Improving Methane Emission Estimates from Underground Pipeline Leaks

In this project, research was conducted to develop a technical approach to quantify methane emissions from gas mains and service pipelines. The new method will provide an increased level of accuracy and an improved ability for utilities to comply with future regulations.

Project Description

Due to the growing concern over climate change and greenhouse gas (GHG) emissions, the natural gas industry is developing more accurate emission-estimation methodologies.

In this project, research is addressing methodologies for quantifying fugitive and methane emissions.

In Phase 1 of the project (completed in 2010), researchers assessed existing methodologies and proposed a technical approach for measuring leak flow rates at their aboveground state. Measurements of aboveground methane flow rates were performed in controlled tests where gas leaks were captured at the surface and measured using the Hi Flow Sampler™. The results of the tests showed good correlation with the applied leak rates from the pipes.

Phase 2 of the research program (completed in 2013) included field tests at utility sites with known leaks to evaluate surface measurements in various site conditions and develop emission factors for plastic pipe. The measurements correlated to below-ground measurements in isolated pipe segments.

Phase 3 of the project (completed in 2014) focused on performing field measurements to establish the emission factors for emissions from cast-iron and unprotected steel pipes.

Phase 4 involved the implementation of the project results and improving estimates for activity data.

Deliverables

Deliverables include updated emissions factors for methane emissions from plastic, cast-iron, and unprotected steel pipes, and a new methodology for more accurate estimation of methane emissions using aboveground measurements of pipe leaks.

Capturing the gas leak area for rate measurements.

Benefits

Results from this project will directly improve a company's ability to:

- Provide accurate, cost-effective, and manageable emissions management
- Satisfy regulatory requirements
- Implement methodologies that can be integrated with existing gas-distribution software and system tools.

With the new methodology, records are updated regularly using a combination of various technologies to search, pinpoint, and classify leaks. The estimates of activity data from utility inventory will also allow for the development of custom-made emission factors that address company-specific infrastructure characteristics.

Technical Concept & Approach

This project is being executed in four phases:

- Phase 1: Technical Approach and Methodology Assessment *(Completed)*
- Phase 2: Field Measurement of Emission Factors of Plastic Pipelines *(Completed)*
- Phase 3: Field Measurement of Emission Factors of Steel and Cast-Iron Pipelines *(Completed)*
- Phase 4: Implementation *(Completed)*.

Results

In Phase 1 of this project researchers assessed the previous methodologies used in estimating leak rates from below-ground pipelines and proposed a technical approach for surface measurements of the flow rates at leak sites. Above-ground measurements were performed in controlled tests where gas leak areas were covered and the leak rates were measured using the Hi-Flow Sampler device. The results of these tests demonstrated the applicability of using the Hi-Flow device to measure gas flow rates at the surface and provided a framework for the tests at utility sites in the subsequent phases.

Following the development of a testing methodology, 30 tests at utility sites and field-testing facilities were performed. Leak measurements were taken at each site to cover the various factors associated with leaks in polyethylene (PE) pipe. The field measurements consisted of identifying the leakage areas using the standard utility leak-detection tools and the Hi-Flow device in measuring gas flow rates in the covered leak areas at the surface.

The results validated the Hi-Flow surface measurements and provided an updated estimate of the Emission Factor for the PE mains. Most of the PE leaks at the utility sites were characterized by low gas-concentration readings at the surface and low emission-rate measurements. The field measurements provided a representative distribution of the full range of the gas concentrations in the utility records. Phase 2 work is completed.

Most of the leaks in the mains were characterized as joint leaks, located at the joints between the main lines and the service lines.

Phase 3 involved the application of the developed field-testing procedures to obtain similar emission factors for cast-iron and unprotected steel pipes. Leak measurements were performed in California, Alabama, New York, Massachusetts, and Illinois, and subsequently analyzed.

In 2015, the project team requested leak records/data from utilities to gain a better understanding of various leak parameters (e.g., as the distributions for various leak grades, annual leak repairs, time required to make leak repairs, number of leaks outstanding and the number of leaks per mile). All of this information will be used to develop more appropriate activity data for estimating methane emissions.

Six distribution companies responded to the survey, representing approximately 10% of the U.S. natural gas distribution system in terms of miles of mains and number of services. When compared to a 1996 study, the number of equivalent leaks per mile of distribution main decreased significantly: decreasing from 1.54 equivalent leaks per mile of main from the 1996 study to an average of 1.04 equivalent leaks per mile of distribution main from the current survey data. The survey data also indicate that the number of equivalent leaks per mile of main or per service has decreased significantly since 1996 for most pipeline material types.

Status

An analysis of data gathered from field tests will be presented in a Final Report to be issued in 2016.

For more information:

Maureen Droessler
Vice President, Operations
Operations Technology Development, NFP
Phone: 847/768-0608
maureen.droessler@otd-co.org