November 5-6, 2014

Smart LDAR
New Paradigm That Works

Energy lives here™

Key Topics

Introduction

Explaining the Paradigm

Testing the Paradigm

Current Uses Today

Questions?

Explaining The Paradigm – *What Is Smart LDAR?*

Smart LDAR is about finding and fixing large leaks sooner.

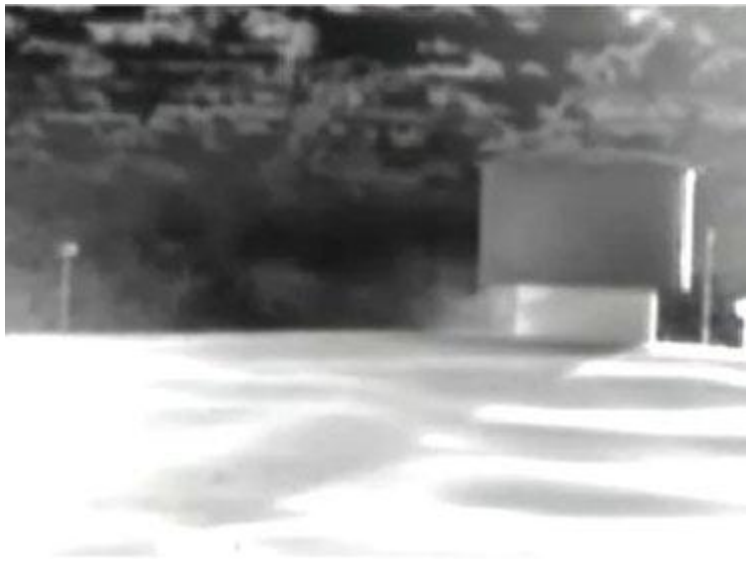
- Current best technology to find and fix leaks sooner is to use Optical Imaging to replace or serve as alternative monitoring paradigm to traditional Method 21 LDAR programs.
- Current technology utilizes IR absorption detection to “see” emissions in real-time with the help of special lens developed specifically for the range of hydrocarbons.
- Expectation is that it is more efficient and effective at finding large leaks than traditional LDAR programs currently in place.

Will it work and is it better?

Optical Imaging Finds Leaks Quickly

You Can SEE The Leaks!

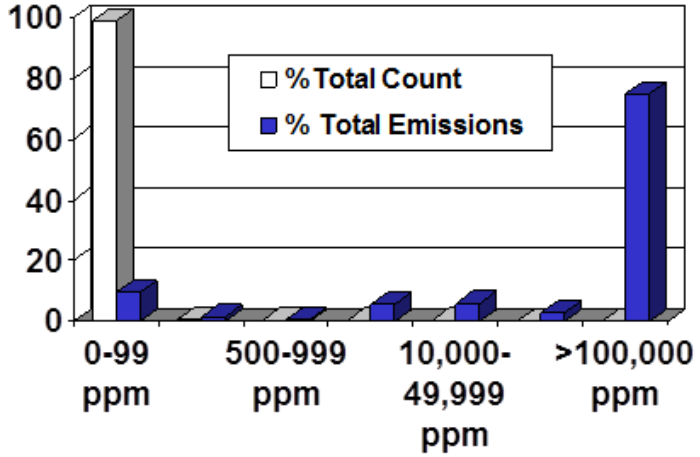
- Hydrocarbon plume appears through the Optical Imaging Camera in real time as a "dark area" from the leaking component.
- Ability to see the process piping facilitates precise location of leak.
- Expectation is that it is more efficient and effective at finding large leaks than traditional LDAR programs currently in place.
- Technology has evolved rapidly for detection and visual image capture.



Sock Missing/Damaged

Explaining The Paradigm – Find Leaks Sooner!

- Emissions from equipment leaks are predominantly driven by a small number of more significant “leakers.”
- API Study showed that 92% of reducible emissions come from only ~0.13% of components (API Publication 310).
- Key to emission reduction is detecting the more significant “leakers” earlier and making repairs faster.
- If you want to reduce emissions, then you must reduce the leak duration of these critical few “leakers.”



The Math Works – Show Me The Numbers!

					Daily Mass Rate Calculation				Method 21 Monitoring			Optical Imaging Monitoring		
	ppm	kg/hr	lb/hr	lb/day	Assumed % Leakers	196,979	Total Emis (lbs/day)	% of Total	Leak Duration (days)	Total Emis (lbs/yr)	% of Total	Leak Duration (days)	Total Emis (lbs/yr)	% of Total
Connector	0	7.50E-06	1.65E-05	0.00	0.92	181,221	72	2.8%	365	26,248	5.6%	365	26,248	12.4%
	500	1.45E-04	3.21E-04	0.01	0.01	1,970	15	0.6%	365	5,533	1.2%	365	5,533	2.6%
	1,000	2.42E-04	5.34E-04	0.01	0.01	1,970	25	1.0%	180	4,542	1.0%	365	9,209	4.4%
	5,000	7.90E-04	1.74E-03	0.04	0.01	1,970	82	3.2%	180	14,824	3.1%	365	30,059	14.2%
	10,000	1.32E-03	2.90E-03	0.07	0.01	1,970	137	5.4%	180	24,672	5.2%	60	8,224	3.9%
	25,000	2.58E-03	5.69E-03	0.14	0.01	1,970	269	10.6%	180	48,383	10.2%	60	16,128	7.6%
	50,000	4.29E-03	9.46E-03	0.23	0.01	1,970	447	17.6%	180	80,529	17.0%	60	26,843	12.7%
	100,000	7.14E-03	1.58E-02	0.38	0.02	3,940	1489	58.7%	180	268,065	56.7%	60	89,355	42.2%
					1.00		**2537**	**100.0%**		**472,797**	**100.0%**		**211,600**	**100.0%**
					Assumed % Leakers	**1,388**	Total Emis (lbs/day)	% of Total	Leak Duration (days)	Total Emis (lbs/yr)	% of Total	Leak Duration (days)	Total Emis (lbs/yr)	% of Total
	ppm	kg/hr	lb/hr	lb/day										
Pump	0	2.40E-05	5.29E-05	1.27E-03	0.92	1,277	2	1.1%	365	592	9.6%	365	592	7.1%
	500	2.14E-03	4.71E-03	1.13E-01	0.01	14	2	1.1%	365	572	9.2%	365	572	6.9%
	1,000	3.26E-03	7.18E-03	1.72E-01	0.01	14	2	1.7%	365	874	14.1%	365	874	10.5%
	5,000	8.70E-03	1.92E-02	4.60E-01	0.01	14	6	4.4%	30	192	3.1%	365	2,332	28.0%
	10,000	1.33E-02	2.93E-02	7.02E-01	0.01	14	10	6.8%	30	292	4.7%	30	292	3.5%
	25,000	2.32E-02	5.12E-02	1.23E+00	0.01	14	17	11.8%	30	511	8.3%	30	511	6.1%
	50,000	3.54E-02	7.81E-02	1.87E+00	0.01	14	26	18.0%	30	781	12.6%	30	781	9.4%
	100,000	5.41E-02	1.19E-01	2.86E+00	0.02	28	79	55.1%	30	2,383	38.5%	30	2,383	28.6%
					1.00		**144**	**100.0%**		**6,197**	**100.0%**		**8,337**	**100.0%**
					Assumed % Leakers	**234,056**	Total Emis (lbs/day)	% of Total	Leak Duration (days)	Total Emis (lbs/yr)	% of Total	Leak Duration (days)	Total Emis (lbs/yr)	% of Total
	ppm	kg/hr	lb/hr	lb/day										
Valve	0	7.80E-06	1.72E-05	4.13E-04	0.92	215,332	89	1.8%	365	32,437	12.2%	365	32,437	12.4%
	500	2.35E-04	5.18E-04	1.24E-02	0.01	2,341	29	0.6%	365	10,630	4.0%	365	10,630	4.0%
	1,000	3.94E-04	8.69E-04	2.09E-02	0.01	2,341	49	1.0%	45	2,198	0.8%	365	17,827	6.8%
	5,000	1.31E-03	2.89E-03	6.93E-02	0.01	2,341	162	3.2%	45	7,302	2.7%	365	59,227	22.6%
	10,000	2.20E-03	4.84E-03	1.16E-01	0.01	2,341	272	5.4%	45	12,246	4.6%	30	8,164	3.1%
	25,000	4.35E-03	9.60E-03	2.30E-01	0.01	2,341	539	10.6%	45	24,259	9.1%	30	16,173	6.2%
	50,000	7.30E-03	1.61E-02	3.86E-01	0.01	2,341	904	17.8%	45	40,686	15.3%	30	27,124	10.3%
	100,000	1.22E-02	2.70E-02	6.48E-01	0.02	4,681	3033	59.7%	45	136,470	51.3%	30	90,980	34.7%
					1.00		**5077**	**100.0%**		**266,227**	**100.0%**		**262,562**	**100.0%**
									0	59,277	8.0%	0	59,277	12.3%
									500	16,735	2.2%	500	16,735	3.5%
									1,000	7,613	1.0%	1,000	27,910	5.8%
									5,000	22,317	3.0%	5,000	91,618	19.0%
									10,000	37,211	5.0%	10,000	16,681	3.5%
									25,000	73,154	9.8%	25,000	32,812	6.8%
									50,000	121,995	16.4%	50,000	54,747	11.3%
									100,000	406,919	54.6%	100,000	182,718	37.9%
									Total Emissions	**745,221**	**100.0%**		**482,498**	**100.0%**

35.25% **Reduction!**

ExxonMobil

Reality Check – Using Actual Emissions and Repair Data

Use actual unit performance but adjust for new paradigm

- Assumptions for the calculations:
  1. Repair only components which leak > 10,000 ppm
  2. Emission duration (under new paradigm) is 60 days
- Actual emissions of leaking components = 66,571 lbs/yr
- Estimated emissions (under new paradigm) = 37,920 lbs/yr
- Emissions are reduced by 28,651 lbs/yr

Why Not Just Increase Monitoring Interval?

Unsustainable process for more large facilities

- Requires an “army” of technicians simply to do the initial monitoring
- Huge investment in instrumentation and equipment
- Investment better served in repairs and maintenance activities.

	Sample Population	# of Man-Days Needed (350/d)	# of Techs Needed (25 d/mon)
Connector	196,979	563	23
Agitator	252	1	<1
Compressor	124	4	<1
Pump	1,388	40	2
Valve	234,056	669	27
Totals	**432,799**	**1275**	**51**

Simple Analogy of Optical Imaging and Method 21

- Traditional LDAR is like trying to catch speeding cars before radar guns were invented.
- The police car had to chase each car to tell exactly how fast it was going. Trooper can only look at one car at a time. Other speeders get away undetected!
- Optical imaging is like have a radar gun to catch speeding cars.
- Trooper can look at many cars at a time without have to risk a high speed chase or leave his location.

Current Uses Today

Agency Use

- EPA and state agencies receptive to and no longer resistant to optical imaging technology.
- Agencies utilizing cameras during inspections and incident response.
- Unfortunately, traditional LDAR program requirements remain in place.

Industry Use

- Incorporated into fixed equipment inspections (ie., piping, tanks)
- Leak and odor response/investigations
- Regular unit monitoring surveys

Questions?

Thank you