Tennessee Guidance on the Use of EPA's MERPs
to Account for Secondary Ozone and
Fine Particulate Formation in Tennessee Under the New Source Review
(NSR) Prevention of Significant Deterioration Program (PSD)

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Introduction

The Tennessee Air Pollution Control Division (TAPCD) reviewed EPA's "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier l Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program". This guidance came in the following two EPA documents and a memo:

1. EPA-454_R-16-005 titled Guidance on the Use of Models for Assessing the Impacts of Emissions from Single Sources on the Secondarily Formed Pollutants: Ozone and $PM_{2.5}$ dated December 2016;

2. EPA's Air Quality Assessment Division Memo and draft document EPA-454_R-16-006 titled Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier l Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program dated Dec 2, 2016;

3. EPA's Air Quality Assessment Division "MERPS Data Distribution and Errata" Memo titled Distribution of the EPA's modeling data used to develop illustrative examples in the draft *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier I Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program* dated Feb 23, 2017; and

4. EPA-454/R-19-003, April 2019 titled 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

Based on EPA's latest photochemical modeling for MERPs utilizing a 12-km domain, TAPCD identified a few nearby hypothetical sources that can be used to represent sources in Tennessee (Table 1 below). Two of these sources designated: Giles, TN & Shelby, TN, are located in the central U.S. (12EUS2) domain used in EPA-454/R-19-003 (see Figure A-2 on page 69 of the EPA document). These are numbered 3 and 8 respectively and shown in Figure 1 of this document. The Giles source may be used to represent sources in south-central Tennessee, while the Shelby source may be used to represent sources in West Tennessee.

Two other sources designated as: Ashe, NC and Barren, KY are located in the eastern U.S. (12EUS3) domain used in EPA-454/R-19-003 (see Figure A-1 on page 68 of the EPA document). These are numbered 13 and 18 respectively and shown in Figure 2 of this document. These two sources, just outside of Tennessee and close to the state boarder, may be used to represent sources in east Tennessee and north-central Tennessee, respectively. Additionally, two more hypothetical sources were added in Anderson, TN and Pemiscot, MO, that can be used to represent sources in Tennessee (Table 1 below). These two sources are located in the contiguous U.S (12US2) domain used in EPA-454/R-19-003 (see Figure A-4 on page 71 of the EPA document). These are numbered 12 and 17 respectively and shown in Figure 3 of this document.

Table 1. Source Locations, emission rates (in tpy), and release heights (H= 90 meters & L = 10 meter for four nearby hypothetical sources.

Source ID, (Domain)	Latitude	Longitude	FIPS	Source Location	Emission Rate & Release Heights
3 (12EUS2)	35.2912°	-86.8975°	47055	Giles, TN	500 tpy (H and L), 1000 tpy (H), and 3000 tpy (H)
8 (12EUS2)	35.1240°	-90.0021°	47157	Shelby, TN	500 tpy (H and L), 1000 tpy (H), and 3000 tpy (H)
13 (12EUS3)	36.3007°	-81.3737°	37009	Ashe, NC	500 tpy (H and L), 1000 tpy (H), and 3000 tpy (H)
18 (12EUS3)	36.8285°	-85.8305°	21009	Barren, KY	500 tpy (H and L), 1000 tpy (H), and 3000 tpy (H)
12 (12US2)	36.079	-84.149	47001	Anderson, TN	500 tpy (H and L), 1000 tpy (H)
17 (12US2)	36.223	-89.851	29155	Pemiscot, MO	500 tpy (H and L), 1000 tpy (H)

Notes:

1. *The source information provided in EPA's MERPs Guidance for Stack ID #3 (Giles, TN) models 500 tpy (L and H), 1000 tpy (H), and 3000 tpy (H) for NOx impacts on ozone. This is different from the emission rates and release heights shown above for VOC impacts on ozone. Also see: https://www3.epa.gov/ttn/scram/guidance/guide/EPA-454_R-19-003.pdf for site listing for coordinates in Appendix A or in https://www.epa.gov/scram/clean-air-act-permit-modeling-guidance for the spreadsheet in MERPS guidance.*

2. *Modeling Domains include: Central US (12EUS2), Eastern US (12EUS3), and the contiguous U.S. (12US2).*
3. *Climate Zones include: Ohio Valley [OV], and South eastern US [SE]*

Additionally, EPA published an on-line set of tools to assist state/local/tribal air agencies and permit applicants in replication of EPA's modeling for purposes of testing, verification, and use of the recommended approach for PSD permitting purposes. The tool set, called "the MERPs VIEW Qlik applications" contains the modeling data presented in the technical guidance, "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 tools provide the data using a set of interactive Qlik applications, where specific sources or groups of sources can be selected to quickly access modeled impacts.
Specifically, the MERPs VIEW Qlik applications may be used:

1. to support Class II NAAQS Tier 1 demonstrations for PSD permits, illustrative hypothetical single source modeled impacts for annual and daily maximum average $PM_{2.5}$ and annual maximum daily 8-hr O_3 (information provided as Modeled Emission Rates for Precursors (MERPs)) and
2. to support Class I PSD increment Tier 1 demonstration for PSD permits, illustrative hypothetical single source modeled impacts of maximum daily average $PM_{2.5}$ concentrations provided by distance from the source

The data is available at https://www.epa.gov/scram/merps-view-qlik

MERP Calculations

MERPS were calculated for each of the six (6) nearby hypothetical sources using the following equations:

$$\boldsymbol{MERP\ (tpy)} = \textbf{Appropriate } \textit{Significant Impact Level} \textbf{ value X } \frac{\textit{Modeled precursor emissions rate (tpy) from hypothetical source}}{\textit{Modeled maximum air quality impact from hypothetical source}}$$

The significant Impact Level (SIL) for ozone is 1 ppb, the SIL for annual $PM_{2.5}$ is 0.2 µg/m^3 and the SIL for daily $PM_{2.5}$ is 1.2 µg/m^3. The units for the Maximum Model Impact are parts per billion (ppb) for ozone and micrograms per cubic meter (µg/m^3) for $PM_{2.5}$. The most conservative (lowest) MERP values from the six (6) nearby hypothetical sources by precursor and pollutant are contained in Table 2 below. These default MERP values can be used for Tier 1 demonstrations in Tennessee without further justification.

Table 2. Default MERP values (tpy) for Tennessee PSD applications

Precursor	8-hour Ozone	Daily $PM_{2.5}$	Annual $PM_{2.5}$
NO_x	156	3,717	7,625
SO_2	-	716	5,817
VOC	1,542	-	-

Note: MERPS values are listed in Table 3 through 8 below. The default values are the lowest (conservative) MERP values for hypothetical sources in and near Tennessee.

An applicant may choose to use a different site specific MERPs based on one of the six nearby hypothetical sources located in Tables 3 to 8 (pages 6 to 11). However, the applicant will need to submit a detailed justification describing why the alternate MERP is representative for their project. The justification should discuss selection of hypothetical sources (distance and direction to the project site, meteorology, terrain, etc.), emission rates and stack heights. The justification for use of an alternate MERPs should be included in the modeling protocol and are subject to TAPCD approval.

Figure 1. Hypothetical source location for the central U.S. (12EUS2) domain.

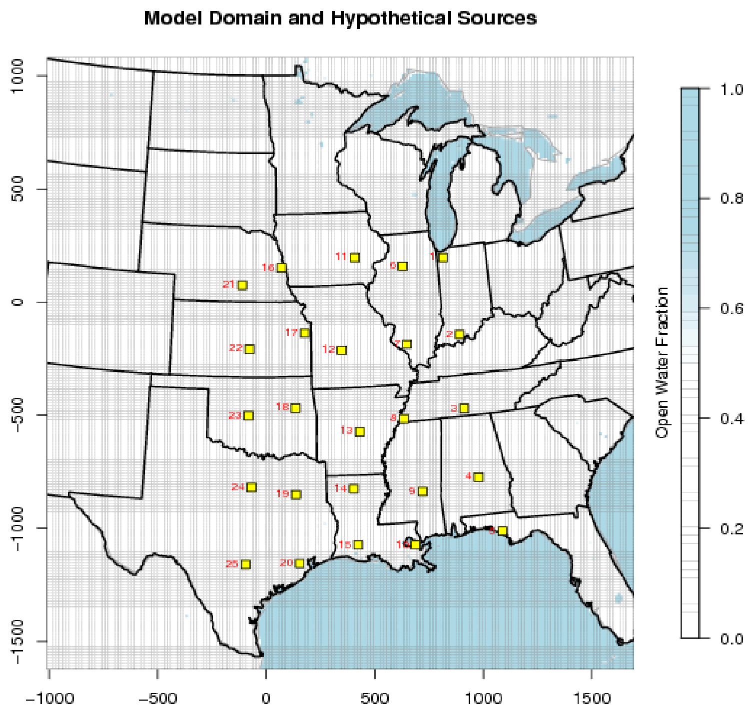

Figure 2. Hypothetical source location for the eastern U.S. (12EUS3) domain.

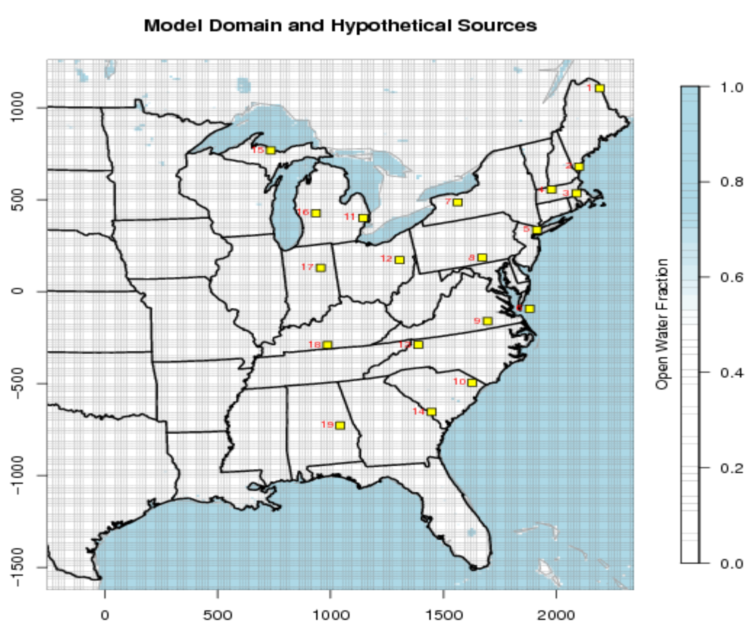

Figure 3. Hypothetical source locations for the contiguous U.S. (12US2) domain.

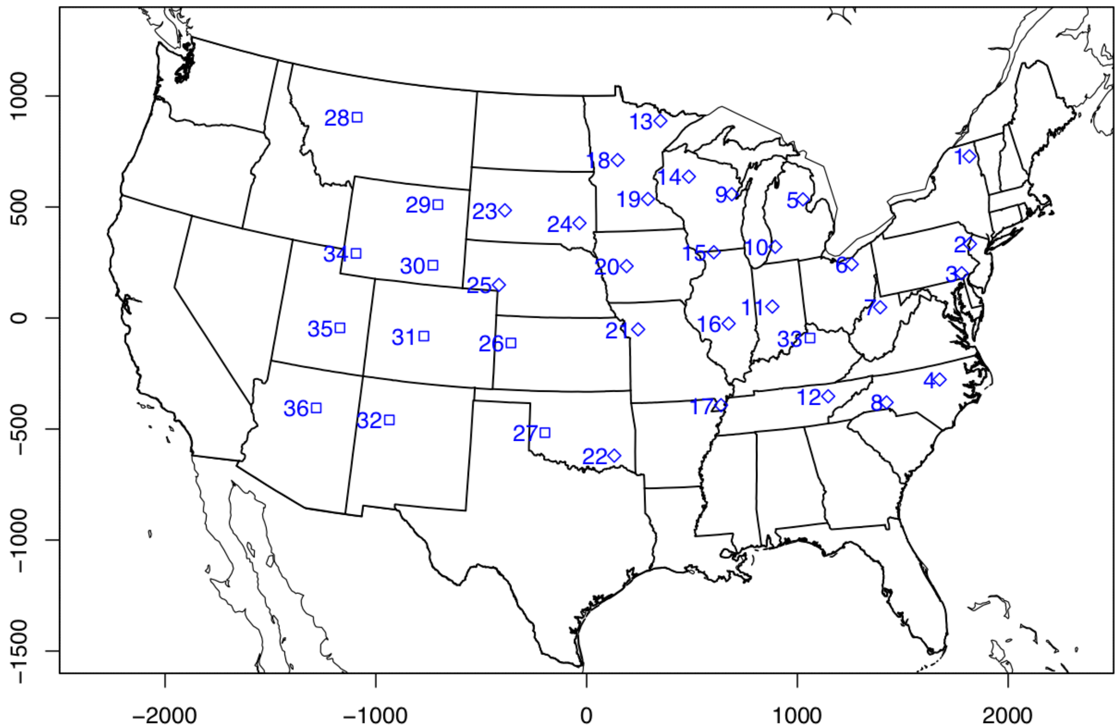
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Table 3. NO_x MERP values for ozone. Lowest MERP is shown in bold red. SIL = 1.00

Precursor	Area	Emissions (tpy)	Height	Source ID	FIPS	State	County	Max. Value (ppbv)	MERP Value (tpy)
NO_x	12EUS2	500	H	3	47055	TN	Giles	3.208	**156**
NO_x	12EUS2	500	L	3	47055	TN	Giles	2.616	191
NO_x	12EUS2	1000	H	3	47055	TN	Giles	5.387	186
NO_x	12EUS2	3000	H	3	47055	TN	Giles	10.356	290
NO_x	12EUS2	500	H	8	47157	TN	Shelby	0.702	713
NO_x	12EUS2	500	L	8	47157	TN	Shelby	0.694	720
NO_x	12EUS2	1000	H	8	47157	TN	Shelby	1.288	777
NO_x	12EUS2	3000	H	8	47157	TN	Shelby	2.23	1346
NO_x	12EUS3	500	H	13	37009	NC	Ashe	1.868	268
NO_x	12EUS3	500	L	13	37009	NC	Ashe	1.814	276
NO_x	12EUS3	1000	H	13	37009	NC	Ashe	3.135	319
NO_x	12EUS3	3000	H	13	37009	NC	Ashe	6.337	473
NO_x	12EUS3	500	H	18	21009	KY	Barren	2.946	170
NO_x	12EUS3	500	L	18	21009	KY	Barren	2.908	172
NO_x	12EUS3	1000	H	18	21009	KY	Barren	5.026	199
NO_x	12EUS3	3000	H	18	21009	KY	Barren	10.687	281
NO_x	12US2	500	L	12	47001	TN	Anderson	1.955	256
NO_x	12US2	500	H	12	47001	TN	Anderson	1.975	253
NO_x	12US2	1000	H	12	47001	TN	Anderson	3.635	275
NO_x	17US2	500	L	17	29155	MO	Pemiscot	1.127	444
NO_x	17US2	500	H	17	29155	MO	Pemiscot	1.106	452
NO_x	17US2	1000	H	17	29155	MO	Pemiscot	1.942	515

Table 4. VOC MERP values for ozone. Lowest MERP is shown in bold red. SIL = 1.00

Precursor	Area	Emissions (tpy)	Height	Source ID	FIPS	State	County	Max. Value (ppbv)	MERP Value (tpy)
VOC	12EUS2	500	L	3	47055	TN	Giles	0.037	13,595
VOC	12EUS2	1000	H	3	47055	TN	Giles	0.085	11,797
VOC	12EUS2	1000	L	3	47055	TN	Giles	0.086	11,564
VOC	12EUS2	3000	H	3	47055	TN	Giles	0.626	4,789
VOC	12EUS2	500	L	8	47157	TN	Shelby	0.25	1,998
VOC	12EUS2	1000	H	8	47157	TN	Shelby	0.547	1,828
VOC	12EUS2	1000	L	8	47157	TN	Shelby	0.551	1,815
VOC	12EUS2	3000	H	8	47157	TN	Shelby	1.946	**1,542**
VOC	12EUS3	500	H	13	37009	NC	Ashe	0.034	14,634
VOC	12EUS3	500	L	13	37009	NC	Ashe	0.062	8,002
VOC	12EUS3	1000	H	13	37009	NC	Ashe	0.078	12,794
VOC	12EUS3	3000	H	13	37009	NC	Ashe	0.363	8,273
VOC	12EUS3	500	H	18	21009	KY	Barren	0.060	8,317
VOC	12EUS3	500	L	18	21009	KY	Barren	0.060	8,306
VOC	12EUS3	1000	H	18	21009	KY	Barren	0.130	7,703
VOC	12EUS3	3000	H	18	21009	KY	Barren	0.896	3,350
VOC	12US2	500	L	12	47001	TN	Anderson	0.201	2,492
VOC	17US2	500	L	17	29155	MO	Pemiscot	0.086	5,831

Table 5. NO_x MERP values for annual $PM_{2.5}$. Lowest MERP is shown in bold red. SIL = 0.20

Precursor	Area	Emissions (tpy)	Height	Source ID	FIPS	State	County	Max. Value ($\mu g/m^3$)	MERP Value (tpy)
NO_x	12EUS2	500	H	3	47055	TN	Giles	0.002253	44,386
NO_x	12EUS2	500	L	3	47055	TN	Giles	0.011523	8,678
NO_x	12EUS2	1000	H	3	47055	TN	Giles	0.005761	34,719
NO_x	12EUS2	1000	L	3	47055	TN	Giles	0.026229	**7,625**
NO_x	12EUS2	3000	H	3	47055	TN	Giles	0.024164	24,830
NO_x	12EUS2	500	H	8	47157	TN	Shelby	0.001604	62,332
NO_x	12EUS2	500	L	8	47157	TN	Shelby	0.003261	30,663
NO_x	12EUS2	1000	H	8	47157	TN	Shelby	0.00348	57,469
NO_x	12EUS2	1000	L	8	47157	TN	Shelby	0.006921	28,897
NO_x	12EUS2	3000	H	8	47157	TN	Shelby	0.012559	47,775
NO_x	12EUS3	500	H	13	37009	NC	Ashe	0.001928	51,856
NO_x	12EUS3	500	L	13	37009	NC	Ashe	0.003708	26,972
NO_x	12EUS3	1000	H	13	37009	NC	Ashe	0.003709	53,929
NO_x	12EUS3	3000	H	13	37009	NC	Ashe	0.01042	57,582
NO_x	12EUS3	500	H	18	21009	KY	Barren	0.002131	46,920
NO_x	12EUS3	500	L	18	21009	KY	Barren	0.007193	13,902
NO_x	12EUS3	1000	H	18	21009	KY	Barren	0.003993	50,087
NO_x	12EUS3	3000	H	18	21009	KY	Barren	0.01032	58,137
NO_x	12US2	500	L	12	47001	TN	Anderson	0.003053	32,756
NO_x	12US2	500	H	12	47001	TN	Anderson	0.001316	75,986
NO_x	12US2	1000	H	12	47001	TN	Anderson	0.002552	78,368
NO_x	17US2	500	L	17	29155	MO	Pemiscot	0.008434	11,856
NO_x	17US2	500	H	17	29155	Mo	Pemiscot	0.002907	34,400
NO_x	17US2	1000	H	17	29155	MO	Pemiscot	0.005594	35,755

Table 6. SO_2 MERP values for annual $PM_{2.5}$. Lowest MERP is shown in bold red. SIL = 0.20

Precursor	Area	Emissions (tpy)	Height	Source ID	FIPS	State	County	Max. Value (µg/m^3)	MERP Value (tpy)
SO_2	12EUS2	500	L	3	47055	TN	Giles	0.009229	10,836
SO_2	12EUS2	500	H	3	47055	TN	Giles	0.003338	29,959
SO_2	12EUS2	1000	H	3	47055	TN	Giles	0.01035	19,323
SO_2	12EUS2	1000	L	3	47055	TN	Giles	0.034382	**5,817**
SO_2	12EUS2	3000	H	3	47055	TN	Giles	0.064314	9,329
SO_2	12EUS2	500	L	8	47157	TN	Shelby	0.008668	11,537
SO_2	12EUS2	500	H	8	47157	TN	Shelby	0.003426	29,193
SO_2	12EUS2	1000	H	8	47157	TN	Shelby	0.007979	25,064
SO_2	12EUS2	1000	L	8	47157	TN	Shelby	0.021839	9,158
SO_2	12EUS3	3000	H	8	47157	TN	Shelby	0.038442	15,608
SO_2	12EUS3	500	H	13	37009	NC	Ashe	0.006971	14,345
SO_2	12EUS3	500	L	13	37009	NC	Ashe	0.010283	9,725
SO_2	12EUS3	1000	H	13	37009	NC	Ashe	0.013102	15,264
SO_2	12EUS3	3000	H	13	37009	NC	Ashe	0.013102	15,264
SO_2	12EUS3	500	H	18	21009	KY	Barren	0.002217	45,103
SO_2	12EUS3	500	L	18	21009	KY	Barren	0.003929	25,455
SO_2	12EUS3	1000	H	18	21009	KY	Barren	0.004474	44,701
SO_2	12EUS3	3000	H	18	21009	KY	Barren	0.013653	43,945
SO_2	12US2	500	L	12	47001	TN	Anderson	0.003862	25,893
SO_2	12US2	500	H	12	47001	TN	Anderson	0.002864	34,920
SO_2	12US2	1000	H	12	47001	TN	Anderson	0.005589	35,783
SO_2	17US2	500	L	17	29155	MO	Pemiscot	0.007458	13,408
SO_2	17US2	500	H	17	29155	MO	Pemiscot	0.002806	35,644
SO_2	17US2	1000	H	17	29155	MO	Pemiscot	0.005513	36,278

Table 7. NO_x MERP values for daily $PM_{2.5}$. Lowest MERP is shown in bold red. SIL = 1.20

Precursor	Area	Emissions (tpy)	Height	Source ID	FIPS	State	County	Max. Value ($\mu g/m^3$)	MERP Value (tpy)
NOx	12EUS2	500	H	3	47055	TN	Giles	0.046	13,042
NOx	12EUS2	500	L	3	47055	TN	Giles	0.133	4,516
NO_x	12EUS2	1000	H	3	47055	TN	Giles	0.108	11,067
NO_x	12EUS2	1000	L	3	47055	TN	Giles	0.281	4,269
NO_x	12EUS2	3000	H	3	47055	TN	Giles	0.455	7,910
NO_x	12EUS2	500	H	8	47157	TN	Shelby	0.047	12,825
NO_x	12EUS2	500	L	8	47157	TN	Shelby	0.060	9,957
NO_x	12EUS2	1000	H	8	47157	TN	Shelby	0.100	12,035
NO_x	12EUS2	1000	L	8	47157	TN	Shelby	0.123	9,754
NO_x	12EUS2	3000	H	8	47157	TN	Shelby	0.330	10,924
NO_x	12EUS3	500	H	13	37009	NC	Ashe	0.041	14,704
NO_x	12EUS3	500	L	13	37009	NC	Ashe	0.052	11,619
NO_x	12EUS3	1000	H	13	37009	NC	Ashe	0.077	15,507
NO_x	12EUS3	3000	H	13	37009	NC	Ashe	0.222	16,214
NO_x	12EUS3	500	H	18	21009	KY	Barren	0.049	12,315
NO_x	12EUS3	500	L	18	21009	KY	Barren	0.107	5,615
NO_x	12EUS3	1000	H	18	21009	KY	Barren	0.089	13,550
NO_x	12EUS3	3000	H	18	21009	KY	Barren	0.203	17,710
NO_x	12US2	500	L	12	47001	TN	Anderson	0.038	15,912
NO_x	12US2	500	H	12	47001	TN	Anderson	0.025	24,175
NO_x	12US2	1000	H	12	47001	TN	Anderson	0.048	24,987
NO_x	17US2	500	L	17	29155	MO	Pemiscot	0.161	**3,717**
NO_x	17US2	500	H	17	29155	MO	Pemiscot	0.065	9,172
NO_x	17US2	1000	H	17	29155	MO	Pemiscot	0.117	10,266

Table 8. SO_2 MERP values for daily $PM_{2.5}$. Lowest MERP is shown in bold red. SIL = 1.20

Precursor	Area	Emissions (tpy)	Height	Source ID	FIPS	State	County	Max. Value (µg/m^3)	MERP Value (tpy)
SO_2	12EUS2	500	H	3	47055	TN	Giles	0.157	3,823
SO_2	12EUS2	500	L	3	47055	TN	Giles	0.468	1,283
SO_2	12EUS2	1000	H	3	47055	TN	Giles	0.801	1,498
SO_2	12EUS2	1000	L	3	47055	TN	Giles	1.645	729
SO_2	12EUS2	3000	H	3	47055	TN	Giles	5.03	**716**
SO_2	12EUS2	500	H	8	47157	TN	Shelby	0.234	2,559
SO_2	12EUS2	500	L	8	47157	TN	Shelby	0.671	894
SO_2	12EUS2	1000	H	8	47157	TN	Shelby	0.559	2,146
SO_2	12EUS2	1000	L	8	47157	TN	Shelby	1.503	798
SO_2	12EUS2	3000	H	8	47157	TN	Shelby	2.089	1,723
SO_2	12EUS3	500	H	13	37009	NC	Ashe	0.236	2,545
SO_2	12EUS3	500	L	13	37009	NC	Ashe	0.274	2,187
SO_2	12EUS3	1000	H	13	37009	NC	Ashe	0.429	2,800
SO_2	12EUS3	3000	H	13	37009	NC	Ashe	0.889	4,052
SO_2	12EUS3	500	H	18	21009	KY	Barren	0.06	9,988
SO_2	12EUS3	500	L	18	21009	KY	Barren	0.129	4,658
SO_2	12EUS3	1000	H	18	21009	KY	Barren	0.111	10,851
SO_2	12EUS3	3000	H	18	21009	KY	Barren	0.264	13,614
SO_2	12US2	500	L	12	47001	TN	Anderson	0.118	5,087
SO_2	12US2	500	H	12	47001	TN	Anderson	0.036	16,463
SO_2	12US2	1000	H	12	47001	TN	Anderson	0.075	15,988
SO_2	17US2	500	L	17	29155	MO	Pemiscot	0.323	1,855
SO_2	17US2	500	H	17	29155	MO	Pemiscot	0.102	5,882
SO_2	17US2	1000	H	17	29155	MO	Pemiscot	0.197	6,076

Table notes: Emissions are shown in tons per year (tpy) and release heights relate to surface release (L) or elevated release (H). Source type "L" refers to sources modeled with surface level emissions releases: stack height of 10 m, stack diameter of 5 m, exit temperature of 311 K, exit velocity of 27 m/s, and flow rate of 537 m^3/s. Source type "H" refers to sources modeled with elevated emissions releases: stack height of 90 m, stack diameter of 5 m, exit temperature of 311 K, exit velocity of 27 m/s, and flow rate of 537 m^3/s.

SILs Analysis

MERPs can be used to determine if a facility's proposed emission increases will result in secondary impacts that are above the SILs. Once either one of the precursor pollutants triggers this analysis because their emissions are above the PSD Significant Emission Rates (SERs), then emissions of the other precursor pollutant must be included in the analysis to determine the synergistic impact that both pollutants have together, even though the other pollutant's emissions may fall below the SER. The analysis is unnecessary only when emissions of both precursor pollutants are below the respective SERs.

For ozone, the following equation should be used:

$$\frac{\text{EMIS\_NOx}}{\text{MERP\_NOx}} + \frac{\text{EMIS\_VOC}}{\text{MERP\_VOC}} < 1$$

EMIS_NOx and *EMIS_VOC* are the proposed emission increases for NO_x and VOC (tpy). *MERP_NOx* and *MEPR_VOC* are the MERPs for NO_x and VOC (tpy). If the sum of the ratios is less than 1, then the secondary ozone impacts are below the ozone SIL and the applicant does not need to perform a cumulative analysis for ozone. If the sum of the ratios is equal to or greater than 1, the applicant must perform a cumulative analysis for ozone.

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

$$\frac{\text{HMC\_PM2.5}}{\text{SIL\_PM2.5}} + \frac{\text{EMIS\_SO2}}{\text{MERP\_SO2}} + \frac{\text{EMIS\_NOx}}{\text{MERP\_NOx}} < 1$$

HMC_PM2.5 is the highest modeled concentration (annual or H1H averaged over 5 years) using AERMOD with the proposed primary (direct) $PM_{2.5}$ emission increases. *SIL_PM2.5* is 0.2 $\mu g/m^3$ for annual $PM_{2.5}$ and 1.2 $\mu g/m^3$ for daily $PM_{2.5}$. *EMIS_SO2* and *EMIS_NOx* are the proposed emission increases for NO_x and SO_2 (tpy). *MERP_SO2* and *MEPR_NOx* are the MERPs for SO_2 and NO_x (tpy). If the sum of the ratios is less than 1, then the $PM_{2.5}$ impacts are below the $PM_{2.5}$ SIL 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 must perform a cumulative analysis for $PM_{2.5}$.

Cumulative Analysis

MERPs can be used to determine if a facility's proposed emission increases will result in secondary impacts that are above the SILs. Once either one of the precursor pollutants triggers this analysis because their emissions are above the Significant Emission Rates (SERs), then emissions of the other precursor pollutant must be included in the analysis to determine the synergistic impact that both pollutants have together, even though the other pollutant's emissions may fall below the SER. The analysis is unnecessary only when emissions of both precursor pollutants are below the respective SERs.

For ozone, the following equation should be used:

$$Background_{ozone} + \left[\left(\frac{EMIS\_NOx}{MERP\_NOx} + \frac{EMIS\_VOC}{MERP\_VOC}\right) * \text{SIL\_ozone}\right] \leq NAAQS\_ozone$$

Background$_{ozone}$ is the 3-year design values from a representative background ozone monitor. *EMIS_NOx* and *EMIS_VOC* are the proposed emission increases for NO_x and VOC (tpy). *MERP_NOx* and *MEPR_VOC* are the MERPs for NO_x and VOC (tpy). *SIL_ozone* is 1 ppb. If the sum of the terms is less than or equal to the *NAAQS_ozone* (70 ppb), then the proposed project does not cause or contribute to a violation of the ozone NAAQS. If the sum of the terms is greater than the ozone NAAQS, then the applicant will want to consider performing a Tier 2 demonstration.

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

$$Background_{PM2.5} + DV_{PM2.5} + \left[\left(\frac{EMIS\_SO2}{MERP\_SO2} + \frac{EMIS\_NOx}{MERP\_NOx}\right) * SIL\_PM2.5\right] \leq NAAQS\_PM_{2.5}$$

$Background_{PM2.5}$ is the 3-year design values from a representative background $PM_{2.5}$ monitor. $DV\_PM_{2.5}$ is the modeled design value using AERMOD with the proposed primary (direct) $PM_{2.5}$ emission increases and primary (direct) $PM_{2.5}$ emissions from nearby offsite sources. *EMIS_SO2* and *EMIS_NOx* are the proposed emission increases for SO_2 and NO_x (tpy). *MERP_SO2* and *MEPR_NOx* are the MERPs for SO_2 and NO_x (tpy). $SIL\_PM_{2.5}$ is 0.2 $\mu g/m^3$ for annual $PM_{2.5}$ and 1.2 $\mu g/m^3$ for daily $PM_{2.5}$. If the sum of the terms is less than or equal to the $NAAQS\_PM_{2.5}$ (12.0 $\mu g/m^3$ for annual $PM_{2.5}$ and 35 $\mu g/m^3$ for daily $PM_{2.5}$), then the proposed project does not cause or contribute to a violation of the $PM_{2.5}$ NAAQS. If the sum of the terms is greater than the $PM_{2.5}$ NAAQS, then the applicant will want to consider performing a Tier 2 demonstration.

Examples

In this section, an example of a PSD permit application scenario is presented to illustrate how modeled emissions and secondary pollutant impacts from EPA's modeling of hypothetical sources could be used to derive a MERP Tier 1 demonstration tool for a given location. As illustrated below in this example, representative MERPs for each precursor were developed based on the most conservative (lowest) value across the Tennessee region from Table E-4.

Single Source Analysis for O_3 and $PM_{2.5}$ on SILs, then NAAQS Cumulative Analysis

The following section contains calculations for an example PSD application regarding a hypothetical source in Tennessee. Emissions (Table E-1), maximum AERMOD impacts (Table E-2), background monitor concentrations (Table E-3), and default MERPs (Table E-4) are provided for the example PSD application.

Table E-1. Emissions for an example PSD application.

Precursor	Emissions (tpy)
NO_x	500
SO_2	500
VOC	500
$PM_{2.5}$	500

Table E-2. Maximum AERMOD impacts for an example PSD application.

Precursor	Project HMC	Project + Offsite Sources Impacts
Annual $PM_{2.5}$	0.15 $\mu g/m^3$	0.3 $\mu g/m^3$
Daily $PM_{2.5}$	0.6 $\mu g/m^3$	3.0 $\mu g/m^3$

Table E-3. Background monitor concentrations for an example PSD application.

Precursor	Background Concentration
Ozone	67 ppb
Annual $PM_{2.5}$	10.5 $\mu g/m^3$
Daily $PM_{2.5}$	29 $\mu g/m^3$

Table E-4. Default MERP values (tpy) for Tennessee PSD applications.

Precursor	8-hour Ozone	Daily $PM_{2.5}$	Annual $PM_{2.5}$
NO_x	156	3,717	7,625
SO_2	-	716	5,817
VOC	1,542	-	-

Example SILs Analysis

Ozone

(500/156) + (500/1,542) = 3.21 + 0.32 = 3.53, which is greater than 1. Therefore, the applicant must perform a cumulative analysis for ozone.

Annual $PM_{2.5}$

(0.15/0.2) + (500/5,817) + (500/7,625) = 0.75 + 0.086 + 0.066 = 0.90, which is less than 1. Therefore, the applicant does not need to perform a cumulative analysis for annual $PM_{2.5}$.

Daily $PM_{2.5}$

(0.6/1.2) + (500/716) + (500/3,717) = 0.50 + 0.70 + 0.13 = 1.33, which is greater than 1. Therefore, the applicant must perform a cumulative analysis for daily $PM_{2.5}$.

Example Cumulative Analysis

Ozone

67 ppb + {[(500/156) + (500/1,542)] * 1 ppb} = 67 + 3.21 + 0.32 = 70.53 (truncates to 70 ppb), which does not exceed 70 ppb. Therefore, the applicant does not cause or contribute to a violation of the ozone NAAQS.

Daily $PM_{2.5}$

29 $\mu g/m^3$ + 3.0 $\mu g/m^3$ + {[(500/716) + (500/3,717)] * 1.2 $\mu g/m^3$} = 29 + 3.0 + (0.70 + 0.13) * 1.2 = 29 + 3.0 + 0.84 + 0.16 = 33.0 $\mu g/m^3$, which does not exceed 35 $\mu g/m^3$. Therefore, the applicant does not cause or contribute to a violation of the daily $PM_{2.5}$ NAAQS.

Note: Further examples using hypothetical sites across the nation can be found in the following sections of EPA's final MERPs guidance document: EPA-454/R-19-003, April 2019, at *https://www3.epa.gov/ttn/scram/guidance/guide/EPA-454_R-19-003.pdf*

1. 4.1. Illustrative MERP Tier I Demonstrations for Example PSD Permit Scenarios.
2. 4.1.1. Source Impact Analysis: O_3 and $PM_{2.5}$ NAAQS.
3. 4.1.2. Source Impact Analysis: Class 1 PSD Increment for $PM_{2.5}$.
4. 4.1.3. Cumulative Impact Analysis: O_3 and $PM_{2.5}$ NAAQS.