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.
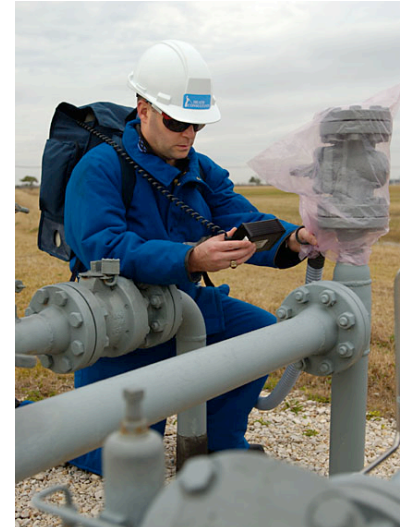
A) Emission Factors

- Test Method: From surface measurements of gas emission (in scf/leak-hour).

Hi-Flow Sampler

Ground Surface

Identified leak areas at surface

PE Pipe

Leak Source
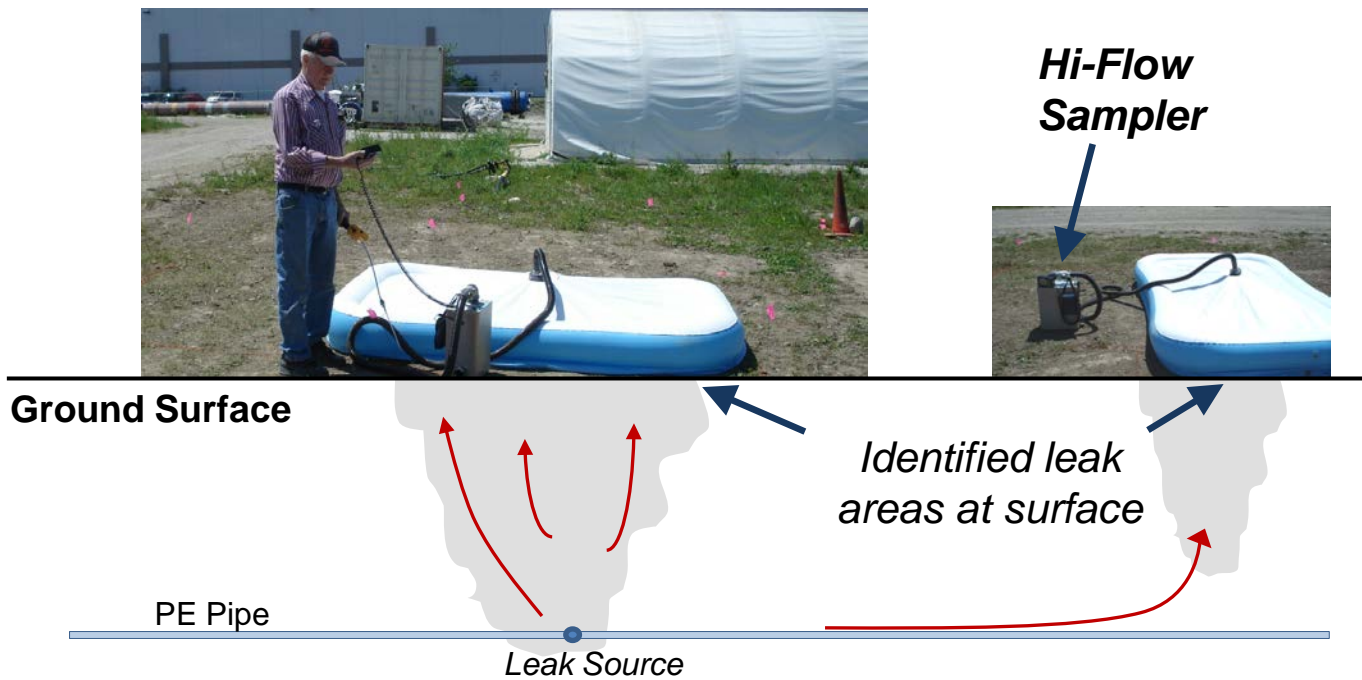
A) Emission Factors

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.
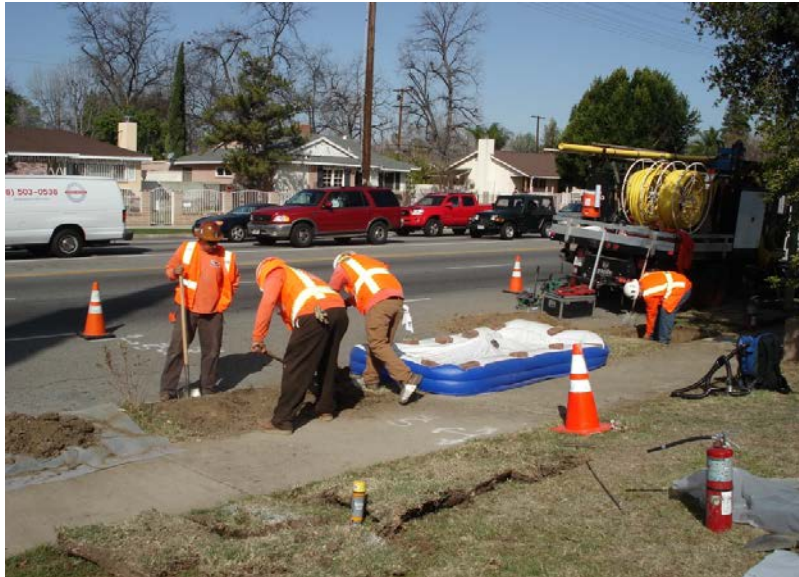
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A) Emission Factors

- 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

Measure surface leaks

Excavate bellholes

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A) Emission Factors - Field Tests

Flow meters

Pressurized Gas

Optional bypass line

Ground Surface

Approx. 40 ft Dist.

Leak Source

Cut & Cap

Isolated section of the PE Pipe

Cut & Cap

Excavation

Excavation
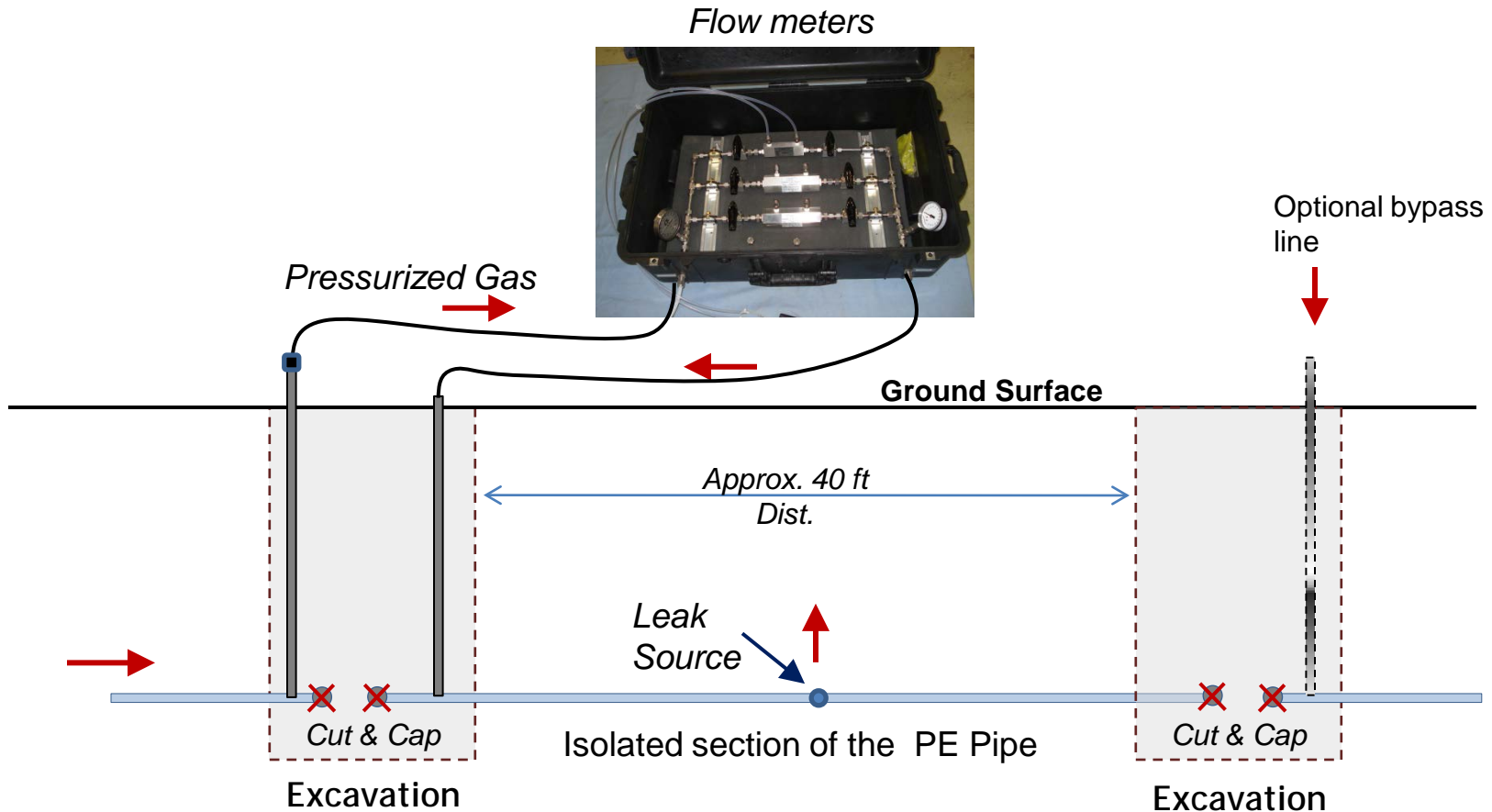
A) Emission Factors - Field Tests

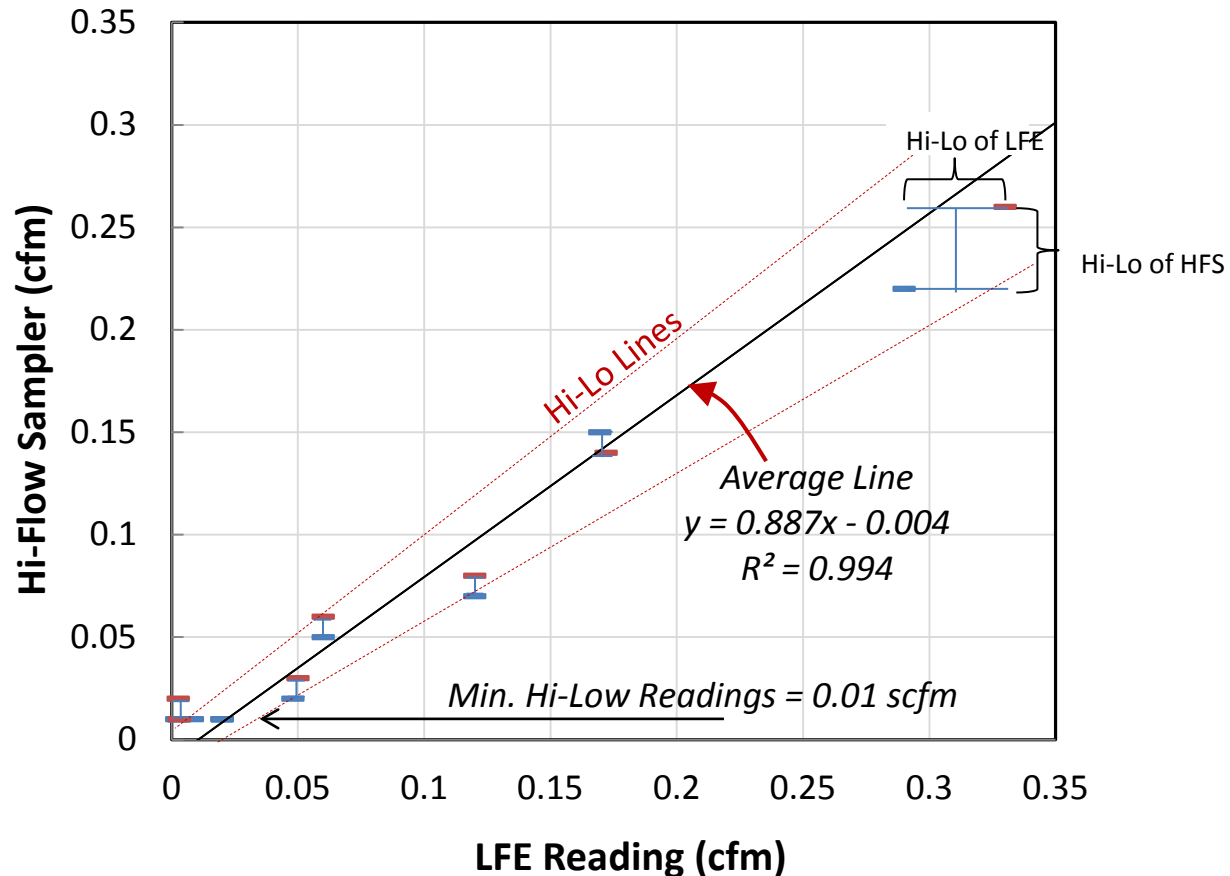**Isolate leaking section**

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.

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A) Emission Factors - Field Tests

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

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.

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A) Emission Factors – 1994 GRI/EPA Study

Total Emission = **Emission factor** x Activity factor

GRI Field Tests

Test	Flow rate (scf/leak-hour)
1	0.008
2	0.7
3	1.13
4	1.62
5	10.266
6	61

Mean   12.454

METHANE EMISSION FACTORS FOR UNDERGROUND DISTRIBUTION PIPELINES[a]

Pipe Use	Pipe Material	Average Methane Leakage Rate (scf/leak-yr)	Soil Oxidation (%)	Average Emission Factor[d] (scf/leak-yr)	90% Confidence Interval[a,b] (scf/leak-yr)
Mains	Cast Iron	399,867[c]	40.3	238,736[c]	152,059[c]
	Unprotected Steel	52,748	1.8	51,802	48,212
	Protected Steel	20,891	3.0	20,270	17,243
	Plastic	101,897	2.0	99,845	165,617

- *Adjusted for 94% Quality gas*
- *Adjusted for oxidation*

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B) Activity Factors

Total Emission = Emission factor x **Activity factor**

2008 Data and CH₄ Emissions (Mg) for the Natural Gas Distribution Stage

Activity	2008 EPA Adjusted Values					
	Activity Data		Emission Factor		Emissions	
Pipeline Leaks						
Mains—Cast Iron	36,462	miles	239	Mscf/mile-yr	167,628	
Mains—Unprotected steel	69,374	miles	110	Mscf/mile-yr	147,229	
Mains—Protected steel	479,502	miles	3	Mscf/mile-yr	28,324	
Mains—Plastic	603,377	miles	10	Mscf/mile-yr	115,164	

*   *Mscf: Thousand Standard cubic ft*
** *Source: EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008, and table W-7, 40 CFR part 98 , Subpart W.*

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'.

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B) Activity Factors

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

(in Leak-year)

OL = Σ [Outstanding leak records carried out for the full year]

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

UDL = Σ [Undetected leaks which cannot be found using industry standard survey procedures]
(estimated 15% of LI, in full year)

RL = Σ [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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