# GHG Emission Factor Development Project for Selected Sources in the Natural Gas Industry

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Quarterly Progress Report

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Submitted to

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**Project Overview**

Methane ($CH_4$) is the primary component of natural gas and is also a potent greenhouse gas (GHG). Emissions of $CH_4$ from natural gas production, processing, and distribution are among the top ten source categories of greenhouse gas emissions in the United States, expressed on a $CO_2$ equivalent basis. The overall goal of the project is to update default $CH_4$ emission factors for selected processes and equipment used in the natural gas industry. The default emission factors will be updated by compiling and synthesizing existing data for a variety of source categories and by acquiring new emission rate measurement data for selected sources where existing data have unacceptably large uncertainties or are insufficiently representative of current practices or equipment.

The project is organized into four tasks:

- *Task 1, Data Synthesis and Gap Analysis:* The purposes of this task are to: (1) identify, compile, and synthesize existing $CH_4$ emission factor and activity factor data; (2) critically review the quality and representativeness of the existing data; (3) recommend and prioritize emission source characteristics for new data collection efforts under Task 3.
- *Task 2, Technical Plan Development:* The purpose of this task is to develop technical work plans and detailed cost estimates for conducting data collection and measurement studies aimed at filling the emission data gaps identified in Task 1. In doing so, we will consider the range of potential activity data metrics that could be used for updating default emission factors and gather preliminary data on relevant metrics to ensure that all the major subgroups of equipment or processes are taken into account.
- *Task 3, Measurements and Analysis:* The purposes of this task are to: (1) execute the technical plans developed in Task 2, contingent on authorization by EPA; and (2) analyze the resulting data to develop new default emission factors and uncertainty estimates for the measured sources.
- *Task 4, Reporting and Dissemination:* The purpose of this task is to report on the default emission factors developed in Tasks 1 and 3 of this study, including the methods used in the process. Reporting and communication with stakeholders will be integrated into all of the tasks and a final reporting will disseminate project results.

**Progress on Tasks**

***Task 1***

A draft review of sources of emission factor and/or activity factor data that may have relevance to the natural gas sources of interest was prepared at the end of 2008. A series of stakeholder conference calls to solicit input on the report were organized (calls were held beginning in January, 2009) and an updated literature review was prepared. The updated review, dated March 31, 3009, was posted to the project web site:
(***http://www.utexas.edu/research/ceer/GHG/tasks.htm*** )

On a subsequent conference call (May 12, 2009), stakeholders identified additional reports and reports that, while not currently available, would likely become available during the lifetime of the project. These reports will be incorporated into the Task 1 report as they emerge, so the report will continue to be updated throughout the project.

***Task 2***

During the first quarter of 2009 a work plan specifying methods and procedures for gathering additional data needed for updating factors used for estimating methane emissions from centrifugal and reciprocating compressors used in natural gas transmission and processing was drafted. A series of stakeholder conference calls to solicit input on the plan were organized (calls were held beginning in January, 2009). A second draft of the work plan was added to the project web site: (***http://www.utexas.edu/research/ceer/GHG/tasks.htm*** ). During the third quarter, final updates were made to the Quality Assurance Project Plan (QAPP) for compressor sampling, in anticipation of sampling beginning in the fourth quarter of 2009 and the first quarter of 2010. The QAPP for compressor sampling was approved in late October, prior to sampling in November.

***Task 3***

During the second and third quarters of 2009, the focus was on identifying compressor sampling sites. At least 4 different companies considered opening multiple sites to the study team. During the fourth quarter of 2009, site access agreements were finalized with two companies that provided initial sampling sites. The University also procured additional liability insurance for sampling.

The compressor station sampling techniques were as follows:

- Station Fugitive screening by FLIR camera (non-quantitative)
- Fugitive measurement on found leakers by High Volume Sampler device
- Vent Measurement by alternate methods (pitot tube, anemometer, or calibrated bag)

Sampling at the first group of sites in east Texas, all belonging to a single company, occurred for a week in November, 2009. A second week of sampling occurred in February, 2010, at a group of sites belonging to a different company in west Texas. The strategy in conducting the sampling was to collect as much data as possible at the sites, using three different types of instruments, and to perform a cost analysis of the sampling program. Measurements included compressor related fugitive components (flanges, valves, open-ended-lines, pressure relief valves) as well as blowdown vent lines and compressor seal and rod packing emissions, the latter which were measured by anemometer and calibrated bag techniques. Table 1 describes the instruments that were deployed at the sites.

Table 1. Summary of sampling done to date

| Ownership of site | Type/Number of Compressors | Date sampled | IR Screening | Hi Flow on Component leaks | Vent pipes measured |
|---|---|---|---|---|---|
| Company 1 | Recip./6 | 11/3/09 | √ | √ | √ |
| Company 1 | Recip./5 | 11/4/09 | √ | √ | √ |
| Company 1 | Centrif./3 | 11/3/09 | √ | √ | √ |
| Company 2 | Recip. | 2/23/10 | √ | √ | √ |
| Company 2 | Recip. | 2/24/10 | √ | √ | √ |

The most significant findings in this first round of sampling were high emission rates for some compressor vent pipes and emission rate variability in the vent pipes, summarized in Table 2.

Table 2. Emissions from compressor vents

| | scfm* | Mscfy** | GRI/EPA Data Mscf/compressor/year |
|---|---|---|---|
| Company 1 (3 sites) | | | |
| Average blowdown vent for compressors at idle | 1.33 | 699 | 3683 |
| Average blowdown vent for compressors running and idle | 30.03 | 15,787 | |
| Average packing vent | 15.94 | 8,379 | 396 |
| Company 2 (2 sites) | | | |
| Average blowdown vent for compressors at idle | 27.30 | 14,347 | 3683 |
| Average blowdown vent for compressors running | 16.76 | 8,807 | |
| Average packing vent | 26.25 | 13,798 | 396 |

*standard cubic feet per minute
**thousand standard cubic feet per year

The overall emissions from fugitive emissions from valves, flanges, and other sources are reported as an average over all five sites in Table 3.

Table 3. Fugitive emissions from valves, flanges and other components

| | scfm* | Mscfy** | GRI/EPA Data Mscf/recip. compressor/year |
|---|---|---|---|
| Pressurized idle | 0.114 | 60 | 180 per Recip compr; |
| Operating | 0.091 | 48 | |
| Average | 0.099 | 52 | |

*standard cubic feet per minute
**thousand standard cubic feet per year

As was found in the previous GRI/EPA study, the largest single emission sources at a compressor station site are the compressor blowdown (BD) vent lines and the compressor seal vents. These remain the largest sources in the sampling for this project. For compressor vent lines, measurements at the Company 2 stations exceeded the values previously reported for the GRI/EPA study. However, measurements at the Company 1 stations had lower values for idle reciprocating compressors. One potential reason for the variability in compressor vent emissions at idle is differences in practices for pressurizing compressors at idle. Figure 1 shows a representation of a typical compressor blowdown line configuration. When compressors are idle

and pressurized, the small (often 2 inch size) valve to the open vent is the only open-ended line (OEL) leak point. However, if the compressor is isolated from the suction and discharge lines and blown-down, the OEL leak points are the very large suction and discharge block vales, which can leak at a much higher rate.

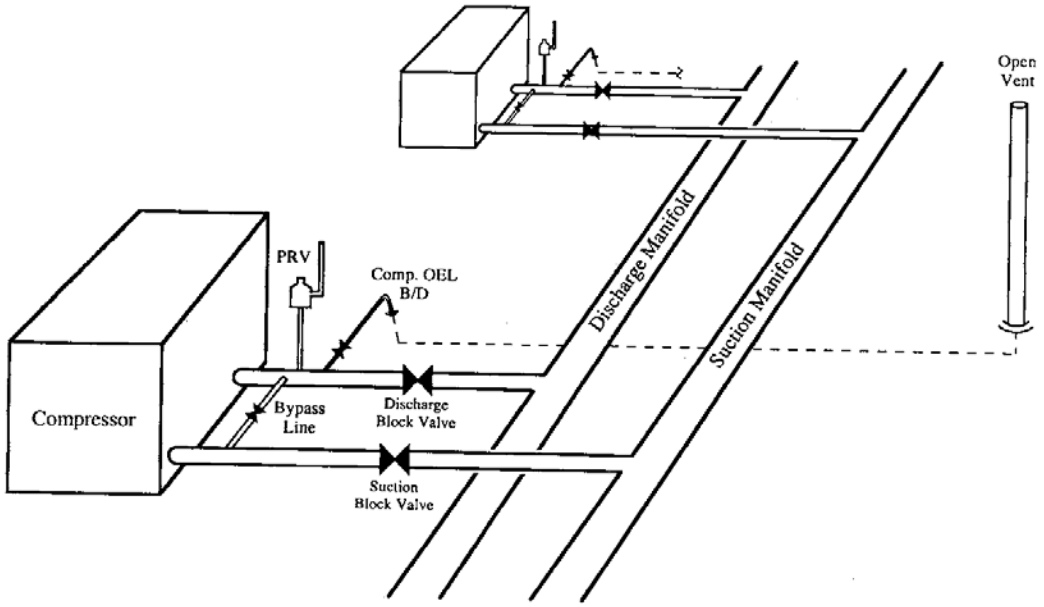


Figure 1. Compressor blowdown line configuration

At the Company 1 stations, the practice for idle compressors was to leave the compressor pressurized. This reduces leakage through the compressor BD line versus other practices.

Based on these data, it was concluded that more stations would have to be visited across a broader geographic area to cover a representative sample of US transmission compressor stations and their operating practices. During the first quarter of 2011, the project team made arrangements to visit sites provided by a new volunteer company participant. Multiple sites were offered; sites in New Mexico were selected because the volunteer company could provide many sites that could be sampled in one week from one base of operation. The available sites were production gathering stations; although not transmission sites, much of their compression equipment is of the same make and size as transmission sites and so should be comparable to transmission station data. Sampling was done in May, 2011. Six facilities were visited and measured for compressor seal emissions (rod packing leaks or centrifugal wet seal gas emissions), and for compressor blowdown line leakage. Three (3) gathering compressor stations were visited with medium sized reciprocating compressors (1500 HP). One large centrifugal gathering station was visited and two natural gas processing plants were visited where the resid gas compressors were measured.

In addition to our regular vent rate measurement equipment (anemometers, calibrated bags), the team also brought along a "through-valve acoustic leak detection device" as allowed by the new GHGRP Subpart W for gas plant and transmission compressors. A representative of the acoustic

device manufacturer attended the tests. Dual measurements were taken, where possible, with both the acoustic device and the direct flow measurements.

Results from these sampling events were presented to both EPA project officers and a stakeholder group. Overall, the data from the May 2011 sampling indicated that emissions from compressor vents show substantial variability from site to site. Differences due to compressor configurations, venting configurations, and variability in compressor operation meant that it would be difficult to generalize results across stations. Since upcoming regulatory requirements will necessitate emission reporting from all stations, the project team concluded that the best course of action would be to end sampling and prepare the project final report. Much had been learned about sampling challenges and requirements from the field measurements made in the project and rapid dissemination of these findings was, in the view of the project team, the highest priority for the project. The project team made this recommendation in presentations to both the EPA and a stakeholder group. Both the EPA and the stakeholder group supported the project team's recommendation to terminate sampling and to complete the final report as expeditiously as possible. Currently the plan is to complete a draft final report by the end of the original project period (September 30, 2011). In order to allow time for the project team to respond to comments from the EPA and stakeholders on the draft final report, a project extension until December 31, 2011 was approved.

**Plans for Next Quarter**

Sampling has been completed and in the next quarter, a draft final report (Task 4) will be prepared and submitted to the EPA and the stakeholder group.