THE SNIFFERS

Realizing your Environmental and Sustainability Ambition

Pipeline Integrity

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28-10-2019

Site Surveys

- Pipeline Integrity
- Emission Reduction
- Energy Savings

Pipeline Integrity Services

Achievements and Results

650.000 km Pipelines inspected

20.000 yards supervised

100.000 km Gas Leak Surveys

12.500 Detected Leaks

46.000 Cathodic Protection Measurements

Pipeline Integrity

Broad range of Services

Pipeline Localization & Digitalization

Pipeline Leak Detection
Sat, Heli, Drone, Car, foot, dogs

Corrosion Coating & Cathodic Protection Surveys

Pipeline Inspection & 3th Party Interference

Pipeline Information Management Software PERSEUS

Innovation: Short Circuit Detection, IoT, Ai, Remote Sensing, Drones & Satellites

Training Competence Development

Pipeline Integrity Program Development

Pipeline Lifetime Extension Assessment

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Emission Reduction

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From Well to Market

- Wells – E&P
- Processing
- Transportation
- Storage
- Distribution

Emission Types

- Unintended or Fugitive Emissions
- Flaring and Venting
- Gas driven Equipment
- Safety Infrastructure
- Maintenance Activities

Emission Sources

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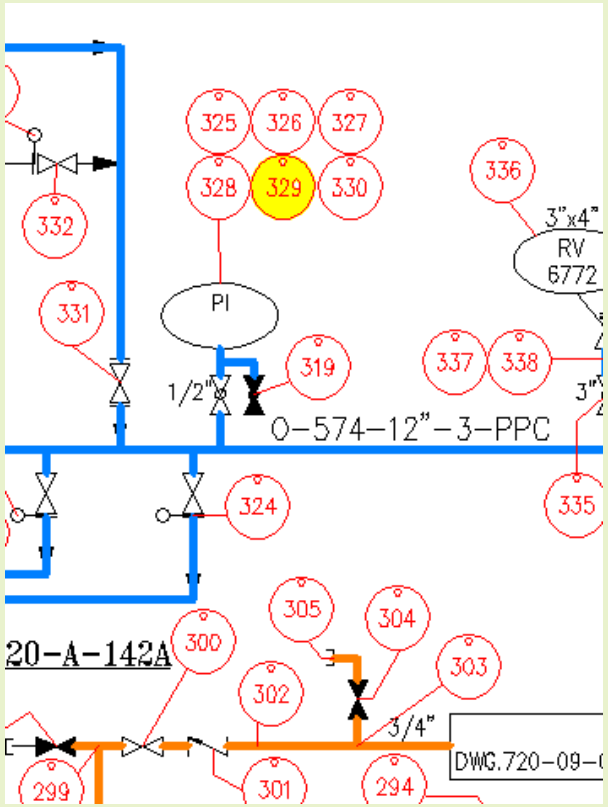
Emission management program

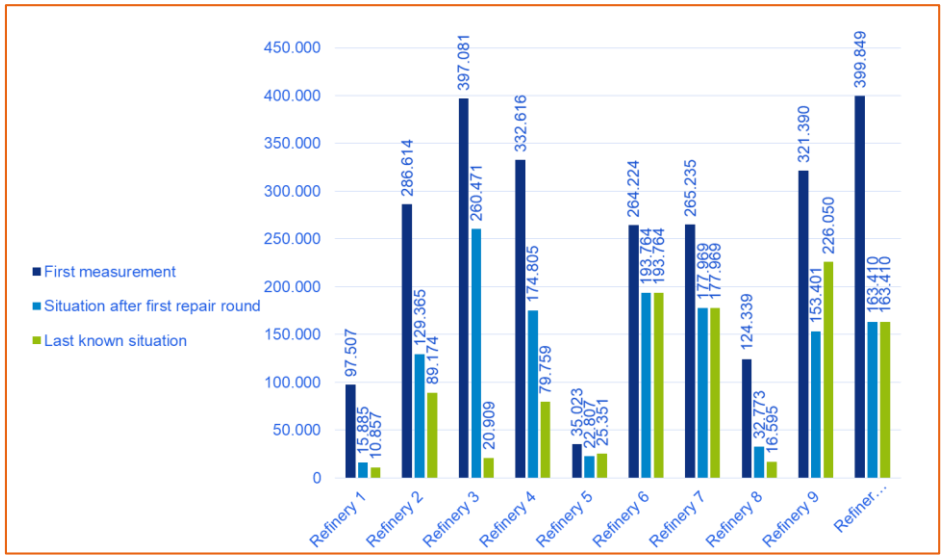
Inventory:
Detailed & high quality

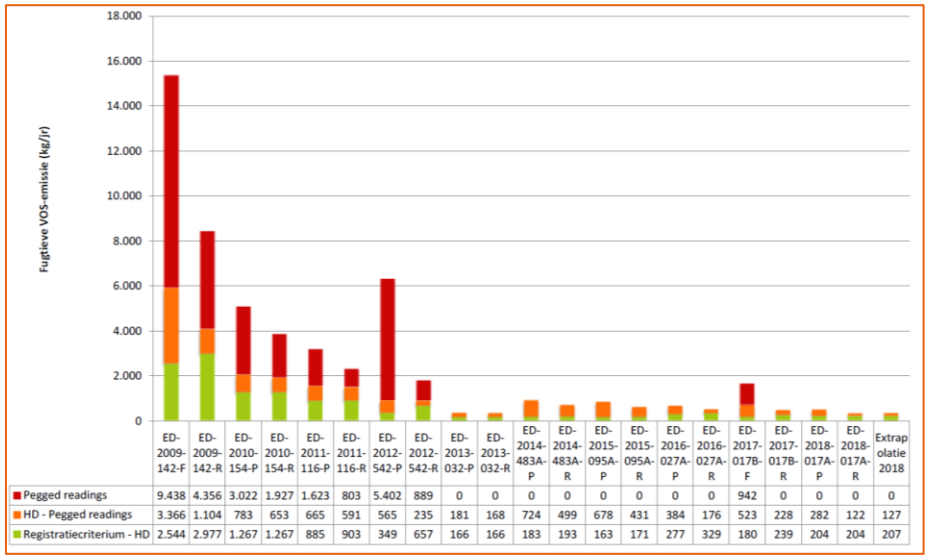


Measurements:
Technology agnostic

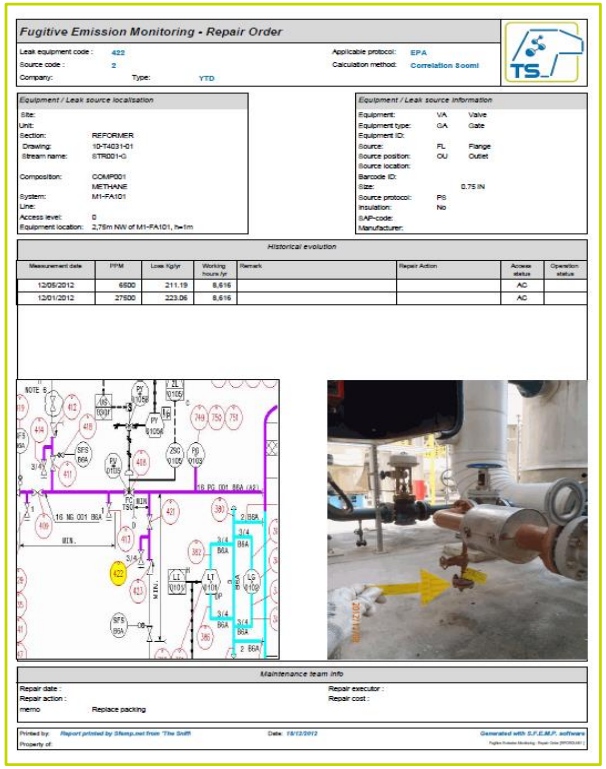
Emission reporting:
Overview, Drill-down, Benchmark

DIFFERENT RESULTS FOR DIFFERENT STAKEHOLDERS





	ED-2009-142-F	ED-2009-142-R	ED-2010-154-P	ED-2010-154-R	ED-2011-116-P	ED-2011-116-R	ED-2012-542-P	ED-2012-542-R	ED-2013-032-P	ED-2013-032-R	ED-2014-483A-P	ED-2014-483A-R	ED-2015-095A-P	ED-2015-095A-R	ED-2016-027A-P	ED-2016-027A-R	ED-2017-017B-F	ED-2017-017B-R	ED-2018-017A-P	ED-2018-017A-R	Extrapolatie 2018
Pegged readings	9.438	4.356	3.022	1.927	1.623	803	5.402	889	0	0	0	0	0	0	0	0	942	0	0	0	0
HD - Pegged readings	3.366	1.104	783	653	665	591	565	235	181	168	724	499	678	431	384	176	523	228	282	122	127
Registratiecriterium - HD	2.544	2.977	1.267	1.267	885	903	349	657	166	166	183	193	163	171	277	329	180	239	204	204	207



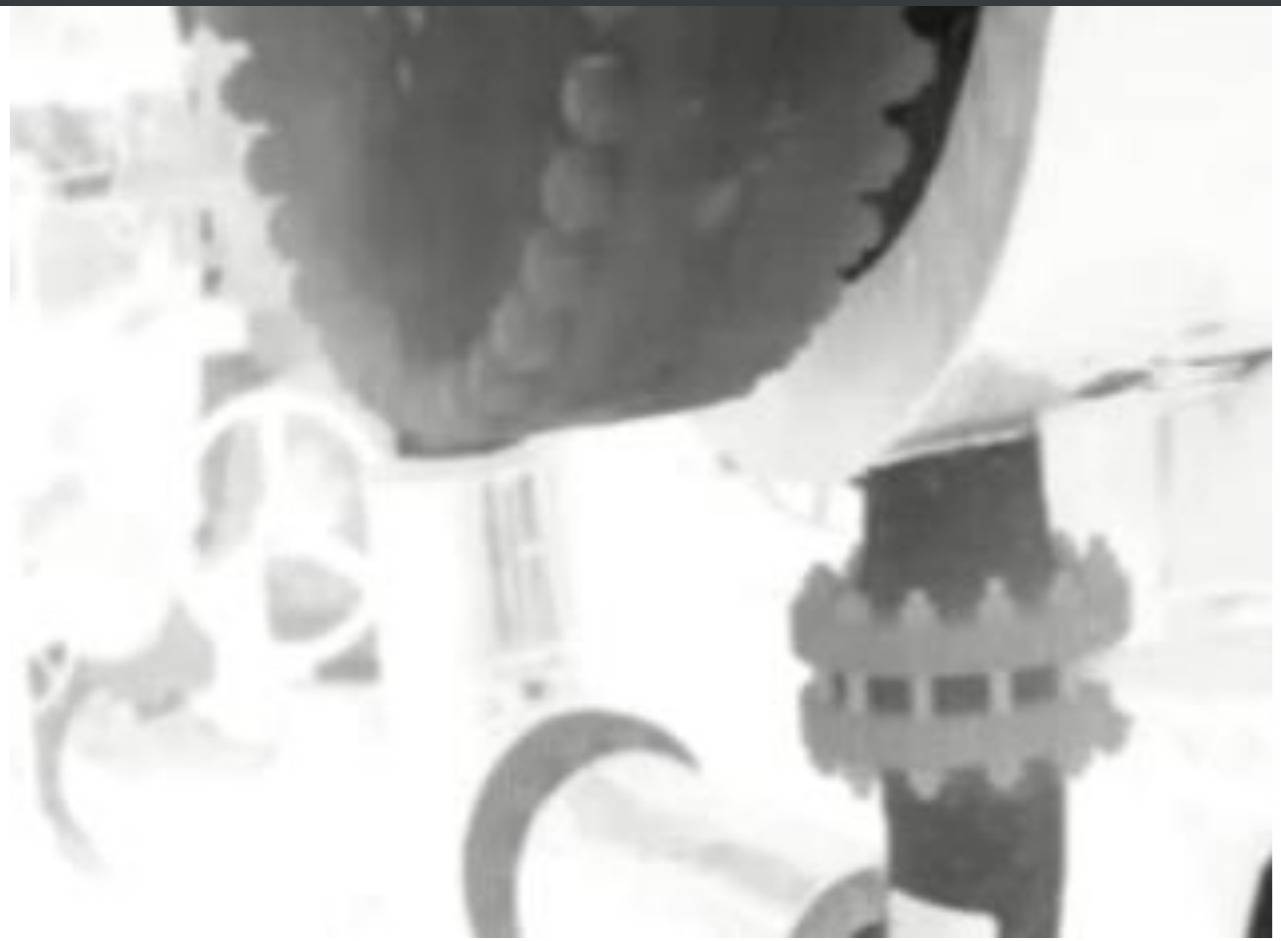
- **Maintenance:** Detailed leak traceability and repair information, SAP integration, update of database with new or changed components, bad actors.
- **HSE:** Leak follow up information and emission values, with higher focus on HAPS and risks, emissions per medium, compliance.
- **Management:** Success rate of LDAR program, emission reduction, benchmarking
- **Board:** Corporate social responsibility, positioning of the company
- **Authorities:** Compliance audits, legislation

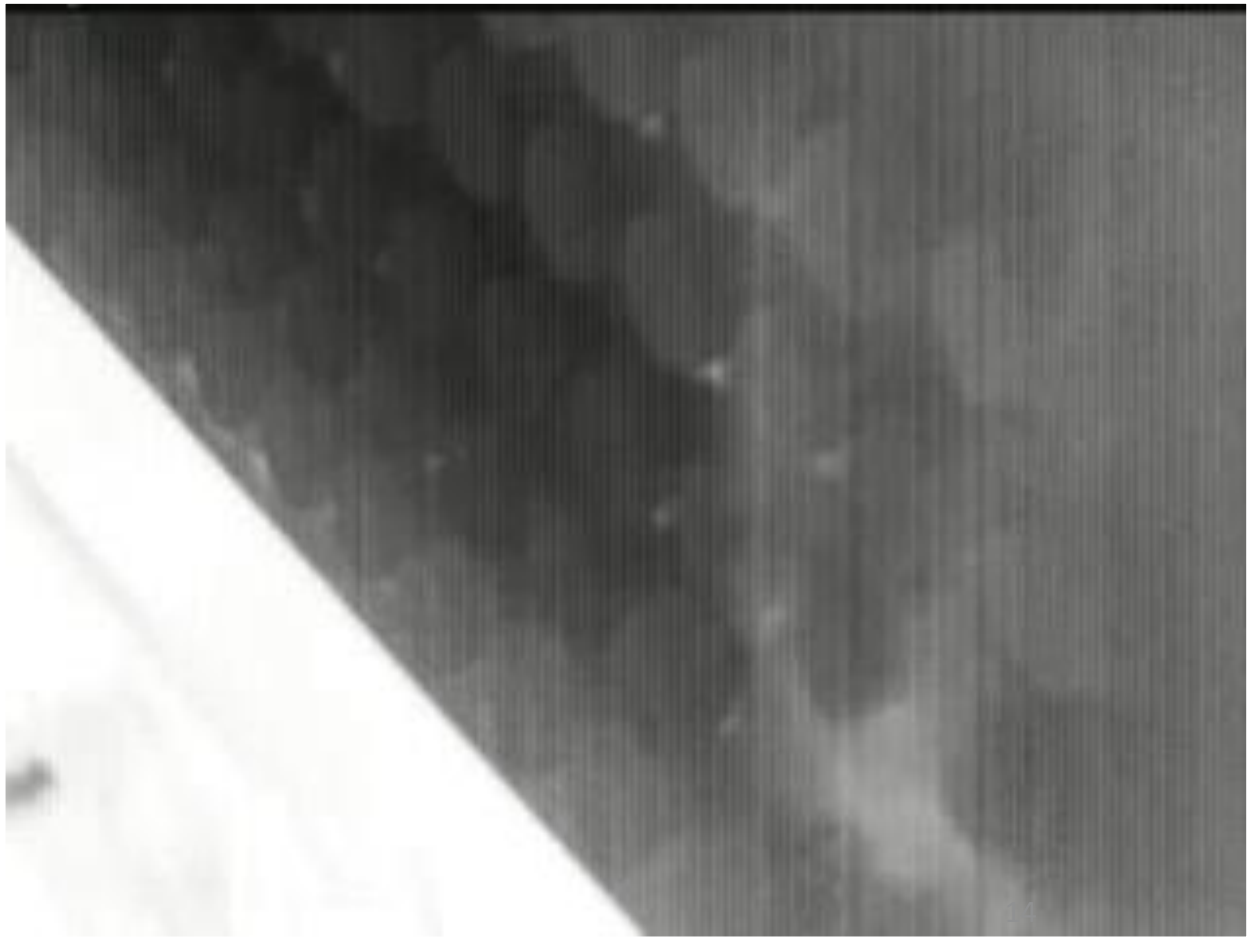
SOURCES BASED MEASUREMENTS

- Bagging / HFS:
  - 50-100 sources / day
  - Direct loss measurement (Kg/yr)
  - Most accurate field measurement
  - Development of new emission correlation factors (e.g. CH4)
- Sniffing (FID, PID, :
  - 700-800 sources / day
  - Concentration measurement, converted in to loss using correlation tables (EPA M21 SOCMI, PI)
- OGI (infrared camera):
  - 2000-5000 sources / day
  - Only qualitative, converted in to loss using average leak rate tables (API leak-no-leak), or combined with HFS / sniffing for quantification

EXAMPLE LEAKS DETECTED WITH OGI

EXAMPLE LEAKS DETECTED WITH OGI





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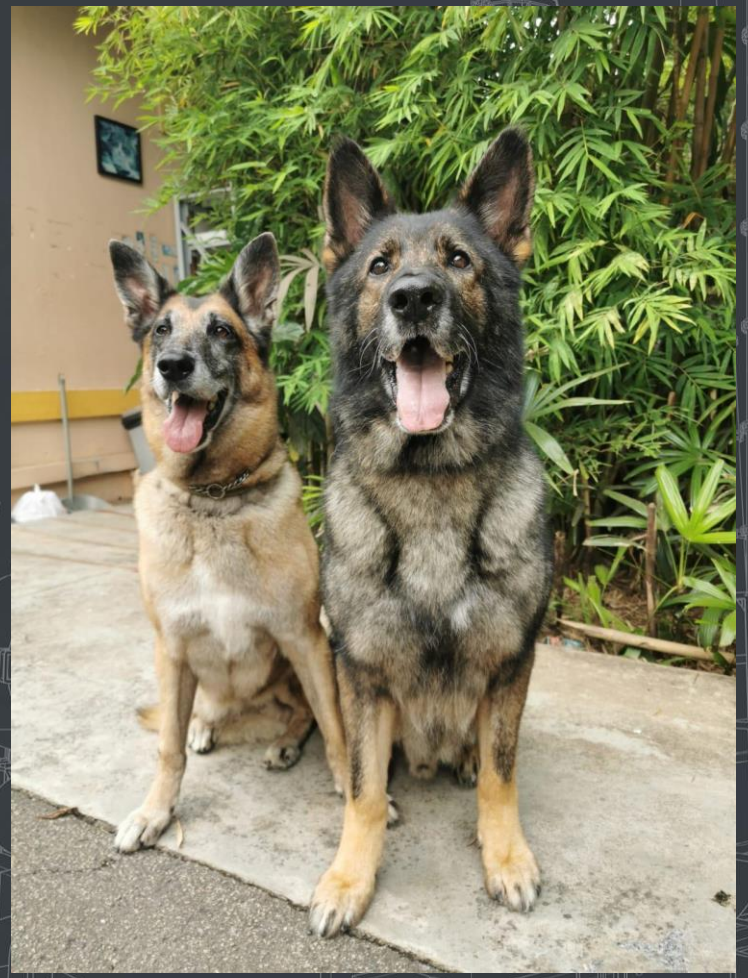
Leak detection with Sniffer dogs



LEAK DETECTION WITH CANINES

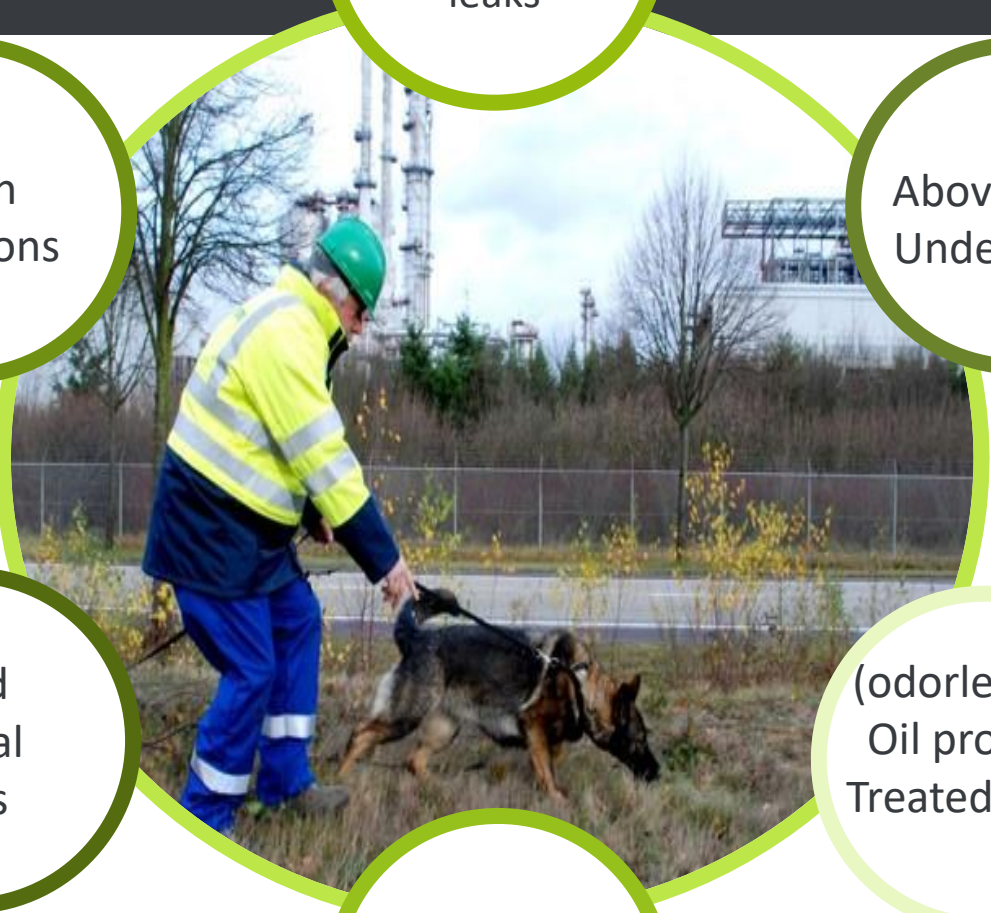
The ***highest probability*** of finding the smallest leaks and illegal taps.

HOW?

1. Unique interaction between dog and handler:
   - Giving and interpreting signals (Bidirectional)
   - Pipeline knowledge and experience

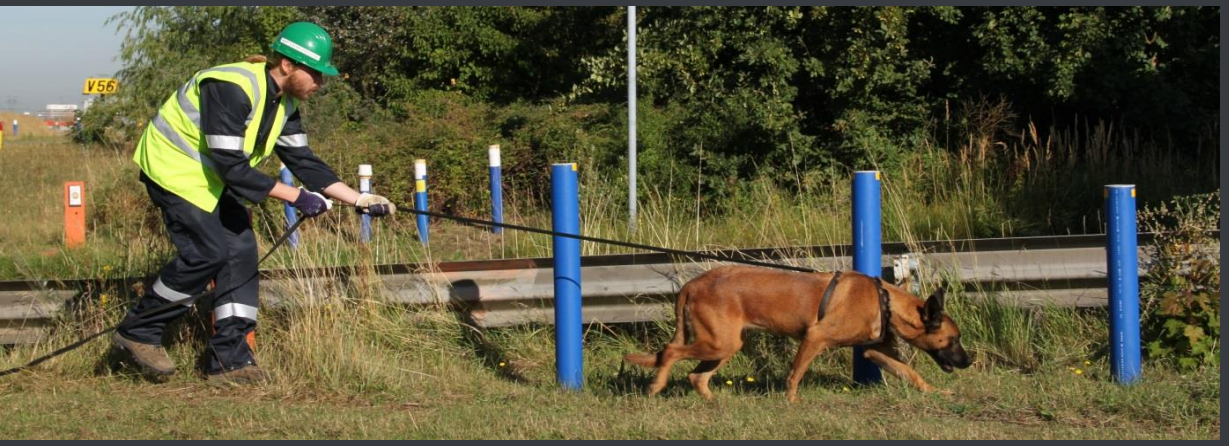
2. Effective training and working method:
   - Define the right walking path, in changing circumstances
   - Dog picks up molucules and goes to the source, which a normal measurement device cannot do.

3. Measurement tool with highest sensitivity in the world: the dogs' nose



UNDERGROUND PIPELINES

Pipeline integrity



Our area of expertise:

- Pipeline Leaks: Detect the smallest
- Third party Interference
- Illegal tapping
- Corrosion
- Soil Contamination
- Ground Water Pollution
- Oil, fuels, Methane, VOC's, H2S, chemical substances

Key success factors for finding illegal taps with dogs:

- Our dogs are *trained pipeline inspectors*!
- Our dog-handlers are also pipeline inspectors and technicians with knowledge of pipeline assets.
- Unique combination of the dog's sensitivity, experience, and relationship with dog handler

We are pipeliners

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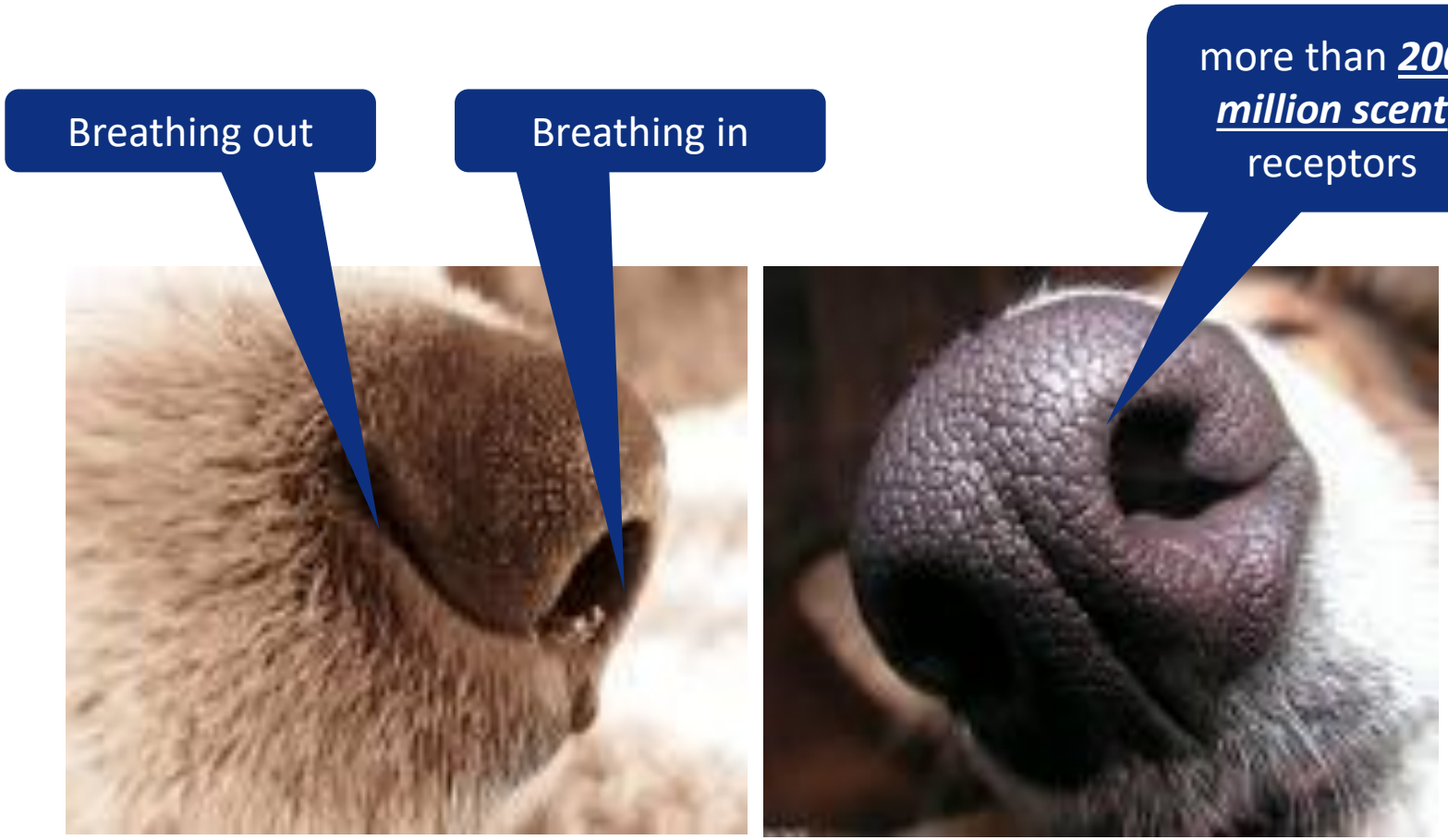
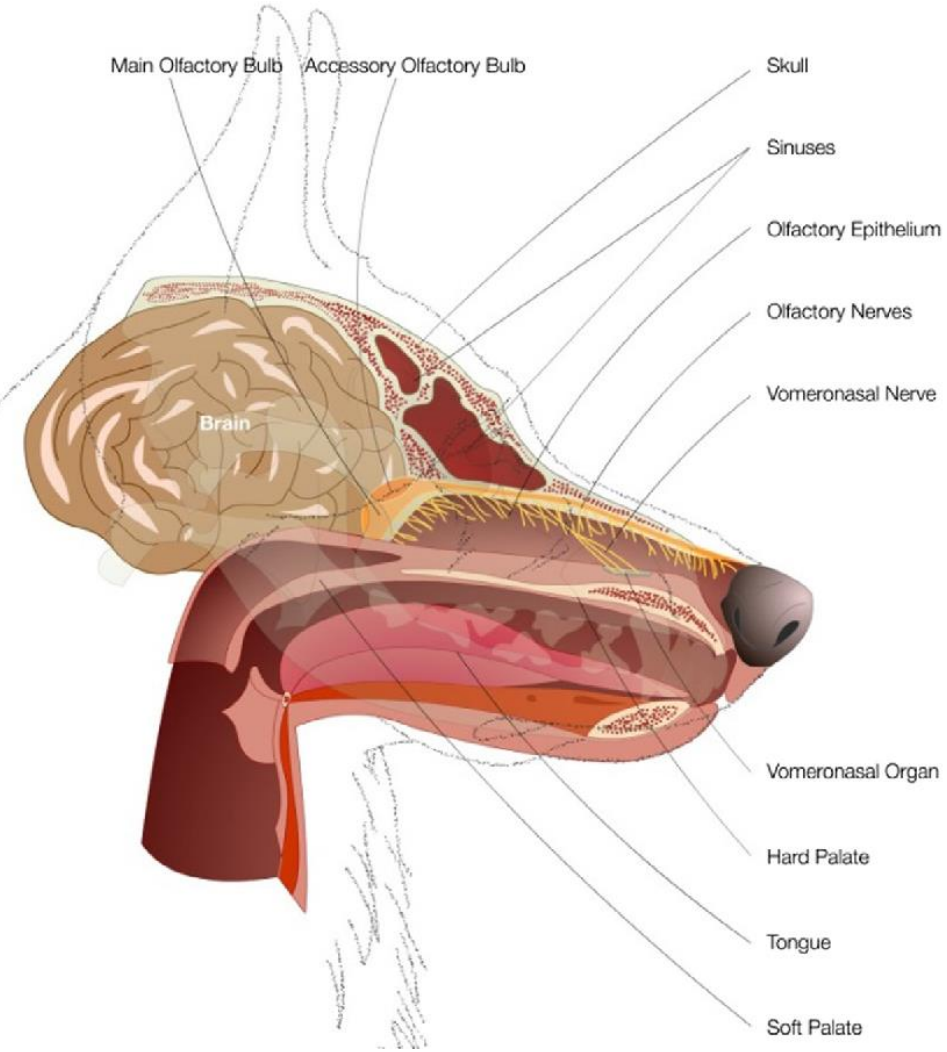
Continuously sampling air at the highest speed and sensitivity



A dog “sees” the world with his nose



- The canine olfactory system consists of soft tissue, bones, nerves, and parts of the brain. The soft tissue and bony structures make up the cavities into which odor particles flow. These cavities are lined with scent receptor cells which connect to olfactory nerves that connect with the olfactory lobe of the dog's brain.

- Dogs have large folds of mucous membranes inside their nose containing more than ***200 million scent*** receptors compared to smaller areas of mucous membranes containing about 4 million in humans. Their olfactory bulbs are also about 4 times larger than ours. Their noses are also uniquely designed to draw air samples through — ***They can smell a few parts per billion (PPB)***, where the most sophisticated equipment can only measure parts per Million (PPM).

TRAINING PROGRAM:
1 year initial training + continuous ongoing training for expansion of difficulty and experience level

1- Selection of the best dogs; Breed, character, physique

2- Basic police dog training; behavior, obedience

3- Identify hydrocarbon sample in one box

4- Training the dogs to identify various hydrocarbons

5- Training the dogs to identify different smells against background odors

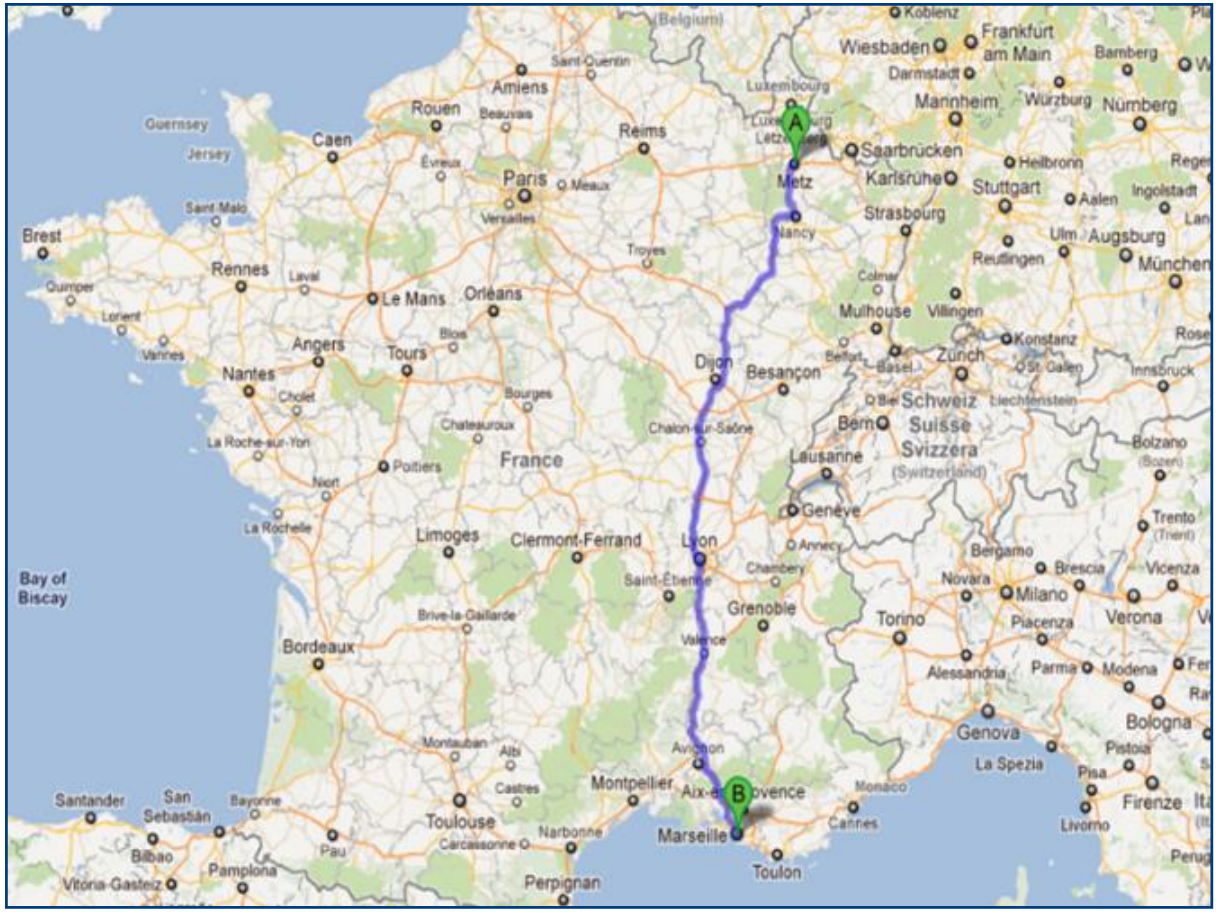
6- Training the dogs on pipeline samples

7- Higher difficulty levels, minimizing leak sims

8- Always positive reward for result

Example case: Leak detection through France

- **800 kilometres** of underground Ethylene pipelines in France through rural area
- Two specialized dog handlers – 4 months
- **Diversity of landscapes**
  - Alps with mountains 1200 meters, rivers, paddocks with angry bulls, barb wire fences, suburban areas, private properties, highways, railways,…
- Final Detailed inspection report
  - Not Accessible Areas, remarks on leak indications, Google Earth files with GPS coordinates of walked route



DOG EFFICIENCY AND AFFECTIVENESS STUDY, GERMANY

Comparative study on German Propylene Pipeline

In rural area's through agricultural corn fields from Cologne to Dormhagen

Time & team capacity: 2 dogs & 2 handlers in comparison to 8 people with equipment

➔ Dog team faster detection method

Quality: dog team found 4 leaks and equipment team only 2

➔ Dogs have a bigger range (50 meters)

➔Equipment searches only straight underneath

Result comparative study – TÜV protocol

After this case study and after an intense evaluation program with TÜV, The Sniffers received the official certification for the dogs and the handlers' working method

CASE EXAMPLE: ILLEGAL TAP DETECTION GEORGIA

Loss of pressure in the pipeline

Suspicion of an illegal tap

The pipeline was checked every day by guards on horses, with no result

Check of 200 Km pipeline in Georgia for illegal taps

Duration project - 2 weeks with 2 teams (trainer + dog)

CASE EXAMPLE: ILLEGAL TAP DETECTION BRAZIL

Detection of illegal tap in Brazil

The dog picked up smell a few hundred meters before the site and indicated the exact spot immediately, when walking over it for the first time.

Only a few drops of spill are sufficient.

The dogs are by experience also sensitive to:

- Change is vegetation (due to longer active illegal tap)
- Change in smell of disturbed earth (due to digging or covering up)

ULTRA HIGH SENSITIVITY: SHORT CIRCUIT DETECTION ON UNDERGROUND ELECTRICITY CABLES

locate electrical short circuits
Developed together with Electricity Provider after intense research period

Fast localization and repair **of short circuits** is essential to limit downtime

Detection of short circuits with equipment is:

- **Difficult:** Urban areas, difficult acoustic methods combined with costly measurement trucks
- **Very slow:** All connected houses have to be disconnected from the inside.

Dogs locate short circuits **accurately and fast**, without additional equipment, without having to enter or disconnect houses.

EXPERIENCE IN DIFFERENT CIRCUMSTANCES IS KEY!

Other references*:
Leak detection and illegal tap detection in:
Brazil, Georgia, Bolivia, France, Italy, The Netherlands, Belgium, Singapore, Spain and Germany

* Due to confidentiality, detailed customer information cannot be disclosed

Paco verifies leak location

Mecky finds difficult sample: Some of our dogs still dig to indicate, Mecky is trained to sit (preferred method)

Mecky finds underground leaks against difficult background odors of hydrocarbons

GERMAN TÜV CERTIFICATION OF DOGS AND TRAINING METHOD

TÜV NORD

Zeugnis
über die
Eignungsprüfung
zur Detektion von Undichtheiten

Hiermit bescheinigen wir, dass der

Hund Senna

Rasse:	**Mechelse Herder**
Geschlecht:	**weiblich**
Zuchtname:	**Senna**
Geb.-datum:	**16.07.2010**
Chipnr.:	**528246002066699**
Geprüfte Gase/ Flüssigkeiten	**Ethylen/Propylen/ Rohöl/Toluene**

der Firma
The Sniffers
Poeierstraat 14
2490 Balen, Belgien

geeignet ist, schleichende Undichtheiten einer Rohrfernleitungsanlage im Sinne des Abschnittes 11.5.2.3 der TRFL festzustellen.

Verbindlich ist unser „Bericht über die Eignungsuntersuchung der Sniffers (Spürhunde) zur Detektion von Undichtheiten" SEP-165/13 Nkp/ Keb vom 12.08.2013

Essen, den 12.08.2013

TÜV Nord Systems GmbH & Co.KG
Bereich Energietechnik
Abteilung Prozessindustrie

Verlängerung der Qualifizierung durch den Prüfer für die nächsten zwei Jahre

Datum	Unterschrift

Bestätigung der Gültigkeit durch den Arbeitgeber für die folgenden sechs Monate

Datum	Unterschrift

TÜV NORD

Zeugnis
über die
Eignungsprüfung
zur Detektion von Undichtheiten

Hiermit bescheinigen wir, dass der

Hund Casey

Rasse:	**Deutscher Schäferhund**
Geschlecht:	**weiblich**
Zuchtname:	**Queen vom Schloß-Zweibrüggen**
Geb.-datum:	**31.03.2007**
Tätowierungsnr.:	**G-C 2071**
Geprüfte Gase/ Flüssigkeiten	**Ethylen/ Rohöl/Toluene**

der Firma
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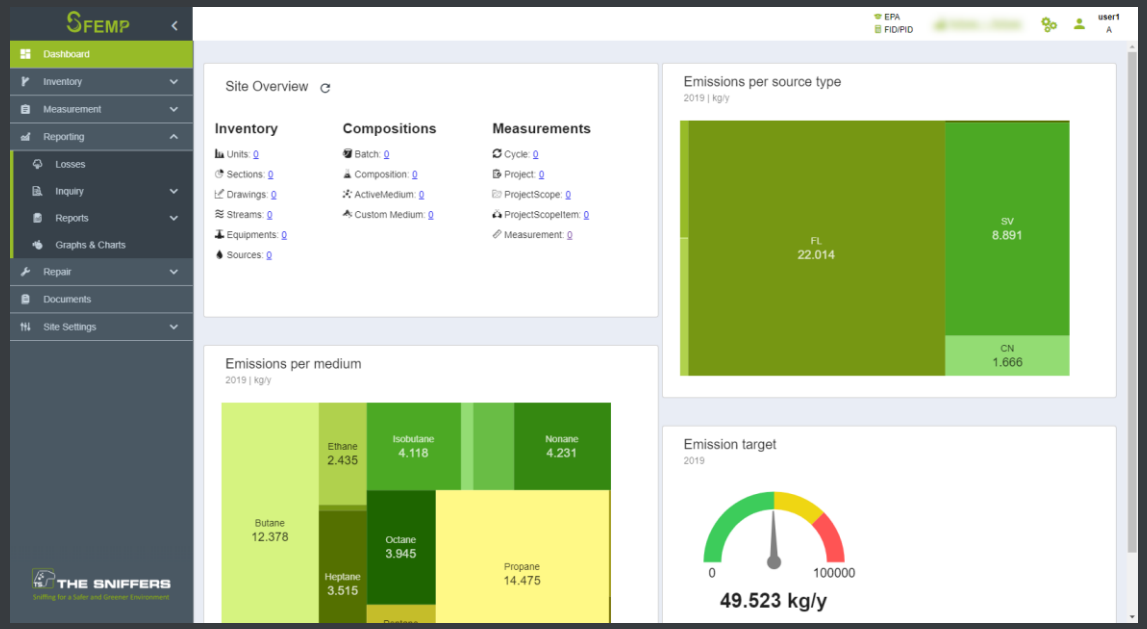
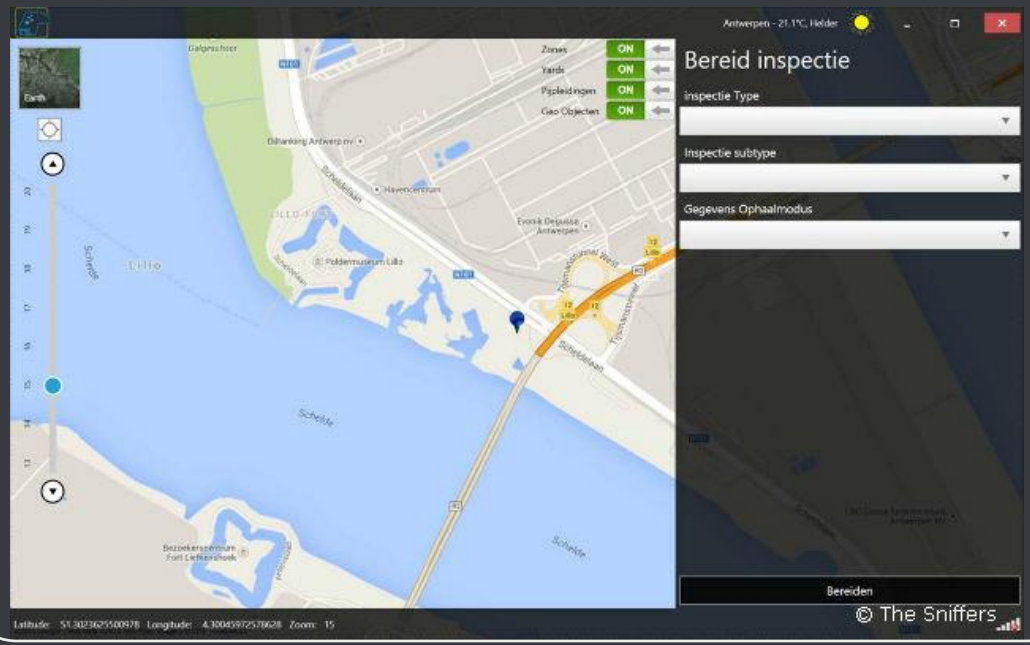
SFEMP

Sniffers Full Emission Management Platform



Perseus

Pipeline Information Management System



In-house developed proprietary software platforms

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Project preparation:

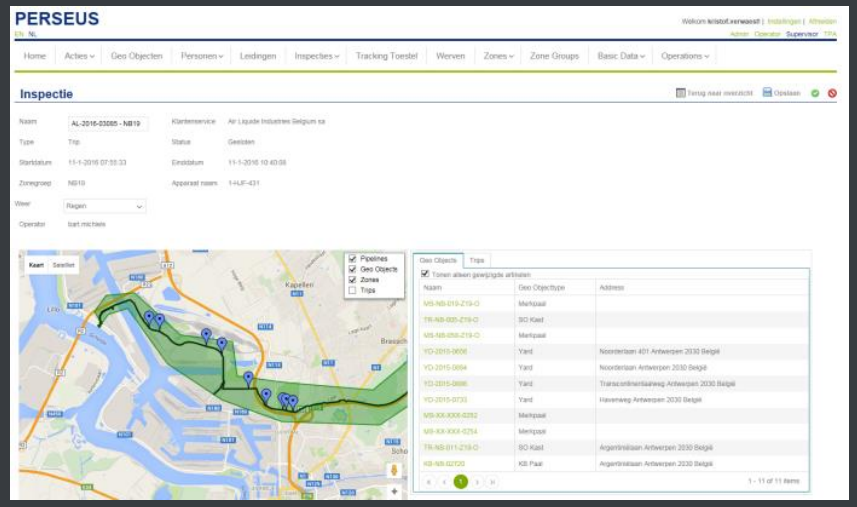
- Data gathering
- Project planning, permits
- Safety requirements
- Logistics

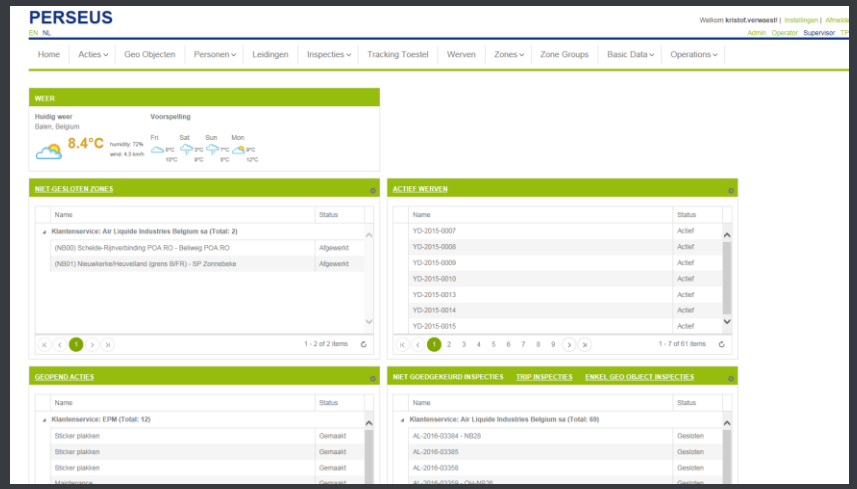
Onsite detection:

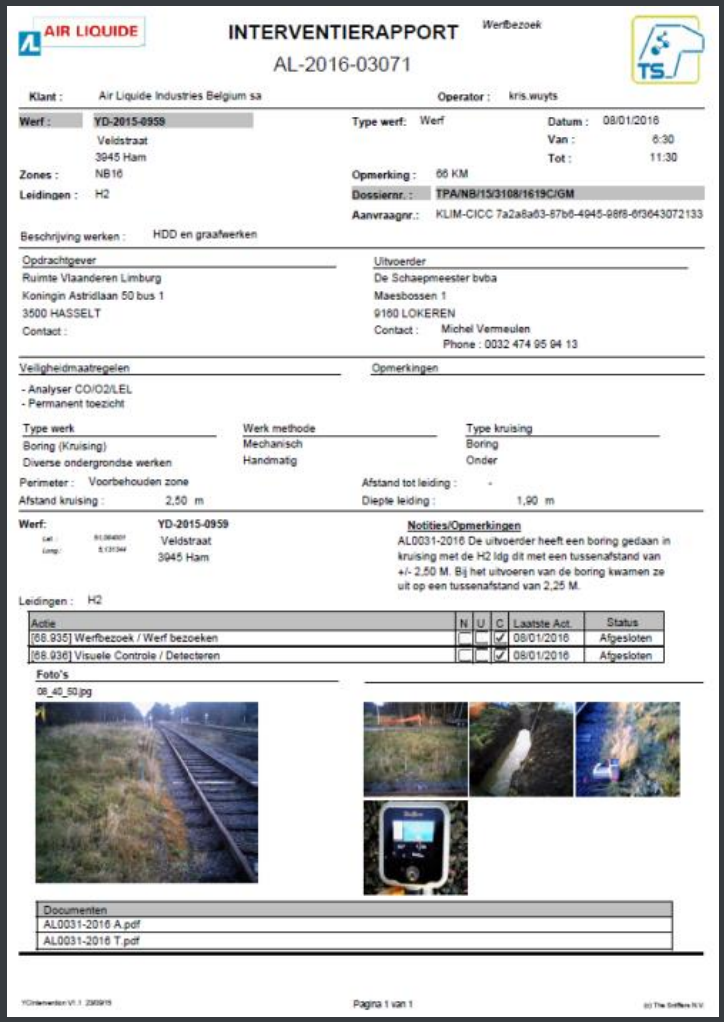
- leaks + illegal tap detection
- verification and quantification with best in class devices
- accurate GPS logging
- Data logging: Perseus software

Reporting:

- KMZ, KML file
- High quality report through Perseus software
- All image and GPS material







Complete service:

Project preparation → onsite detection → data analysis and Reporting

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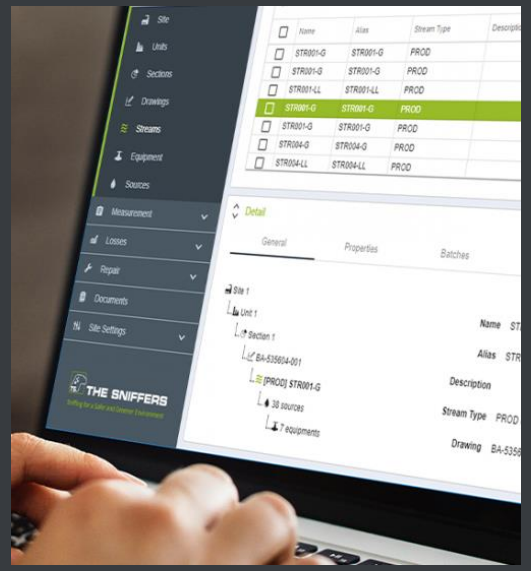
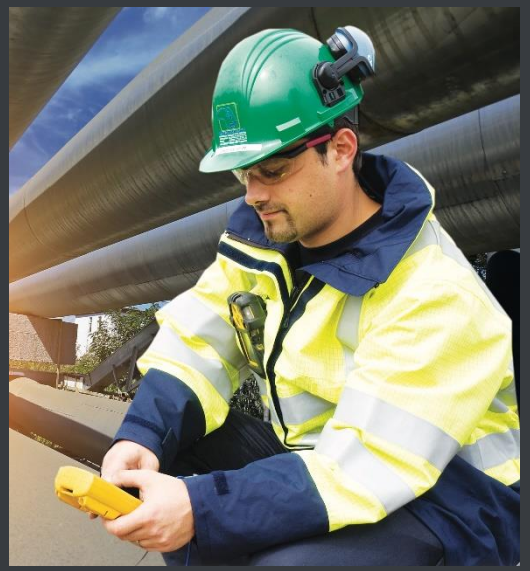
REFERENCES

GDF SUEZ E&P Nederland B.V.





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