Guidance on the Use of EPA's MERPs

The United States Environmental Protection Agency (US EPA) developed a Tier 1 demonstration tool for ozone and $PM_{2.5}$ precursor emissions called Modeled Emission Rates for Precursors (MERPs). The development of the tool and related guidance is summarized in a memorandum from EPA dated December 2, 2016, with a subject, "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program." The basic idea behind the MERPs is to use technically credible air quality modeling to relate precursor emissions and peak secondary pollutant impacts from specific or hypothetical sources. The TCEQ Air Dispersion Modeling Team (ADMT) used the air quality modeling results presented in EPA MERPs memorandum to derive MERPs for the hypothetical sources located in Texas.

MERP Calculations

To derive a MERP value, the model predicted relationship between precursor emissions from hypothetical sources and their downwind maximum impacts can be combined with a critical air quality threshold using the following equation:

$$MERP = Critical\ Air\ Quality\ Threshold\ * \frac{Modeled\ Emission\ Rate\ from\ Hypothetical\ Source}{Modeled\ Air\ Quality\ Impact\ from\ Hypothetical\ Source}$$

The ADMT used the air quality modeling results presented in Appendix A of the EPA MERPs memorandum to derive the most conservative (lowest) MERPs for the hypothetical sources located in Texas using the EPA recommended significant impact level (SIL) as the critical air quality threshold for 8-hr ozone (1 ppb), annual $PM_{2.5}$ (0.2 $\mu g/m^3$), and 24-hr $PM_{2.5}$ (1.2 $\mu g/m^3$). The worst-case derived MERPs for the hypothetical Texas sources are presented below in Table 1. To use the MERP values in Table 1 as a Tier 1 demonstration, an analysis will need to be provided that shows that the emissions characteristics of the project source and the chemical and physical environment in the vicinity of the project source are adequately represented by the various hypothetical Texas sources modeled by the EPA (and documented in the EPA MERPs memorandum).

Table 1. Worst-case MERPs for the Hypothetical Texas Sources

Precursor	8-hr Ozone (tpy)	24-hr $PM_{2.5}$ (tpy)	Annual $PM_{2.5}$ (tpy)
NO_x	250	2,500	10,000
SO_2	----	343	1,801
VOC	2,290	----	----

If the worst-case MERP values listed in Table 1 are overly conservative, then applicants may use MERP values for a specific hypothetical source, provided a demonstration is shown that the identified hypothetical source is representative for the project source. Tables 2-7 located in the *MERP Values for Hypothetical Texas Sources* section of this document show the derived MERPs for all of the hypothetical Texas sources.

Preliminary Impact Determination

MERPs can be used during the preliminary impact determination to demonstrate that projected impacts from a proposed source are less than a SIL value and would not cause or contribute to a violation of a NAAQS or PSD increment for that pollutant.

For ozone, the following equation should be used:

$$\frac{NO_x\ Increase\ (tpy)}{NO_x\ MERP\ (tpy)} + \frac{VOC\ Increase\ (tpy)}{VOC\ MERP\ (tpy)} < 1$$

The NO_x and VOC increases are the project proposed emission increases in tons per year.

A value less than 1 indicates that the SIL for ozone will not be exceeded when considering the combined impacts of the precursors on 8-hr daily maximum ozone and a cumulative analysis for ozone is not required. If the value is greater than or equal to 1, then the applicant should conduct a cumulative analysis for ozone.

For $PM_{2.5}$, the following equation should be used:

$$\frac{Preliminary\ Direct\ PM_{2.5}\ Impact\ (\mu g/m^3)}{PM_{2.5}\ SIL\ (\mu g/m^3)} + \frac{NO_x\ Increase\ (tpy)}{NO_x\ MERP\ (tpy)} + \frac{SO_2\ Increase\ (tpy)}{SO_2\ MERP\ (tpy)} < 1$$

The NO_x and SO_2 increases are the proposed project emission increases in tons per year.

Similar to ozone, a value less than 1 indicates that the SILs for $PM_{2.5}$ will not be exceeded. However, in the case of $PM_{2.5}$, the direct $PM_{2.5}$ emission increases from the proposed project must be considered. The *Preliminary Direct $PM_{2.5}$ Impact* is the highest modeled concentration (annual or H1H averaged over 5 years) for the proposed project increases of direct $PM_{2.5}$ emissions. If the sum of the direct $PM_{2.5}$ impact and the precursor impacts is less than 1, then the $PM_{2.5}$ impacts are below the $PM_{2.5}$ SILs and the applicant does not need to perform a cumulative analysis for $PM_{2.5}$. If the sum of the ratios is equal to or greater than 1, the applicant should conduct a cumulative analysis for $PM_{2.5}$.

Cumulative Analysis

MERPs can be used during a cumulative analysis to demonstrate that projected impacts from a proposed source would result in values less than the NAAQS or PSD increment for that pollutant.

For ozone, the following equation should be used:

$$BKGND\_O_3(ppb) + \left(\frac{NO_x\ Increase\ (tpy)}{NO_x\ MERP\ (tpy)} + \frac{VOC\ Increase\ (tpy)}{VOC\ MERP\ (tpy)}\right) * Ozone\ SIL\ (ppb) \leq Ozone\ NAAQS\ (ppb)$$

The NO_x and VOC increases are the project proposed emission increases in tons per year. *$BKGND\_O_3$* is the background ozone design value determined from a representative monitor. Guidance on determining the appropriate background concentrations can be found in Appendix D of the TCEQ Air Quality Modeling Guidelines:

www.tceq.texas.gov/assets/public/permitting/air/Modeling/guidance/airquality-mod-guidelines6232.pdf.

If the equation results in a value less than or equal to the ozone NAAQS, the proposed project would not be expected to cause or contribute to a violation of the ozone NAAQS. If the value is greater than the ozone NAAQS, then the applicant may need to consider a Tier 2 demonstration.

For $PM_{2.5}$, the following equation should be used:

$$BKGND\_PM_{2.5}(\mu g/m^3) + DirectPM_{2.5}\ Impact\ (\mu g/m^3) + \left(\frac{NO_x\ Increase\ (tpy)}{NO_x\ MERP\ (tpy)} + \frac{SO_2\ Increase\ (tpy)}{SO_2\ MERP\ (tpy)}\right) * PM_{2.5}\ SIL\ (\mu g/m^3) \leq PM_{2.5}\ NAAQS\ (\mu g/m^3)$$

The NOx and SO_2 increases are the project proposed emission increases in tons per year. *BKGND_PM2.5* is the background $PM_{2.5}$ design value determined from a representative monitor. Guidance on determining the appropriate background concentrations can be found in Appendix D of the TCEQ Air Quality Modeling Guidelines:

www.tceq.texas.gov/assets/public/permitting/air/Modeling/guidance/airquality-mod-guidelines6232.pdf.

Similar to ozone, if the equation results in a value less than or equal to the $PM_{2.5}$ NAAQS, the proposed project would not be expected to cause or contribute to a violation of the $PM_{2.5}$ NAAQS. However, in the case of $PM_{2.5}$, direct $PM_{2.5}$ emissions from the proposed project and nearby sources must be considered. *Direct PM2.5 Impact* is the modeled design value from the proposed project direct $PM_{2.5}$ emissions and direct $PM_{2.5}$ emissions from nearby sources. If the value is greater than the $PM_{2.5}$ NAAQS, then the applicant may need to consider a Tier 2 demonstration.

Examples

This section demonstrates the steps recommended for conducting a Tier 1 MERPs analysis for an example PSD application with proposed emission rates of 200 tpy of NO_x, 150 tpy of SO_2, 700 tpy of VOC, and 40 tpy of $PM_{2.5}$. The direct $PM_{2.5}$ AERMOD predicted concentrations for the preliminary impact is 0.9 $\mu g/m^3$ for the 24-hr averaging time and 0.1 $\mu g/m^3$ for the annual averaging time. The worst-case MERPs for the hypothetical Texas sources listed in table 1 are used in the following example.

Example Preliminary Impact Determination Calculations

Ozone

$$\frac{200\ tpy}{250\ tpy} + \frac{700\ tpy}{2290\ tpy} = 0.8 + 0.31 = 1.11$$

The result is greater than 1 and the applicant will need to conduct a cumulative analysis.

24-hr PM2.5

$$\frac{0.9\ \mu g/m^3}{1.2\ \mu g/m^3} + \frac{200\ tpy}{2500\ tpy} + \frac{150\ tpy}{343\ tpy} = 0.75 + 0.08 + 0.44 = 1.27$$

The result is greater than 1 and the applicant will need to conduct a cumulative analysis.

Annual PM2.5

$$\frac{0.1\ \mu g/m^3}{0.2\ \mu g/m^3} + \frac{200\ tpy}{10000\ tpy} + \frac{150\ tpy}{1801\ tpy} = 0.5 + 0.02 + 0.08 = 0.6$$

The result is less than 1 and the proposed project would not cause or contribute to a violation of a NAAQS or PSD increment for annual $PM_{2.5}$.

The example above follows the same procedure described in the EPA MERPs memorandum. However, the Air Quality Analysis (AQA) report should take an additional step in order to quantify the secondary Ozone and $PM_{2.5}$ impacts for the preliminary impacts analysis. Quantifying the secondary Ozone and $PM_{2.5}$ impacts for the preliminary impact determination is necessary in order to determine the predicted concentrations to report in the AQA. The preliminary impact determination predicted concentrations reported in the AQA can be calculated using the following equation:

$$(Preliminary\ Impact\ Determintation\ result) * (SIL)$$

Using the project information and results provided above, the preliminary impact concentrations reported in the AQA are calculated as follows:

Ozone

$$1.11 * 1\ ppb = 1.11\ ppb$$

24-hr $PM_{2.5}$

$$1.27 * 1.2\ \mu g/m^3 = 1.524\ \mu g/m^3$$

Annual $PM_{2.5}$

$$0.6 * 0.2\ \mu g/m^3 = 0.12\ \mu g/m^3$$

Example Cumulative NAAQS Analysis Calculations

The example preliminary impact determination results require a cumulative impact analysis for ozone and 24-hr $PM_{2.5}$. Representative background concentrations for the proposed project are 62 ppb for ozone and 22 µg/m^3 for 24-hr $PM_{2.5}$. The direct $PM_{2.5}$ AERMOD predicted concentrations for the cumulative analysis is 5 µg/m^3 for the 24-hr averaging time.

Ozone

$$62\ ppb + \left(\frac{200\ tpy}{250\ tpy} + \frac{700\ tpy}{2290\ tpy}\right) * 1\ ppb = 62\ ppb + 1.11\ ppb = 63.11\ ppb$$

The result is less than the ozone NAAQS of 70 ppb and the proposed project would not cause or contribute to a violation of the ozone NAAQS.

24-hr $PM_{2.5}$

$$22\ \mu g/m^3 + 5\ \mu g/m^3 + \left(\frac{200\ tpy}{2500\ tpy} + \frac{150\ tpy}{343\ tpy}\right) * 1.2\ \mu g/m^3$$
$$= 22\ \mu g/m^3 + 5\ \mu g/m^3 + (0.08 + 0.44) * 1.2\ \mu g/m^3$$
$$= 22\ \mu g/m^3 + 5\ \mu g/m^3 + 0.624\ \mu g/m^3$$
$$= 27.624\ \mu g/m^3$$

The result is less than the 24-hr $PM_{2.5}$ NAAQS of 35 µg/m^3 and the proposed project would not cause or contribute to a violation of the 24-hr $PM_{2.5}$ NAAQS.

MERP Values for Hypothetical Texas Sources

The ADMT used the air quality modeling results presented in Appendix A of the EPA MERPs memorandum to derive MERPs for the hypothetical sources located in Texas using the EPA recommended SIL as the critical air quality threshold for 8-hr ozone (1 ppb), annual $PM_{2.5}$ (0.2 µg/m^3), and 24-hr $PM_{2.5}$ (1.2 µg/m^3). In order to use a MERP value for a specific hypothetical source, an applicant must first conduct an analysis to compare the chemical and physical environment in the vicinity of the project source relative to the hypothetical source. Information used in the analysis may include average and peak temperatures, humidity, terrain, rural/urban nature of the area, regional sources of pollutants (biogenic, industrial, etc.), and ambient concentrations of relevant pollutants.

Table 2. NO_x MERP Values for Ozone from Hypothetical Texas Sources

Source	Emissions (tpy)	Height	MERP (tpy)
5 (Terry)	500	H	427
5 (Terry)	500	L	416
5 (Terry)	1000	H	490
5 (Terry)	3000	H	699
19 (Henderson)	500	H	259
19 (Henderson)	500	L	250
19 (Henderson)	1000	H	289
19 (Henderson)	3000	H	356
20 (Harris)	500	H	641
20 (Harris)	500	L	632
20 (Harris)	1000	H	740
20 (Harris)	3000	H	1,067
24 (Parker)	500	H	384
24 (Parker)	500	L	387
24 (Parker)	1000	H	432
24 (Parker)	3000	H	583
25 (Guadalupe)	500	H	694
25 (Guadalupe)	500	L	684
25 (Guadalupe)	1000	H	746
25 (Guadalupe)	3000	H	980

Table 3. VOC MERP Values for Ozone from Hypothetical Texas Sources

Source	Emissions (tpy)	Height	MERP (tpy)
5 (Terry)	500	H	16,666
5 (Terry)	500	L	16,666
5 (Terry)	1000	H	16,666
5 (Terry)	3000	H	13,636
19 (Henderson)	500	L	10,000
19 (Henderson)	1000	H	6,666
19 (Henderson)	1000	L	10,000
19 (Henderson)	3000	H	5,882
20 (Harris)	500	L	3,571
20 (Harris)	1000	H	3,448
20 (Harris)	1000	L	3,703
20 (Harris)	3000	H	2,752
24 (Parker)	500	L	2,941
24 (Parker)	1000	H	3,030
24 (Parker)	1000	L	3,030
24 (Parker)	3000	H	2,290
25 (Guadalupe)	500	L	3,125
25 (Guadalupe)	1000	H	2,941
25 (Guadalupe)	1000	L	2,777
25 (Guadalupe)	3000	H	2,325

Table 4. NO_x MERP Values for 24-hr $PM_{2.5}$ from Hypothetical Texas Sources

Source	Emissions (tpy)	Height	MERP (tpy)
5 (Terry)	500	H	15,789
5 (Terry)	500	L	7,317
5 (Terry)	1000	H	16,666
5 (Terry)	3000	H	17,560
19 (Henderson)	500	L	5,000
19 (Henderson)	1000	H	15,000
19 (Henderson)	1000	L	5,217
19 (Henderson)	3000	H	13,846
20 (Harris)	500	L	4,615
20 (Harris)	1000	H	13,333
20 (Harris)	1000	L	5,000
20 (Harris)	3000	H	10,909
24 (Parker)	500	L	2,857
24 (Parker)	1000	H	7,500
24 (Parker)	1000	L	2,500
24 (Parker)	3000	H	6,000
25 (Guadalupe)	500	L	5,454
25 (Guadalupe)	1000	H	10,000
25 (Guadalupe)	1000	L	5,000
25 (Guadalupe)	3000	H	8,780

Table 5. SO_2 MERP Values for 24-hr $PM_{2.5}$ from Hypothetical Texas Sources

Source	Emissions (tpy)	Height	MERP (tpy)
5 (Terry)	500	H	8,823
5 (Terry)	500	L	2,166
5 (Terry)	1000	H	9,836
5 (Terry)	3000	H	10,112
19 (Henderson)	500	L	1,621
19 (Henderson)	1000	H	2,307
19 (Henderson)	1000	L	1,132
19 (Henderson)	3000	H	1,764
20 (Harris)	500	L	363
20 (Harris)	1000	H	1,348
20 (Harris)	1000	L	343
20 (Harris)	3000	H	1,258
24 (Parker)	500	L	1,090
24 (Parker)	1000	H	1,463
24 (Parker)	1000	L	585
24 (Parker)	3000	H	1,014
25 (Guadalupe)	500	L	1,052
25 (Guadalupe)	1000	H	1,621
25 (Guadalupe)	1000	L	851
25 (Guadalupe)	3000	H	1,328

Table 6. NO_x MERP Values for annual $PM_{2.5}$ from Hypothetical Texas Sources

Source	Emissions (tpy)	Height	MERP (tpy)
5 (Terry)	500	H	90,909
5 (Terry)	500	L	27,027
5 (Terry)	1000	H	95,238
5 (Terry)	3000	H	107,142
19 (Henderson)	500	L	20,000
19 (Henderson)	1000	H	66,666
19 (Henderson)	1000	L	16,666
19 (Henderson)	3000	H	50,000
20 (Harris)	500	L	11,111
20 (Harris)	1000	H	50,000
20 (Harris)	1000	L	10,000
20 (Harris)	3000	H	40,000
24 (Parker)	500	L	25,000
24 (Parker)	1000	H	66,666
24 (Parker)	1000	L	20,000
24 (Parker)	3000	H	46,153
25 (Guadalupe)	500	L	20,000
25 (Guadalupe)	1000	H	66,666
25 (Guadalupe)	1000	L	16,666
25 (Guadalupe)	3000	H	42,857

Table 7. SO_2 MERP Values for annual $PM_{2.5}$ from Hypothetical Texas Sources

Source	Emissions (tpy)	Height	MERP (tpy)
5 (Terry)	500	H	52,631
5 (Terry)	500	L	25,641
5 (Terry)	1000	H	54,054
5 (Terry)	3000	H	58,823
19 (Henderson)	500	L	16,666
19 (Henderson)	1000	H	28,571
19 (Henderson)	1000	L	10,526
19 (Henderson)	3000	H	15,384
20 (Harris)	500	L	2,500
20 (Harris)	1000	H	9,090
20 (Harris)	1000	L	1,801
20 (Harris)	3000	H	6,000
24 (Parker)	500	L	12,500
24 (Parker)	1000	H	22,222
24 (Parker)	1000	L	7,692
24 (Parker)	3000	H	13,953
25 (Guadalupe)	500	L	7,692
25 (Guadalupe)	1000	H	14,285
25 (Guadalupe)	1000	L	5,000
25 (Guadalupe)	3000	H	8,955

The sources are identified by number and county. The numbers are the same numbers used to identify sources in the EPA MERP memorandum. For source height, a value of H represents an elevated release (90 meters) and a value of L represents a surface release (1 meter).