

**Underground Coal Mines (subpart FF)
Greenhouse Gas Reporting Program
40 Code of Federal Regulations Part 98**

Technical Guidance on Using Mine Ventilation Data from the Mine Safety and Health Administration (MSHA) to report Quarterly Methane Emissions from Mine Ventilation Systems

1.0 Summary

Since 2011, active underground coal mines liberating at least 36,500,000 actual cubic feet of methane (CH₄) per year from mine ventilation shafts and/or degasification systems have been required to submit annual reports of their greenhouse gas (GHG) emissions to EPA's Greenhouse Gas Reporting Program (GHGRP) under 40 Code of Federal Regulations (CFR) Part 98.

In their annual GHG reports, mines must include a report of CH₄ liberated from mine ventilation systems on a quarterly basis. Facilities may choose one of three methods listed in §98.324(b) to measure ventilation air methane (VAM): (1) they may take their own grab samples; (2) they may obtain from MSHA the results of mine inspectors' quarterly measurements of VAM at the mine; or (3) they may use continuous emissions monitoring systems (CEMs). Approximately 50 percent of reporting mines used MSHA data in each of the first three reporting years (2011-2013). EPA is currently evaluating how the use of MSHA data may be impacting the quality of reports submitted to the GHGRP.

EPA is releasing this document to provide technical guidance to subpart FF reporters on how to use data included in MSHA reports to be consistent with existing Part 98 requirements. This document is intended to provide assistance to reporters based on existing rules, and is not and should not be construed as a rulemaking action.

2.0 Background

Since 2011, active underground coal mines liberating at least 36,500,000 actual cubic feet of methane (CH₄) per year from mine ventilation shafts and/or degasification systems have been required to submit annual reports of their greenhouse gas emissions to EPA's Greenhouse Gas Reporting Program (GHGRP) under 40 Code of Federal Regulations (CFR) Part 98.

The purpose of the GHGRP is to gain a better understanding of where greenhouse gas emissions are coming from and to improve the ability to make informed policy, business, and regulatory decisions. The GHGRP data set includes public information from facilities that directly emit large quantities of GHGs, as well as suppliers of certain fossil fuels and industrial gases.

Underground coal mines are defined in Subpart A, 40 CFR 98.6, definition of "Facility", and in Subpart FF, 40 CFR 98.320(a), "Definition of the source category" as a "mine at which coal is produced by tunneling into the earth to the coalbed, which is then mined with underground mining equipment such as cutting machines and continuous, longwall, and shortwall mining machines, and transported to the surface."

Mine ventilation systems are one of the primary sources of CH₄ emissions from coal mines, and all facilities subject to the rule are required to report the mass of CH₄ liberated from mine ventilation shafts on a quarterly basis, §98.324(b). To derive this figure for each shaft for each quarter of the reporting year, each facility must use Equation FF-1 in 40 CFR Part 98.323(a), which requires inputs including volumetric CH₄ flow, CH₄ concentration, temperature, pressure and moisture content.

Facilities may choose one of three methods to measure CH₄ liberated from ventilation shafts according to 40 CFR 98.324(b):

- Method (b)(1) Collect quarterly or more frequent grab samples (with no fewer than 6 weeks between measurements) for methane concentration and make quarterly measurements of flow rate, temperature, pressure and moisture content. The sampling and measurements must be made at the same locations as MSHA inspection samples are taken.

- Method (b)(2) Obtain results of the quarterly (or more frequent) testing performed by MSHA for the methane flow rate and concentration. MSHA inspectors visit each underground mine on (at least) a quarterly basis, and they provide this data to mines in quarterly reports. At the same location and within seven days of when the MSHA samples were taken, the facility must make measurements of temperature and pressure. The annual average barometric pressure from the nearest National Oceanic and Atmospheric Administration (NOAA) weather service station may be used as a default for pressure.

- Method (b)(3) Monitor emissions through the use of one or more continuous emissions monitoring systems (CEMs), and provide documentation on the process for using data obtained from CEMS to estimate emissions from mine ventilation systems.

Approximately 50 percent of facilities reporting to the GHGRP used MSHA data (Method (b)(2)) in each of the first three reporting years (2011-2013). In reviewing these reports and the supporting MSHA data, EPA has determined that, in some cases, mines have been misinterpreting the MSHA data and/or submitting data that is inconsistent with that provided by MSHA, and as a result have been submitting inaccurate or difficult to verify GHGRP reports. The four most common issues are presented in Table 2-1 below. Section 3.0 of this document provides technical guidance on how reporters may remedy these common problems.

Table 2-1: Common Reporting Problems for Subpart FF

Reporting problems	Technical guidance section listing remedy
MSHA quarterly reports are labeled according to the federal fiscal year, which begins on October 1st and ends on September 30th of the following year, whereas the GHGRP reporting year is on a calendar basis beginning on January 1st each year and ending on December 31st. Some mines appear to be relying on the quarter number contained in the MSHA report, and as a result are reporting incorrect information for the calendar year quarter to the GHGRP.	Section 3.1

Reporting problems	Technical guidance section listing remedy
Some GHGRP reporters label shafts differently than they are labeled in their MSHA reports. This makes verification of GHGRP annual reports difficult and increases the likelihood that a reporter will be contacted for additional information about their report.	Section 3.2
Ventilation air can enter a mine shaft from more than one mine entry, in which case the shaft will be at the intersection of these entries. In these cases, MSHA refers to each entry as an “approach” in the MSHA quarterly report. Quarterly volumetric and concentration measurements are taken for each approach. In some cases, GHGRP reporters are incorrectly calculating shaft ventilation and CH ₄ concentration values aggregated from measurements taken in multiple approaches.	Section 3.3
MSHA quarterly reports may exclude a shaft or an approach required to be reported to the GHGRP. This can lead to underreporting of shaft emissions in a GHGRP report that relies on MSHA reports for VAM data.	Section 3.4

3.0 Technical guidance on how to correctly interpret MSHA quarterly reports for the purpose of reporting to the Greenhouse Gas Reporting Program under subpart FF

3.1 Select Correct MSHA Quarterly Reports

Reporters should ensure that they are reporting data to the GHGRP from the correct MSHA quarterly report. Figure 3-1 below should serve as a guide. Note that the calendar year quarters of the GHGRP correspond to MSHA quarterly reports from two different MSHA fiscal years:

Figure 3-1: MSHA Fiscal Year Reporting vs. GHGRP Calendar Year Reporting

Jan – Mar 2014	Apr – Jun 2014	Jul – Sep 2014	Oct – Dec 2014	Jan – Mar 2015	Apr – Jun 2015	Jul – Sep 2015	Oct – Dec 2015
MSHA Fiscal Year				MSHA Fiscal Year			
Q2 2014	Q3 2014	Q4 2014	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Q1 2016
GHGRP Reporting (Calendar) Year				GHGRP Reporting (Calendar) Year			
Q1 2014	Q2 2014	Q3 2014	Q4 2014	Q1 2015	Q2 2015	Q3 2015	Q4 2015

3.2 Label shafts in GHGRP reports to be consistent with labels in MSHA reports

If GHGRP reporters use the shaft identification or name used in the MSHA reports, use of the same shaft identification or name in GHGRP reports will facilitate verification and minimize EPA follow-up with reporters. Shafts are named in approved MSHA mine ventilation plans and these names are expected to be used in the MSHA quarterly reports. If a different name is used in the GHGRP, we encourage reporters to note the use of a different name and the reason(s) why a different name has been chosen.

3.3 Calculate shaft volumetric flow and CH₄ concentration correctly using data from MSHA reports

The following sections provide technical guidance on how to use MSHA reports to accurately report to the GHGRP the quarterly volumetric flow and CH₄ concentration for each ventilation shaft.

3.3.1 If there is one volumetric flow and CH₄ concentration measurement per shaft

MSHA quarterly reports provide at least one volumetric flow (cubic feet per minute) and one methane concentration (CH₄ %) reading per shaft. Figure 3-2 is an example of an MSHA report that provides one of each type of reading per shaft.

Figure 3-2: Example of an MSHA quarterly report with one shaft and a single approach

United States Department of Labor		District Total Methane Liberation (TL)			
MSHA		Mine Safety and Health Administration			
Mine ID:	Mine ID#	Company:	Mining Company A	Field Office:	
Collection Date	Bottle No.	Location in Mine		Mine:	Mine A1
1/31/2012	P0001	SHAFT #1 UPCAST - NORTH APPROACH		Event:	1234567
				Methane CH ₄ %	Cubic Feet Air/Minute
				0.3	255,437
					Cubic Feet Methane within 24 Hrs.
					1,103,488
				Event Total Methane Liberation:	1,103,488

In this instance, a proper report reflects the following information on Tab 4 of the e-GGRT Subpart FF reporting form for each quarter each shaft is in operation:

Volumetric Flow The cubic feet air/minute (MSHA report) is reported in the column *Quarterly Volumetric Flow Rate used in Equation FF-1* in the e-GGRT report. The correct units are actual cubic feet per minute (acfm). In this example, the reporter would enter into the reporting form: 255,437 acfm for the flow rate in Q1 of 2012 for SHAFT #1 UPCAST.

CH₄ Concentration The Methane CH₄ % (MSHA report) is reported in the column *Quarterly CH₄ Concentration used in Equation FF-1* in the e-GGRT report. In this example, the reporter would enter into the reporting form 0.3% for the CH₄ concentration in Q1 of 2012 for SHAFT #1 UPCAST.

3.3.2 If there are multiple approaches per shaft

At many mines, a vertical shaft may pull ventilation air from multiple entries or approaches, and each of these approaches is sampled by MSHA. Figure 3-3 presents an example of this type of report.

Figure 3-3: Example of an MSHA quarterly report with multiple shafts and with each shaft having multiple approaches

MSHA		District Total Methane Liberation (TL)			
Field Office:					
Mine ID: Mine ID#	Company:	Mining Company A	Mine: Mine A1	Event:	1234567
Collection Date	Bottle No.	Location in Mine	Methane CH ₄ %	Cubic Feet Air/Minute	Cubic Feet Methane within 24 Hrs.
1/31/2012	P0001	SHAFT #1 UPGAST - NORTH APPROACH	0.3	255,437	1,103,488
1/31/2012	P0002	SHAFT #1 UPGAST - SOUTH APPROACH	0.25	265,891	957,208
1/31/2012	P0003	SHAFT #1 UPGAST - EAST APPROACH	0.45	215,428	1,395,973
1/31/2012	P0004	SHAFT #2 UPGAST - WEST APPROACH	0.1	176,523	254,193
1/31/2012	P0005	SHAFT #2 UPGAST - SOUTH APPROACH	0.25	149,967	539,881
Event Total Methane Liberation:					4,250,743

The MSHA report in Figure 3-1 identifies two shafts at a hypothetical mine, Mine A1. The two shafts are Shaft #1 Upcast and Shaft #2 Upcast. Shaft #1 takes ventilation flow from three approaches (North, South and East) and Shaft #2 takes ventilation flow from two approaches (West and South). MSHA takes air flow and CH₄% measurements at each approach that feeds each ventilation shaft, as shown in the example report.

The reporter has two options. First, the reporter can list all shaft approaches in the e-GGRT reporting form with the corresponding CH₄% (CH₄ concentration) and Cubic Feet Air/Minute (quarterly volumetric flow rate), being careful to only list shafts where methane is emitted from the mine.

The second option is to aggregate the data for each shaft and calculate a single value for the CH₄ concentration and the volumetric flow rate for each shaft in a particular quarter. If choosing the second option, the following methodology correctly calculates the volumetric flow and CH₄ concentration for each quarter for each shaft that has more than one approach:

Volumetric Flow To obtain the quarterly volumetric flow for a shaft, sum the cubic feet air/minute (MSHA report) of all approaches for that shaft and report the total in Tab 4 of the e-GGRT reporting form, in the column *Quarterly Volumetric Flow Rate used in Equation FF-1*. Units will be actual cubic feet per minute (acfm). Below are examples using the data provided in Figure 3-3:

Shaft #1 Volumetric Flow for Q1 2012:

255,437 acfm – North Approach
+ 265,891 acfm – South Approach
+ 215,428 acfm – East Approach
736,756 acfm - Volumetric Flow reported to GHGRP for Shaft #1 in Q1 2012

Shaft #2 Volumetric Flow for Q1 2012:

176,523 acfm –West Approach
+ 149,967 acfm – South Approach
326,490 acfm - Volumetric Flow reported to GHGRP for Shaft #2 in Q1 2012

CH₄ Concentration The appropriate manner for reporting the CH₄ concentration for a shaft with multiple approaches is to calculate the weighted average of the CH₄ concentrations (CH₄ %) for all approaches associated with that shaft. Using the data in Figure 3-3, the weighted average CH₄ concentrations for Shaft #1 and Shaft #2 are calculated in the examples below. If properly reported, the calculated CH₄ concentration appears in Tab 4 of the e-GGRT reporting form in the column *Quarterly CH₄ Concentration used in Equation FF-1*.

Shaft #1 CH₄ Concentration for Q1 2012:

0.30% * (255,437 ÷ 736,756) – North Approach
+ 0.25% * (265,891 ÷ 736,756) – South Approach
+ 0.45% * (215,428 ÷ 736,756) – East Approach
0.326% = Weighted average CH₄ Concentration reported to GHGRP for Shaft #1 in Q1 2012

Shaft #2 CH₄ Concentration for Q1 2012:

0.10% * (176,523 ÷ 326,490) – West Approach
+ 0.25% * (149,967 ÷ 326,490) – South Approach
0.169% = Weighted average CH₄ Concentration reported to GHGRP for Shaft #2 in Q1 2012

3.4 Accounting for Missing MSHA Data

In some instances MSHA reports may not include shafts or approaches that are required to be reported to the GHGRP.

3.4.1 Missing shaft data

In instances where a shaft is not listed in the MSHA report for a specific quarter but was listed in the quarterly report immediately prior to or immediately after, the facility should follow the provisions of §98.325 – “Procedures for estimating missing data” to derive volumetric flow and CH₄ concentration data for the shaft(s) with missing data.

Specifically, §98.325(b) states that for each missing value of CH₄ concentration and ventilation, the substitute data value shall be the arithmetic average of the quality-assured values of that parameter immediately preceding and immediately following the missing data incident. If, for a particular parameter, no quality-assured data are available prior to the missing data incident, the substitute data value shall be the first quality-assured value obtained after the missing data period.

Figure 3-4 provides an example of when to use missing data procedures. In the example, Shaft #2 was not included in the report for Quarter 2 despite being listed in the reports for Quarter 1 and Quarter 3. Although not listed for some reason, it is assumed that Shaft #2 was operating in Quarter 2; therefore, methane liberation from Shaft #2 must still be reporting in Quarter 2 for the GHGRP report. In this example, missing data procedures are used here to calculate substitute values for the Quarter 2 ventilation flow and CH₄ concentration.

Figure 3-4: Quarterly reports for Mine A1 for Quarters 1, 2 and 3

United States Department of Labor		District Total Methane Liberation (TL)					
MSHA		Mine Safety and Health Administration					
Field Office:							
Mine ID:	Mine ID#	Company:	Mining Company A	Mine:	Mine A1	Event:	1234567
Collection Date	Bottle No.	Location in Mine		Methane CH ₄ %	Cubic Feet Air/Minute	Cubic Feet Methane within 24 Hrs.	
1/31/2012	P0001	SHAFT #1 UPCAST - NORTH APPROACH		0.3	255,437	1,103,488	✓
1/31/2012	P0002	SHAFT #1 UPCAST - SOUTH APPROACH		0.25	265,891	957,208	✓
1/31/2012	P0003	SHAFT #1 UPCAST - EAST APPROACH		0.45	215,428	1,395,973	✓
1/31/2012	P0004	SHAFT #2 UPCAST - WEST APPROACH		0.1	176,523	254,193	✓
1/31/2012	P0005	SHAFT #2 UPCAST - SOUTH APPROACH		0.25	149,967	539,881	✓
Event Total Methane Liberation:						4,250,743	



District Total Methane Liberation (TL)

Mine ID: Mine ID#			Company: Mining Company A	Field Office:			Event: 1234888
Collection	Bottle No.	Location in Mine		Mine: Mine A1	Methane CH4 %	Cubic Feet Air/Minute	Cubic Feet Methane within 24 Hrs.
Date							
5/15/2012	P0001	SHAFT #1 UPGAST - NORTH APPROACH			0.38	260,437	1,425,111
5/15/2012	P0002	SHAFT #1 UPGAST - SOUTH APPROACH			0.28	265,331	1,069,815
5/15/2012	P0003	SHAFT #1 UPGAST - EAST APPROACH			0.55	217,483	1,722,465
Event Total Methane Liberation:							4,217,391



District Total Methane Liberation (TL)

Mine ID: Mine ID#			Company: Mining Company A	Field Office:			Event: 1244775
Collection	Bottle No.	Location in Mine		Mine: Mine A1	Methane CH4 %	Cubic Feet Air/Minute	Cubic Feet Methane within 24 Hrs.
Date							
8/1/2012	P0001	SHAFT #1 UPGAST - NORTH APPROACH			0.25	257,000	925,200
8/1/2012	P0002	SHAFT #1 UPGAST - SOUTH APPROACH			0.25	264,015	950,454
8/1/2012	P0003	SHAFT #1 UPGAST - EAST APPROACH			0.43	220,033	1,362,444
8/1/2012	P0004	SHAFT #2 UPGAST - WEST APPROACH			0.2	175,100	504,288
8/1/2012	P0005	SHAFT #2 UPGAST - SOUTH APPROACH			0.27	151,236	588,006
Event Total Methane Liberation:							4,330,392

In the example provided, the simple average (arithmetic mean) of the Quarter 1 and Quarter 3 values are properly used to calculate and report the quarterly average ventilation flow at Mine A1, Shaft #2 in Quarter 2. An arithmetic average is also used to calculate the CH₄ concentration.

Figure 3-5 and Figure 3-6 show how the Quarter 2 values should be calculated.

Figure 3-5: Deriving substitute data for missing ventilation flow data

Shaft #2 Upcast Approach	Q1 Actual Volumetric flow (acfm)	Q3 Actual Volumetric flow (acfm)	Q2 Missing data element Estimated Volumetric flow (acfm) Simple Average
West Approach	176,523	175,100	$(176,523 + 175,100) \div 2 = 175,812$
South Approach	149,967	151,236	$(149,967 + 151,236) \div 2 = 150,602$
Volumetric Flow for Shaft #2 to be reported for Q2	$175,812 + 150,602 = 326,414$		

Figure 3-6: Deriving substitute data for missing CH₄ concentration data

Substitute data for missing CH₄ concentrations can be derived by taking the arithmetic average of the CH₄% in the MSHA reports for the shaft approaches in the quarters immediately prior to and after the quarter with the missing data.

Shaft #2 Upcast Approach	Q1 Actual CH ₄ %	Q3 Actual CH ₄ %	Q2 Missing Date Element Estimated CH ₄ %
West Approach	0.1%	0.20%	$(0.10\% + 0.20\%) \div 2 = 0.15\%$
South Approach	0.25%	0.27%	$(0.25\% + 0.27\%) \div 2 = 0.26\%$
CH ₄ % For Shaft #2 to be reported for Q2			$(0.15\% + 0.26\%) \div 2 = 0.205\%$

3.4.2 Missing approach data

In some cases, the MSHA report for a specific quarter may include all operating shafts but exclude the ventilation and CH₄ measurements at an approach for a shaft. Figure 3-7 presents an example. The Quarter 4 report for Mine A1 shows both the #1 and #2 shafts as would be expected. However, there is no mention of the South Approach at Shaft #2 despite being listed as an approach for Shaft #2 in the quarterly reports for the first three quarters of the year.

Figure 3-7: Example where an approach is missing from an MSHA report

United States Department of Labor		District Total Methane Liberation (TL)			
MSHA		Mine Safety and Health Administration			
Mine ID: Mine ID#	Company: Mining Company A	Field Office: Mine: Mine A1		Event: 1245668	
Collection Bottle No.	Location in Mine	Methane CH ₄ %	Cubic Feet Air/Minute	Cubic Feet Methane within 24 Hrs.	
Date					
11/21/2012 P0001	SHAFT #1 UPCAST - NORTH APPROACH	0.25	245,000	882,000	
11/21/2012 P0002	SHAFT #1 UPCAST - SOUTH APPROACH	0.3	261,275	1,128,708	
11/21/2012 P0003	SHAFT #1 UPCAST - EAST APPROACH	0.5	228,963	1,648,534	
11/21/2012 P0004	SHAFT #2 UPCAST - WEST APPROACH	0.2	180,505	519,854	
Event Total Methane Liberation:				4,179,096	

If this is the case, application of missing data procedures assures a proper report. In turn, this ensures that that the GHGRP report submitted through e-GGRT more accurately reflects the total shaft flow and CH₄ concentration for that particular shaft in the reporting quarter. Section 3.4.1, *Missing shaft data* explains procedures to estimate substitute data values for CH₄ concentration and air flow for the South Approach of Shaft #2 in Q2.

4.0 Additional assistance

If additional assistance is necessary, please refer to the GHGRP Help Center at <http://www.epa.gov/ghgreporting/help/index.html>.