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APPENDIX 5 - STATIONARY M&R STATION METHANE DETECTOR PILOT STUDY UPDATE

2021 Winter Workshop (R. 15-001-08)— Jan 22, 2021

OVERVIEW OF DISTRIBUTION M&R STATIONS

» Stationary Methane Detector Phase One Update

- **Project Objective:**
  - Evaluate commercially available stationary methane detectors for early notification and measurement of gas leakage at above ground distribution M&R regulator stations with >300 psig line pressure.
- **Background:**
  - BP 18 directed utilities to evaluate the feasibility and cost effectiveness of using stationary methane detectors for early leak detection and flux rate estimation.
  - The sensors evaluated in this study have lower detection limits ranging from approximately 3% LEL (1,500 ppm) point sensors to approximately 0.2 ppm open path laser sensors.
  - Sensors were evaluated in terms of implementation requirements, leak detection, and cost effectiveness.

Stationary Methane Detector Phase One Update

» **Background:**

- Evaluated one (1) Non-Dispersive Infrared (NDIR) point sensor unit
  - *0 to 25,000 ppm, ±3%*
  - *5,000 to 50,000 ppm, ±5%*

- Evaluated three (3) Tunable Diode Laser (TDL) open path sensor units
  - Brand A
    - *0 to 10,000 ppm-m, ±2 ppm*
  - Brand B
    - *0.2 to 2500 ppm, ±2%*
  - Brand C
    - *0.5 to 750 ppm, ≤ ± 2 % of full scale*

Stationary Methane Detector Phase One Update

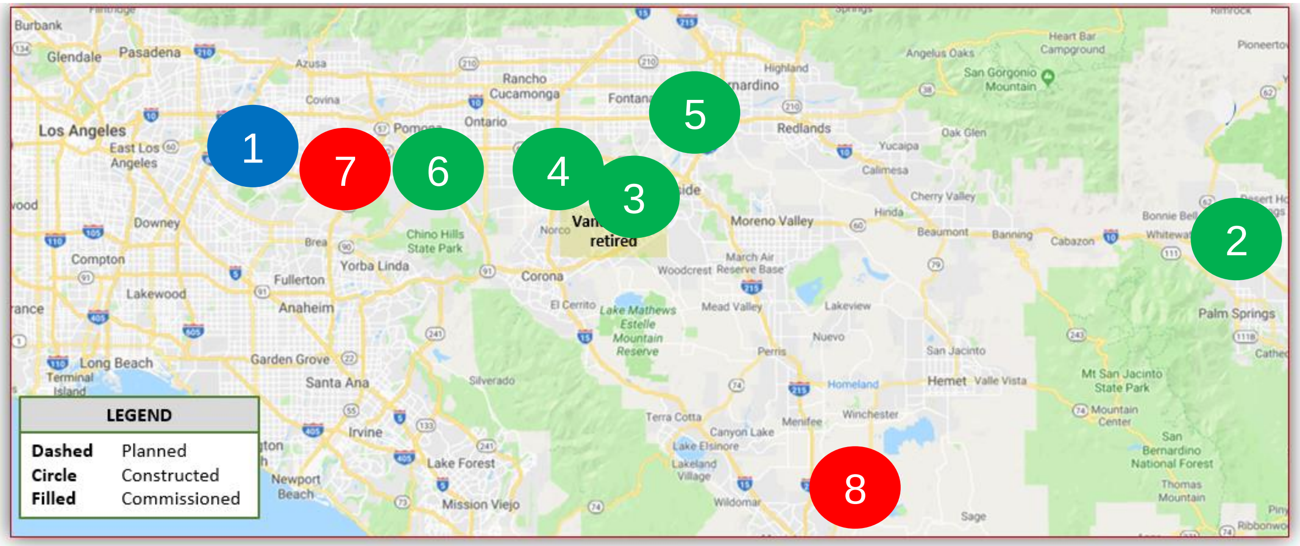
» Background:

- Conducted laboratory testing under controlled environmental conditions
  - Point sensor demonstrated degradation and failure to respond consistently at the high temperature (120°F) condition.
  - All open path sensors consistently detected methane at room temperature using a 1,000 ppm methane gas cell.
  - Temperature extremes (20°F, 120°F) and/or low methane concentration (20 ppm) impeded operation and/or performance of the open path sensors.
  - All open path sensors demonstrated degradation or failure at cold temperatures (20°F).
- Conducted simulated field testing under controlled leak rate conditions
  - Point sensors were only effective when positioned directly above and within 3 feet of potential leak sources.
  - All open path sensors were effective in detecting methane concentrations as low as <1 ppm above the background methane level.
  - All open path sensors were effective at detecting methane from controlled leaks located downwind of the sensor detection areas.

Stationary Methane Detector Phase One Update

» **Background:**

- Field Testing (Jan 2020 – Sept 2020)
  - Installed detection technologies at **8 above ground M&R Regulator stations** with inlet pressure above 300 psig
  - Monitored emissions from normal operations and investigated all alarm conditions
  - Performed controlled emission testing to gather comparative leak detection data
  - To minimize costs and facilitate comparison, **multiple open path sensor technologies were installed at select sites**. Additionally, two (2) point sensors were installed at each site.



Open Path Sensor Technologies Installed
Brand A and Brand B
Brand B
Brand B and Brand C

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Stationary Methane Detector Phase One Update

» **Results:**

- NDIR Point Sensor
  - Low implementation cost
  - Very limited capability to recognize medium to small leaks in this application
  - Sensor had to be positioned directly above the leak point and within 3 feet of the leak source
  - Only simulated leaks above 20 CFH registered

- TDL Open Path Sensors
  - Brand A units demonstrated baseline measurement drift providing inconsistent performance
  - Brand B units performed well except under extreme (120 °F) temperature conditions
    - Clearly indicated leak rates of ≥2 CFH
    - Small leaks (0.5-2 CFH) were recognized within 20-30 minutes, but are **at risk** for false positives due to normal emission variations
    - Small leaks (0.5-2 CFH) were **confidently detected** within 24 hours at wind speeds less than 2 mph
    - Very small leaks (0.3-0.5 CFH) may be detected within 48 hours at wind speeds less than 1 mph
  - Brand C units demonstrated stability issues

Stationary Methane Detector Phase One Update

» **Results:**

- A Leak Confidence Detection chart was created using both passive monitoring data and controlled emission evaluations from the **brand B** systems

Leak Rate (CfH)		% Confidence of Detection	Elapsed Time to Detect	Elapsed Time to Remediate	Comment
Low	High				
-	≥5.0	100%	3 days	7 days	Highly confident for all leak types and station environments
2.0	5.0	100%	7 days	7 days	
1.5	2.0	100%	14 days	7 days	
1.0	1.5	75%	14 days	7 days	Easily detectable in all tested scenarios. Reduced to 75% confidence to allow for extreme wind conditions at some stations.
0.5	1.0	25%	14 days	7 days	Reliably detected in our overnight testing scenarios. Reduced to 25% confidence to allow for challenging leak location, high wind scenarios, and stations with higher background levels.
0.3	0.5	10%	14 days	7 days	Leaks of this type were detected in our overnight testing but concede that conditions were favorable. Reduced to 10% confidence to acknowledge the challenge of detection even given normal station background levels and even modest wind conditions.
-	≤0.3	No reliable detection	N/A	N/A	Given standard wind conditions and background levels, the team does not believe leaks at this rate can be detected without a substantial frequency of false positives

Stationary Methane Detector Cost Basis Evaluation

» **Results:**

- Leak Confidence Detection chart was applied to 2015-2019 Historical leak data for the stations in scope for BP18 to determine theoretical emission reduction potential. Leak rates were estimated based on component leaker Emission Factors from CARB Mandatory Reporting Regulation (MRR)
- Estimated that 77% of the leak-based emissions over the past five years would have been eliminated. This amounts to an overall emission reduction of 1,393 MSCF (overall reduction from 1806 MSCF to 413 MSCF over 5 years).
- Total Reported Leaker Emissions are overstated due to conservative leak duration assumptions and emission calculations. Actual incremental reduction would decrease compared to theoretical emission reduction that will further reduce cost effectiveness.

	Number of A3 Stations	Total Leaks	Total Reported Leaker Emissions *(Mscf)*	Theoretical BP18 Reduction amt *(Mscf)*	Theoretical Emission BP18 Reduction *(percent)*
2015	158	50	258.0	161.9	62.8%
2016	164	77	448.7	344.4	76.8%
2017	165	48	321.3	279.3	86.9%
2018	165	68	408.4	312.7	76.6%
2019	165	60	369.5	294.9	79.8%
	Total	**303**	**1805.8**	**1393.2**	**77.2%**

Stationary Methane Detector Phase One Update

» Results:

- Average installation cost per site is $99k with $6k in annual operating costs. An additional $148k is required for communications system installation and commissioning.
- Cost effectiveness: $\frac{10\ years * (Average\ Annaul\ Revenue\ Requirement - Cost\ Benefits)}{Emissions\ Reductions,\ 2021-2030}$ = **$18,043/MCF**
  - NOTE: Direct costs were used as opposed to Average Annual Revenue Requirement (AARR); actual cost effectiveness would be higher using AARR
- Cost to perform additional leak survey each year $150/station ≈ $86/MCF

Recommended Equipment

- Sensor Brand B
- Weather Station
- Power: Dedicated Solar array and battery
- Capture/Transmission: On-site datalogger, cell modem

Installation & Operations Costs *Per Site*

Installation Costs per Site *(Capital)*

Site Design, Assessments, & Data Capture	$	26,040.00
Sensor purchase & install	$	63,760.00
Subtotal	**$**	**89,800.00**
Contingency - 10%	$	8,980.00
Total	**$**	**98,780.00**

Long-term Annual Operations Costs Per Site *(O&M)*

Annual Cost of Operations / sensor	$	5,980.00
Contingency - None	$	-
Total	**$**	**5,980.00**

Initial Solution Stand-up *One-time for all sites*

Total Costs *(Capital)*

Network & Technology Setup	$	134,200.00
Subtotal	**$**	**134,200.00**
Contingency - 10%	$	13,420.00
Total	**$**	**147,620.00**

Risks

- Some sites will require land acquisition to accommodate the new equipment and reflector mounting
- Sites with persistent high-wind will need to be evaluated for feasibility

Stationary Methane Detector Phase One Update

» Conclusions:

- Current implementation of stationary methane detector technology at above ground distribution M&R regulator stations for early leak detection and measurement is not cost effective compared to performing additional leak surveys

» Next Steps:

- Maintain sensor systems installed during this study for one (1) year to obtain data on leak durations. This data can be used to discuss possible corrections to current emission estimation assumptions for leaks at M&R facilities.
- Explore potential for improving cost effectiveness of repair of small leaks by intentionally deferring repair until work can be bundled with other leak repairs. This can reduce repair costs and total emissions vented during the repair process. Emissions from deferred leaks are monitored and tracked by system leak records.
- Evaluate methane sensor feasibility and cost effectiveness for various other types of transmission M&R facilities.

Questions?

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