Improving Methane Emission Estimates for Belowground Pipeline Leaks

EPA Stakeholder Workshop on Natural Gas in the Inventory of U.S. Greenhouse Gas Emissions and Sinks

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Total Emission Estimate

Total Emission = Emission factor x Activity factor

- EF = Leak rate in scf/leak-year
- AF = Number of equivalent leaks leaking year round, from database of leak repairs.
A) Emission Factors

Use the Hi-Flow Sampler for surface measurements

- The Hi Flow Sampler is a portable, intrinsically safe, battery-powered instrument designed to determine the rate of gas leakage.
- Commonly used around pipe fittings, valves, and compressor in natural gas facilities.
A) Emission Factors

- Field tests were performed at 4 utilities.
- About three leak sites were tested at each utility.
- Measurements at ‘Test Sites’ were also performed at GTI and SW Gas.
- The measurements provided a comparison between the aboveground Hi-Flow Sampler with the earlier GRI/EPA method of isolating and measuring the leak belowground.
A) Emission Factors - Field Tests

- Excavate bellholes
- Measure surface leaks
A) Emission Factors - Field Tests

Pressurized Gas

Flow meters

Ground Surface

Approx. 40 ft Dist.

Leak Source

Cut & Cap

Excavation

Isolated section of the PE Pipe

Optional bypass line

Cut & Cap

Excavation
A) Emission Factors - Field Tests

Isolate leaking section
A) Emission Factors - Field Tests

- The leaks at most of the sites were grade 3, characterized by small flow rates.
- The surface measurements using the Hi-Flow Sampler compared well for the leak rates at and above 0.01 scfm.
A) Emission Factors - Field Tests

Hi-Flow and LFE measurements at GTI test site and utility sites

Average Line
\[ y = 0.887x - 0.004 \]
\[ R^2 = 0.994 \]

Min. Hi-Low Readings = 0.01 scfm
A) Emission Factors - Summary

- Emission Factors (from surface reading at utilities and test sites) = 2.36 scf/leak-hour.
- Additional surface measurements using the Hi-Flow Device at utility sites will be performed to have a representative distribution to the utility leak records.
- The total Emission Factor will be updated at the completion of the surface measurement test sets.
A) Emission Factors – 1994 GRI/EPA Study

Total Emission = Emission factor x Activity factor

**GRI Field Tests**

<table>
<thead>
<tr>
<th>Test</th>
<th>Flow rate (scf/leak-hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.008</td>
</tr>
<tr>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td>3</td>
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<td>4</td>
<td>1.62</td>
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<tr>
<td>5</td>
<td>10.266</td>
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<tr>
<td>6</td>
<td>61</td>
</tr>
</tbody>
</table>

**Mean** 12.454

- Adjusted for 94% Quality gas
- Adjusted for oxidation

![Methane Emission Factors for Underground Distribution Pipelines](chart)
B) Activity Factors

Total Emission = Emission factor x Activity factor

* Mscf: Thousand Standard cubic ft

B) Activity Factors

Two Activity Factors are proposed:

a) **National Emission Estimate**
   - Utilizes a procedure similar to GRI study, with updated estimates for emission inventory.
   - In units of ‘leak-year’ or ‘mile-year’.

b) **Utility-Specific Emission**
   - Uses utility-specific ‘leak records’ and ‘repair records’ to reach their emission estimates.
   - In units of ‘leak-year’.
B) Activity Factors

Utility-Specific Equivalent Leak = OL + LI + UDL - RL

(in Leak-year)

**OL** = \( \sum \) [Outstanding leak records carried out for the full year]

**LI** = \( \sum \) [New leak indications x (End of Year - Report Date)/365]

**UDL** = \( \sum \) [Undetected leaks which cannot be found using industry standard survey procedures]

(estimated 15% of LI, in full year)

**RL** = \( \sum \) [No. of Repaired leaks x (Repair date - Report Date)/365]
B) Activity Factors

**National Activity Factor**
- General & simple,
- Provides a conservative estimate,
- Similar approach to the GRI study,
- Used in emission inventory.

**Utility-Specific Activity Factors**
- Specific to the utility inventory,
- Utilizes actual leak & repair records,
- Uses actual leak durations,
- Flexible (easy to adjust when utilities change their inventory or pipe type),
- AF’s are the responsibility of the utility to provide,
- Identifies utilities aggressive repairs,
- Easy to update with changes in utility leak detection practices.
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Questions ...

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