

# Managing Lost And Unaccounted For Gas Volumes

## Part 4 - Reporting Requirements For LAUF

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### Introduction

This series of papers will focus on possible causes of what is often known as Lost And Unaccounted For (LAUF) gas. The LAUF is a calculated value which compares the amount of gas coming into a system (purchased) to the amount of gas leaving the system (sold and/or otherwise accounted for). LAUF most often results from measurement issues, improper adjustment and handling of measured values, lack of accounting of controlled gas venting, and gas lost due to damage and leakage. The series will discuss and address each of these areas, starting with measurement calculations and ending with reporting requirements.

The three previous parts to this series focused on measurement calculation and hardware topics, and operation and maintenance practices that can contribute LAUF. This Part 4 will focus on US reporting requirements.

Although LAUF is a general concern for any operating company, there are specific accounting and reporting requirements imposed by several US regulatory agencies. This part will explore these federal requirements. In addition, to these federal requirements, some states may impose their own requirements. Those requirements are beyond the scope of this paper.

### PHMSA Form 7100

The Pipeline and Hazardous Material Safety Administration (“PHMSA”) is an agency of the United States Department of Transportation. It is responsible for administrating and enforcing the Natural Gas Safety Act of 1968 as well as other more recent related acts. For the natural gas industry, PHMSA enforces 49 CFR Parts 191 and 192 (“DOT 191” and “DOT 192” respectively). DOT 191 establishes certain annual reporting requirements. The reports are very different for “transmission” and “distribution” operators. Transmission operators are not required to report LAUF. However, distribution operators are. The following describes the LAUF requirements for distribution operators.

Under DOT 191.17 (Distribution system: Annual report), operators of distribution systems are required to complete and submit PHMSA Form F7100.1-1 annually. In addition to other information required by this form, Part G of the current year (CY 2021) requires reporting of the PERCENT OF UNACCOUNTED FOR GAS. The requirements of this section are shown in the adjacent figure.

| <b>PART G - PERCENT OF UNACCOUNTED FOR GAS</b>   |
|--|
| Unaccounted for gas as a percent of total consumption for the 12 months ending June 30 of the reporting year.  |
| $\frac{[(\text{Purchased gas} + \text{produced gas}) \text{ minus } (\text{customer use} + \text{company use} + \text{appropriate adjustments})]}{(\text{customer use} + \text{company use} + \text{appropriate adjustments})} \text{ times } 100$ equals percent unaccounted for. |
| For year ending 6/30 _____ %.  |

PHMSA instructions for this part are as follows:

#### PART G – PERCENT OF UNACCOUNTED FOR GAS

“Unaccounted for gas” is gas lost; that is, gas that the operator cannot account for as usage or through appropriate adjustment. Adjustments are appropriately made for such factors as variations in temperature, pressure, meter-reading cycles, or heat content; calculable losses from construction, purging, line breaks, etc., where specific data are available to allow reasonable calculation or estimate; or other similar factors.

State the amount of unaccounted for gas as a percent of total consumption for the 12 months ending June 30 of the reporting year.

$$\frac{[(\text{Purchased gas} + \text{produced gas}) \text{ minus } (\text{customer use} + \text{company use} + \text{appropriate adjustments})]}{(\text{customer use} + \text{company use} + \text{appropriate adjustments})} \text{ times } 100 \text{ equals percent unaccounted for.}$$

Let's look at each of the items mentioned in the instructions:

*Unaccounted for gas* refers to the quantity of gas that cannot be measured, estimated, or calculated.

In the previous Parts of this series, various activities and events were identified where gas was “lost”. Even though this gas was considered lost in the sense that it left the system without being sold, often the amount of the lost gas can be estimated or calculated, and therefore accounted for. See the previous Parts of this series, especially Part 3, for suggestions on how to “account” for these lost gas amounts.

*Variations in temperature* can refer to a variation in gas flowing temperature compared to the base temperature, or a variation in the purchased gas base temperature compared to the sales gas base temperature. In either case, the quantities associated with these conditions can be adjusted using the equations listed in Part 1 of this series.

*Variations in pressure*, similar to temperature, can refer to a variation in meter pressure compared to the base pressure, or a variation in the purchased gas base pressure compared to the sales gas base pressure. In either case, the quantities associated with these conditions can be adjusted using the equations listed in Part 1.

*Variations in meter-reading cycles*. In many cases, the measurement and control systems used at the custody transfer stations (town border station, city gate station, etc) from the gas transporter to the distribution company are sophisticated enough to record and report “sales” on an hourly and daily basis. Daily sales volumes are often available and used in the monthly billing from the transporter. In that case, the reported monthly volumes are from the first day of the associated month to the last day of the month. In terms of “annual” reporting, this means that the values can be very accurate in terms of the billing cycle.

From the distribution side of the operation, the billing cycle is not as precise. Cycles often overlap, or usage/sales for a “month” may vary depending on when the work days fall during the month. If the beginning or end of the month occurs on a weekend, holiday, or work stopping weather event, meters may not be read and the billing cycle may be shorter or longer than the actual month. In the case of reporting, this can be compensated for by reviewing the actual read dates for the first and last cycles, and cycle following the last cycle in the reporting period. Billing cycles falling between the first and last cycles in the reporting period do not need to be adjusted. If the actual read dates and number of days in the billing cycle are known, an adjustment may be made by prorating the days in the billing cycle and including only the number of days falling within the reporting period in the reported value.

*Heat Content* has an unclear effect on the measured amount/volume of the gas. It can certainly affect the amount of gas used. However its effect on the measured quantity of the gas is non-existent. For a distribution system, the heat content of the gas purchased, in general, is the same as the heat content of the gas sold. It is not clear how this adjustment would be applied.

*Calculable losses from...*

*construction.* It is not clear what these losses would constitute. Generally the only loss from construction would be from purging a new line into service or clearing an existing line. These losses are specifically identified separate from construction losses. However, if some sort of gas loss does occur from construction activities, certainly include them as an adjustment.

*purging.* These are losses that occur when purging a new line into service or clearing an existing line.

*line-breaks.* These are losses that occur from both leakage and damage. Losses from leakage are difficult to account for. Losses from damage can often be estimated and accounted for.

*etc.* These are losses that occur from all other events and sources not specifically mentioned in the instructions.

Part 3 of this series discusses suggested handling and accounting methods for the type of losses described above.

*Reporting period.* Although the introduction to the instructions for this report state “The annual reporting period is on a calendar year basis ending on December 31<sup>st</sup> of each year”, the instructions for Part G state that the reporting period for this part is “for the 12 months ending June 30 of the reporting year”. This means that the values used to calculate the PERCENT OF UNACCOUNTED FOR GAS are for the period from July 1 of the year previous to the reporting year, to June 30 of the reporting year. Be sure to note this distinction when preparing the report values.

*Purchased gas* refers to the total volumetric amount of gas “purchased” by the operator from an outside party, and passing through the custody transfer points into the system, during the reporting period. This does not include gas purchased but not input into the system. For example, if gas was purchased and placed into storage outside the system, it should not be included in this amount. This value is generally provided by the gas transporter, or can be taken from the monthly invoice values. Make sure to note and adjust for the Base Pressure and Base Temperature that the volume is reported in. You may need to refer to the transporter’s tariff agreement to find those values.

*Produced gas* refers to the total volumetric amount of gas “produced” by the operator downstream of the custody transfer points during the reporting period. In modern times, this might include gas being supplied into the system from a propane/air system, LNG storage, or perhaps RNG sources connected downstream of the transporter’s custody transfer point. This value might come from the operator’s own operations records or other transactional records. Make sure to note and adjust for the Base Pressure and Base Temperature that the volume is reported in for each of the supply points.

*Customer use* refers to the total volumetric amount of gas “used” by the customers supplied by the system for which the report is being prepared. This value would come from the operator’s own “billing” records for the reporting period, adjusted for billing cycle differences, and Base Pressure and Base Temperature variations. If reporting for multiple geographic locations, remember to adjust the amount for each area by the appropriate Base Pressure when combining amounts. Part 1 of this series describes how to make adjustments for varying Base Pressures and Base Temperatures.

*Company use* refers to the total volumetric amount of gas “used” by the “company” or operator. This includes amounts for building heat, vehicle fuel, line heating, compression, and any other use that is not included in the *Customer use* value.

*Appropriate adjustments* refers to the items mentioned above, which are not included in the *Customer use* or *Company use* values. These adjustments, sources, and events are discussed in Parts 1 and 3 of this series.

When calculating the PERCENT OF UNACCOUNTED FOR GAS for this report, ensure that Base Pressure and Base Temperature for all of the volumetric values used in the calculation are consistent. Adjust the various values using the equations in Part 1 of this series as appropriate. The value listed in Part G is a measure of the LAUF for your system. A LAUF value greater than +/- 3 percent indicates that there are probably opportunities for improvement.

#### **49 CFR Part 191.5**

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DOT 191.3 has a particular and specific definition of an “incident”. Within this definition the estimation of “gas loss” from the event is implied/required. If an event reaches the level of an *incident*, DOT 191.5 requires the estimation and reporting of “the product released” during the event. The implication of these two requirements is that any event involving a moderately large release of gas will require estimation of the lost gas quantity. Regardless of these requirements, it is good practice to attempt to estimate and account for any gas released during an event.

#### **EIA Form 176**

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The US Energy Information Administration is an agency of the US Federal Statistical System. It is responsible for collecting various information about “energy” in the United States, including data associated with natural gas production, transportation, and use. There is a mandatory requirement to file Form EIA-176 annually for all companies that deliver natural gas to consumers or that transport gas across state lines. A single report form is used for both “transmission” and “distribution” operators, although certain items apply only to one or the other type of operator. The following describes the LAUF requirements of the form for distribution operators:

All values reported on this form are on a “calendar-year” basis, from January 1 to December 31. Recognize that this is a different reporting period than is used on PHMSA Form F7100.1-1. Values reported on this form must be in 1000's Cubic Feet (Mcf) at a Base Pressure of 14.73 psia and a Base Temperature of 60 Fahrenheit. Use the equations listed in Part 1 of this series to adjust your recorded values to the required reporting conditions as appropriate.

Part 4, Line 4 through 6 of the form requires reporting of various volumes delivered to the city gate or introduced to the system. In this context, “gas introduced to the system” refers to any gas delivered into the system downstream of the city gate.

- . 4.0 If you are a distributor, report receipts at city gates within the report state ... ..
- ... 4.1 Purchase gas received in distribution service area for delivery to your sales customers.....
- . 4.2 Receipts of gas in distribution service area for delivery to your transportation customers....
- 5.0 Report any other receipts of natural gas within the report state (excluding federal offshore)...
- 6.0 Supplemental gaseous fuels supplies (specify type) 

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|  |
- .. 7.0 Total supply within report state (sum of all items in lines 1.0 through 6.0)..... ..

Part 4, Line 4 of the form requires a distribution system operator to report the volume of gas delivered to the operator's city gate stations. This value can be obtained from the gas transporter or extracted from monthly bills for purchased gas. Only include amounts actually delivered through the city gates, not gas delivered to off system storage.

Part 4, Line 5.0 mentions the receipt/purchase of any other gas within the reporting state. Realize that this must be gas delivered to the city gate, or otherwise introduced into the downstream system. This would generally include amounts of gas introduced into the system downstream of the city gate from non-transportation sources, but not including "supplemental" gas to be reported on Line 6. Volumes purchased and placed into storage upstream of the city gate station should not be included in this amount. Volumes taken from storage and delivered to the city gate should be included with the values on Line 4.

Part 4, Line 6.0 is used to report the receipt/purchase of any "supplemental" gas within the reporting state, including propane-air or LNG introduced to the system downstream of the city gate. Again realize that gas reported on this line must have been gas delivered to the city gate, or otherwise introduced into the downstream system. Volumes purchased and placed into storage upstream of the city gate station should not be included in this amount.

The above values are totaled on Part 4, Line 7.0.

Part 6, Line 10.0 and 11.0 are used to report deliveries to end-use consumers. When reporting these values remember to convert or adjust from your local Base Pressure and Base Temperature to the required reporting conditions.

As discussed in the PHMSA report section, billing cycles do not always correspond with the reporting period. When they do not, and the billing cycle dates are known, prorate the cycle values and adjust the reported values as appropriate for the cycles at the beginning and end of the reporting period.

Part 6, Line 12 is used to report various uses of the received gas by the operator. These are mostly self explanatory. However, this author believes that these should only include values used downstream of the city gates, and should not include item Line 12.2. As explained in Part 3 of the series, this type of use is not consumed or lost. It remains in the system and is eventually included in sales from the system. If a value is included for this item, the "disposition" portion of Part 6, Line 20.0 will be skewed.

- 12.0 Natural gas consumed in your operations:
  - 12.1 Space heat of your facilities .....
  - 12.2 New pipeline fill .....
  - 12.3 Pipeline distribution or storage compressor use .....
  - 12.4 Vaporization/liquefaction/LNG fuel .....
  - 12.5 Vehicle fuel used in company fleet (exclude these volumes from Items 10.5 and 11.5) .
  - 12.6 Other .....(specify type)

Part 6, Line 17.0 is used to report all of the "accountable" amounts from events and sources mentioned in Part 3 of this series, which are not reported elsewhere.

Part 6, Line 19.0 is the summation of all of the appropriate values in Part 6 of the form. Enter the value on this line.

Part 6, Line 20.0 lists the difference between the gas supply (Part 4, Line 7) and disposition (Part 4, Line 19.0). If the value for this item is greater than +/- 3 percent of the value on Part 4, Line 7, there are probably opportunities for improvement.

## **EIA Form 857**

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In addition to the mandatory annual reporting of Form 176, the EIA also administers another mandatory survey, Form EIA-857, which is due monthly for select distribution operators. This form is basically an abbreviated version of Part 4 and Part 6 of Form 176. However it does not require the comparison of the delivered and disposed gas volumes, so there is no real connection to LAUF values. It does, however, require that all values be reported in Mcf at a Base Pressure of 14.73 Psia and a Base Temperature of 60 Fahrenheit. The equations listed in Part 1 of this series can be used to convert your recorded values to the required conditions if necessary.

## **EPA Subpart W & NN**

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EPA Greenhouse Gas Emissions reporting (GHG Report) is mandated under CFR 98. Subpart NN specifically applies to Local Distribution Companies (referred to as LDCs in the regulations). Portions of Subpart W applies to “distribution pipelines”. Neither of these subparts specifically address LAUF. However, both Subpart W and NN do require reporting of certain volumes.

Gas volumes reported or used to meet the requirements of the above subparts must be reported in Mscf (1000's standard cubic feet). According to the definitions in the regulations, standard pressure is 14.7 Psia and standard temperature is 60 or 68 Fahrenheit. Elsewhere in the regulations a value of 60 Fahrenheit is often used in the Subpart W calculations. Since a value of 68 Fahrenheit is not used in those calculations, it can probably be assumed that 60 Fahrenheit should be used as the Base Temperature for expressing values required by this report.

The PHMSA and EIA reports require statement of gas volumes in Mcf at a Base Pressure of 14.73 Psia. Although not much different, if the quantities from these reports are used in the GHG Report, they should be adjusted using the equations listed in Part 1 of this series.

Subpart W of the regulations section 98.236(aa)(9) and Subpart NN section 98.403 require the reporting of several values similar to those included in the PHMSA and EIA reports. If you use values from these reports to complete this report, remember to convert them to the required reporting conditions.

A specific threshold of emissions must be reached before this report is required to be submitted. Unfortunately, many of the calculations must be completed before it can be determined whether that threshold is reached.

## **What's Next**

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That's it for the discussion. Hopefully you can and will take the information presented in this series and use it to improve your LAUF results.

If you need help doing so, B3PE ([www.b3pe.com](http://www.b3pe.com)) provides software tools to assist in calculating and estimating many of the values required by the reports mentioned in this Part 4, in converting and adjusting volumes between differing base conditions, estimating lost gas from events and operations mentioned in Part 3, including tools for properly sizing regulators and meters as mentioned in Part 2, and to calculate all of the adjustments and corrections mentioned in Part 1. The firm provides services to assist in the calculation of all of the amounts and review of the operational practices mentioned in this series.

## **About The Author**

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Bradley Bean is the manager and senior partner of B3PE. Through its predecessor company (Bradley B Bean PE) the firm has been providing engineering software and services to the Natural Gas Industry since 1992. Mr Bean has been involved in the industry since 1982.

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