



***National Ambient Air Quality Standards-Carbon Monoxide***

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Carbon monoxide (CO) is a colorless, odorless gas that is primarily the result of fuel combustion. In 1971, the Environmental Protection Agency (EPA) established two primary CO standards based upon a 1-hour averaging period and an 8-hour averaging period. The standards are deterministically based and allow for one exceedance per year before an area is determined to be in violation of the National Ambient Air Quality Standards (NAAQS). On January 8, 2011, the EPA decided to retain the primary CO NAAQS from 1971, at nine parts per million for the 8-hour averaging period and 35 parts per million for the 1-hour averaging period, refer to Table 1.

<b>Table 1 CO NAAQS</b>			
<b>Pollutant</b>	<b>Averaging Time</b>	<b>NAAQS (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>Comment</b>
CO	1-Hour	40,000	Not to be exceeded more than once per year
CO	8-Hour	10,000	Not to be exceeded more than once per year

If a facility is required to conduct a full impact analysis for CO, the study must include the emissions from the proposed source, existing “interactive” sources and monitored background concentrations. The modeled emission rates must reflect the maximum allowable operating conditions for each source based upon federally enforceable emission limits and operating level(s).

If the predicted impact due to the proposed source, interactive sources and the monitored background value is below the NAAQS for each applicable averaging period, compliance has been demonstrated and no further analysis for CO is necessary.

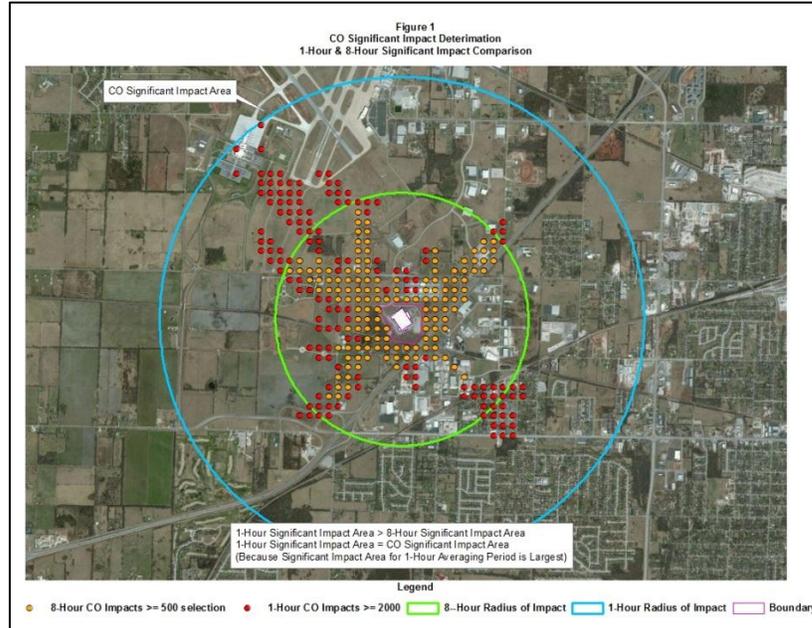
If, on the other hand, violations of the CO NAAQS are predicted to occur at one or more receptors, the applicant will be required to determine if the proposed project or modification has a significant ambient impact. If the source can demonstrate that it does not have a significant impact on a violating receptor(s), measured in time and space, a permit can be issued without further review of the standards. If the source cannot demonstrate less than significant impacts, the facility must consider emission limits, the installation of controls or other measures in order to reduce its ambient impact at all violating receptors.

The following paragraphs provide a hypothetical example of a NAAQS evaluation for CO. The data describes a basic situation and is not meant to address all modeling scenarios and/or issues that might arise during the review process.

**Example NAAQS Demonstration**

Facility A is proposing to install a coal-fired boiler at a greenfield site. Based upon the emissions from the worst case operating load, the preliminary impact analysis indicates that Facility A’s radius of impact extends 2.5-kilometers beyond the center of the proposed facility, refer to Figure 1.

**National Ambient Air Quality Standards-Carbon Monoxide**

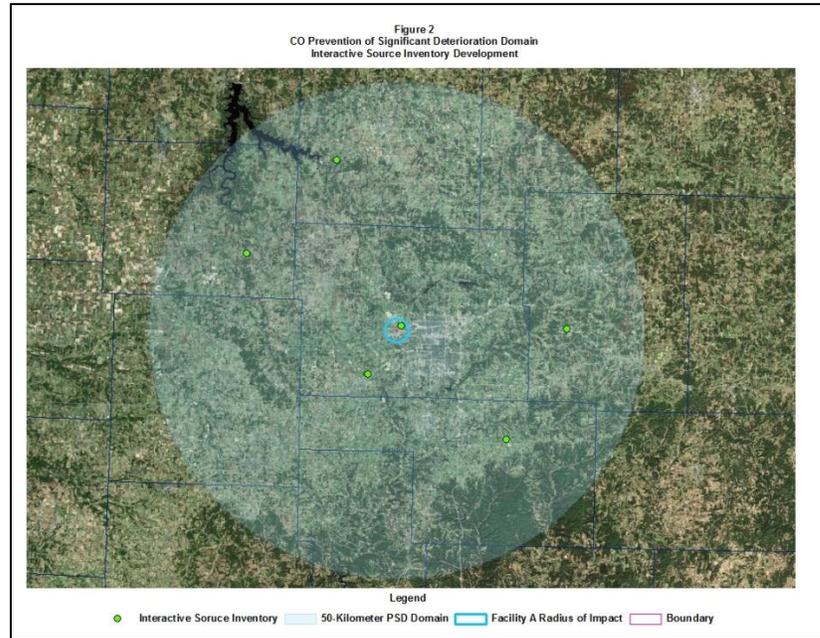


Because the ambient impact due to the proposed construction exceeds both the 1-hour and 8-hour significant impact thresholds,  $2,000 \mu\text{g}/\text{m}^3$  and  $500 \mu\text{g}/\text{m}^3$ , a full impact analysis is required and must include an evaluation of compliance with the NAAQS.

As noted in the introduction, NAAQS compliance is based upon the impact due to the combination of the emissions from the proposed source, existing “interactive” sources and monitored background concentrations. In order to determine the impact due to the proposed source and interactive sources, the emissions from Facility A and existing CO sources were explicitly modeled. The monitored background value was obtained from a representative monitoring site.

The radius of impact due to the proposed project determined what sources were explicitly modeled for compliance purposes. Facility A is undergoing a Prevention of Significant Deterioration (PSD) review and, as such, the air quality analysis considered any emission source that could significantly impact the air quality within the region of Facility A, i.e. 50-kilometers beyond the furthest extent of the significant impact area, refer to Figure 2.

**National Ambient Air Quality Standards-Carbon Monoxide**



Emission rates and release parameters for each source within the inventory were input into the air quality model. The combined ambient impact due to the modeled sources were calculated and output on a receptor by receptor basis for use in the compliance demonstration. It is important to note that the model outputs do not include the monitored background concentration; this value must be added to the model predictions prior to determining compliance with the NAAQS. Table 2 contains the model outputs for a sampling of receptors that were evaluated for this example.

1-Hour Averaging Period (NAAQS = 40,000 $\mu\text{g}/\text{m}^3$ )											
Easting (Meters)	Northing (Meters)	Elevation (Meters)	Hill (Meters)	2003 ( $\mu\text{g}/\text{m}^3$ ) (H2H)	2004 ( $\mu\text{g}/\text{m}^3$ ) (H2H)	2005 ( $\mu\text{g}/\text{m}^3$ ) (H2H)	2006 ( $\mu\text{g}/\text{m}^3$ ) (H2H)	2007 ( $\mu\text{g}/\text{m}^3$ ) (H2H)	Max ( $\mu\text{g}/\text{m}^3$ ) (H2H)	Background ( $\mu\text{g}/\text{m}^3$ ) (Monitored)	NAAQS ( $\mu\text{g}/\text{m}^3$ ) (H2H)
467200.00	4120700.00	395.61	395.61	46831.73	33968.92	115006.44	27413.52	96889.72	115006.44	3200.00	118206.44
467300.00	4120700.00	396.53	396.53	32741.81	14084.08	29499.42	44626.80	89376.02	89376.02	3200.00	92576.02
467100.00	4120700.00	393.85	393.85	53051.65	51192.82	26631.96	81222.52	26258.41	81222.52	3200.00	84422.52
467200.00	4120800.00	394.47	394.47	66394.50	36523.76	77256.38	48602.09	38994.53	77256.38	3200.00	80456.38
466900.00	4120300.00	396.41	396.41	29882.88	18689.06	22475.89	70519.21	14340.61	70519.21	3200.00	73719.21
465500.00	4120100.00	392.09	392.09	4225.15	4866.68	5883.06	12645.51	37029.98	37029.98	3200.00	40229.98
466583.50	4119850.24	393.40	393.40	9050.32	9447.49	10434.44	36628.89	5679.49	36628.89	3200.00	39828.89
466500.00	4120600.00	388.86	388.86	18636.00	10957.41	11905.67	35847.42	12814.74	35847.42	3200.00	39047.42
466800.00	4120300.00	394.51	394.51	35802.80	15681.44	17129.37	25942.73	14030.21	35802.80	3200.00	39002.80
466623.48	4119848.97	393.92	393.92	8843.86	8854.14	10898.78	35697.84	6577.08	35697.84	3200.00	38897.84



**National Ambient Air Quality Standards-Carbon Monoxide**

8-Hour Averaging Period (NAAQS = 10,000 $\mu\text{g}/\text{m}^3$ )											
Easting	Northing	Elevation	Hill	2003	2004	2005	2006	2007	Max	Background	NAAQS
(Meters)	(Meters)	(Meters)	(Meters)	( $\mu\text{g}/\text{m}^3$ )							
				(H2H)	(H2H)	(H2H)	(H2H)	(H2H)	(H2H)	(Monitored)	(H2H)
467100.00	4120800.00	393.59	393.59	18948.68	24063.99	12066.02	30634.95	18370.92	30634.95	1500.00	32134.95
467100.00	4120700.00	393.85	393.85	14673.04	14825.36	7892.29	23370.23	9512.35	23370.23	1500.00	24870.23
467100.00	4120900.00	392.70	392.70	12559.64	16554.66	14275.57	21255.21	14406.04	21255.21	1500.00	22755.21
467000.00	4120800.00	391.09	391.09	18949.60	17703.28	15677.35	20911.73	16668.59	20911.73	1500.00	22411.73
467000.00	4120900.00	391.10	391.10	14780.94	14358.23	16134.59	20903.79	13821.13	20903.79	1500.00	22403.79
467000.00	4120700.00	392.24	392.24	12972.64	9797.81	10474.18	19887.28	8907.73	19887.28	1500.00	21387.28
466800.00	4120700.00	391.18	391.18	6774.52	6318.34	7926.64	6702.25	4835.06	7926.64	1500.00	9426.64
466700.00	4120600.00	391.43	391.43	7895.56	3033.34	3016.83	6269.55	4905.62	7895.56	1500.00	9395.56
467400.00	4120300.00	397.38	397.38	7358.80	5064.77	7891.05	6052.39	5711.97	7891.05	1500.00	9391.05
466600.00	4121200.00	388.10	388.10	7866.22	4645.31	5310.70	6469.90	3970.02	7866.22	1500.00	9366.22

The first four columns contain information regarding the location of the receptor under review, followed by the predicted concentration from the dispersion model for each year under consideration. The second highest concentration for the five-year period was obtained and added to the monitored background number. The sum represents the total concentration that should be compared to the NAAQS in order to determine compliance. Based upon the results contained within Table 2, the first six concentrations for the 1-hour and 8-hour averaging periods exceed the NAAQS of 40,000  $\mu\text{g}/\text{m}^3$  and 10,000  $\mu\text{g}/\text{m}^3$ , respectively. Because NAAQS violations are predicted to occur, the analysis must go one step further to determine if Facility A has a significant impact on a violating receptor, refer to Table 3.

Table 3 CO NAAQS Violations vs. Significant Impact					
1-Hour NAAQS (40,000 $\mu\text{g}/\text{m}^3$ ) vs. Significance (2,000 $\mu\text{g}/\text{m}^3$ )					
Easting	Northing	Elevation	Hill	NAAQS	Significant Impact Concentration
(Meters)	(Meters)	(Meters)	(Meters)	( $\mu\text{g}/\text{m}^3$ )	( $\mu\text{g}/\text{m}^3$ )
				(H2H)	(H1H)
467200.00	4120700.00	395.61	395.61	118206.44	1623.31
467300.00	4120700.00	396.53	396.53	92576.02	1779.82
467100.00	4120700.00	393.85	393.85	84422.52	1590.29
467200.00	4120800.00	394.47	394.47	80456.38	1561.86
466900.00	4120300.00	396.41	396.41	73719.21	1725.85
465500.00	4120100.00	392.09	392.09	40229.98	1703.53
8-Hour NAAQS (10,000 $\mu\text{g}/\text{m}^3$ ) vs. Significance (500 $\mu\text{g}/\text{m}^3$ )					
Easting	Northing	Elevation	Hill	NAAQS	Significant Impact Concentration
(Meters)	(Meters)	(Meters)	(Meters)	( $\mu\text{g}/\text{m}^3$ )	( $\mu\text{g}/\text{m}^3$ )
				(H2H)	(H1H)
467100.00	4120800.00	393.59	393.59	32134.95	492.52
467100.00	4120700.00	393.85	393.85	24870.23	553.90
467100.00	4120900.00	392.70	392.70	22755.21	491.52
467000.00	4120800.00	391.09	391.09	22411.73	560.24
467000.00	4120900.00	391.10	391.10	22403.79	520.48
467000.00	4120700.00	392.24	392.24	21387.28	585.97

***National Ambient Air Quality Standards-Carbon Monoxide***

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For the 1-hour averaging period, Facility A did not have a significant impact on any of the violating receptors; as such, Facility A's compliance with the 1-hour NAAQS has been demonstrated and no further analysis is necessary. On an 8-hour basis, Facility A had a significant impact on four of the violating receptors; as such, it must be determined if the significant impact occurs at the same time as a violation, i.e. the same hour, day, month and year. In order to demonstrate that a significant impact does not occur at the same time as a violation, the applicant must determine the ambient concentration for each eight hour period in the year due to the proposed project (significance analysis) and due to all sources (NAAQS analysis) at each violating receptor. For example, if a NAAQS violation was predicted to occur at hour 16, on December 4, 2003, the applicant would be required to determine what its impact was at hour 16, on December 4, 2003. If the facility's impact is less than 500  $\mu\text{g}/\text{m}^3$ , no further analysis is necessary and compliance has been demonstrated. Table 4 contains sample output for one of the exceedance receptors from a time of day evaluation.

Table 4 CO Time of Day Evaluation								
Easting	Northing	Elevation	Hill	First High Modeled NAAQS Concentration	Background	NAAQS	Significant Impact Concentration	Date
<i>(Meters)</i>	<i>(Meters)</i>	<i>(Meters)</i>	<i>(Meters)</i>	<i>(<math>\mu\text{g}/\text{m}^3</math>)</i>	<i>(<math>\mu\text{g}/\text{m}^3</math>)</i>	<i>(<math>\mu\text{g}/\text{m}^3</math>)</i>	<i>(<math>\mu\text{g}/\text{m}^3</math>)</i>	<i>(YYMMDDHH)</i>
467100	4120800	393.59	393.59	0.39223	1500	1500.39233	0	03010108
467100	4120800	393.59	393.59	10.55182	1500	1510.55182	0.91371	03010116
467100	4120800	393.59	393.59	0.80103	1500	1500.80103	0.0001	03010124
467100	4120800	393.59	393.59	2.01177	1500	1502.01177	0.00029	03010208
467100	4120800	393.59	393.59	7.33474	1500	1507.33474	0.62048	03010216

Based upon the time of day evaluation, Facility A did not have a significant impact at the same time that a violation occurred; as such, no further analysis is necessary and NAAQS compliance has for Facility A has been demonstrated.