated Entity No.:**	RN100215979
Area Name:	Lon C Hill Power Station			**Customer Reference No.:**	CN602656688

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

AIR CONTAMINANT DATA			EMISSION POINT DISCHARGE PARAMETERS										
1. Emission Point			4. UTM Coordinates of Emission Point			Source							
						5. Building Height (Ft.)	6. Height Above Ground (Ft.)	7. Stack Exit Data			8. Fugitives		
EPN (A)	FIN (B)	Name (C)	Zone	East (Meters)	North (Meters)			Diameter (Ft.) (A)	Velocity (FPS) (B)	Temperature (°F) (C)	Length (Ft.) (A)	Width (Ft.) (B)	Axis Degrees (C)
STK-101	CC-101	Unit 101 Combined Cycle (GT+HRSG)	14	636481	3080988		152.0	22.0	44.6	195			
STK-102	CC-102	Unit 102 Combined Cycle (GT+HRSG)	14	636441	3081016		152.0	22.0	44.6	195			
LOVSTK-101	CC-101	Unit 101 GT Lube Oil Vent	14	636443	3080919		6.8	0.5	12.7	amb.			
LOVSTK-102	CC-102	Unit 102 GT Lube Oil Vent	14	636403	3080947		6.8	0.5	12.7	amb.			
LOVSTK-103	ST-103	ST Lube Oil Vent	14	636362	3080977		6.8	0.5	12.7	amb.			
ABLSTK-100	ABL-100	Auxiliary Boiler	14	636499	3081008		14.0	2.5	78.3	400			
EGENSTK-100	EGEN-100	Emergency Generator	14	636472	3081077		10.0	0.5	60.0	200			
FWPSTK-100	FWP-100	Firewater Pump	14	636499	3081113		10.0	0.5	60.0	200			
CTW-100	CTW-100	Cooling Tower 1	14	636271	3081221	41.0	59.0	28.0	34.6	107.5			
CTW-200	CTW-200	Cooling Tower 2	14	*	*	45.0	50.0	12.0	44.3	106.7			
OWS-100	OWS-100	Oil Water Separator	14	636542	3081152		5.0	TBD	TBD	amb.			
TKSTK-101	TK-101	Diesel Tank (Emergency Generator)	14	636457	3081084		6.0	TBD	TBD	amb.			
TKSTK-102	TK-102	Diesel Tank (Firewater Pump)	14	636497	3081112		5.0	TBD	TBD	amb.			
TKSTK-103	TK-103	Gasoline Tank	14	636250	3080871		5.0	TBD	TBD	amb.			
FUGNG-100	FUGNG-100	Fugitive Natural Gas Service	14	636436	3080966					amb.	TBD	TBD	TBD
FUGSCR-100	FUGSCR-100	Fugitive Ammonia Service	14	636475	3081023					amb.	TBD	TBD	TBD
FUGDS-100	FUGDS-100	Fugitive Diesel Service	14	636474	3081095					amb.	TBD	TBD	TBD
PURG-100	PURG-100	MSS Fuel Purging Emissions	14	636436	3080966					amb.	TBD	TBD	TBD
OFFWASH-100	CC-101 and CC-102	MSS Offline Turbine Washing	14	636436	3080966					amb.	TBD	TBD	TBD
WELD	WELD	MSS Soldering, Welding, Brazing	14	636349	3081089					amb.	TBD	TBD	TBD

EPN = Emission Point Number
FIN = Facility Identification Number

* UTM Coordinates for Cooling Tower 2 will be provided in the AQA.

Attachment B

AERSURFACE Output

AERSURFACE Output

```
** Generated by AERSURFACE, dated 13016
** Generated from "C:\Users\frodriguez\Desktop\texas_se_NLCD_092800_erd.tif"
** Center UTM Easting (meters):    636463.0
** Center UTM Northing (meters):  3081042.0
** UTM Zone:  14    Datum: NAD83
** Study radius (km) for surface roughness:   1.0
** Airport? N, Continuous snow cover? N
** Surface moisture? Average, Arid region? N
** Month/Season assignments? Default
** Late autumn after frost and harvest, or winter with no snow: 12 1 2
** Winter with continuous snow on the ground: 0
** Transitional spring (partial green coverage, short annuals): 3 4 5
** Midsummer with lush vegetation: 6 7 8
** Autumn with unharvested cropland: 9 10 11


   FREQ_SECT  ANNUAL  1
   SECTOR   1    0  360
**                  Sect    Alb      Bo       Zo
   SITE_CHAR    1       1     0.16     0.42     0.201
```

Attachment C

Seabrook-Baytown-Clinton Land Area

Table 16 – Seabrook-Baytown-Clinton Land Area

City	Area (square miles)	Population[1]
Seabrook	5.33	11,952
Houston	599.59	2,097,217
Pasadena	42.76	149,293
La Porte	18.63	33,800
Webster	6.34	10,618
Deer Park	10.46	32,010
Friendswood	20.74	35,803
Galena Park	4.86	10,887
Baytown	35.45	71,802
Pearland	47.02	91,252
League City	51.29	83,560
Total:	**842**	**2,628,194**
Nueces County	**838**	**340,223**

(1) http://quickfacts.census.gov

Attachment D

Appendix N to 40 CFR Part 50: Substitution Test Demonstration

Appendix N to 40 CFR Part 50 Substitution Test Demonstration

Annual PM$_{2.5}$ NAAQS Design Value

Two substitution tests are detailed in Appendix N to validate the annual PM$_{2.5}$ NAAQS Design Value (DV), the minimum quarterly value and the maximum quarterly value data substitution tests. The minimum quarterly value data substitution test, detailed in 40 CFR Part 50, Appendix N 4.1(c)(i), is used when the annual PM$_{2.5}$ NAAQS Design Value DV from the monitor data is above the level of the NAAQS. The maximum quarterly value data substitution test, detailed in 40 CFR Part 50, Appendix N 4.1(c)(ii), is used when the annual PM$_{2.5}$ NAAQS DV from the monitor data is equal to or below the level of the NAAQS.

The PM$_{2.5}$ NAAQS DVs from the active Nueces County monitors were evaluated to determine whether the maximum or the minimum quarterly value data substitution test should be applied. As detailed in Table 17, the annual PM$_{2.5}$ NAAQS DV for all the monitors is below the level of the NAAQS; therefore, the maximum quarterly value data substitution test was applied.

Table 17 – Annual PM$_{2.5}$ NAAQS Data Substitution Test Applicability

Year	Design Value (µg/m^3) [1]			NAAQS (µg/m^3)
	Huisache 1 (EPA ID: 483550032)	Huisache 2 (EPA ID: 483550032)	Dona Park (EPA ID: 483550034)	
2010	10.2	9.6	9.3	12
2011	9.9	10.3	9.3	
2012	10.6	9.7	9.6	
Calculated DV (µg/m^3)	**10.2**	**9.7**	**9.6**	

(1) www.epa.gov/airdata/ad_rep_mon.html

The maximum quarterly value data substitution test can only be performed if at least 50 percent of data capture was achieved for each quarter that is deficient. During the first quarter of 2011, the Huisache 2 monitor (EPA ID: 48-355-0032) recorded 7 samples out of 15 scheduled samples, resulting in a data capture of less than 50 percent. For this reason, the maximum quarterly value data substitution test cannot be applied to validate the Huisache 2 monitor 2011 annual PM$_{2.5}$ NAAQS DV and the monitor will not be considered further.

To perform the maximum quarterly value data substitution test, the missing daily data in the deficient quarters was substituted by the highest reported daily PM$_{2.5}$ value for the quarter across the three years under consideration. The highest reported daily PM$_{2.5}$ values used for the substitution test are shown in Table 18 for the Huisache 1 (EPA ID: 48-355-0032) and Dona Park (EPA ID: 48-355-0034) monitors.

Table 18 – Highest Reported Daily PM$_{2.5}$ Values

Quarter	Dona Park (µg/m^3) [1]	Huisache 1 (µg/m^3) [1]
First Quarter	18.3	23.3
Second Quarter	26.3	26.4
Third Quarter	23.4	43.8
Fourth Quarter	25.4	47.2

(1) http://www5.tceq.state.tx.us/tamis/

After substituting the highest reported daily PM$_{2.5}$ value for a quarter for all missing daily data in the matching deficient quarters in order to make them 100 percent complete, a recalculated annual PM2.5 NAAQS Test DV (TDV$_{max}$) was calculated, per the equations detailed in 40 CFR Part 50, Appendix N 4.4. If the TDV$_{max}$ calculated is less than or equal to the NAAQS, then the annual PM$_{2.5}$ NAAQS DV has passed the diagnostic test and it deemed valid. The TDV$_{max}$ for the Huisache 1 monitor (EPA ID: 48-355-0032) is above the level of the annual PM$_{2.5}$ NAAQS. The TDV$_{max}$ for the Dona Park monitor (EPA ID: 48-355-0034) is less than the level of the annual PM$_{2.5}$ NAAQS. Consequently, the PM$_{2.5}$ NAAQS DV for the Dona Park monitor is deemed valid while the Huisache 1 monitor PM$_{2.5}$ NAAQS DV is invalid, as detailed in Table 19. The number of reported of values for the incomplete quarters on which maximum quarterly value substitution was performed are highlighted in Table 19.

Table 19 – Annual PM$_{2.5}$ NAAQS Maximum Quarterly Value Data Substitution Test

	Huisache 1 (EPA ID: 483550032)				Dona Park (EPA ID: 483550034)			
Quarter	No. Reported Values	Quarterly Mean [1] (µg/m$_3$)	Annual Mean [2] (µg/m^3)	TDV$_{max}$ [3] (µg/m^3)	No. Reported Values	Quarterly Mean [1] (µg/m$_3$)	Annual Mean [2] (µg/m^3)	TDV$_{max}$ [3] (µg/m^3)
Q1 2010	30	7.5	12.7	12.8	11	10.3	10.0	11.0
Q2 2010	27	11.5			13	11.4		
Q3 2010	29	12.1			14	10.9		
Q4 2010	22	19.8			14	7.7		
Q1 2011	29	9.2	15.1		13	6.9	12.2	
Q2 2011	26	12.3			10	16.7		
Q3 2011	22	19.2			12	10.3		
Q4 2011	21	19.7			9	14.9		
Q1 2012	30	-	10.6		15	8.0	10.7	
Q2 2012	24	-			11	14.5		
Q3 2012	27	-			14	11.6		
Q4 2012	30	-			15	8.5		

(1) Calculated per Equation 1 in Appendix N to 40 CFR Part 50.
(2) Calculated per Equation 2 in Appendix N to 40 CFR Part 50.
(3) Calculated per Equation 3 in Appendix N to 40 CFR Part 50.

24-Hour $PM_{2.5}$ NAAQS Design Value

Although the results of the annual $PM_{2.5}$ NAAQS DV substitution test do not preclude the Huisache 1 monitor (EPA ID: 48-355-0032) from being considered for the 24-Hour $PM_{2.5}$ NAAQS DV substitution test, the Huisache 1 monitor will not be considered for the 24-Hour $PM_{2.5}$ NAAQS unless the Dona Park monitor (EPA ID: 48-355-0034) 24-Hour $PM_{2.5}$ NAAQS DV is invalidated. The 24-Hour $PM_{2.5}$ NAAQS DV substitution test can only be performed if at least 50 percent of data capture was achieved for each quarter that is deficient and as detailed in the annual $PM_{2.5}$ NAAQS demonstration, the Huisache 2 monitor (EPA ID: 48-355-0032) does not meet the minimum data capture criteria.

The maximum quarterly value data substitution test, detailed in 40 CFR Part 50, Appendix N 4.2(c)(i), is used to validate the 24-Hour $PM_{2.5}$ NAAQS DV from years that do not meet the completeness requirement when the DV is equal to or below the level of the NAAQS. As detailed in Table 20, the 24-Hour $PM_{2.5}$ NAAQS DV for the Dona Park (EPA ID: 48-355-0034) monitor is below the level of the NAAQS; therefore, the maximum quarterly value data substitution test can be applied.

Table 20 – 24-Hour $PM_{2.5}$ NAAQS Data Substitution Test Applicability

Year	Design Value ($\mu g/m^3$) [1] Dona Park (EPA ID: 483550034)	NAAQS ($\mu g/m^3$)
2010	20	35
2011	26	
2012	25	
Calculated DV ($\mu g/m^3$)	**23.7**	

(1) **www.epa.gov/airdata/ad_rep_mon.html**

To perform the maximum quarterly value data substitution test, the missing daily data in the deficient quarters was substituted by the highest reported daily $PM_{2.5}$ value for the quarter across the three years under consideration. The highest reported daily $PM_{2.5}$ values used for the substitution test are shown in Table 18 in the Annual $PM_{2.5}$ NAAQS DV substitution test demonstration.

After substituting the highest reported daily $PM_{2.5}$ value for a quarter for all missing daily data in the matching deficient quarters in order to make them 100 percent complete, a recalculated 24-Hour $PM_{2.5}$ NAAQS TDV_{max} was calculated, per the equations detailed in 40 CFR Part 50, Appendix N 4.5. If the TDV_{max} calculated is less than or equal to the NAAQS, then the 24-Hour $PM_{2.5}$ NAAQS DV has passed the diagnostic test and it deemed valid. The TDV_{max} for the Dona Park monitor (EPA ID: 48-355-0034) is less than the level of the annual $PM_{2.5}$ NAAQS. Consequently, the $PM_{2.5}$ NAAQS DV for the Dona Park monitor is deemed valid, as detailed in Table 21.

Table 21 – 24-Hour $PM_{2.5}$ NAAQS Maximum Quarterly Value Data Substitution Test

Year	Annual 98th Percentile ($\mu g/m^3$) [1] Dona Park (EPA ID: 483550034)	NAAQS ($\mu g/m^3$)
2010	19.7	35
2011	26.3	
2012	26.3	
TDV_{max} ($\mu g/m^3$) [2]	**24.1**	

(1) Per Table 1 in Appendix N to 40 CFR Part 50.

(2) Calculated per Equation 4 in Appendix N to 40 CFR Part 50.

Attachment E
NO_2/NO_x In-Stack Ratio Source

Modeling Compliance of The Federal 1-Hour NO_2 NAAQS

CAPCOA Guidance Document

CAPCOA
CALIFORNIA
AIR
POLLUTION
CONTROL
OFFICERS
ASSOCIATION

Prepared by:
CAPCOA Engineering Managers

Approved for Release
October 27, 2011

CAPCOA Engineering Managers NO_2 Modeling Committee

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Preface

The California Air Pollution Control Officers Association (CAPCOA) has prepared this document to provide a common platform of information, tools, and recommendations to address the new federal 1-hour NO_2 National Ambient Air Quality Standard (NAAQS).

The U.S. Environmental Protection Agency has provided some guidance for demonstrating through modeling that a proposed new or modified source will comply with the 1-hour nitrogen dioxide (NO_2) NAAQS. That guidance is specifically for major sources and major modifications that are subject to Prevention of Significant Deterioration (PSD) requirements, and for those projects applicants should prepare protocols for the review by the appropriate agency that meet those requirements.

However, agencies in California must demonstrate compliance with the 1-hour NO_2 NAAQS for a variety of other regulatory programs. Existing rules may require such demonstrations for new or modified sources located in nonattainment areas. A demonstration may be necessary to satisfy the requirements of the California Environmental Quality Act (CEQA). Although federal guidance is useful for these demonstrations, such guidance is not prescriptive. The intent of this guidance document is to outline the steps necessary to demonstrate compliance with the 1-hour NO_2 NAAQS. For each step, the document identifies and discusses alternative approaches that a reviewing agency can use when preparing specific guidance for projects. In addition, the document provides alternative approaches that may be incorporated into an agency's guidance prepared specially for their jurisdiction.

Table of Contents

Glossary

AERMOD	AMS/EPA Regulatory Model
ARM	Ambient Ratio Method
AMS	American Meteorological Society
EPA	Environmental Protection Agency
ERC	Emission Reduction Credits
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
GEP	Good Engineering Practice
ISCST3	Industrial Source Complex Short-Term version 3
Monin-Obukhov Length	The Monin-Obukhov Length is a parameter with dimension of length that gives a relation between parameters characterizing dynamic, thermal, and buoyant processes. At altitudes below this length scale, shear production of turbulence kinetic energy dominates over buoyant production of turbulence.
NAAQS	National Ambient Air Quality Standard
NO	Nitric oxide
NO_2	Nitrogen Dioxide
NO_X	Mono-Nitrogen Oxides (NO and NO_2) or Total Oxides of Nitrogen
O_3	Ozone
OLM	Ozone Limiting Method
PVMRM	Plume Volume Molar Ratio Method

1 Background

On January 22, 2010, EPA revised the primary nitrogen dioxide (NO_2) NAAQS in order to provide requisite protection of public health. Specifically, EPA established a new 1-hour standard at a level of 100 ppb (188.68 $\mu g/m^3$), based on the 3-year average of the annual 98th percentile of the daily maximum 1-hour concentrations (form of the standard), in addition to the existing annual secondary standard (100 $\mu g/m^3$). EPA has also established requirements for a NO_2 monitoring network that will include monitors at locations where maximum NO_2 concentrations are expected to occur, including within 50 meters of major roadways, as well as monitors sited to measure the area-wide NO_2 concentrations that occur more broadly across communities.

The effective date of the new 1-hour standard was 60 days after the final rule was published in the Federal Register. The final rule was published in the Federal Register on February 9, 2010 with an effective date of April 12, 2010. The Federal Register Notice can be downloaded from http://www.epa.gov/ttn/naaqs/standards/nox/fr/20100209.pdf.

2 NO_2 Chemistry

NO_x is a generic term for the total concentration of mono-nitrogen oxides, nitric oxide (NO) and nitrogen dioxide (NO_2). NOx is produced from the reaction of nitrogen and oxygen gases in during combustion with air, especially at high temperatures wherein an endothermic reaction produces various oxides of nitrogen.

In the ambient air, during daylight, NO_X concentrations tend towards a photostationary state (equilibrium), where the ratio NO/NO_2 is determined by the intensity of sunshine (which converts NO_2 to NO) and the concentration of ozone and other reactive species (which react with NO to again form NO_2). At night time, NO is converted to NO_2 by its reaction with ozone (O_3)

Also, in the presence of excess molecular oxygen (O_2), nitric oxide (NO) reacts with the oxygen to form nitrogen dioxide (NO_2). The time required depends on the temperature and the reactant concentrations and is relatively slow in the ambient air but may be much more rapid in combustion systems.

For modeling purposes, the following methods have been developed to simulate the chemical reaction of NO_X to NO_2 formation.

2.1 Appendix W

Appendix W of Part 51 of Title 40 of the CFR "Guideline on Air Quality Models" has codified three methods that can be used to estimate NO_2 concentration (Tier 1 - Total Conversion, Tier 2 - Ambient Ratio Method or ARM, Tier 3 - Ozone Limiting Method or OLM). **Please note**: The Plume Volume Molar Ratio Method (PVMRM) is considered by EPA to be a Tier 3 screening method, similar to OLM.

2.1.1 Tier 1 - Total Conversion

Tier 1 - Total Conversion, assumes that the NO_X emitted from a source is converted completely to NO_2. No adjustment is made to consider the chemistry noted above.

2.1.2 Tier 2 - Ambient Ratio Method (ARM)

Tier 2 – ARM, the concentration from the Tier 1 analysis is multiplied by an empirically derived NO_2/NO_X value for the ambient air.

2.1.3 Tier 3 - Ozone limiting Method (OLM):

The following is a simplified explanation of the basic chemistry relevant to the OLM.

First, the relatively high temperatures in the primary combustion zone typical of most conventional combustion sources primarily promote the formation of NO over NO_2 by the following thermal reaction:

$N_2 + O_2 \Longrightarrow 2\,NO$ NO formation in combustion zone

In lower temperature regions of the combustion zone or in the combustion exhaust, the NO that is formed can be converted to NO_2 via the reaction.

$2\,NO + O_2 \Longrightarrow 2\,NO_2$ In-stack formation of NO_2

(In addition, other reactive species can convert NO to NO_2 during and immediately following combustion as can oxidation catalysts in the exhaust—such as oxidation catalysts used to control carbon monoxide and volatile organic compounds.)

Thus, a portion of the NOx exhausted is in the form of NO_2. This is referred to as the in-stack NO_2/NOx ratio, which is in general different from the ambient ratio such as that used in the ARM.

Historically, a default value of 10% of the NO_x in the exhaust was assumed to be NO_2. It is assumed that no further conversion by direct reaction with O_2 occurs once the exhaust leaves the stack because of the much lower temperature once the exhaust mixes with the ambient air. Thus the remaining percentage of the NO_x emissions is assumed to be NO.

As the exhaust leaves the stack and mixes with the ambient air, the NO reacts with ambient ozone (O_3) to form NO_2 and molecular oxygen (O_2):

$NO + O_3 \Longrightarrow NO_2 + O_2$ Oxidation of NO by ambient O_3

The OLM assumes that at any given receptor location (ground level), the amount of NO that is converted to NO_2 by this reaction is controlled by the ambient O_3 concentration. If the O_3 concentration is less than the NO concentration, the amount of NO_2 formed by this reaction is limited. If the O_3 concentration is greater than or equal to the NO concentration, all NO is assumed to be converted to NO_2.

In the presence of radiation from the sun, ambient NO_2 can be destroyed:

$NO_2 + \text{sunlight} \Longrightarrow NO + O$ Photo-dissociation of NO_2

As a conservative assumption, the OLM ignores this reaction.

Another reaction that can form NO_2 in the atmosphere is the reaction of NO with reactive hydrocarbons (HC):

$NO + HC \Longrightarrow NO_2 + HC$ Oxidation of NO by reactive HC

The OLM also ignores this reaction.

2.1.4 Tier 3 - Plume Volume Molar Ratio Method (PVMRM):

Building on the basic OLM chemistry, the PVMRM determines the conversion rate for NO_x to NO_2 based on a calculation of the number of NO_x moles emitted into the plume, and the number of O_3 moles contained within the volume of the plume between the source and receptor. Unlike the OLM, the PVMRM method assumes an upper bound for the ambient NO_2/NOx ratio. This default ambient ratio is 0.9.

Please note: OLM and PVMRM are implemented as non-regulatory options in the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The Industrial Source Complex – Short-Term model (ISCST3) does not contain the PVMRM algorithms. At one time, there was a version of ISCST3 that contained the OLM algorithm. However, that particular version is not able to run on current computers. OLM can be implemented by using a post-processor program. PVMRM was initially implemented using ISCST3. But, no version of ISCST3 with the PVMRM algorithm is currently available.

The dispersion algorithms in AERMOD and other steady-state plume models are based on the use of total dispersion coefficients, which are formulated to represent the time-averaged spread of the plume. A more appropriate definition of the volume of the plume for purposes of determining the number of moles of ozone available for conversion of NOx is based on the instantaneous volume of the plume, which is represented by the use of relative dispersion coefficients, (Cole and Summerhays, 1979; Bange, 1991). The implementation of PVMRM in AERMOD is based on the use of relative dispersion coefficients to calculate the plume volume. Weil (1996 and 1998) has defined formulas for relative dispersion that are consistent with the AERMOD treatment of dispersion, and which can be calculated using meteorological parameters available within AERMOD.

3 Conducting NO_2 Modeling

The following section only describes how and what is needed to conduct NO_2 modeling. This section does not provide any details regarding the development of modeling input parameters.

Please Note: Any guidance from the reviewing agency should always be followed and the information contained herein is only provided as recommendations to assist agencies in developing their own guidance.

3.1 What information is needed to conduct NO_2 Modeling?

The information needed to conduct NO_2 modeling will depend on the Tier and option selected to show compliance with the federal 1-hour NAAQS. Table 1 provides a quick reference of the basic information that is needed for each of the Tiers and options that are discussed in more detail in following sections. As seen in the table below each progressively refined option may require additional information and/or resources. The appropriate reviewing agency should be consulted before selecting any of the options listed in Table 1

.

Table 1- NO_2 Tier Quick Reference

Tier	Option	Information Needed
I Total Conversion	1	1. Model (ISCST3/AERMOD) 2. Significant Impact Level (SIL)
	2 – 11	3. Background Air Quality Data
	6 –11	4. Post processor*
	11	5. Hourly NO_2 Background Data 6. Paired-Sum Post Processor*
II ARM	1	1. Model (ISCST3/AERMOD) 2. Significant Impact Level (SIL) 3. ARM Ratio
	2 – 11	4. Background Air Quality Data
	6 –11	5. Post processor*
	11	6. Hourly NO_2 Background Data 7. Paired-Sum Post Processor*
III OLM/PVMRM	1	1. Model (ISCST3/AERMOD with a post-processor) 2. Significant Impact Level (SIL) 3. Hourly Ozone Background data 4. In-Stack NO_2/NO_X Ratio
	2 – 11	5. Background Air Quality Data
	6 –11	6. Post processor*
	11	7. Hourly NO_2 Background Data 8. Paired-Sum Post Processor*

*EPA's updated AERMOD program version 11103 will support post processing and background data inputs

3.2 *Selecting the Appropriate Model*

Selection of the appropriate model (ISCST3/AERMOD) depends primarily on the following two items; 1) the reviewing agency's acceptability of the model and 2) availability of appropriate meteorological data (met data).

For regulatory purposes EPA's "Preferred Model" is AERMOD. Other agencies may still be using ISCST3 as the model of choice, because most agencies in the state have or can acquire met data in ISCST3 format. Data processing requirements for AERMOD are more rigorous than for ISCST3. It may be difficult to obtain met data for some areas in the state that can be processed for use in AERMOD.

A brief description and limitations of each model are provided below in order to assist agencies in determining which model should be recommended. Additionally a list of met data resources has been compiled and can be found in Appendix D.

This should assist agencies in locating the resources needed for processing AERMOD met datasets.

3.2.1 ISCST3

The ISCST3 model is based on a steady-state Gaussian plume algorithm with Pasquill-Gifford stability classes. It is applicable for estimating ambient impacts from point, area, and volume sources out to a distance of about 50 kilometers from the source. ISCST3 includes algorithms for addressing building downwash influences, dry and wet deposition, and the complex terrain screening algorithms from the COMPLEX1 model which are used to estimate concentrations for receptors that are above the top of the stack but below the plume rise.

The standard version of ISCST3 is only able to perform options 1 though 5 of Tier 1 and Tier 2 of Section 3.3 without the use of a post-processor program. Therefore, its ability to conduct a more refined analysis is limited.

3.2.2 AERMOD

AERMOD is a steady-state Gaussian plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. It does not use Pasquill-Gifford stability classes. AERMOD includes algorithms for building downwash and dry and wet deposition. It includes the algorithms from the Complex Terrain Dispersion Model (CTDM) and is a refined model for intermediate and complex terrain.

With the release of AERMOD (11103), it is now able to perform modeling for all Tiers in Section 3.3. This version of AERMOD has incorporated a post-processor and options for adding background data directly into the model.

3.3 Selecting the Appropriate Tier Approach

There are several options available to demonstrate compliance with the federal 1-hour NO_2 standard. Not all options may be allowed by all agencies. Therefore, the reviewing agency should be consulted before applying any of the Tiers and/or options listed below.

3.3.1 Definition of Options

- **Significant Impact Level (SIL)** is defined as a *de minimis* impact level below which a source is presumed not to cause or contribute to an exceedance of a NAAQS.

- **Maximum Modeled** is defined as the maximum concentration predicted by the model at any give receptor in any given year modeled.

- **8th Highest Modeled** is defined as the highest 8th highest concentration derived by the model at any given receptor in any given year modeled.

- **5yr Ave of the 98th percentile** is defined as the highest of the average 8th-highest (98th percentile) concentrations derived by the model across all receptors based on the length of the meteorological data period or the X years average of 98th percentile of the annual distribution of daily maximum 1-hour concentrations across all receptors, where X is the number of years modeled. (EPA recommends in Appendix W that 5-years of meteorological data from a National Weather Service site or 1-year on-site data be modeled.)

- **Monthly Hour-Of-Day** is defined as the 3 year average of the 1st highest concentrations (Maximum Hourly) for each hour of the day

- **Seasonal Hour-Of-Day** is defined as the3year average of the 3rd highest concentrations for each hour of the day and season

- **Annual Hour-Of-Day** is defined as the 3yr average of the 8th highest concentration for each hour of the day

- **Paired-Sum (**5 yr Ave of the 98th percentile) is the merging of the modeled concentration with the monitored values paired together by month, day, and hour. The sum of the paired values are then processed to determine the X years average of 98th percentile of the annual distribution of daily maximum 1-hour concentrations across all receptors, where X is the number of years modeled.

3.3.2 Tier 1 - Maximum Conversion (No OLM or PVMRM)

1. Significant Impact Level (SIL)
2. Maximum Modeled + Maximum Monitor Value
3. Maximum Modeled + 98th Monitor Value
4. 8th Highest Modeled + Maximum Monitor Value
5. 8th Highest Modeled + 98th Monitor Value
6. 5 yr Ave of the 98th percentile + Maximum Monitor Value*
7. 5 yr Ave of the 98th percentile + 98th Monitor Value*
8. 5 yr Ave of the 98th percentile + Monthly Hour-Of-Day (1st highest)*
9. 5 yr Ave of the 98th percentile + Seasonal Hour-Of-Day (3rd Highest)*
10. 5 yr Ave of the 98th percentile + Annual Hour-Of-Day (8th Highest)*
11. Paired-Sum (5 yr Ave of the 98th percentile)**

*EPA recommended option
**May use with the approval of the reviewing agency.

3.3.3 Tier 2 - ARM (w/ Justification)

Please note: a value of 0.80 or 80% can be used without justifications as per EPA's clarification memo dated March 1, 2011 (http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf)

1. Significant Impact Level (SIL)
2. Maximum Modeled + Maximum Monitor Value
3. Maximum Modeled + 98th Monitor Value
4. 8th Highest Modeled + Maximum Monitor Value
5. 8th Highest Modeled + 98th Monitor Value
6. 5 yr Ave of the 98th percentile + Maximum Monitor Value*
7. 5 yr Ave of the 98th percentile + 98th Monitor Value*
8. 5 yr Ave of the 98th percentile + Monthly Hour-Of-Day (1st highest)*
9. 5 yr Ave of the 98th percentile + Seasonal Hour-Of-Day (3rd Highest)*
10. 5 yr Ave of the 98th percentile + Annual Hour-Of-Day (8th Highest)*
11. Paired-Sum (5 yr Ave of the 98th percentile)**

*EPA recommended option with justification of the ARM used
**May use with the approval of the reviewing agency.

3.3.4 Tier 3 - OLM or PVMRM (w/ Justification)

1. Significant Impact Level (SIL)
2. Maximum Modeled + Maximum Monitor Value
3. Maximum Modeled + 98th Monitor Value
4. 8th Highest Modeled + Maximum Monitor Value
5. 8th Highest Modeled + 98th Monitor Value
6. 5 yr Ave of the 98th percentile + Maximum Monitor Value*
7. 5 yr Ave of the 98th percentile + 98th Monitor Value*
8. 5 yr Ave of the 98th percentile + Monthly Hour-Of-Day (1st highest)*
9. 5 yr Ave of the 98th percentile + Seasonal Hour-Of-Day (3rd Highest)*
10. 5 yr Ave of the 98th percentile + Annual Hour-Of-Day (8th Highest)*
11. Paired-Sum (5 yr Ave of the 98th percentile)**

*EPA recommended option with justification of OLM or PVMRM
**May use with the approval of the reviewing agency

3.4 Other Things to Consider

3.4.1 What is Ambient Air?

The following is provided to assist the reviewing agency in making a determination of their interpretation of "Ambient Air".

3.4.1.1 Code of Federal Regulations (CFR)

40 CFR part 50.1(e) defines "Ambient Air" as meaning that portion of the atmosphere, external to buildings, to which the general public has access.

3.4.1.1.1 *EPA’s Interpretation*

In a letter date December 19, 1980, from Douglas Costle to Senator Jennings Randolph, EPA further clarified this definition by stating that the exemption from ambient air is available only for the atmosphere over land owned and controlled by the source and to which public access is precluded by a fence or other physical barriers.

3.4.1.1.2 *Other Interpretation*

As noted in the CFR notice dated February 9, 2010 entitled “Primary National Ambient Air Quality Standards for Nitrogen Dioxide”, page 6475, or 75 FR 6475 (2010-2-9), the second footnote states “The legislative history of section 109 indicates that a primary standard is to be set at ‘‘the maximum permissible ambient air level * * * which will protect the health of any [sensitive] group of the population,’’ and that for this purpose ‘‘reference should be made to a representative sample of persons comprising the sensitive group rather than to a single person in such a group.’’ S. Rep. No. 91–1196, 91st Cong., 2d Sess. 10(1970).”

Taking this additional citation into consideration one could conclude that EPA’s original interpretation of ambient air is focused on a single individual and not a representative sample of persons for which the NAAQS was developed to address. Additionally, it would not be reasonable to assume that persons would be present on property owned and controlled by a source for any length of time. Therefore, it would be reasonably conservative to assume that any property owned and/or controlled, including property that is not fenced in, by a source to be exempt from ambient air as long as the appropriate and legal posting is/are provided. This posting would provide the legal means by which a source would ensure that persons would not be allowed on said property and provide the means by which said persons would be removed.

4 NO_2 Background Data

Based on the Tier and option selected from section 3.3 it may be necessary to calculate either the maximum 1-hour or the 3yr average of the annual 98th percentile of the maximum daily 1-hour NO_2 concentration. This section provides links to online NO_2 resources from EPA, CARB, and Local Agencies.

To assist with the conversion of NO_2 concentrations reported by the following resources the following equation is provided:

NO_2 Conversion (ppm to ug/m3) at Standard Temperature and Pressure

$$\frac{100\ \text{ug/m}^3}{53\ \text{ppb}} = \left(\frac{1.8868\ \text{ug/m}^3}{\text{ppb}} * \frac{\text{ppb}}{0.001\ \text{ppm}}\right) = \frac{1886.8\ \text{ug/m3}}{\text{ppm}}$$

4.1 Maximum Hourly Concentration

There are several online resources available for determining the maximum 1-hour NO_2 concentration at a given monitoring site. These include CARB, EPA, and local agencies.

For some Tier options listed in section 3.3 the maximum 1-hour monitored concentration will be needed.

4.1.1 CARB Data

Data from CARB is located on the Air Quality Data Branch's main webpage located at http://www.arb.ca.gov/aqmis2/aqdselect.php?tab=specialrpt. Once you navigate to the webpage follow the steps below to find the maximum 1-hour NO_2 concentrations for a given monitor site.

- Fill-in the information requested, except for "Step 4". Leave "Step 4" as "Annual Statistics by Site". Once all the information is filled in click "Retrieve Data". **Please note:** you need to select Nitrogen Dioxide in "Step 1".

4.1.2 EPA's Formatted Data

NO_2 information is also available on EPA's AIRDATA website located at http://www.epa.gov/oar/data/geosel.html . Once you navigate to the website follow the steps below to find the maximum 1-hour NO_2 concentrations for a given monitor site. **Caution:** data available on EPA's site may not be as recent as that from CARB.

Step 1

Under "Select From List" header select "Select County". Remember to also select a State. Then click "Go".

Step 2

Select the county of interest and click the "Select County" button

Step 3

Under Monitoring → Reports click “Monitor Values”

Step 4

Under Pollutant click “NO_2 – Nitrogen Dioxide” and select the year of concern. Then click the “Generate Report” Button. **Please note:** Additional information can be included on the report generated by selecting optional site information listed under “Optional Report Columns” header.

4.1.3 EPA’s Raw Data

EPA also provides data in raw format that can be downloaded at http://www.epa.gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm. **Please note:** Files listed contain data for sites throughout the nation and can be several hundred mega bytes in size.

4.1.4 EPA’s AQS Web Application

EPA also has the Air Quality System (AQS) web application. This web application is used exclusively by Federal, State, Territorial, and Tribal environmental agencies to load and maintain air quality data. The web application can also be used to retrieve reports in formatted or raw data formats.

If your agency has an AQS contact person then you can, possibly, request reports through that person. If you would like a user and password follow the instruction found at http://www.epa.gov/ttn/airs/airsaqs/registration.htm. The main AQS web application page is located at http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

4.1.5 Local Agencies

Local agencies typically rely on the resources provided in section 4.1.1 thru 4.1.4 to determine the maximum 1-hour concentration at a given monitor. Therefore you should contact the reviewing agency to determine which resource they would prefer, if they do not have data available.

4.2 98th Percentile Hourly Concentration

For other options listed in section 3.3 the 3yr average of the annual 98th percentile of the maximum daily 1-hour NO_2 concentration will be needed. It is important to note that guidance on how to determine the 3yr average of the annual 98th percentile of the maximum daily 1-hour NO_2 concentration is included in Appendix S of 40 CFR Part 50. This guidance outlines two procedures that must be performed; the highest value is determined to be the monitor’s design value (background).

4.2.1 CARB

Currently no online NO_2design value data is available from CARB.

4.2.2 EPA's AQS Web Application

Currently no online NO_2 design values are available from EPA. In the future the AQS web application, discussed in section 4.1.4, may include a design value report that would provide the required information.

4.2.3 Local Agencies

Currently some local agencies have posted the 3yr average of the annual 98th percentile of the maximum daily 1-hour NO_2 concentration data either in their NO_2 modeling guidance documents or on their agency's website. Additionally, some agencies may have developed raw data processors that can process raw data available from online sources, see section 4.1.3 and 4.1.4.

4.3 EPA Acceptable Background Datasets

On March 1, 2011, EPA provided additional clarification on the implementation of the 1-Hour NO_2 NAAQS; one area in which they provided guidance was on acceptable NO_2 background data. The following discussion describes the options provided in the referenced memo:

Please Note: The following is only a summary of the referenced memo which provided an explanation of each the following items. The memorandum can be found at http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf.

The following three refined background datasets can be used, with the approval of the reviewing agency, and will be supported in AERMOD (11059).

- Hour-Of-Day 98th-percentile (8th Highest) value
- Monthly Hour-Of-Day
- Seasonal Hour-Of-Day

Each of the above background datasets are described below.

4.3.1 98th percentile of the Monthly Hour-Of-Day (1st Highest)

Monthly Hour-Of-Day is determined by organizing all of the NO_2 concentrations by hour of day (1AM, 2AM, 3AM, etc) for each month in descending order and selecting the 1st highest NO_2 concentrations (Maximum Hourly) for each hour of the day.

For example, (1AM)

1. First take all the 1AM NO_2 concentrations (maximum of 28-31 numbers) for each month

2. Organizing the NO_2 concentrations in descending order (highest to lowest)
3. Take the 1st highest NO_2 concentrations
4. This value will be used to represent the 1AM maximum hour or 98th-percentile of available data
5. The above process is repeated for each hour of the day and month
6. Repeat steps 1 thru 5 for each of the three years under review
7. Average the three 1AM NO_2 concentrations
8. This value will be used in AERMOD as the NO_2 background concentrations (3yr average of the 98th percentile) for the 1AM hour and month
9. Repeat step 7 and 8 for each of the hours in the day and month

4.3.2 98th percentile of the Seasonal Hour-Of-Day (3rd Highest)

Seasonal Hour-Of-Day is determined by organizing all of the NO_2 concentrations by hour of day (1AM, 2AM, 3AM, etc) for each season of the year in descending order and selecting the 3rd highest NO_2 concentrations for each hour of the day and season.

For example, (1AM)

1. First take all the 1AM values (maximum of 90-92 numbers) for each Season
    a. Winter = December Of Previous Year, January, February
    b. Spring = March, April, May
    c. Summer = June, July, August
    d. Autumn = September, October, November
2. Organizing the NO_2 concentrations in descending order (highest to lowest)
3. Take the 3rd highest NO_2 concentrations
4. This value will be used to represent the 1AM 3rd highest or 98th- percentile of available data
5. The above process is repeated for each hour of the day and season
6. Repeat steps 1 thru 5 for each of the three years under review
7. Average the three 1AM NO_2 concentrations
8. This value will be used in AERMOD as the NO_2 background concentrations (3yr average of the 98th percentile) for the 1AM hour and season
9. Repeat step 7 and 8 for each of the hours in the day and season

4.3.3 98th percentile of The Annual Hour-Of-Day (8th Highest)

Hour-Of-Day is determined by organizing all of the NO_2 concentrations by hour of day (1AM, 2AM, 3AM, etc) in descending order and selecting the 8th highest NO_2 concentration for each hour of the day. This process is repeated for each of the three years under review. The procedure is similar to that used to determine a monitor's design value (instead of daily values you use each hour of the day).

For example, (1AM)

1. First take all the 1AM NO_2 concentrations (maximum of 365-366 numbers)
2. Organizing the NO_2 concentrations in descending order (highest to lowest)

3. Take the 8th highest NO_2 concentrations
4. This value will be used to represent the 1AM 98th- percentile of available data
5. The above process is repeated for each hour of the day
6. Repeat steps 1 thru 5 for each of the three years under review
7. Average the three 1AM NO_2 concentrations
8. This value will be used in AERMOD as the NO_2 background concentrations (3yr average of the 98th percentile) for the 1AM hour
9. Repeat step 7 and 8 for each of the hours in the day

4.3.4 Missing Data (Gap Filling)

Missing Hour-Of-Day values, for the most part, are attributed to the required QA/QC and calibration requirements established by EPA and are typically scheduled during an hour(s) of low concentration. In order to ensure that all Hour-Of-Day concentrations are included the following gap filling technique is used to ensure that all Hour-Of-Day concentrations are included. **Please note:** EPA's March 1, 2011 guidance document does not address missing data and therefore the following procedure is provided as an option that can be used, if required by the reviewing agency, to fill-in missing data.

4.3.4.1 Gap Filling

The same gap filling technique established by EPA for filling a single hour of missing meteorological data should be used; the missing NO_2 concentration is filled using a linear interpolation using the NO_2 concentration from the hour before and the hour after to replace the missing NO_2 concentration.

4.3.5 Seasonal Hour-Of-Day "Winter"

To ensure consistency between the Modeled definition and the background NO_2 data, the seasonal winter Hour-Of-Day values represents data from January and February of the year under review and December of the previous year. This is the definition of winter provided in the AERMOD guidance document for Seasonal Hour-Of-Day where winter is identified as including December, January, and February. It would not be appropriate to add the last month of the year, under review, to the first two months of the year.

5 Ozone and NO_2 Datasets

There are two main issues that need to be addressed when dealing with ozone and NO_2 datasets. First, the modeling control parameter “OZONEVAL” or the default missing hourly ozone value of 40ppb. The second issue is how to deal with missing data in both the ozone and NO_2 datasets. This section provides a discussion and options on how to address these issues.

5.1 Default Value for Missing Hourly Ozone Data (40ppb)

Currently there is an assumption that 40ppb is an appropriate default value for all missing ozone data. This assumption comes, in part, from an EPA addendum entitled “AERMOD: Model Formulation Document” which can be download at http://www.epa.gov/scram001/7thconf/aermod/aermod_mfd_addm_rev.pdf.

Specifically, the section entitled “Minimum Ozone Concentration for Stable Concentrations” which is intended to ensure that surface measurements that may be artificially low during nighttime stable conditions due to the formation of stable vertical temperature gradient is not under estimated. This section outlines the three scenarios in which this procedure would be used in AERMOD:

- $0 < MO_L < 50$ meters (positive – very stable), then 24_{MAX} value is substituted up to a limit of 40 ppb.
- $50 <= MO_L <500$ meters (positive - stable), then a linear interpolation is used to determine the ozone concentration (Min(40 ppb. 24_{MAX}) * (500 - MO_L)/450)
- MO_L => 500 meters (positive – slightly stable/neutral), then 24_{MAX} value is substituted without limit

Where:
MO_L = Monin-Obukhov length
24_{MAX} = AERMOD maximum ozone concentration over previous 24 hours

A review of the AERMOD FORTRAN source code located on EPA’s SCRAM website, specifically code file name “aermod.f” (subroutine = HRLOOP), indicates that this option is currently implemented in AERMOD.

Please Note: Since the value of 40 ppb is implemented in AERMOD and as noted above, the value was never intended to be used as a default for missing data; it is recommended that the default value of 40ppb not be used unless it has been justified and approved by the reviewing agency. Section 5.1.1 describes options on how an appropriate default value, if needed, can be developed.

5.1.1 Default Ozone Value Determination

The purpose of a default ozone value is to take the place of any data that have been identified in an ozone file as missing (-99). Therefore, the default ozone value should be representative of the ozone data collected from the monitor to be used in the model. There are several ways that a default value can be generated. (**Please note:** The reviewing agency should be consulted to ensure that the selected method is appropriate.) The following are options that can be used to derive a default value in the order of conservativeness. (**Note:** If the ozone file has been filled in completely, every hour of the year, through gap filling then a default value does not need to be developed.)

Options:

1. Maximum Annual Hourly Concentration Over the Model Period (5yrs)
   - Determine maximum hourly concentration for each year
   - Select the highest hourly concentration over the modeled period
2. Maximum Annual Hourly Concentration – For each year modeled
   - Determine maximum hourly concentration for each year
3. Maximum Annual Average Hourly Concentration – Over the modeling period (5yrs)
   - Determine maximum hourly concentration for each year
   - Take the average of the maximum hourly concentration over the modeled period
4. Another option would be to use a gap filling procedure to fill-in all missing data, See Section 6 for more details.

5.2 Are data available?

There are several locations were Ozone and NO_2 raw data and compiled datasets are available. EPA maintains two methods, on the web, of assessing raw air quality data from the Air Quality System (AQS) database that can be accessed depending on your agency's affiliation. The AQS Web Application is for government agencies that maintain the monitoring sites and the TTN/AQS website which can be accessed by the general public.

Additionally, some local air districts provide pre-processed Ozone and NO_2 datasets that are AERMOD ready.

5.2.1 EPA's AQS Web Application

This web application is used exclusively by Federal, State, Territorial, and Tribal environmental agencies to load and maintain air quality data. The web application can also be used to retrieve reports in formatted (PDF) or raw data formats.

If your agency has an AQS contact person, then you can request reports through that person. If you would like a user name and password follow the instruction found at http://www.epa.gov/ttn/airs/airsaqs/registration.htm. The main AQS web application page is located at http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

5.2.2 EPA's Technology Transfer Network (TTN)/Air Quality System (AQS)

EPA also provides monitoring data for download to the general public from the following web site http://www.epa.gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm. This web site provides the same data as that of the AQS web application except that some updates may not be included in a selected file depending on the date the file was generated. Please note that the data files are for the complete national monitoring network and not by state. Therefore the file size for some datasets can be in the hundreds of megabytes. It is recommended that a post-processor be used to extract the specific data that will be used for a given project.

5.2.3 Local Agencies

Local agencies have also been working on processing raw data provided by EPA or collected locally into AERMOD ready datasets. Some agencies have started posting the AERMOD ready datasets on their agency's website. It is recommended that the reviewing agency be consulted to determine the appropriate dataset to be used.

5.2.3.1 Pre-Processor

As part of providing AERMOD ready ozone and NO_2 datasets, some agencies have developed pre-processors that can be used to extract state specific data from the national data files on the Technology Transfer Network (TTN)/Air Quality System (AQS) website. The same pre-processor can generate ozone and NO_2 monitoring site specific files by local air district. Below is a list of agencies that have pre-processors available:

- San Joaquin Valley APCD's pre-processor can be requested by emailing HRAModeler@valleyair.org. Additionally, the pre-processor is able to read the AMP501 report format, for ozone and NO_2, generated by the AQS Web Application. This program is **only** for regulatory agencies.

6 Gap Filling For Ozone and NO_2 Datasets

There are several reasons why missing data may exist in a dataset. They may be missing because of equipment malfunction, human error, or maintenance of the monitoring equipment. Nevertheless data gaps should be addressed to ensure that underestimation of NO_2 impacts are minimized. The following section provides several options that may be used to fill-in data gaps. **Please note:** The reviewing agency should be consulted to determine the appropriate method to be used.

This section only describes the method by which missing data can be filled and does not describe in any detail the procedure used to create/update ozone or NO_2 files used in ISCST3 or AERMOD.

6.1 Missing Data Procedures

Several approaches may be taken when addressing missing data, but each has its own issues from being too conservative or not conservative enough. Therefore, the reviewing agency will need to determine which method is appropriate for its regulatory needs.

6.1.1 Single Hour

For a single hour, it is widely accepted that the best method of gap filling is the use of a liner interpolation of the hour before and after the missing hour. This method is also known as the mean-before-after.

- Sum of the concentrations for the hour before and after
- Divide the sum by 2

6.1.2 Multiple Hours

For data gaps spanning more than a single hour no single acceptable method has been developed to date. Therefore the following section will describe several methods that maybe used to fill-in gaps when more than a single hour is missing. **Please note:** The methods presented here are not an exhaustive list of procedures that maybe acceptable to the reviewing agency. Therefore, the reviewing agency should be consulted before processing any dataset.

Note: The following methods are only intended to be used for multiple consecutive missing hours, unless otherwise noted. If only a single hour is missing it is recommended that the method described in Section 6.1.1 be used.

6.1.2.1 Simple Fill Methods

These methods are considered to be simple fill methods because they require a minimum amount of resources to be implemented and are more conservative in nature.

Gap filling Methods for Multi-hour Gaps:

1. Maximum Annual Hourly Concentration Over the Model Period (5yrs)
   - Determine maximum hourly concentration for each year
   - Select the highest hourly concentration over the modeled period
   - Use this value to fill-in all remaining missing hours
2. Maximum Annual Hourly Concentration – For each year modeled
   - Determine maximum hourly concentration for each year
   - Use this value to fill-in all remaining missing hours
3. Maximum Annual Average Hourly Concentration – Over the modeling period (5yrs)
   - Determine maximum hourly concentration for each year
   - Take the average of the maximum hourly concentration over the modeled period
   - Use this concentration to fill-in all remaining missing hours
4. Quarterly Maximum Concentration – For each year
   - Determine maximum hourly concentration for each quarter (1st Qtr = Jan - March, 2nd Qtr = April – June, 3rd Qtr = July – Sept, 4th Qtr = Oct – Dec)
   - Use each quarter's maximum concentration to substituted for any missing data within that quarter until all missing data is filled
5. Monthly Maximum Concentration
   - Determine maximum hourly concentration for each month
   - Use each month's maximum concentration to fill gaps for any missing data within that month until all missing data is filled.

6.1.2.2 Complex Fill Methods

The method described in this section are considered complex in nature since they are resource intensive and may require some programming or expertise in meteorology and using spreadsheets. Additionally, this method provides a more realistic interpolation of the actual missing data because it accounts for the diurnal and seasonal change in ozone and NO_2 concentration.

Gap Filling Methods:

1. Monthly Hourly Concentration - Option 1 (For each year)
   - For each month determine the maximum concentration for each hour (1, 2, 3, …) of the day. For each month you should have 24 values.
   - For each missing hour within a month use the corresponding maximum hourly concentration.
   - Perform the above steps until all hours are filled.
   - Any missing hour will be filled in manually

2. Monthly Hourly Concentration - Options 2 (For each year)
    a. Fill any single missing hour with the maximum of the:
        i. Preceding hour
        ii. Succeeding hour
        iii. Same hour of day on previous day
        iv. Same hour of day on succeeding day

        If there is missing data for either iii and/or iv, use only the maximum of the available data to fill the missing hour (both a and b are guaranteed to be present since only single missing hours are filled in this step). Note that the most likely scenario for both c and d to be missing is for years when the monitor is calibrated at the same hour each day. In this case, the 30-day rolling average (see step b) for that hour will also not be available.

    b. For hours that are not filled by step a (all periods with more than one hour missing), fill the missing hour with the maximum for that hour of day for a 30-day rolling period centered on the hour (i.e., for the 15 preceding days and the 15 succeeding days). Note that 30-day rolling period will extend into the preceding and succeeding year at the start or end, respectively, of the modeling period.
    c. For hours not filled by step b, fill the missing data with the maximum of the 30-day rolling period for the preceding or succeeding hour.
    d. Any hours not filled by steps a–c, are likely periods with more than a month of missing data for all hours. These will be filled on a case-by-case basis.
    e. **For NO_2 File Only** - Check all filled hours for which the filled concentration is higher than the maximum monitored concentration recorded for that day (for a complete day of missing data, the maximum monitored concentration is considered zero for purposes of this comparison). If the filled concentration is higher than the appropriate nth highest daily maximum monitored concentration for the calendar year for determining compliance with federal 1-hour standard (e.g., for 351 or more days of valid data, the 8th highest daily maximum is the appropriate value), then replace filled concentration with the appropriate nth highest daily maximum to fill that hour. Note: This prevents the filling procedure from changing the nth highest daily maximum for the year.

7 In-Stack NO2/NOX Ratio

In the guidance provided by EPA the importance of in-stack NO_2/NO_X ratios when performing OLM or PVMRM modeling is specifically addressed. This section is intended to assist agencies in determining what in-stack NO_2/NO_X information is available. Data that has been gathered is provided in Appendix C.

7.1 Why is the NO_2/NO_X ratio important?

Equation 1 provides a basic equation that explains the importance of the in-stack NO_2/NO_X ratio.

Equation 1:

$$NO_2 = [\text{Ratio} * (NO_x)_{pred}] + \text{MIN}\ [\ (1\text{-Ratio}) * (NO_x)_{pred}\ ,\ \text{or}\ (46/48) * (O_3)_{bkgd}\ ]$$

Where:

NO_2	is the predicted NO_2 concentration (µg/m^3)
Ratio	is the in-stack NO_2/NO_X ratio (from 0.0 thru 1.0)
$(NO_x)_{pred}$	is the model predicted NO_x concentration (µg/m^3)
MIN	means the minimum of the two quantities within the brackets
$(O_3)_{bkgd}$	is the representative ambient O_3 concentration (µg/m^3)
(46/48)	is the molecular weight of NO_2 divided by the molecular weight of O_3

In Equation 1, the predicted NO_x concentration is multiplied by the in-stack NO_2/NO_X ratio to account for the in-stack thermal conversion of NO_x to NO_2. The remaining NO_x (assumed to be NO) is challenged by the background O_3 concentration to determine the quantity of NO that is converted to NO_2 in the presence of ozone.

Examples: The NO_x emissions from a point source are modeled with AERMOD/ISC3 model with an in-stack NO_2/NO_X ratio of 0.1 (10 percent). The maximum predicted NO_x concentration is 100 µg/m^3. Representative ambient O_3 data for the area indicate an hourly concentration of 75 µg/m^3. Using Equation 1, the predicted NO_2 concentration would be:

$$NO_2 = [(0.1) * 100] + \text{MIN}\ [(1-0.1) * 100,\ \text{or}\ (46/48) * 75]$$

$$= 10 + \text{MIN}\ [90,\ \text{or}\ 72]$$

$$= 82\ \mu g/m^3$$

This is an ozone limited case where the amount of NO_2 formed is limited by the amount of O_3 available.

In a second example, assume the same source impact as above, but with an in-stack NO_2/NO_X ratio of 0.3 (30 percent).

$$NO_2 = [(0.3) * 100] + MIN\ [(1-0.3) * 100, \text{ or } (46/48) * 75]$$

$$= 30 + MIN\ [70, \text{ or } 72]$$

$$= 100\ \mu g/m^3$$

This second case is not ozone limited, and all of the NO_x emissions are assumed to be converted to NO_2.

7.1.1 Conclusion

The basic explanation provided above demonstrates the importance of the in-stack ratio on the final results predicted by the model. Therefore, it is recommended that the best available in-stack ratio for a specific source be used. If no data is available for a specific source the reviewing agency should be consulted to determine best applicable in-stack ratio to be used in the model.

7.2 EPA Database

EPA is currently gathering data and developing a database of in-stack NO_2/NO_X ratios. EPA has not provided a date by which data will be available. Therefore it is recommended that EPA's SCRAM webpage be reviewed periodically (http://www.epa.gov/scram001/) to determine if any data is available.

Please note: a value of 0.50 or 50% can be used without justifications as per EPA's clarification memo dated March 1, 2011 (http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf)

7.3 Manufacturer's Dataset

For new sources or projects where in-stack NO_2/NO_X ratio data may not be available through other means the project proponent should contact the manufacture to determine if any in-house source test or summarized data is available. If data is available, any and all data justifying the in-stack NO_2/NO_X ratio should be provided to the reviewing agency to determine the acceptability of the data.

7.4 Source Testing

Source testing conducted by a manufacture or conducted by a reputable source testing firm at a site with an equivalent piece of equipment after it has been reviewed/verified by a local air district, state, and/or EPA for regulatory compliance determination are good sources of NO_2/NO_X ratios. Data collected from source test reports allow for a comparison of the proposed equipment versus the same or similar tested equipment for the operational and control parameters implemented during the test.

7.5 NO_2/NO_X Ratio Resources

Currently there is no one widely accepted repository of NO_2/NO_X data available. As noted above, EPA is currently gathering data that will be available on their website in the near future. Other state agencies have expressed interest in gathering NO_2/NO_X ratio data for their own organizations, but to date no data have been published.

In an effort to provide data needed for modeling and to address issues noted in EPA's NO_2 guidance memoranda, the San Joaquin Valley APCD has started gathering data from internal and external resources and has compiled NO_2/NO_X ratio for a variety of sources. The NO_2/NO_X ratios can be downloaded from http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm#modeling_resources under Quick Links -→Modeling Guidance-→ NO_2/NO_X In-Stack Ratios. The San Joaquin Valley APCD has also committed to update the list of ratios as new data become available. NO_2/NO_X ratios that have been compiled to date are also contained in Appendix C of this document. **Please note:** Before using any of the NO_2/NO_X ratio provided in Appendix C or from any other source the reviewing agency should consulted.

8 Demonstrating Compliance with the NAAQS

If modeling results indicate that a project's impact is greater than the NAAQS based on a modeled violation the options discussed below may be considered/utilized. **Please note:** The reviewing agency should be consulted to assist in determining the appropriate option that will be utilized to show compliance with the NAAQS.

8.1 Less than Significant Impact

If a project's proponent can demonstrate that a project's impact "at the point and time of any modeled violation" would not have a significant impact (less than the significant impact level or SIL) the reviewing agency can conclude that the project's emissions would not contribute to a modeled violation and permits could be issued.

This type of demonstration is only done when 1) the impacts from a project, at all locations, are less than the SIL and 2) when conducting a cumulative impact assessment.

Please note: The reviewing agency should be consulted to determine the appropriate SIL to be used until such time EPA promulgates an official 1-hour NO_2 SIL. (EPA has suggested using an interim value of 4 ppb, see http://www.epa.gov/nsr/documents/20100629no2guidance.pdf)

8.2 Mitigation

As noted in EPA's memoranda, from Anna Marie Wood dated June 28, 2010 (http://www.epa.gov/nsr/documents/20100629no2guidance.pdf), there is two basic methods for mitigating modeled impacts as describe below.

8.2.1 Additional Onsite Controls

A proponent can propose additional control equipment on existing equipment at the facility to offset any modeled impact. **Please note:** The reviewing agency should be consulted to assist in determining the quantity of emission reductions needed to compensate for impacts of modeled violation.

The reviewing agency may require that modeling be conducted to show the reduction in modeled impacts from the proposed additional controls (Impact w/o controls - Impact w/controls = Reduction in modeled impact) to demonstrate that the proposed control would reduce the modeled impact below the NAAQS or SIL.

8.2.2 On-site/Off-site Emission Reduction Credits (ERC)

The second method for mitigating a modeled violation is for a proponent to provide either on-site or off-site ERCs. When determining the quantity of ERCs needed a reviewing may consider:

- Modeling procedures used to estimate impacts
- NO_X-→NO_2 conversion rates
- Ambient Ozone concentrations
- Other meteorological conditions in the area of concern

Therefore it is recommended that the reviewing agency be consulted in determining the appropriate quantity of ERCs needed to mitigate the modeled violation.

Please note: Providing ERCs to mitigate modeled violation may not be acceptable to by all agencies. Therefore it is highly recommended that the reviewing agency be consulted.

8.3 Operating Conditions

Operating conditions can be used to demonstrate compliance with the 1-hour NAAQS. As long as those operating conditions, used to demonstrate compliance, are included as part of unit's permit to operate issued by the reviewing agency.

8.3.1 Time of Day

"Time of day" is the concept of taking advantage of periods during the day, typically evening hours, where meteorological conditions are more favorable for dispersion and in turn reducing modeled impacts. This method is typically used by units such as emergency or back-up equipment that can be scheduled to operate **only** during these periods.

Variable emissions or scalars can be used to adjust the operational schedule of a unit to limit its impacts. The reviewing agency may require that modeling be conducted to show the reduction from the proposed operational schedule and to demonstrate that the proposal would reduce the modeled impact below the NAAQS. **Please note:** The reviewing agency should be consulted to determine if this approach is appropriate.

8.3.2 Operating less than One Hour

For units that are not required to operate for a full hour they can reduce their hourly modeled impact by limiting the time they operate to less than 1-hour. For example, a unit with an hourly emissions rate of 7.0 lbs/hr of NO_X can reduce its emission in half by limiting its operation to only 30 minute in any rolling hour.

It is important to note that the term "in any rolling hour" is used instead of "per hour" when defining the operational limit. This term is used to ensure that the unit is not operated continuously in two different hours. For example, operating the last half of one hour and the first half of the next would result in a total of one hour of continuous operation.

In addition to establishing a condition(s) that limits the total time or time period a source would be allowed to operate, additional conditions may be needed to ensure compliance such as record keeping and/or non-resettable hour meter may be needed. **Please note:** The reviewing agency should be consulted to determine if this approach is appropriate.

8.4 Source Parameters

Similar to operating conditions, source parameters beyond those originally provided to the reviewing agency or those that modify standard operating parameters used to reduce modeled violations should be identified and added as a condition to permits issued by the reviewing agency. This will ensure that those assumption used are implemented and enforceable.

8.4.1 Raising Stack Height To GEP

It is widely accepted that a unit can increase its stack height to GEP as a method of reducing its modeled impacts. It must also be noted that stack height greater than GEP cannot be used when conducting modeling for demonstrating compliance with the NAAQS. **Please note:** If a stack height greater than GEP is proposed the reviewing agency should be consulted before being used in any modeling regiment.

8.4.2 Other Dispersion Techniques

When implementing other dispersion techniques consideration should be given to EPA’s Revised Stack Height Regulation. Guidance on the implementation of this regulation was provided by EPA in a memo dated October 10, 1985 entitled “Question and Answers on Implementing the Revised Stack Height Regulation”, see http://www.epa.gov/region7/air/nsr/nsrmemos/reinders.pdf.

8.4.2.1 Increasing Exit Velocity

For units that have low exit velocities, increasing the velocity by reducing the stack diameter or adding a blower can reduce the modeled impacts from the unit. It is important to understand that reducing a unit’s design stack diameter can cause back pressure that may affect the units operation. Therefore it is recommended that the manufacturer be consulted to determine the appropriateness of the proposed exit velocity and to ensure that any change to a unit’s stack diameter will not affect a unit’s operation.

Please note: Appropriate permit conditions should be included on an agency’s permit(s) issued for a project that will ensure that the proposed unit parameters are implemented and are enforceable based on the information provided by the applicant to the reviewing agency.

8.5 Site Design

Another option that a proponent may implement is to redesign the facility layout / relocate equipment that is causing the modeled violation. When relocating equipment it is important to consider the following:

- Distance to facility boundaries
- Location to Buildings or other large airflow obstructions such as above-ground water storage tanks (Building Downwash can be a Pro or a CON)
- Combined Plume Effects
- Predominant hourly wind direction

Please note: If possible, this option should be implemented before any submissions to the reviewing agency are made. If this option is done during a reviewing agency's permit review process, remodeling will be needed to demonstrate compliance with the NAAQS. Additionally, other permit conditions may be needed to ensure that proposed changes are implemented and are enforceable. Therefore, if a unit is relocated during the review process, the reviewing agency should be consulted to determine if any additional requirements will be needed.

8.6 Intermittent Operations

Intermittent operating units are those units that may or may not have a set schedule and that only operate short periods of time during the year. For example:

- An emergency fire water pump driven by a diesel engine. This device must be tested for 30 minutes once per week to meet National Fire Protection Association codes.
- An auxiliary generator at a power plant may operate only once per month for 60 minutes, as required by the original equipment manufacturer to ensure reliability.

This means that these units would only have an incremental impact 12 to 52 times per year. Thus, the eighth highest facility incremental impact (i.e., 98th percentile project increment) may be zero at a site with variable wind direction or very close to zero at a site with an extremely consistent wind direction.

8.6.1 Modeling Technique

On March 1, 2011 EPA provided additional clarification on intermittent operating sources that allows the reviewing agency, at their desecration, to exempt intermitted units from model requirements. The clarification memorandum can be found at http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf.

8.6.1.1 EPA Suggested Approach

Guidance was also provided on how intermittent unit(s) could be included in a modeling regime, if requested by the reviewing agency, by calculating an average 1-hour emission rate. This emissions rate would replace the maximum hourly emission rate provided by the manufacture when performing modeling.

For Example:
A 903 BHP emergency internal combustion engine is permitted to operate 100 hour per year for maintenance and test. The unit does not have a set schedule when it will operate. The manufacture's maximum hourly NOx emissions rate is 4.2 g/BHP-hr or (1.054 g/sec)

Calculation:

AER = MER * (HrsOp / HrsYr)
= 1.054 g/sec * (100 hrs / 8760 hrs per yr)
= 0.012 g/sec (used in AERMOD)

Where:

AER = Average hourly emission rate (g/sec)
MER = Maximum hourly emission rate provided by the manufacture (g/sec)
HrsOp = Permitted hours of operation
HrsYr = Hours in a year (Default 8760)

- The calculates AER value would replace the MER in AERMOD and;
- The unit(s) would be modeled for every hour of the year(s)

8.6.1.2 Alternative Approach

Some regulatory agencies may need to conduct additional analyses to evaluate compliance with the California Environmental Quality Act (CEQA). This analysis may be needed even if local rules would otherwise exempt routine testing of intermittent equipment from modeling analysis. One approach that could be used to evaluate the impact of routine readiness testing is to do the following:

1. Determine the frequency and duration of routine testing.
    a. For example, a diesel-fueled engine driving an emergency fire water pump must be tested for a minimum of 30 minutes, once per week.
        i. This frequency and duration should be expressly limited by permit condition.
        ii. Hours operated for emergency use should be exempted.
2. Determine the equivalent hourly emissions rate for the duration of the allowed operation or Hourly Adjustment Factor (HAF).

    a. For example, if a unit operates for 30 minutes, divide the maximum hourly emissions rate by a HAF of 2
        i. HAF Calculation: 60min/hr / duration of operation in minutes (min/hr).

3. Run the model with the intermittent unit modeled as "on" for each hour of each year modeled.
    a. Limit emergency equipment operation to certain hours of the day for every day of the year if needed , see Step 8 below
4. Break the results for each year into periods consistent with the testing period.
    a. For example, break the year into 52 weeks if the emergency equipment is only operated for routine testing once per week.
    b. Retain the highest 1-hour result at each receptor location for each time period (weekly) and for each year
    c. Discard any remaining values.
5. Determine the 8th highest 1-hour NO_2 incremental impact at each receptor location for each year modeled.
    a. At each receptor location, add this 8th highest weekly maximum due to the intermittent unit to the 8th highest daily maximum due to the main stack(s) to calculate the cumulative project impact.
6. Compute the highest sliding 3-year average of the project's incremental impacts at each receptor location for the years modeled.
7. Add the highest 3-year impact from step 6 to the NO_2 background concentration (3yr average of the 8^{th} highest daily maximum 1-hour NO_2 monitoring concentrations).
8. If the result from Step 7 is above the federal NO_2 standard due to the intermittent unit, consider limiting the allowable hours of routine readiness testing of the intermittent unit, see page 11 of EPA's March 1, 2011 clarification memorandum (http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf)
    a. For example, from 24 hours to 7 hours in a day (between the hours of 9 am to 4 pm).
    b. Redo Steps 3-7. If this step is needed, write a condition imposing the allowable testing time limits.

Please Note: The responsible CEQA agency and the local reviewing agency should both be consulted to determine the appropriate approach to address intermittent unit(s).

Appendix A – Modeling Procedure

1 Introduction

This modeling protocol is meant to define the stepwise approach necessary to satisfy the requirements 40 CFR 51, Appendix W section 3.2.2 (e)(v) requirements. This protocol does not override guidance provided by EPA or Appendix W of Part 51 of Title 40 of the *Code of Federal Regulations*.

2 Non-Regulatory Option Checklist

The AERMOD Non-Regulatory Option Checklist should be completed for each project even if the ozone limiting method (OLM) or plume volume molar ratio method (PVMRM) is not used. Specific information to be provided includes the Facility Information, Project Information, Modeling Information, and Final Results. Source Parameters for all sources modeled must also be provided with the Checklist. (See Section 12)

3 Model Selection Discussion and Rationale

It is recommended that the latest version of the American Meteorological Society/Environmental Protection Agency Regulatory Model or AERMOD should be used for all NO_2 modeling. Use of an alternative model will require an evaluation as defined in Appendix W. Note that AERMOD is no longer a preferred model if the ambient ratio method (ARM), OLM or PVMRM are used. The use of any of these methods must be justified in accordance with the Applicability of Appendix W section 3.2.2 (e) requirements.

This recommendation is based on the assumption that AERMOD ready meteorological data is available for the area under consideration. If this is not the case ISCST3 maybe used on approval from the reviewing agency.

4 Modeling Tier and Option Selection

The following provides a tiered approach to analyzing compliance with the NO_2 1-hour NAAQS. This tier approach is organized from the least resource intensive to most resource intensive tier and option combination. **Please note:** Consultation with the reviewing agency before starting a modeling analysis is highly recommended.

4.1 Tiers

Appendix W of 40 CFR 51 provides for a three tier approach for assessing compliance with the NO_2 NAAQS. Each of these tiers progressively requires more detailed information to be gathered.

- **Tier 1** is known as “Total Conversion”. In this approach it is assumed that the amount of NO_X emitted by a source or a group of sources is converted totally into NO_2.

- **Tier 2** is known as the Ambient Ratio Method or ARM. In this approach an empirical ratio of NO_2 to NO_X is derived. This ratio is then applied to the model concentration.
- **Tier 3** utilizes either of two methods (OLM/PVMRM) to consider NO_2 chemistry when determining the concentration at a given receptor(s).

4.2 *Tier Options*

Within each of the three tiers described above there are eleven options that may be applied to assess a projects compliance with the NAAQS. Each progressive option will require more information and/or resources.

Table 1 – Modeling Options

Option #	Description
1	Significant Impact Level (SIL)
2	Maximum Modeled + Maximum Monitor Value
3	Maximum Modeled + 98th Monitor Value
4	8th Highest Modeled + Maximum Monitor Value
5	8th Highest Modeled + 98th Monitor Value
*6	5 yr Ave of the 98th percentile + Maximum Monitor Value
*7	5 yr Ave of the 98th percentile + 98th Monitor Value
*8	5 yr Ave of the 98th percentile + Monthly Hour-Of-Day
*9	5 yr Ave of the 98th percentile + Seasonal Hour-Of-Day
*10	5 yr Ave of the 98th percentile + Hour-Of-Day
**11	Paired-Sum (5 yr Ave of the 98th percentile)

*EPA acceptable options
**May use with the approval of the reviewing agency.

4.2.1 Detailed Option Descriptions

- **Significant Impact Level (SIL)** is defined as a <u>*de minimis*</u> impact level at which a source is presumed not to cause or contribute to an exceedance of a NAAQS.

- **Maximum Modeled** is defined as the maximum concentration predicted by the model at any give receptor in any given year modeled.

- **8th Highest Modeled** is defined as the highest 8th highest concentration derived by the model at any given receptor in any given year modeled.

- **5yr Ave of the 98th percentile** is defined as the highest of the average 8th-highest (98th percentile) concentrations derived by the model across all receptors based on the length of the meteorological data period or the X years average of 98th percentile of the annual distribution of daily maximum 1-hour concentrations across all receptors, where X is the number of years modeled. (EPA recommends in Appendix W that 5-years or meteorological data from a National Weather Service site or 1-year on-site data be modeled.)

- **Monthly Hour-Of-Day** is defined as the 3 year average of the 1st highest concentrations (Maximum Hourly) for each hour of the day
- **Seasonal Hour-Of-Day** is defined as the3year average of the 3rd highest concentrations for each hour of the day and season
- **Annual Hour-Of-Day** is defined as the 3yr average of the 8th highest concentration for each hour of the day
- **Paired-Sum (**5 yr Ave of the 98th percentile) is the merging of the modeled concentration with the monitored values paired together by month, day, and hour. The sum of the paired values are then processed to determine the X years average of 98th percentile of the annual distribution of daily maximum 1-hour concentrations across all receptors, where X is the number of years modeled.

4.3 Stepwise Modeling Approach

The following section provides an explanation of each of the tiers and options that can be used to comply with the NO_2 standard. Table 2 below provides a quick look at the information and resources that will be needed to utilize each of the tiers and options.

Table 2- NO_2 Tier Quick Reference

Tier	Option	Information Needed
I Total Conversion	1	1. Model (ISCST3/AERMOD) 2. Significant Impact Level (SIL)
	2 – 11	3. Background Air Quality Data
	6 –11	4. Post processor*
	11	5. Hourly NO_2 Data 6. Paired-Sum Post Processor*
II ARM	1	1. Model (ISCST3/AERMOD) 2. Significant Impact Level (SIL) 3. ARM Ratio
	2 – 11	4. Background Air Quality Data
	6 –11	5. Post processor*
	11	6. Hourly NO_2 Background Data 7. Paired-Sum Post Processor*
III OLM/PVMRM	1	1. Model (AERMOD or ISCST3 with a post-processor) 2. Significant Impact Level (SIL)

		3. Hourly Ozone Background data 4. In-Stack NO_2/NO_X Ratio
	2 – 11	5. Background Air Quality Data
	6 –11	6. Post processor*
	11	7. Hourly NO_2 Background Data 8. Paired-Sum Post Processor*

*EPA's updated AERMOD program version 11059 will support post processing and background data inputs

4.3.1 Modeling Assumptions

The following are some basic assumptions that apply to all tiers and options, unless otherwise noted:

- 1 year of site specific or 5-years of NWS meteorological data will be used. **Please note:** A reviewing agency may approve the use of less than five years of meteorological data.
- Maximum 1-hour emissions for each source will be used

4.3.2 Tier 1 – Total Conversion

Tier 1 assumes that the amount of NO_X emitted by a source or group of sources is completely converted to NO_2. Within Tier 1 eleven options are provided to progressively evaluate a project's impact compared to the 1-hour NO_2 NAAQS.

4.3.2.1 Option 1 – Significant Impact Level (SIL)

- The maximum 1-hour concentration from any of the years modeled is compared to the ***interim*** SIL of 4 ppb. **Please note**: This interim SIL has not been promulgated by EPA. Therefore, agencies are allowed to develop and use their own SIL until which time EPA promulgates an official SIL.
  - If the concentration is below the 1-hour NO_2 SIL no further evaluation is needed.
  - Else a more refined approach will be needed or;
  - The facility may provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.2.2 Options 2 – Maximum Modeled + Maximum Monitor Value

- The maximum 1-hour concentration from any of the years modeled is added to the maximum 1-hour monitored concentration.
- The sum is then compared to the 1-hour NO_2 NAAQS.
  - If the concentration is below the 1-hour NO_2 NAAQS no further evaluation is needed.
  - Else a more refined approach will be needed or;
  - The facility may provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.2.3 Options 3 – Maximum Modeled + 98th Monitor Value

- The maximum 1-hour concentration from any of the years modeled is added to the 3yr average of the annual 98th percentile of the daily 1-hour maximum monitored concentration.
- The sum is then compared to the 1-hour NO_2 NAAQS.
    - If the concentration is below the 1-hour NO_2 NAAQS no further evaluation is needed.
    - Else a more refined approach will be needed or;
    - The facility may provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.2.4 Option 4 – 8th Highest Modeled + Maximum Monitor Value

- The highest 8th highest maximum 1-hour concentration from any of the years modeled is added to the maximum1-hour monitored concentration.
- The sum is then compared to the 1-hour NO_2 NAAQS.
    - If the concentration is below the 1-hour NO_2 NAAQS no further evaluation is needed.
    - Else a more refined approach will be needed or;
    - The facility may provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.2.5 Options 5 – 8th Maximum Modeled + 98th Monitor Value

- The highest 8th highest maximum 1-hour concentration from any of the years modeled is added to the 3yr average of the annual 98th percentile of the daily 1-hour maximum monitored concentration.
- The sum is then compared to the 1-hour NO_2 NAAQS.
    - If the concentration is below the 1-hour NO_2 NAAQS no further evaluation is needed.
    - Else a more refined approach will be needed or;
    - The facility may provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.2.6 Option 6 – 5 yr Ave of the 98th percentile + Maximum Monitor

Please note: *The following procedure can be used with the updated version of AERMOD 11103. AERMIOD will perform the steps listed below using the built-in post-processor.*

- Each year's meteorological dataset is run independently to generate a hourly Post-Processing file:
    - Unformatted (Fortran format);
    - Formatted Plot file – most post-processor are designed to read this file format

- For each year and receptor modeled, determine the maximum 1-hour concentration for each day.
- For each year and receptor modeled, determine the 8th-highest daily 1-hour maximum concentration (365 or 366 values per receptor per year).
- For each receptor average the 8th-highest daily 1-hour maximum concentrations across the modeled years.
- The highest of the average 8th-highest[1] (98th percentile) concentrations across all receptors represents the modeled 1-hour NO_2 design value based on the form of the standard.
- The highest 5yr average of 8th highest maximum daily 1-hour concentration is added to the maximum 1-hour monitored concentration.
- The sum is then compared to the 1-hour NO_2 NAAQS.
    - If the concentration is below the 1-hour NO_2 NAAQS no further evaluation is needed.
    - Else a more refined approach will be needed or;
    - The facility may provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.2.7 Option 7 – 5yr Ave of the 98th percentile + 98th Monitor Value

Please note: *The following procedure can be used with the updated version of AERMOD 11103. AERMIOD will perform the steps listed below using the built-in post-processor.*

- Each year's meteorological dataset is run independently to generate a hourly Post-Processing file:
    - Unformatted (Fortran format);
    - Formatted Plot file – most post-processor are designed to read this file format
- For each year and receptor modeled, determine the maximum 1-hour concentration for each day.
- For each year and receptor modeled, determine the 8th-highest daily 1-hour maximum concentration (365 or 366 values per receptor per year)..
- For each receptor average the 8th-highest daily 1-hour maximum concentrations across the modeled years,
- The highest of the average 8th-highest (98th percentile) concentrations across all receptors represents the modeled 1-hour NO_2 design value based on the form of the standard.
- The highest 5yr average of 8th highest maximum daily 1-hour concentration is added to the 3yr average of the 98th percentile of the daily 1-hour maximum monitored concentration.
- The sum is then compared to the 1-hour NO_2 NAAQS.

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[1] The 8th higest concentration is used if a full year of data are available. Otherwise, a higher rank value must be selected.

  - If the concentration is below the 1-hour NO_2 NAAQS no further evaluation is needed.
  - Else a more refined approach will be needed or;
  - The facility may provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.2.8 Option 8 – 5yr Ave of the 98th percentile + Monthly Hour-Of-Day

Please note: *The following procedure can be used with the updated version of AERMOD 11103. AERMIOD will perform the steps listed below using the built-in post-processor.*

- Five years of NCDC meteorological data is run in AERMOD or one year of onsite meteorological data
- The NO_2 Background option "BACKGRND" is used with the Monthly Hour-Of-Day parameter to:
  - Enter each Month's hour of the day NO2 concentrations
  - 24 values for each Month
- Set the RECTABLE to the 8th Highest Value
- Set POLLUTID to NO2
- AERMOD will process each of the years and determine the 5yr average of the 8th highest maximum daily 1-hour concentration (98th percentile) which includes the NO_2 background concentrations entered.

Please note: Other options are available in this version of AERMOD to determine each sources contribution to the maximum concentration noted in the AERMOD output file. Please refer to the amended AERMOD manual for more information on the use of these options (http://www.epa.gov/ttn/scram/models/aermod/aermod_userguide_addendum_v11059_draft.pdf).

4.3.2.9 Option 9 – 5yr Ave of the 98th percentile + Seasonal Hour-Of-Day

Please note: *The following procedure can be used with the updated version of AERMOD 11103. AERMIOD will perform the steps listed below using the built-in post-processor.*

- Five years of NCDC meteorological data is run in AERMOD or one year of onsite meteorological data
- The NO_2 Background option "BACKGRND" is used with the Seasonal Hour-Of-Day parameter to:
  - Enter each Season's hour of the day NO2 concentrations
  - 24 values for each season
- Set the RECTABLE to the 8th Highest Value
- Set POLLUTID to NO2
- AERMOD will process each of the years and determine the 5yr average of the 8th highest maximum daily 1-hour concentration (98th percentile) which includes the NO_2 background concentrations entered.

Please note: Other options are available in this version of AERMOD to determine each sources contribution to the maximum concentration noted in the AERMOD output file. Please refer to the amended AERMOD manual for more information on the use of these options (http://www.epa.gov/ttn/scram/models/aermod/aermod_userguide_addendum_v11059_draft.pdf).

4.3.2.10 Option 10 – 5yr Ave of the 98th percentile + Hour-Of-Day

***Please note:** The following procedure can be used with the updated version of AERMOD 11103. AERMIOD will perform the steps listed below using the built-in post-processor.*

- Five years of NCDC meteorological data is run in AERMOD or one year of onsite meteorological data
- The NO_2 Background option "BACKGRND" is used with the Hour-Of-Day parameter to:
    - Enter each hour's NO2 concentrations
    - 24 values
- Set the RECTABLE to the 8th Highest Value
- Set POLLUTID to NO2
- AERMOD will process each of the years and determine the 5yr average of the 8th highest maximum daily 1-hour concentration (98th percentile) which includes the NO_2 background concentrations entered.

Please note: Other options are available in this version of AERMOD to determine each source's contribution to the maximum concentration noted in the AERMOD output file. Please refer to the amended AERMOD manual for more information on the use of these options (http://www.epa.gov/ttn/scram/models/aermod/aermod_userguide_addendum_v11059_draft.pdf).

4.3.2.11 Option 11 – Paired-Sum (98th percentile)

***Please note:** The following procedure can be used with the updated version of AERMOD 11103 by including the appropriate background data. AERMIOD will perform the steps listed below using the built-in post-processor.*

- Each year's meteorological dataset is run independently to generate a hourly Post-Processing file:
    - Unformatted (Fortran format);
    - Formatted Plot file – most post-processor are designed to read this file format
- Each year's hourly Post-Processing file is combined temporally with the approved NO_2 monitoring site's dataset and are paired by together on a

monthly, daily and hourly basis to generate a new combined post-processing file (NO_2 datasets must match the modeled post-processing file)

- For each year and receptor modeled, determine the maximum 1-hour concentration for each day.
- For each year and receptor modeled, determine the 8th-highest daily 1-hour maximum concentration (365 or 366 values per receptor per year).
- For each receptor average the 8th-highest daily 1-hour maximum concentrations across the modeled years.
- The highest of the average 8th-highest (98th percentile) concentrations across all receptors represents the modeled 1-hour NO_2 design value based on the form of the standard.
- The highest 5yr average of 8th highest maximum daily 1-hour concentration is then compared to the 1-hour NO_2 NAAQS.
    - If the concentration is below the 1-hour NO_2 NAAQS no further evaluation is needed.
    - Else the facility may need to provide the necessary quantity of mitigation to the satisfaction of the reviewing agency.

4.3.3 Tier 2 – ARM

Tier 2 uses an empirically derived 1-hour NO_2/NO_X ratio, as a method to consider the NO_2 chemistry, to adjust the concentration derived by the model. There are two methods by which this can be done:

- Use the maximum 1-hour NO_X emissions and adjust the modeled concentration by the ARM after the model has completed or;
- Adjust the maximum 1-hour NO_X emissions by the ARM ratio before running the model

Please note: a value of 0.80 or 80% can be used without justifications as per EPA's clarification memo dated March 1, 2011 (http://www.epa.gov/ttn/scram/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf)

4.3.3.1 Options 1 thru 11

The options used to conduct the modeling are the same as those in Tier 1 except as discussed above. The reviewing agency should be consulted to determine the preferred method for conduct Tier 2 modeling.

4.3.4 Tier 3 – OLM/PVMRM

Tier 3 uses non-regulatory options to further consider NO_2 chemistry by using either OLM or PVMRM. Performing Tier 3 modeling will require additional resource:

- AERMOD is currently the only model that incorporates both methods (OLM/PVMRM)

- Yearly Ozone datasets – must match the years being modeled
- In-Stack NO_2/NO_X Ratio (for each source)

4.3.4.1 Options 1 Thru 11

The options used to conduct the modeling are the same as those in Tier 1 except as discussed above. The reviewing agency should be consulted to determine the preferred ozone datasets and In-Stack NO_2/NO_X ratio to be used.

4.4 Additional Guidance

- The use of ARM, OLM, or PVMRM must be justified using the procedures found in Appendix B. To document such approval, the AERMOD Non-Regulatory Option Checklist should be completed.
- For OLM, the “OLMGROUP ALL” option should be used if there are multiple sources.
- If a default ozone concentration for missing ozone data is used, the reviewing agency should be consulted to determine the appropriate method.
- If version 09292 of AERMOD is used with the PVMRM option, variable emission rates should not be used. The NO_2/NO_X ambient equilibrium ratio for PVMRM should be provided by or approved by the reviewing agency.

5 Model Emission Inventory

For sources modeled to determine compliance with the 1-hour NO_2 NAAQS, the maximum 1-hour emission rates must be used unless otherwise discussed or otherwise approved by the reviewing agency. For example, an emission rate lower than the maximum 1-hour rate may be used if it will be enforceable through a permit condition. Table 8-2 in Appendix W provides specific guidance for calculating specific emission rates. The following is an extract from Table 8-2:

Emission Limit (lbs/MMBtu)	X	Operating Level (MMBtu/hr)	X	Operating Factor (e.g., hr/yr, hr/day)
Proposed New or Modified Source				
Maximum allowable emission limit or enforceable permit limit		Design capacity or enforceable permit condition		Continuous operation (i.e., all hours of each time period under consideration) for all hours of the meteorological data base
Nearby Source(s)				
Maximum allowable emission limit or enforceable permit limit		Actual or design capacity (whichever is greater) or enforceable permit condition		Continuous operation (i.e., all hours of each time period under consideration) for all hours of the meteorological data base
Other Source(s)				
Maximum allowable emission limit or enforceable permit limit		Annual level when actually operating averaged over the most recent 2 years		Continuous operation (i.e., all hours of each time period under consideration) for all hours of the meteorological data base

5.1 Model Scenarios

Note that multiple scenarios may need to be run. For example, scenarios may need to include emissions and operating conditions for 100 percent operation, 75 percent, and 50 percent. For some sources, emissions and operating conditions during normal operation, commissioning, emergency, standby, and startup or shutdown may be important as well.

Please note: A reviewing agency may not require all of these scenarios to be evaluated. Consult the reviewing agency to determine which scenarios will be required.

6 Other Non-Project Sources

The analysis may include sources in addition to those that are part of the project. In accordance with Appendix W, “all sources expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration for emission limit(s) should be explicitly modeled.” Professional judgment should be used to identify non-project sources to be included in the analysis. The following are some examples:

1. A source with a short-stack subject to downwash is located in an area where there are a number of other sources with short stacks subject to downwash. Unless there is another source within 100-meters, this source could be modeled alone.

2. A source with a relatively tall stack not subject to downwash is located in an area where there are other sources. The impact area (i.e., the area in which the source will have an impact equal to the SIL) should be determined. Other sources that are within that impact area should be included in the analysis. Consideration of Appendix W's guidance regarding the concentration gradient should be given to selecting sources to model.

7 Background Concentration

All ambient air quality analyses that are intended to determine the total pollutant concentration for comparison with the standard will include explicit modeling of the project sources and may include other non-project sources as discussed above. In addition, a background concentration must be included that represents the contribution from sources that are not modeled.

The most recent air quality design value (i.e., the three-year average of the 98th percentile of the daily maximum 1-hour concentrations) of a representative monitoring site should be used for the background concentration. The representativeness of the monitoring site will depend upon the following factors:

1. Proximity to the source(s) being modeled. In general, the nearest monitoring site is preferable.
2. Similarity of surrounding source(s). Sources in the vicinity of the monitor should be similar to those near the source(s) modeled.
3. Conservativeness of the background concentrations. The intent of any analysis is to ensure that it is "conservative" (i.e., ambient concentrations are overestimated). Thus, an effort should be made to select a background monitoring site where the measured concentrations are equal to or greater than those that would be measured were a monitor to be located in the vicinity of the source(s) to be modeled.
4. Another issue that must be considered is the contribution by sources in the vicinity of the background monitor to concentrations at the monitor. Because many existing monitors are located in urban and suburban areas, numerous small sources in the vicinity of the monitor may be contributing to the concentrations measured at the monitor. The analysis of a source that is located in a similar area would not need to include these additional sources. But, the analysis of a source located in a remote area using background data from a monitor that is not affected by sources surrounding the project may need to include these additional sources to ensure that proper consideration is given.
5. Selection of the background monitoring site and the factors that led to its selection should be documented.

Please note: The reviewing agency should be consulted to determine the appropriateness of a selected monitoring site.

8 Downwash Characterization

Care should be exercised to ensure that downwash is properly considered. When there is reason to believe that inclusion of downwash in the analysis will result in a higher estimate of pollutant concentrations, downwash should be included. Otherwise, the analysis can proceed without downwash.

9 Receptor Selection

Receptors should be selected to ensure that the maximum concentration is predicted. It may be necessary to model a nested refined grid if the original coarser grid does not identify the maximum concentration.

10 Meteorological Data

The meteorological data used in an analysis should be representative of the area in which the source(s) is located. To determine representativeness, consideration should be given to the land uses in the vicinity of the meteorological site versus that near the source(s). For example, it may be appropriate to use a site located further away versus an urban site that is located nearer to a project located in a rural area.

10.1 Gap Filling

If missing meteorological data is to be filled, the reviewing agency should be consulted to ensure the appropriate fill method is utilized. At a minimum the procedures outline by EPA should be reviewed (http://www.epa.gov/ttn/scram/surface/missdata.txt).

11 Post-Processing of the Results

As discussed above, some analytical tiers may require the use of a post-processor. Some agencies have developed interim post-processor for use with AERMOD. AERMOD version 11103 has been enhance to incorporate a post-processor and should be used unless otherwise instructed by the reviewing agency.

12 AERMOD Non-Regulatory Option Checklist

Approved	**Site Specific Parameters** Items that are required for a Case – By – Case determination are noted with an *	
	Facility Information	
	Facility ID	
	Name	
	Address	
	City/State	
Comments		
	Project Information	
	Facility ID	
	Project ID	
	Description	
Comments		
	Modeling Information*	
	Model	EPA AERMOD Version (**XXXXX)**
	Operating Scenario	Normal or Commissioning or Emergency or Standby
	Met Data	
	Site Name	
	Years	Start: End:
	Type	NWS or MM5
	Terrain	Flat or Elevated:
	Site Location	Zone: UTME: UTMN:
	Ozone Limiting	ARM or OLM or PVMRM
	Source Parameter	See Tables Below
	Background Site	
	Name	
	Location	Zone: UTME: UTMN:
	Years	Start: End:
	Location Type	Urban or Rural
	Distance From Project (km)	
Comments		

	Final Results*
	Averaging Period/Concentration (Background + Model)
Comments	

Tier	Option	Information Needed
I Total Conversion	1	1. Model (ISCST3/AERMOD) 2. Significant Impact Level (SIL)
	2 – 11	3. Background Air Quality Data
	6 –11	4. Post processor*
	11	5. Hourly NO_2 Background Data 6. Paired-Sum Post Processor*
II ARM	1	1. Model (ISCST3/AERMOD) 2. Significant Impact Level (SIL) 3. ARM Ratio
	2 – 11	4. Background Air Quality Data
	6 –11	5. Post processor*
	11	6. Hourly NO_2 Background Data 7. Paired-Sum Post Processor*
III OLM/PVMRM	1	1. Model (ISCST3/AERMOD with a post-processor) 2. Significant Impact Level (SIL) 3. Hourly Ozone Background data 4. In-Stack NO_2/NO_X Ratio
	2 – 11	5. Background Air Quality Data
	6 –11	6. Post processor*
	11	7. Hourly NO_2 Background Data 8. Paired-Sum Post Processor*

*EPA's updated AERMOD program version 11103 will support post processing and background data inputs

	Conclusion* It has been determined that enough information has been provided to conclude that OLM or PVMRM are appropriate for the above modeling scenario.	
	Supervisor Name	
	Supervisor Signature	
Comments		

12.1 Source Parameter:

The following information should be provided for each different source that is modeled.

Source Parameters For (Unit ID or Description)			
Source Type	Point	**Location Type**	Urban/Rural
Stack Height (m)		**Max Hours per Year**	
Stack Diameter. (m)		**Fuel Type**	
Stack Exit Velocity (m/s)		**NO_2/NO_x Ratio (%)**	/
Stack Exit Temp. (°K)			
Rating (MMBtu/hr)			

Appendix B - OLM/PVMRM Justification

1 Background

In June of 2010, EPA issued two clarification memoranda concerning the implementation of the federal 1-Hour NO_2 standard as it relates to PSD permitting. These memoranda provided guidance on the use of AERMOD as it relates to modeling options and requirements for using alternative models/non-regulatory options.

In brief, the use of non-regulatory options in AERMOD, specifically the Ozone Limiting Method (OLM) and the Plume Volume Molar Ratio Method (PVMRM), would change the status of the model as stated in Section 3.1.2(c) of 40 CFR Part 51, Appendix W,"A preferred model should be operated with the options listed in Appendix A as ''Recommendations for Regulatory Use.'' If other options are exercised, the model is no longer ''preferred.'' Any other modification to a preferred model that would result in a change in the concentration estimates likewise alters its status as a preferred model. Use of the model must then be justified on a case-by-case basis."

In order for non-regulatory options to be used for regulatory purposes the following determination must be made as per section 3.2.2 (e) "… an alternative refined model may be used provided that:"

i. The model has received a scientific peer review;
ii. The model can be demonstrated to be applicable to the problem on a theoretical basis;
iii. The databases which are necessary to perform the analysis are available and adequate;
iv. Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates; and
v. A protocol on methods and procedures to be followed has been established."

2 Non-Regulatory Option Determination

A reviewing agency may approve the use of a refined alternative model as long as the five items in section 3.2.2 (e) of 40 CFR Part 51, Appendix W have been addressed to the satisfaction of the reviewing agency. This determination must be done on a case-by-case basis.

In order to facilitate this process the following framework will be used to justify those issues that are consistent from one project to another. This will allow for a streamline review of the critical modeling inputs that are unique to each project.

The following approach will justify the use of OLM/PVMRM for projects 1) an overall justification will be provided to address each of the five requirements listed in section 3.2.2 (e) and 2) each project will be required to complete a questionnaire intended to provide project specific information that will allow for a streamline determination of the appropriateness of the non-regulatory option(s) used (OLM/PVMRM) on a case-by-case basis, see Appendix A, Section 12.

2.1 Overall Justification

The following will address each of the five requirements noted in 3.2.2.(e) in order to justify the use of OLM/PVMRM for the purpose of determining compliance with the federal 1-hour NO_2 standard.

2.1.1 Section 3.2.2 (e)(i) Requirement (Peer Review)

The requirement of section 3.2.2 (e)(i) is:

- Has the model received a scientific peer review?

As noted in the memorandum from Taylor Fox on June 28, 2010; "Since AERMOD is the preferred model for dispersion for a wide range of application, the focus of the alternative model demonstration for use of the OLM/PVMRM options within AERMOD is on the treatment of NO_X chemistry within the model, and does not need to address basic dispersion algorithms within AERMOD." Therefore the following will address the basic chemistry of each of the non-regulatory options.

2.1.1.1 Basic OLM Chemistry:

To provide some background, the following is a simplified explanation of the basic chemistry relevant to the OLM. First, the relatively high temperatures typical of most combustion sources promote the formation of NO_2 by the following thermal reaction:

$$2\,NO + O_2 \implies 2\,NO_2 \qquad \text{In-stack formation of } NO_2$$

OLM assumes a default 10% of the NO_x in the exhaust is converted to NO_2 by this reaction, and no further conversion by this reaction occurs once the exhaust leaves the stack. **Please Note:** The District has compiled a list of NO_2/NO_x ratios that can be used as default in-stack NO_2/NO_x ratios until source test data become available, see Table 1. The remaining percentage of the NO_x emissions is assumed to be nitric oxide (NO).

As the exhaust leaves the stack and mixes with the ambient air, the NO reacts with ambient ozone (O_3) to form NO_2 and molecular oxygen (O_2):

$$NO + O_3 \implies NO_2 + O_2 \qquad \text{Oxidation of NO by ambient } O_3$$

The OLM assumes that at any given receptor location, the amount of NO that is converted to NO_2 by this reaction is proportional to the ambient O_3 concentration. If the O_3 concentration is less than the NO concentration, the amount of NO_2 formed by this reaction is limited. If the O_3 concentration is greater than or equal to the NO concentration, all of the NO is assumed to be converted to NO_2.

In the presence of radiation from the sun, ambient NO_2 can be destroyed:

NO_2 + sunlight ==> NO + O Photo-dissociation of NO_2

As a conservative assumption, the OLM ignores this reaction.

Another reaction that can form NO_2 in the atmosphere is the reaction of NO with reactive hydrocarbons (HC):

NO + HC ==> NO_2 + HC Oxidation of NO by reactive HC

The OLM also ignores this reaction. This may be a non-conservative assumption with respect to NO_2 formation in urban/industrial areas with relatively large amounts of reactive HC emissions.

2.1.1.2 Basic PVMRM Chemistry:

Building on the basic OLM chemistry, the PVMRM determines the conversion rate for NO_x to NO_2 based on a calculation of the NO_x moles emitted into the plume, and the amount of O_3 moles contained within the volume of the plume between the source and receptor.

Please note: OLM and PVMRM are implemented as non-regulatory options in the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The Industrial Source Complex – Short-Term model (ISCST3) does not contain the PVMRM algorithms. At one time, there was a version of ISCST3 that contained the OLM algorithm. However, that particular version is not able to run on current computers. OLM can be implemented by using a post-processor program. PVMRM was initially implemented using ISCST3. But, no version of ISCST3 with the PVMRM algorithm is currently available.

The dispersion algorithms in AERMOD and other steady-state plume models are based on the use of total dispersion coefficients, which are formulated to represent the time-averaged spread of the plume. A more appropriate definition of the volume of the plume for purposes of determining the ozone moles available for conversion of NOx is based on the instantaneous volume of the plume, which is represented by the use of relative dispersion coefficients, (Cole and Summerhays, 1979; Bange, 1991). The implementation of PVMRM in AERMOD is based on the use of relative dispersion coefficients to calculate the plume volume. Weil (1996 and 1998) has defined formulas for relative dispersion that are consistent with the AERMOD treatment of dispersion, and which can be calculated using meteorological parameters available within AERMOD.

The chemistry for both models has been peer-reviewed as noted by the documents posted on EPA's Support Center for Regulatory Air Modeling (SCRAM) web site entitled "Sensitivity Analysis Of PVMRM And OLM In AERMOD" and "Evaluation Of Bias In AERMOD-PVMRM". Both documents indicate that the models appear to perform as expected.

2.1.2 Section 3.2.2 (e)(ii)Requirement (Applicable on Theoretical Basis)

The requirement of 3.2.2 (e)(ii) is:

- Can the model (OLM or PVMRM) be demonstrated to be applicable to the problem on a theoretical basis?

As noted in the document entitled "Sensitivity Analysis of PVMRM and OLM In AERMOD" prepared by Roger W. Brode of MACTEC Federal Programs, Inc., (Now with EPA's Office of Air Quality Planning and Standards or OAQPS) "This report presents results of a sensitivity analysis of the PVMRM and OLM options for NO_x to NO_2 conversion in the AERMOD dispersion model. Several single source scenarios were examined as well as a multiple-source scenario. The average conversion ratios of NO_2/NO_x for the PVMRM option tend to be lower than for the OLM option and for the Tier 2 option or the Ambient Ratio Method which has a default value of 0.75 for the annual average. The sensitivity of the PVMRM and OLM options to emission rate, source parameters and modeling options appear to be reasonable and are as expected based on the formulations of the two methods. For a given NO_x emission rate and ambient ozone concentration, the NO_2/NO_x conversion ratio for PVMRM is primarily controlled by the volume of the plume, whereas the conversion ratio for OLM is primarily controlled by the ground-level NO_x concentration.

Overall the PVMRM option appears to provide a more realistic treatment of the conversion of NO_x to NO_2 as a function of distance downwind from the source than OLM or the other NO_2 screening options (Hanrahan, 1999a; Hanrahan, 1999b). No anomalous behavior of the PVMRM or OLM options was identified as a result of these sensitivity tests."

Based on this report for both OLM/PVMRM appear to be applicable to the problem of NO_2 formation and as noted by the author provides a better estimation of the NO_2 impacts compared to other screening options (Tier 1 and 2).

2.1.3 Section 3.2.2 (e)(iii) Requirement

The requirement of 3.2.2 (e)(iii) is:

- The databases which are necessary to perform the analysis are available and adequate.

The data needed to conduct an OLM/PVMRM run are:

- Hourly meteorological data,
- Hourly ozone data, and
- In-stack NO_2/NO_x ratio

2.1.3.1 Meteorological and Ozone Datasets (Availability of Databases)

Meteorological and ozone datasets used for perform modeling runs should be processed using applicable EPA guidance. Guidance for filling in missing meteorological data entitled **“**Missing Data Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models” can be found at http://www.epa.gov/ttn/scram/surface/missdata.txt. Currently no guidance is available from EPA on filling in missing ozone data. Section 7.0 of the main document provides a suggested method for filling in missing ozone data that may be used upon approval of the reviewing agency.

2.1.3.2 In-Stack NO_2/NO_X Ratio

Currently, limited information is available on in-stack NO_2/NO_x ratios nation-wide. A literature search of available data revealed in-stack NO_2/NO_x ratios for a limited number of sources, see Appendix C. If a source is not listed, the source type that best represents the source under review should be used.

In addition EPA and some local air district have started collecting in-stack NO_2/NO_x data that is obtained during annual source testing, if available. These data are being compiled, and new In-stack NO_2/NO_x ratios and source categories are being developed.

2.1.4 Section 3.2.2 (e)(iv) Requirement (Performance Evaluations)

The requirement of 3.2.2 (e)(iv) is:

- Has an appropriate performance evaluations of the model (OLM/PVMRM) shown that the model is not biased toward underestimates?

As noted in the document entitled “Evaluation Of Bias In AERMOD-PVMRM” prepared by Roger W. Brode of MACTEC Federal Programs, Inc.,(Now with EPA OAQPS) “This report presents results of an analysis of evaluation results to determine whether the AERMOD-PVMRM algorithm produces biased or unbiased estimates of the NO_2/NO_x ratio. Evaluation results from two aircraft studies and two long-term field studies were examined, as well as comparisons between AERMOD-PVMRM and other refined chemically reactive plume models. Comparisons between predicted and observed NO_2/NO_x ratios were based on results paired in time and space, providing a more rigorous assessment than is commonly used in evaluating the performance of air dispersion models. While there does not appear to be a clear and objective criterion established by EPA for determining whether a model is biased or unbiased, a general “rule of thumb” that is commonly used as a benchmark in judging the performance of air dispersion models is agreement with observations within a factor of two.

…In all cases, the average ratio between predicted and observed NO_2/NO_x ratios showed agreement within a factor of two, and in most cases within about a factor of 1.5. Based on all of the data available, the AERMOD-PVMRM algorithm is judged to provide unbiased estimates of the NO_2/NO_x ratio based on criteria that are comparable to, or more rigorous than, evaluations performed for other dispersion models that are judged to be refined, implying unbiased performance."

As noted in the above report it has been determined that PVMRM has been judged to provide unbiased estimates based on criteria that are comparable to, or more rigorous than, evaluations performed for other dispersion models.

At the present time no assessment of bias has been conducted for the OLM algorithm. It has been shown in the sensitivity analysis, see discussion on section 3.2.2 (e)(ii) above, that OLM provides similar more conservative results than PVMRM. Therefore is it assumed that OLM would also provide an unbiased estimate of the modeled concentration.

2.1.5 Section 3.2.2 (e)(v) Requirement (Established Protocols)

The requirement of 3.2.2 (e)(iv) is:

- Has a protocol on methods and procedures to be followed been established?

The methods and procedures outlined in Appendix A which is entitled "Modeling Procedures" will be implemented to comply with this requirement.

2.2 Conclusion:

Based on the information provided in section 2.1.1 thru 2.1.5, it has been shown that the method for determining hourly NO_2 concentrations using AERMOD in conjunction with the non-regulatory OLM or PVMRM options is an acceptable option based on the requirements of 40 CFR Part 51, Appendix W, 3.2.2(e), see below.

Section 3.2.2 (e)(i). The model has received a scientific peer review;

- The chemistry for both models has received scientific peer review as noted in "Sensitivity Analysis of PVMRM and OLM in AERMOD" and "Evaluation of Bias in AERMOD-PVMRM". Both documents indicate that the models appear to perform as expected

Section 3.2.2 (e)(ii). The model can be demonstrated to be applicable to the problem on a theoretical basis;

- Both models have been reviewed and the chemistry has been widely accepted by EPA and other government agencies as being appropriate for addressing the formation of NO_2 and the calculation of NO_2

concentration at receptors downwind. Additionally, the ""Sensitivity Analysis of PVMRM and OLM in AERMOD" report would indicate OLM/PVMRM provides a better estimation of the NO_2 impacts compared to other screening options.

Section 3.2.2 (e)(iii). The databases which are necessary to perform the analysis are available and adequate;

- The District will process both the meteorological and ozone data using applicable guidance and procedure. Additionally, the District will continue to gather/develop NO_2 ratios as needed.

Section 3.2.2 (e)(iv). Appropriate performance evaluations of the model have shown that the model is not biased toward underestimates;

- As noted the "Evaluation of Bias In AERMOD-PVMRM" report, PVMRM has been judged to provide an unbiased estimate. Based on the sensitivity study, OLM was estimated to provide similar or more conservative estimates of concentration than PVMRM and therefore would also be judged to be unbiased to underestimation.

Section 3.2.2 (e)(v). A protocol on methods and procedures to be followed has been established."

- The methods and procedures for conducting an assessment for determining compliance with the federal 1-hour NAAQS are contained in Appendix A of this document

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Appendix C - In-Stack NO_2/NOx Ratios

Recommend In-stack NO2/NOx Ratios

Refer #	Fuel	Equipment Category (Controls)	Range of Ratios (%)	Recommended Ratio (%)
		Boilers		
1	**NG**	Default	10	10
2		6.6 MMBtu/Hr (Force Draft)*^{L}	0.0 – 2.90	1.58**
2		7.6 MMBtu/Hr (SCR / FGR)*	3.45 – 15.79	9.65**
2		11.4 MMBtu/Hr (Force Draft)*^{L}	1.81 – 3.51	2.68**
		Compressor IC Engines		
1	**NG**	Default	60	60
2a		225 BHP IGN Timing BTC 17***	11.61 – 11.86	11.76**
2a		350 BHP IGN Timing BTC 18***	4.37 – 4.83	4.66**
2a		550 BHP IGN Timing BTC 20***	0.93 – 2.98	1.96**
2a		625 BHP IGN Timing BTC 10***	10.97 – 11.96	11.6**
2a		773 BHP IGN Timing BTC 9***	58.04 – 58.54	58.3**
2a		773 BHP IGN Timing BTC 20***	72.65 – 73.42	73.12**
2a		880 BHP IGN Timing BTC 8***	9.79 – 14.14	11.93**
2a		880 BHP IGN Timing BTC 15***	0.7 – 8.28	2.52**
2a		1500 BHP IGN Timing BTC 12***	10.32 – 12.03	11.47**
2a		1500 BHP IGN Timing BTC 6.5***	18.42 – 21.33	19.97**
2a		4000 BHP IGN Timing BTC 5***	22.36 – 25.69	23.82**
2a	**Waste Gas (Field Gas)**	880 BHP IGN Timing BTC 20***	1.77 – 6.10	3.86**
2a		1000 BHP***	0.40 – 0.81	0.64**
		Dryer		
	NG	20 MMBTU/Hr (Milk -Tower Dryer)*	3.85 – 11.11	6.88**
		Glass Furnace		
2	**NG**	**Glass Furnace**	2.45 – 11.59	4.32**
		Heaters		
2	**NG / Refinery Gas**	14.1 MMBTU/Hr (John Zink PSMR)*	11.54 – 52.63	32.0**

<table>
<tr><th colspan="7">Recommend In-stack NO2/NOx Ratios</th></tr>
<tr><th>Refer #</th><th>Fuel</th><th>Equipment Category (Controls)</th><th colspan="3">Range of Ratios (%)</th><th>Recommended Ratio (%)</th></tr>
<tr><th colspan="7">IC Engines</th></tr>
<tr><td>2</td><td>Biogas</td><td>200 BHP*</td><td colspan="3">0.0 – 1.90</td><td>0.37**</td></tr>
<tr><td>1</td><td rowspan="2">Diesel</td><td>Default</td><td colspan="3">20</td><td>20</td></tr>
<tr><td></td><td>322 BHP (WP)*</td><td colspan="3">0.0 – 50.0</td><td>15.64**</td></tr>
<tr><td>4</td><td rowspan="10">NG</td><td>Default – Lean Burn</td><td colspan="3">5-10</td><td>10</td></tr>
<tr><td>2</td><td>120 BHP (3-Way Catalyst)*</td><td colspan="3">0.1 – 2.83</td><td>0.9**</td></tr>
<tr><td>2</td><td>162 BHP (catalytic converter, air/fuel ratio)*</td><td colspan="3">0.0 – 12.5</td><td>1.81**</td></tr>
<tr><td>2</td><td>165 BHP (3-Way Catalyst)*</td><td colspan="3">0.0 – 17.58</td><td>3.16**</td></tr>
<tr><td>2</td><td>180 BHP (NSCR)*</td><td colspan="3">1.02 – 3.41</td><td>1.82**</td></tr>
<tr><td>2</td><td>208 BHP (catalytic converter, air/fuel ratio)*</td><td colspan="3">0.0 – 1.44</td><td>0.48**</td></tr>
<tr><td>2</td><td>1,070 BHP (LB/WP–Turbocharger/Intercooler)*</td><td colspan="3">20.91 – 39.62</td><td>34.41**</td></tr>
<tr><td>2</td><td>1,529 BHP (LB - CO Catalyst, SCR)*</td><td colspan="3">2.70 – 4.58</td><td>3.59**</td></tr>
<tr><td>2</td><td>2,775 BHP (SCR)*</td><td colspan="3">14.53 – 26.33</td><td>19.46**</td></tr>
<tr><td>2</td><td>4,175 BHP (SCR,CO & VOC Catalysts)*</td><td colspan="3">0.0 – 21.28</td><td>1.15**</td></tr>
<tr><th colspan="7">Transportation Refrigeration Units (TRUs)</th></tr>
<tr><td rowspan="7">5</td><td rowspan="7"></td><td rowspan="7">CARB= CARB Diesel
GTL = Gas To Liquid</td><td>Fuel</td><td>Eng Speed</td><td>Exhaust</td><td>NO_2/ NO_x Ratio</td></tr>
<tr><td>CARB</td><td>High</td><td>Muffler</td><td>15.37</td></tr>
<tr><td>GTL</td><td>High</td><td>Muffler</td><td>16.17</td></tr>
<tr><td>CARB</td><td>High</td><td>pDPF</td><td>25.71</td></tr>
<tr><td>CARB</td><td>Low</td><td>Muffler</td><td>22.66</td></tr>
<tr><td>GTL</td><td>Low</td><td>Muffler</td><td>25.12</td></tr>
<tr><td>CARB</td><td>Low</td><td>pDPF</td><td>12.98</td></tr>
<tr><th colspan="7">Truck / Cars</th></tr>
<tr><td rowspan="2">6</td><td>Gas/Diesel</td><td>Light / Medium Duty</td><td colspan="3">16-25</td><td>25</td></tr>
<tr><td>Diesel</td><td>Heavy Duty</td><td colspan="3">6-11</td><td>11</td></tr>
<tr><th colspan="7">Turbines</th></tr>
<tr><td>3</td><td>NG</td><td>GE Turbines</td><td colspan="3">8.33 – 9.1</td><td>9.1</td></tr>
</table>

Recommend In-stack NO2/NOx Ratios				
Refer #	**Fuel**	**Equipment Category (Controls)**	**Range of Ratios (%)**	**Recommended Ratio (%)**
2a		Solar Centaur T-4702 (3.4 MW)***	8.43 – 12.42	10.32**

* Samples taken each minute or several minutes

**Value represents the statistical average of all data points
*** 30 min / 1 hour Source
Test

L = Load ratings have been included in average

LB = Lean Burn

WP = Water Pump

References

1. Barrie Lawrence, Environmental Scientist, Government of Newfoundland and Labrador, “Guideline for Plume Dispersion Modeling” 1st Revision: November 20, 2006, Page 14

2. District Database “NO2 -NOx Ratio.mdb” - Data is based on CEMs, source test, and portable analyzer data collected in the San Joaquin Valley

  a. District Database “NO2 -NOx Ratio.mdb” - Data is based on source test data collected from out of state (Arkansas Department of Environmental Quality Office of Air Quality)

3. Roointon Pavri and Gerald D. Moore, GE Energy Services Atlanta, GA, “Gas Turbine Emissions and Control” March 2001 Page 63

4. Nigel N. Clark, Center for Alternative Fuels, Engines and Emissions Department of Mechanical and Aerospace Engineering West Virginia University Morgantown, WV 26506, “Selective NOx Recirculation for Stationary Lean-Burn Natural Gas Engines” April 30, 2007 Page 64

5. Robb A. Barnitt, National Renewable Energy Laboratory, “Emissions of Transport Refrigeration Units with CARB Diesel, Gas-to-Liquid Diesel, and Emissions Control Devices”, May 1, 2010

6. P G Boulter, I S McCrae, and J Green, Transportation research Laboratory, “Primary NIO2 Emissions From Road Vehicles in the Hatfield and Bell Commons Tunnels”, July 2007

Appendix D – Meteorological Resources

1 Meteorological Resources

1.1 Surface Data

Several online resources are available for acquiring and processing raw met data. The EPA's SCRAM website located at (http://www.epa.gov/ttn/scram/metobsdata_databases.htm) has formatted and raw met data for some locations within California for both ISCST3 and AERMOD. Data available for AERMOD must still be processed using the AERMET program.

Guidance on how to download raw data from the NCDC website and general processing techniques can be downloaded from the San Joaquin Valley APCD at http://valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm#modeling_guidance. The document entitled "District Meteorological Processing Procedures" provides a step by step procedure for acquiring and processing raw NCDC data. The second is a zip file entitled "Meteorological Data Template" that provides templates for the raw data from NCDC and the NCDC_CNV program that will convert raw NCDC data in a SAMSON format that AERMET can read. The conversion program was developed and distributed without charge by Russell F. Lee of RF Lee Consulting, Charlotte, NC.

1.2 Upper Air Data

Upper Air Data can be downloaded free of charge from http://esrl.noaa.gov/raobs/.