Gas Leak Detection and Visualization

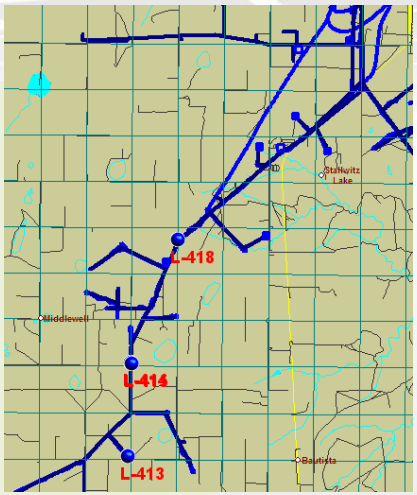
www.dmda.biz

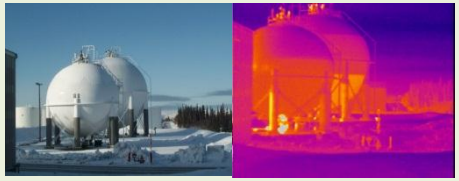
Why Stop Leaks of Fugitive Emissions?

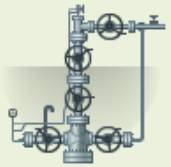
- Loss of Revenue
- Safety
- Environmental

Our - Services

Gas Gathering System






Gas Well (Deep Gas)

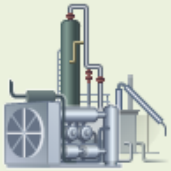

Gas Well (Shallow Gas)

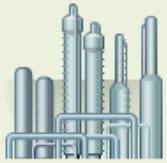
Gas

Gas

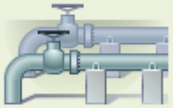
LPG

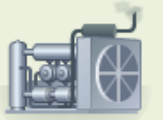

Wellsite Facilities


Gas Battery

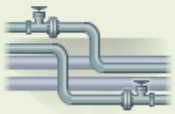

Straddle Plants


Hydrate Control


Gas Transmission


Compression


Gas Processing


Gas Distribution

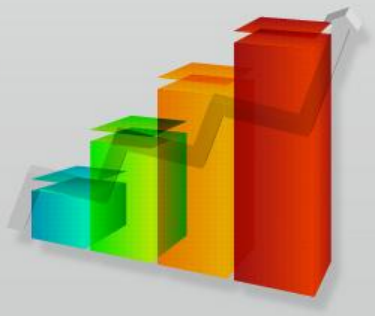
Gas

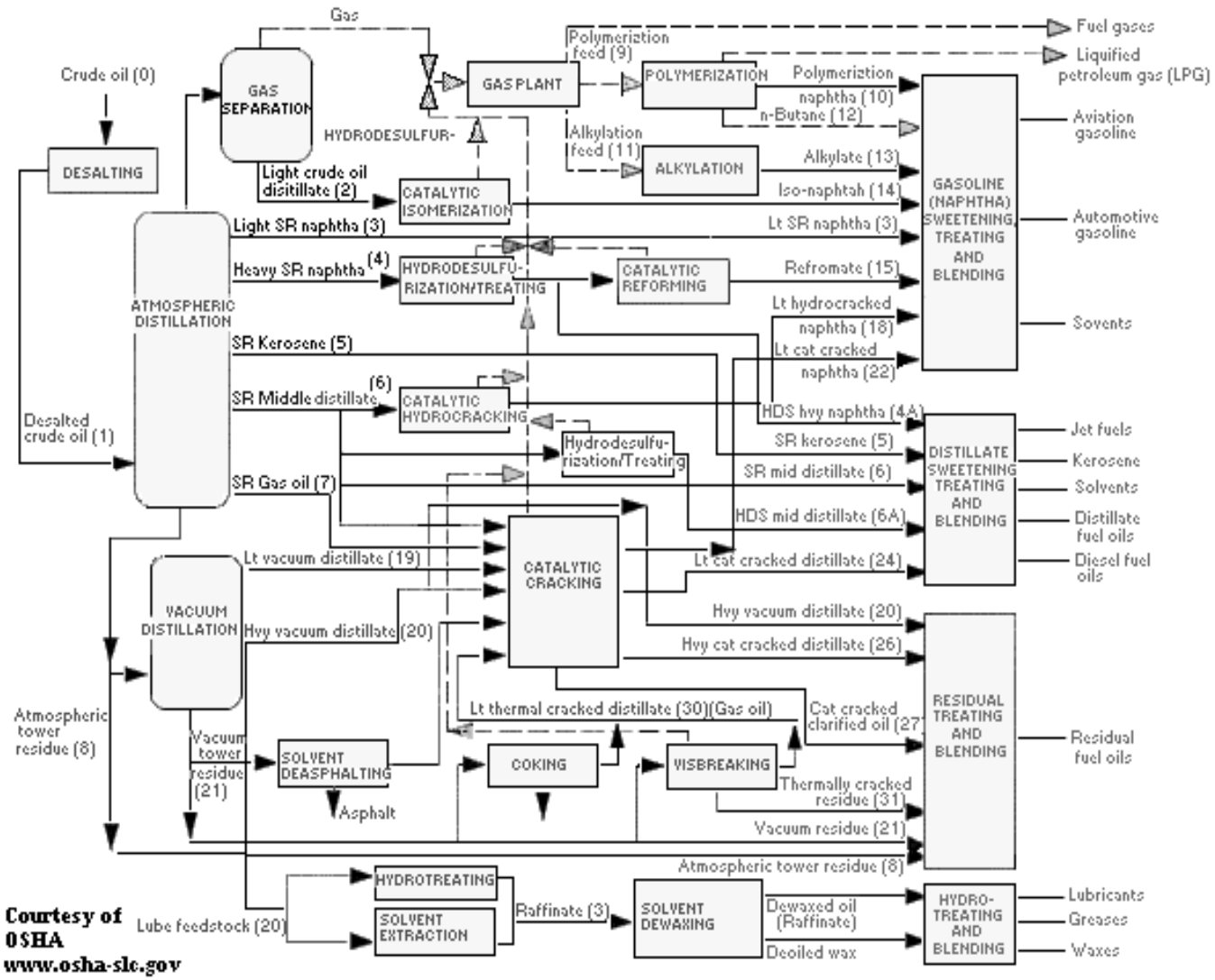

Market

LPG
NGL

Typical Large Refinery

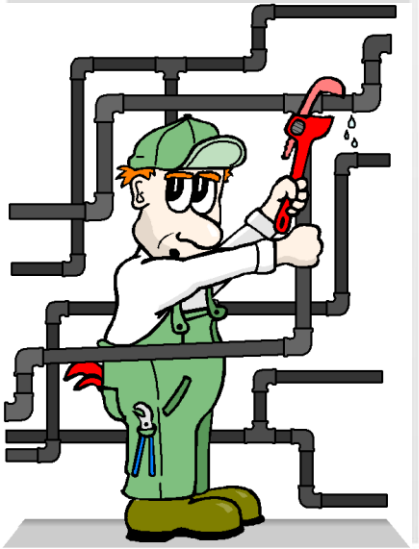
- 130,000 valves
- 325,000 connectors
- 1,000 pump seals
- 100 compressor seals





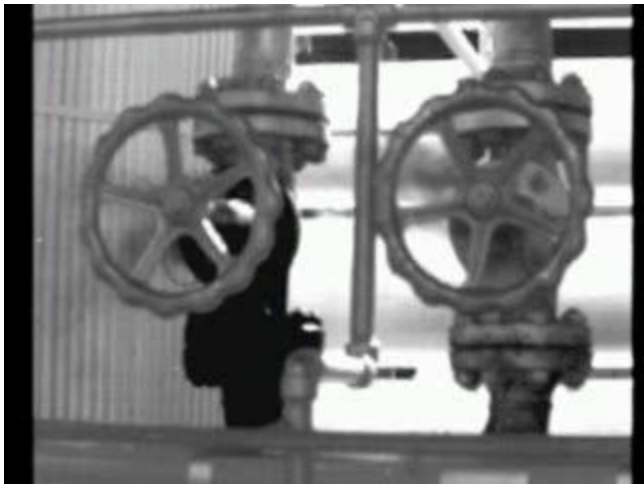
Why worry about small leaks ?

- On average natural gas processing plants lose between 0.05 to 0.5% of their total production to fugitive emissions
- Up to 95% of these emissions can be prevented by identification and repair



A picture is worth more than a thousand words…

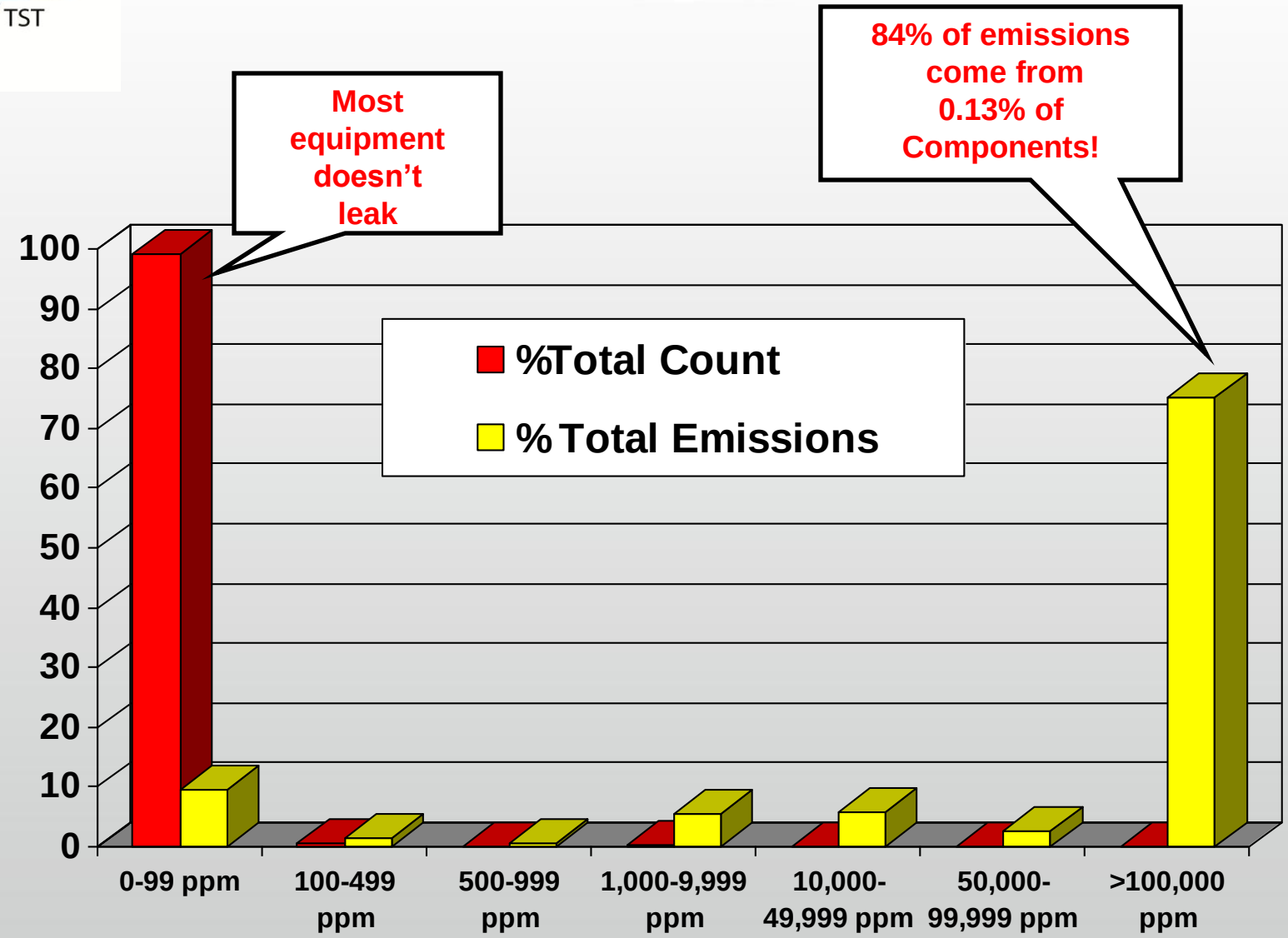
Watch Video



Why worry about small leaks ?

- Based on facility production, fugitive gas loses may amount to between $2,000,000 and $20,000,000 USD per year
- This provides a significant opportunity to increase production through fugitive emission reduction
- Majority of fugitive emissions arise from a minority of leaking components

Current Screening Data

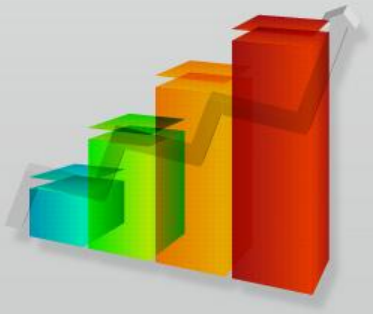


Taback et al., 1997, API Publ 310, "Analysis of Refinery Screening Data"

Our - Platforms

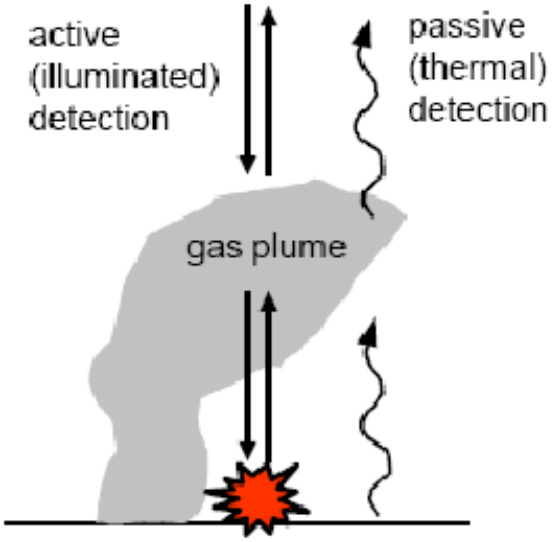
Advantages of Aerial Platforms

- Rapid Measurement Capabilities
- 50 – 200 Feet above the ground
- 30 – 50 mph
- 200 mph
- Capable of measuring complex configuration of GGS pipelines including the lateral lines
- Detection of leaks in areas that are difficult to access for ground based methods

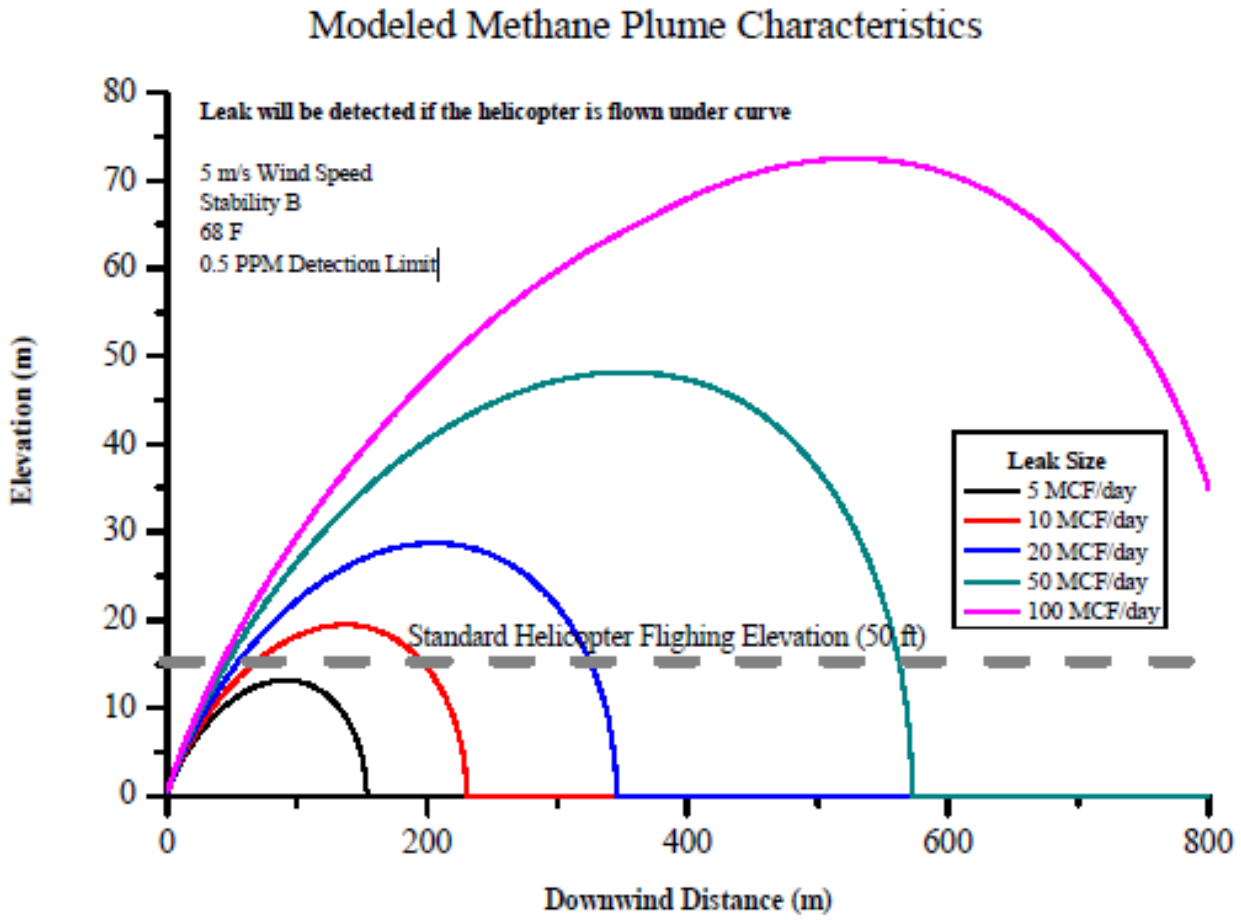


Leak Detection Technologies for Aerial Platforms

- Lasers
- Thermal Imaging Systems
- Gas Sampling



Aerial Platforms



The - Methodology

Current LADAR Metology
(Leak Detection & Repair)

Detection of gas with “Sniffer”

- Current Practice requires every piping component to be monitored individually
- Sniffer’s may “miss the mark.”
  - In certain situations, the “sniffer” could pick up a concentration of gas, but not know the source.

Organic Vapor Analyzer

Watch Video

LADAR & Smart LDAR

- Current LDAR Program
  - Labor intensive to monitor every component individually
  - Almost all the effort appears to be wasted since ~ 98% of components don't leak
  - Current program is costly

- Develop more cost effective fugitive emissions Leak Detection and Repair (Smart LDAR)

Smart LADAR

- Cost effective fugitive emission reduction programs should focus on the very high leakers
  - Less than 1% of the component count are the major contributor to VOC emissions
  - Find the big leaks first!

Smart LADAR

- Allow greater efficiency in monitoring large numbers of components
  - Locating very high leaks quicker
  - Quicker repair will result in lower overall emissions

Gases Detected and Minimum Detected leak rate (MDLR)

Compound	Minimum Detected leak rate (MDLR)
Methane	0.8g/hr
Ethane	0.6g/hr
Propane	0.4g/hr
Butane	0.4g/hr
Pentane	3.0g/hr
Hexane	1.7g/hr
Heptane	1.8g/hr
Octane	1.2g/hr
Ethylene	4.4g/hr
Propylene	2.9g/hr

Detectable Gases

Compound - Composto	Compound - Composto
Isoprene	Methane
1-Pentene	Ethane
Benzene	Propane
Toluene	Butane
Xylene	Pentane
Ethyl-Benzene	Hexane
Methanol	Heptane
Ethanol	Octane
Methyl Ethyl Ketone (MEK)	Ethylene
MIBK	Propylene

Gases Detected and Minimum Detected leak rate (MDLR)

Gases Detected and Minimum Detected leak rate (MDLR)

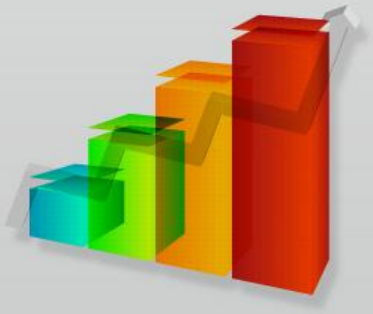
Independent laboratory (third party) testing confirms that the GasFindIR cameras can see the following gases at the minimum detected leak rate (MDLR):

- 1-Pentene - 5.6g/hr
- Benzene - 3.5g/hr
- Butane -0.4g/hr
- Ethane - 0.6g/hr
- Ethanol - 0.7g/hr
- Ethylbenzene - 1.5g/hr
- Ethylene - 4.4g/hr
- Heptane - 1.8g/hr
- Hexane - 1.7g/hr
- Isoprene - 8.1g/hr
- MEK - 3.5g/hr
- Methane - 0.8g/hr
- Methanol - 3.8g/hr
- MIBK - 2.1g/hr
- Octane - 1.2g/hr
- Pentane - 3.0g/hr
- Propane - 0.4g/hr
- Propylene - 2.9g/hr
- SF6 (Sulfur Hexaflouride) - 0.026g/hr
- Toluene - 3.8g/hr
- Xylene - 1.9g/hr

The GF-Series cameras also detect:

- Acetic Acid (C2H4O2)
- Anhydrous Ammonia (NH3)
- Carbon Monoxide (CO)
- Chlorine Dioxide (ClO2)
- Dichlorodifluoromethane "FREON-12" (CCl2F2)
- Ethyl Cyanoacrylate "Superglue" (C6H7NO2)
- Ethylene (C2H4)

AWP
Cost-Effectiveness Calculator



Alternative Work Practice (AWP)
for leak detection and repair using optical gas imaging

Background – Understanding LDAR Program Costs

- Comprised of
  - Monitoring costs
  - Repair costs
  - Documentation costs
- Final form of AWP reduces Repair Cost benefits
  - Annual Method 21 requirement to fix smaller leaks
- Can AWP still be cost-effective on monitoring/documentation-side?
  - What factors are important

Cost Calculator - Basics

- **Inputs**
  - site-specific LDAR requirements / prog. attributes
  - process information (% viewable chemicals)
- **Outputs**
  - current LDAR program monitoring / doc. costs
  - AWP-based program monitoring / doc. costs
- **Based on Sage experience**
  - 9-month AWP program implementation study
  - 50+ years combined LDAR arena work experience

Regulation

In the USA the Environmental Protection Agency requires companies to follow the 'Method 21' process for their LDAR (Leak Detection And Repair) programmes.
This method is less common outside the US but there is still a requirement to carry out leak detection surveys by a method that is acceptable to the regulator.

The use of the gas detection camera is permitted as an 'Alternate Work Practice' under Method 21and is becoming accepted as a suitable method in the EU.

LDAR Program Equipment Inventory and Inspection Frequency Requirements

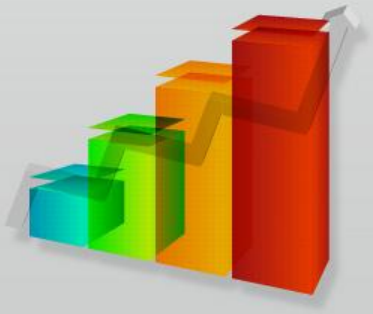
Frequency Multiplier:	12	4	2	1	0.5	0.25	0.125	0
Component Type	**Monthly**	**Quarterly**	**Semiannual**	**Annual**	**Bi-Annual**	**Quad-Ann.**	**Oct-Ann.**	**UTM**
Valves		80,000						--
Pumps	200							--
Connectors								--
Plugs								--
NDEs/Leakless				500				--
DTM Valves				500				--
DTM Connectors								--
UTM Valves								50
UTM Connectors								150

Component Count Details

Percent NDE components of total program	0.6%
Percent DTM valves/connectors of total program	0.6%
Percent UTM valves/connectors of total program	0.25%

CASE STUDY DATA

FACILITY TYPE	#	% OF FACILITY COUNT	% OF TOTAL EMISSIONS
COMPRESSOR STATIONS	265	60.6%	52.2%
MULTIWELL OIL BATTERY	91	20.8%	14.6%
GAS PLANTS	62	14.2%	30.9%
SINGLE WELL OIL BATTERY	12	2.7%	0.6%
WELLSITE	5	1.1%	0.4%
SAGD (Oil Sands)	2	0.5%	1.4%
TOTAL	**437**	**100%**	**100%**



CASE STUDY DATA

Natural Gas ($/mcf)	TYPE	TOTAL # OF SOURCES	ANNUAL GAS VALUE	CO2e CREDIT VALUE ($15/tonne)	EST. COST OF REPAIRS	NET PRESENT VALUE	ASSESSMENT TIME (days)
$5.00							
TOTAL	LEAKS	2330	$1,378,579	$636,267	$160,000	$2,598,091	157
	VENTS	2513	$4,984,093	$2,014,846	$8,160,000	$11,983,033	
	TOTAL	4843	$6,362,672	$2,651,113	$8,320,000	$14,581,124	
AVERAGE / FACILITY	LEAKS	5	$3,155	$1,456	$366	$5,945	0.36
	VENTS	6	$11,405	$4,611	$18,673	$27,421	
	TOTAL	11	$14,560	$6,067	$19,039	$33,366	
AVERAGE / DAY	LEAKS	15	$8,781	$4,053	$1,019	$16,548	1
	VENTS	16	$31,746	$12,833	$51,975	$76,325	
	TOTAL	31	$40,527	$16,886	$52,994	$92,873	

Videos

The following videos are examples

Outdoor – LPG Compressor

Industry: Petro Refinery
Application:

- Verify flange seals do not leak.

Outdoor – Storage Tanks

- **Industry: Storage & Transport**
- Applications:
  - See Gas Leaks
  - Check tank levels for product
  - Confirm sludge levels

Outdoor - Aerial

Industry: Pipeline

Applications:

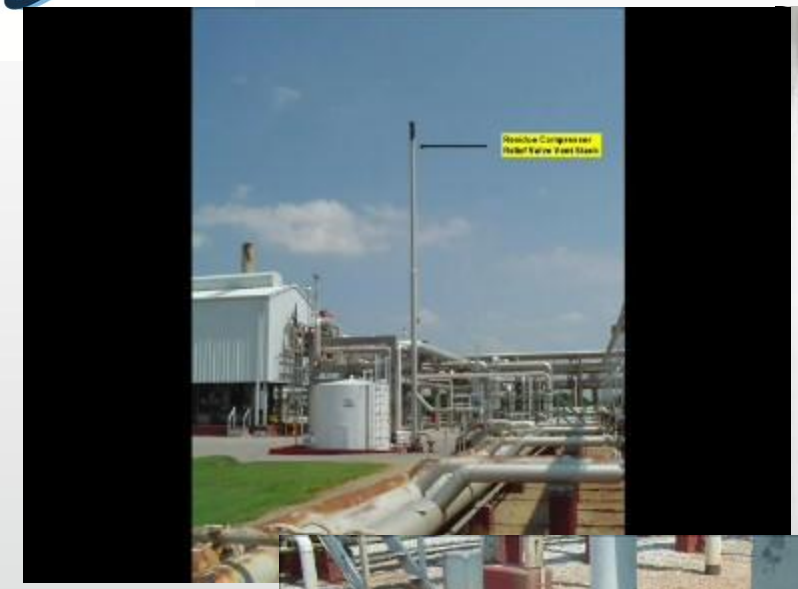
- Scan miles (km) of underground natural pipelines.

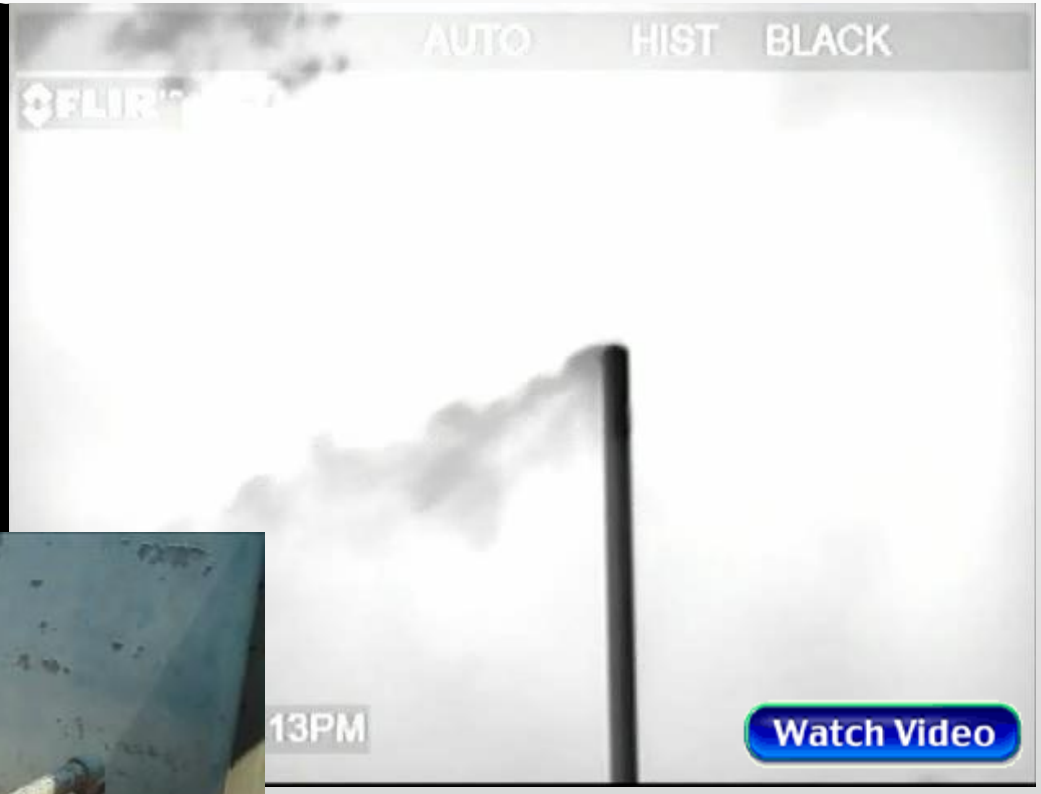
Helicopter is flying at 300m at 60 knots

Notice the “dead” vegetation surrounding the leak!

Let’s Fix the Leak!

Outdoor – Relief valve





~ $50.000 per year!


WIDE
MANUAL
WHITE
FLIR


HIST
BLACK
FLIR
8/24/05 1.49.17PM
DivX
VIDEO


FLIR
HI
MANUAL
WH
6/15/06 12.06.23PM


Unregistered
AUTO
HIST
WHITE
FLIR
9/ 8/05 2.30.09PM


FLIR ME AUTO HIST WH
2/12/08 1.48.48PM
LOW

Watch Video

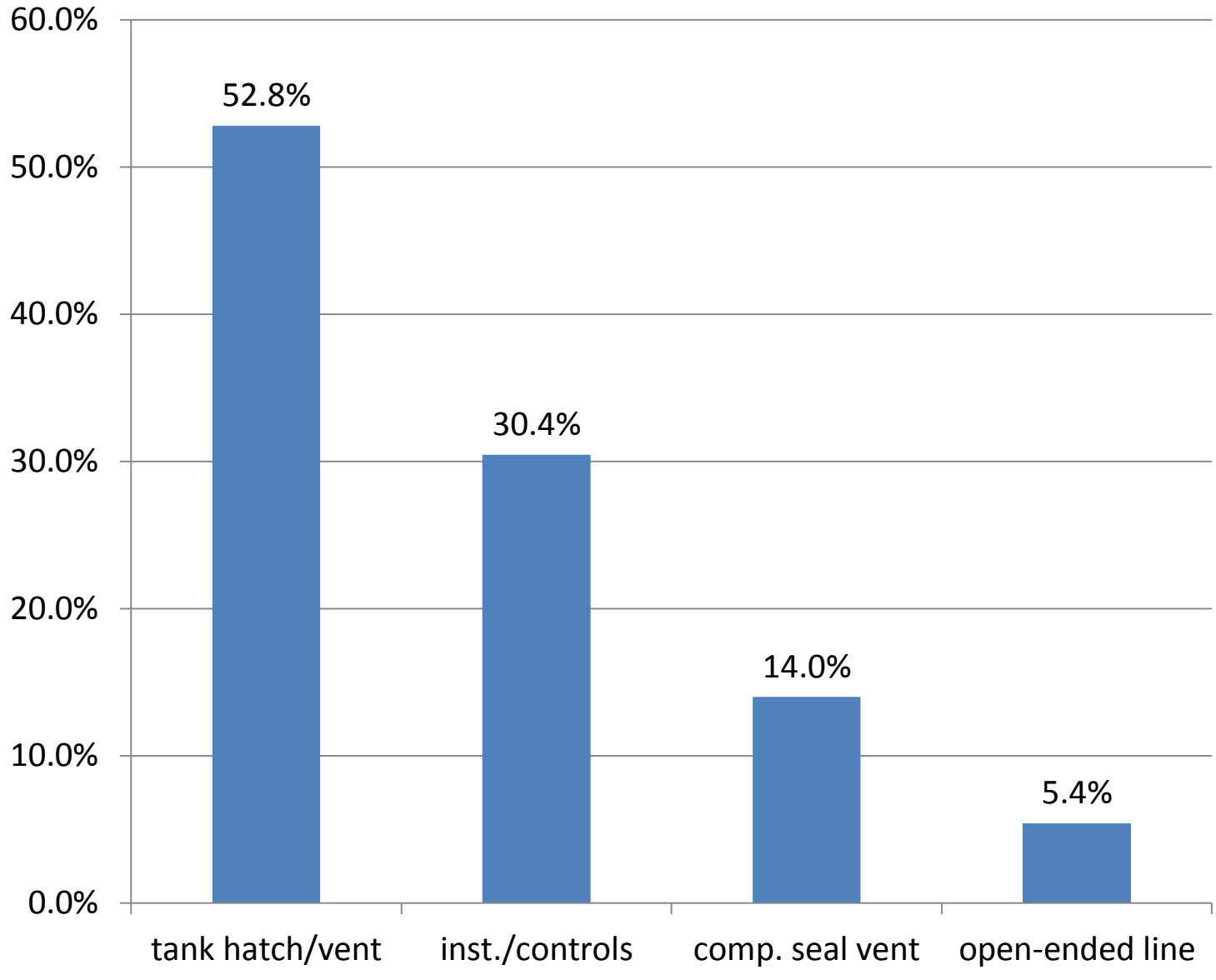

FLIR HI AUTO HIST BL
9/18/07 11.46.20AM

Watch Video

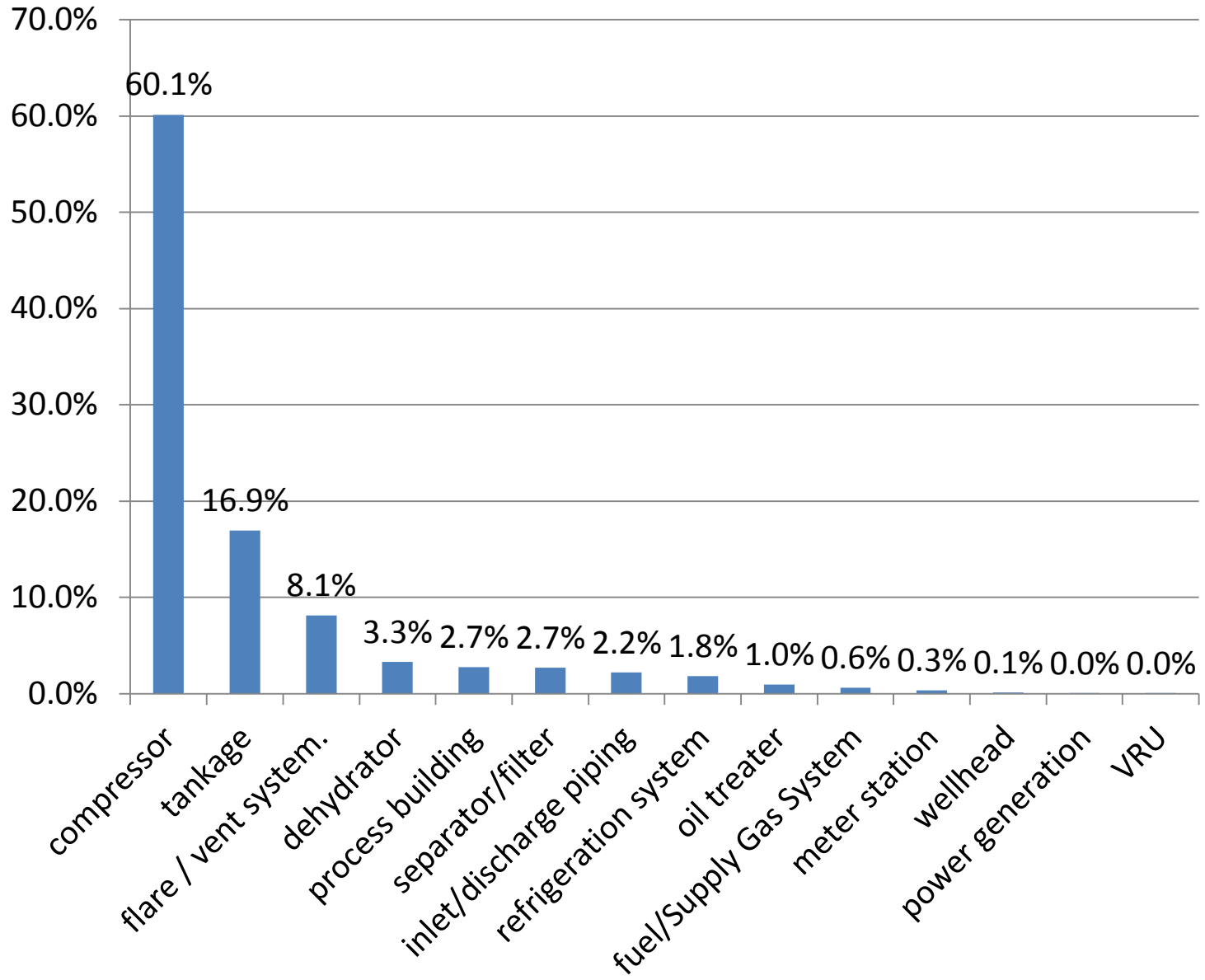
Approximately 26.6 Bcf/yr of Methane are lost from storage tanks

1 Bcf= 1 Billion Cubic Feet

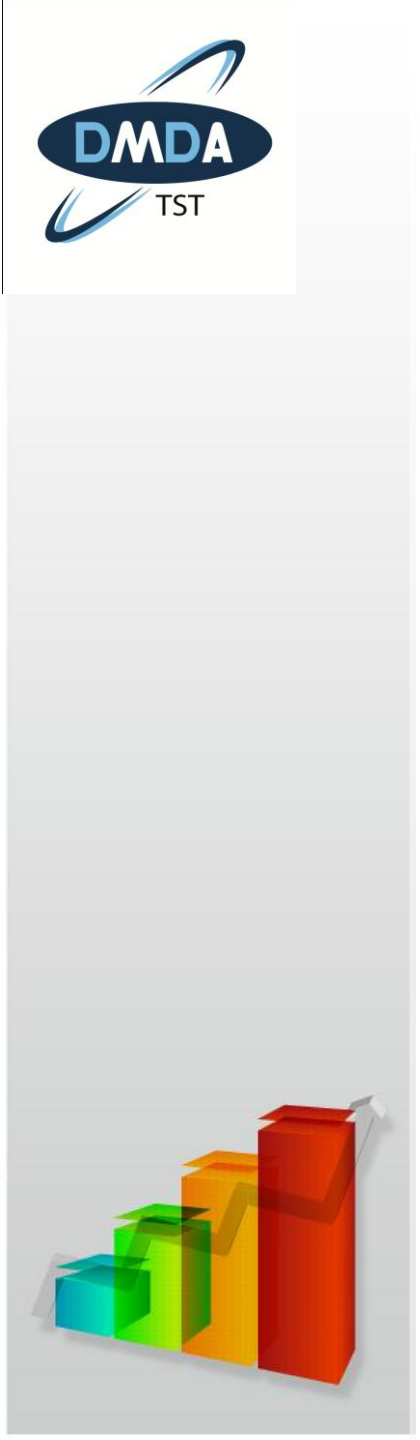
Vent Component %



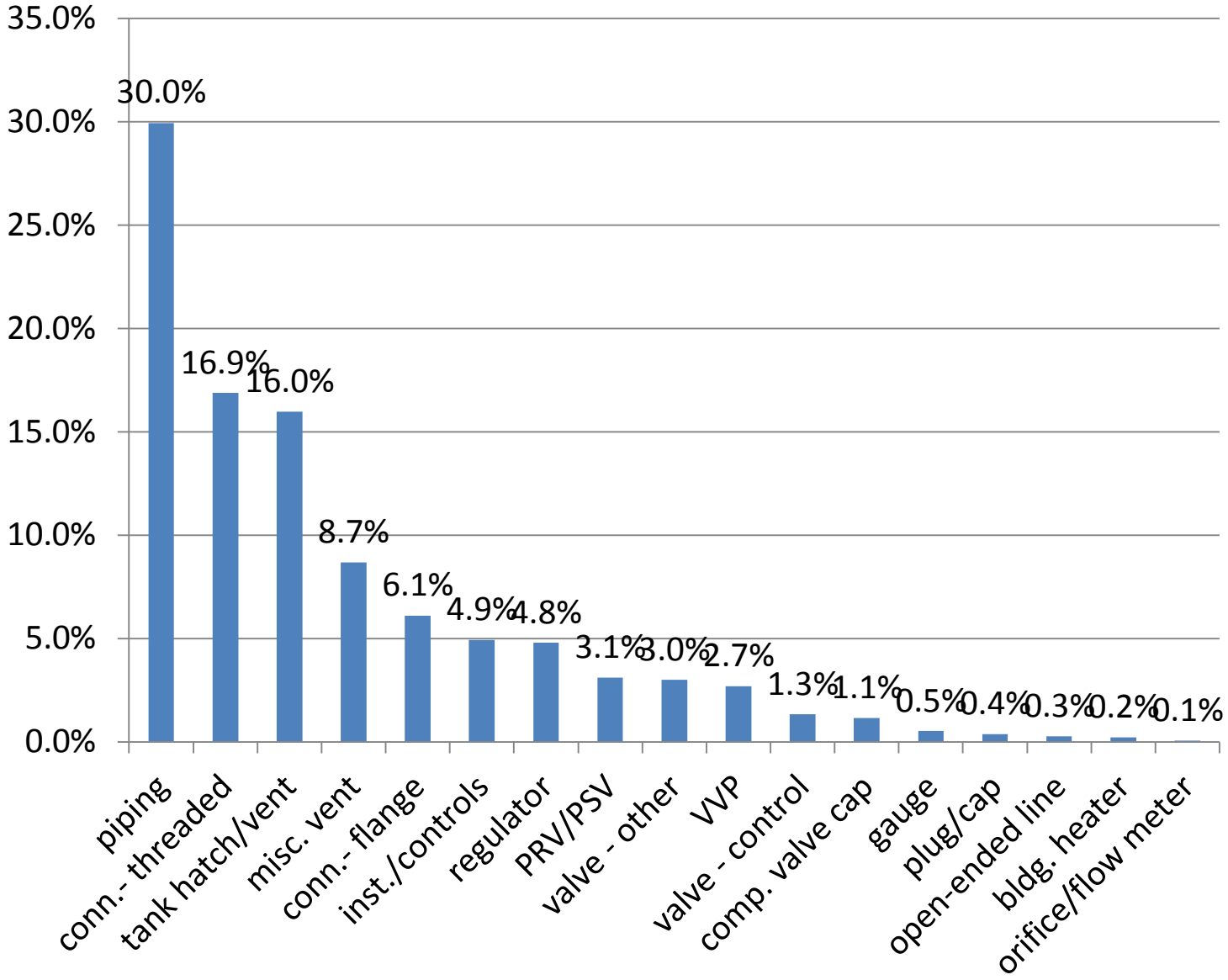
Leak Process Block %



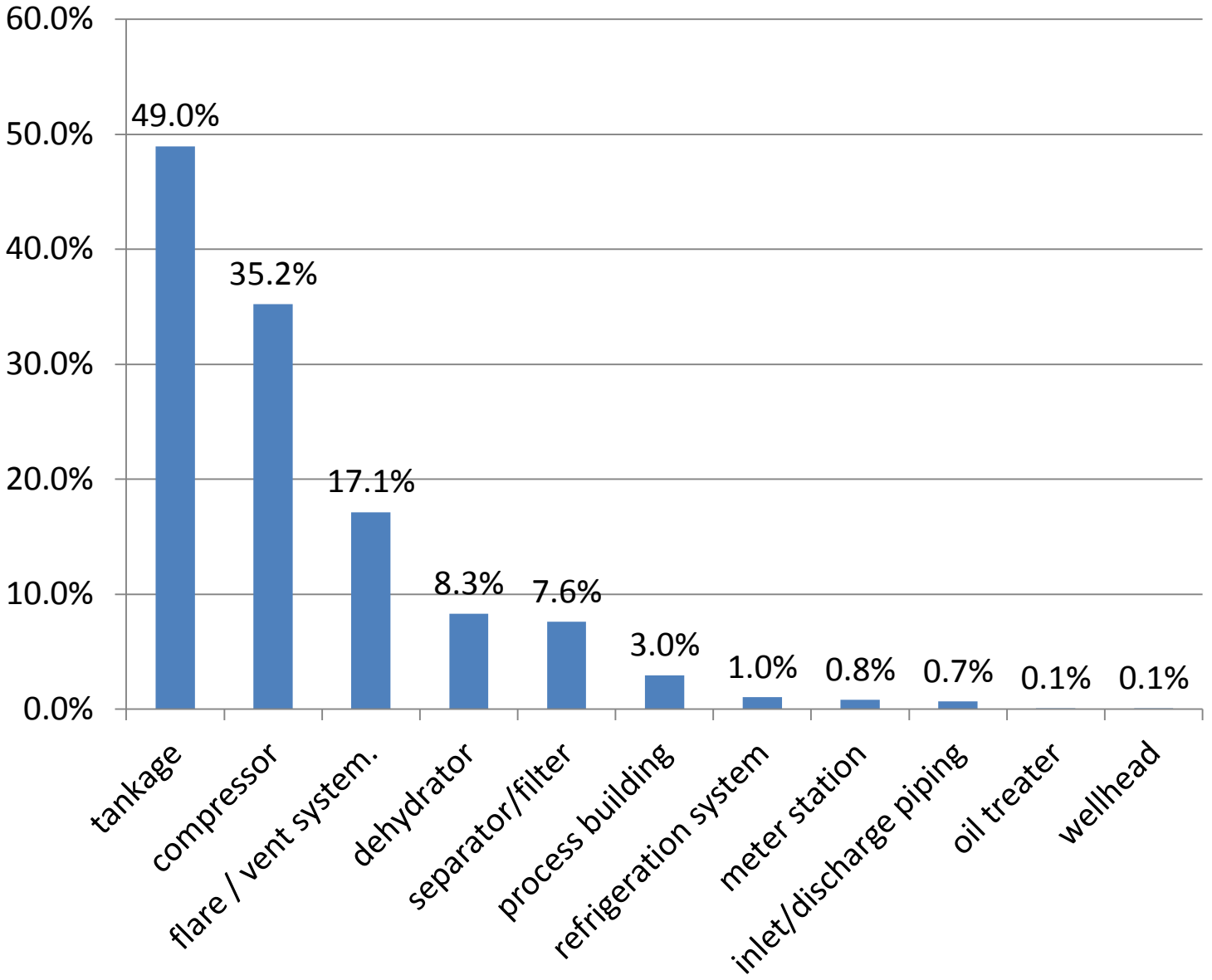
Leak Gas Stream %



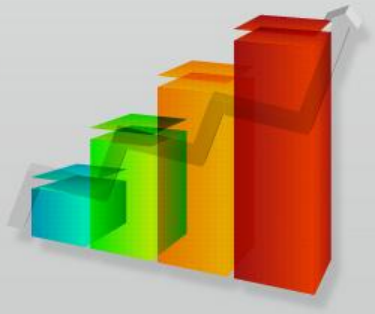
Leak Component %

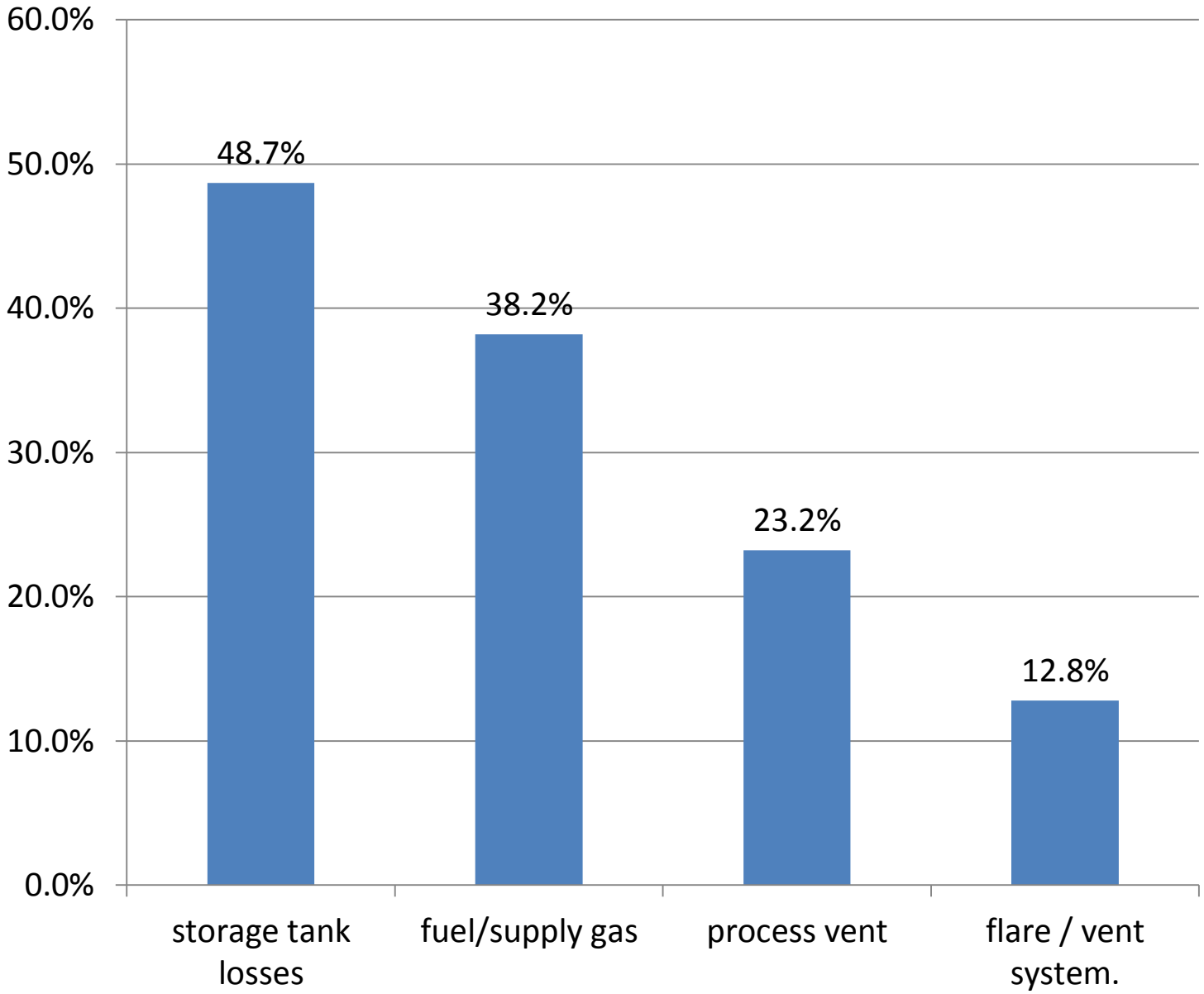


Vent Process Block %



Vent Gas Stream %





Environmental

- State of Delaware uses GasFindIR on the ocean!

Looking for Air Emissions Using New Infrared Imaging

The camera has innumerable applications that range from "looking" for VOC emissions from routine everyday activities such as refueling at gas stations to complex facilities such as the Delaware City petroleum refinery.

DNREC's Air Quality Management Section has begun monitoring fugitive volatile organic compounds (VOCs) emissions using a new **Gas FindIR camera.** This state-of-the-art infrared video camera uses energy, instead of visible light, to "see" VOCs. The camera has innumerable applications that range from "looking" for VOC emissions from routine everyday activities such as refueling at gas stations to complex facilities such as the Delaware City petroleum refinery.

In April 2006, DNREC staff observed a ship off-loading crude oil, a process called "lightering," from a tanker at the Big Stone Anchorage in the Delaware Bay, eight nautical miles north of Lewes. When crude oil is pumped into an empty vessel, VOC vapors are displaced and pushed out through the stacks called "mast risers" into the atmosphere. As soon as pumping began, the camera revealed the VOC vapors as black "smoke" (see photos below). The prevailing winds blew those emissions, invisible to the naked eye, west towards Delaware.

Recently, DNREC successfully negotiated an agreement and air pollution control permit with Maritrans Corporation. Maritrans has committed to a process of vapor recovery to prevent these VOC emissions and has invested more than a half billion dollars to replace their fleet of ships with state-of-the-art vessels containing built-in vapor recovery equipment and other safety features.

FLIR Systems' Gas FindIR camera.

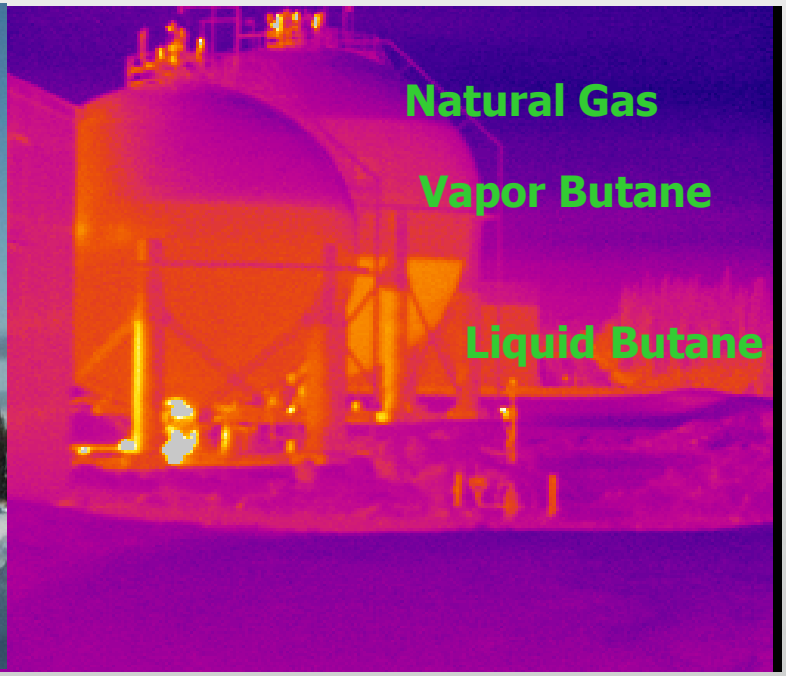
Manufactured by FLIR Systems, the Gas FindIR camera has been used on compliance inspections at several companies to help determine if VOCs leak from their equipment and whether the facility meets its regulatory obligations for leak detection and repair requirements. The new GAS FindIR-camera offers DNREC the ability to implement cutting-edge technologies in its aggressive efforts to achieve healthier air quality for Delawareans, and provide a level playing field for those companies that make investments in controlling emissions.

—Article by Bruce Steltzer/Jim Werner (DAWM)

Crude oil tankers performing lightering operations.

VOC emissions visible during lightering operations.

Tank Levels



Safety

- GasFindIR allows to scan a large area and check for potential gas leaks before entering.
- Personnel can work at safer distance from potential leaks.
- Climbing to reach for probing can in many cases be avoided.
- GasFindIR allows you to find the big leaks fast!


Thanks for yours attention