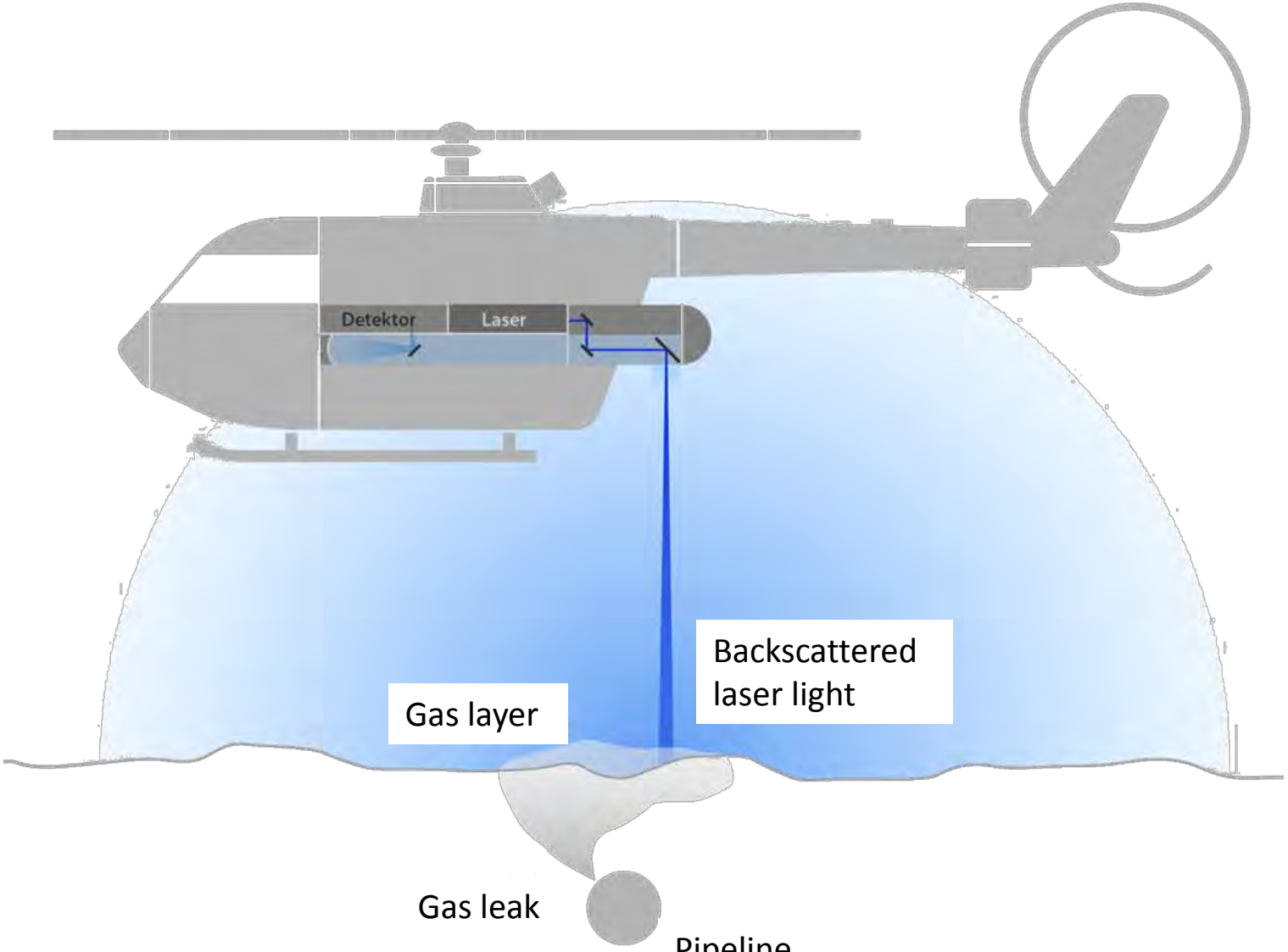
CHARM®

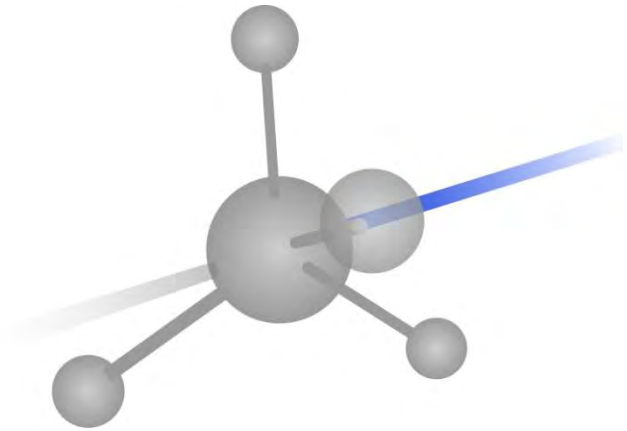
Laser Based Aerial Leak Detection for Gas Pipelines

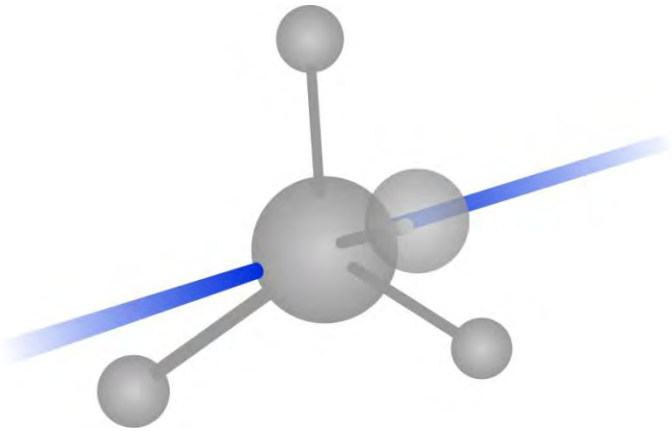
Technology


Detektor
Laser
Backscattered laser light
Gas layer
Gas leak
Pipeline

Differential Absorption LIDAR

System emits laser pulses with two different wavelengths:

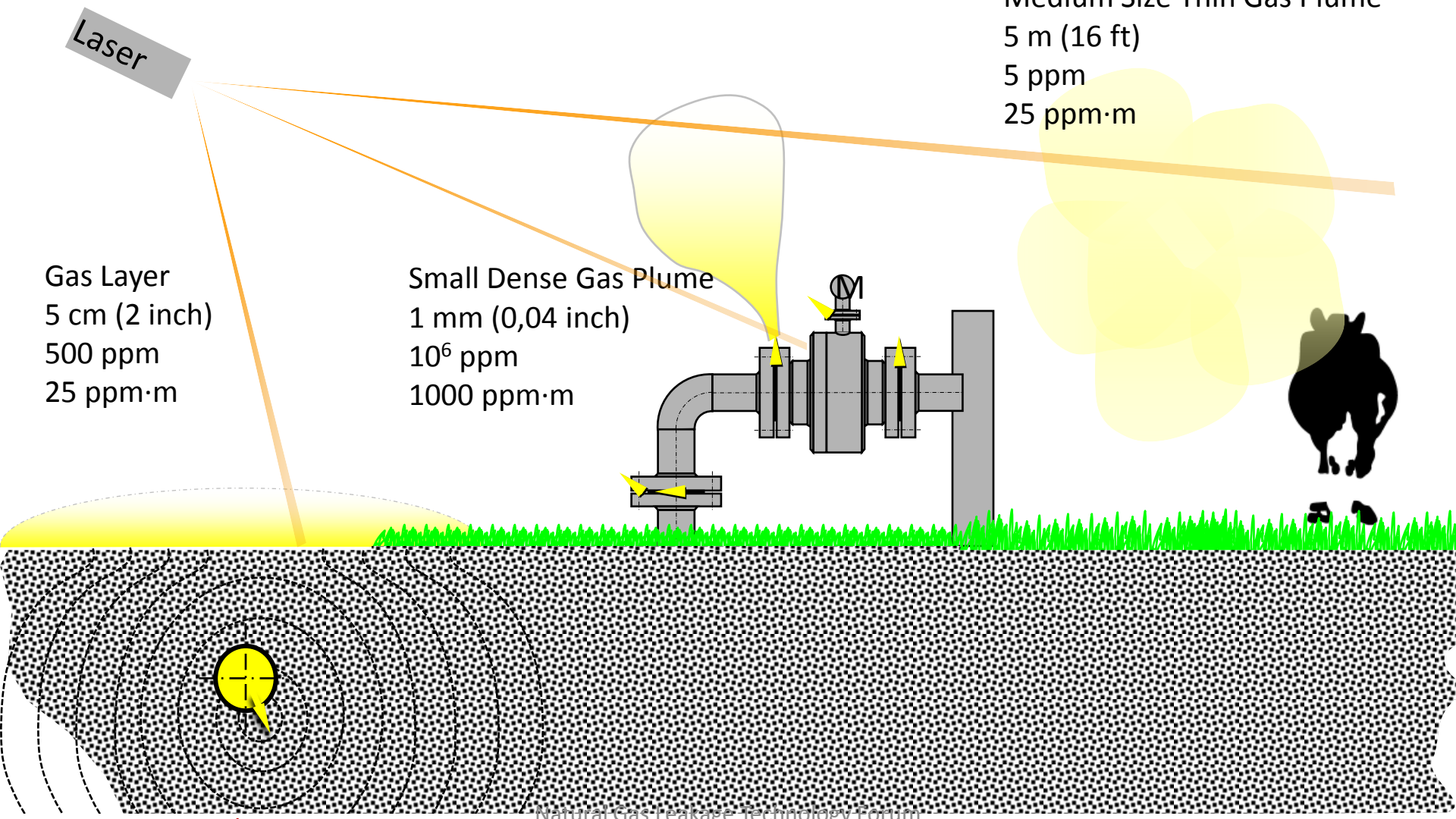




- λ_{on}
  Measurement wavelength:
  light is absorbed by methane
- λ_{off}
  Reference wavelength:
  CH_4 is transparent for this wavelength

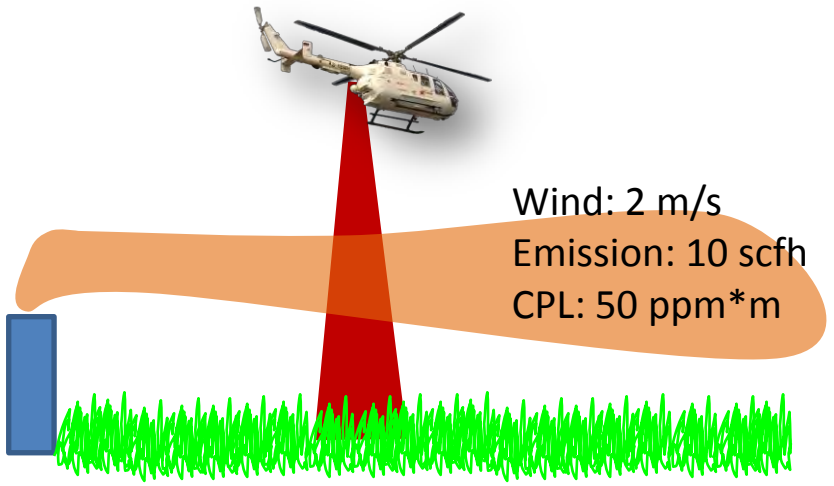
A difference in the backscatter signal indicates the presence of Methane

Concentration Path Length (CPL) Product [ppm · m]



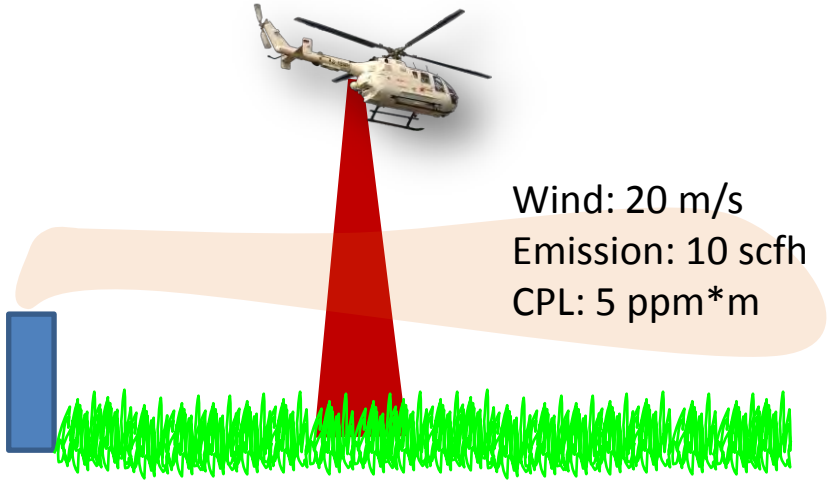
Detection Limit vs. Detectable Leak Rate

- System detection limit (given in ppm·m) depends few external parameters like:
  - Target (reflectivity, roughness, …)
  - Methane concentration (only for very high concentrations)
- **System detection limit does not depend on the wind speed**



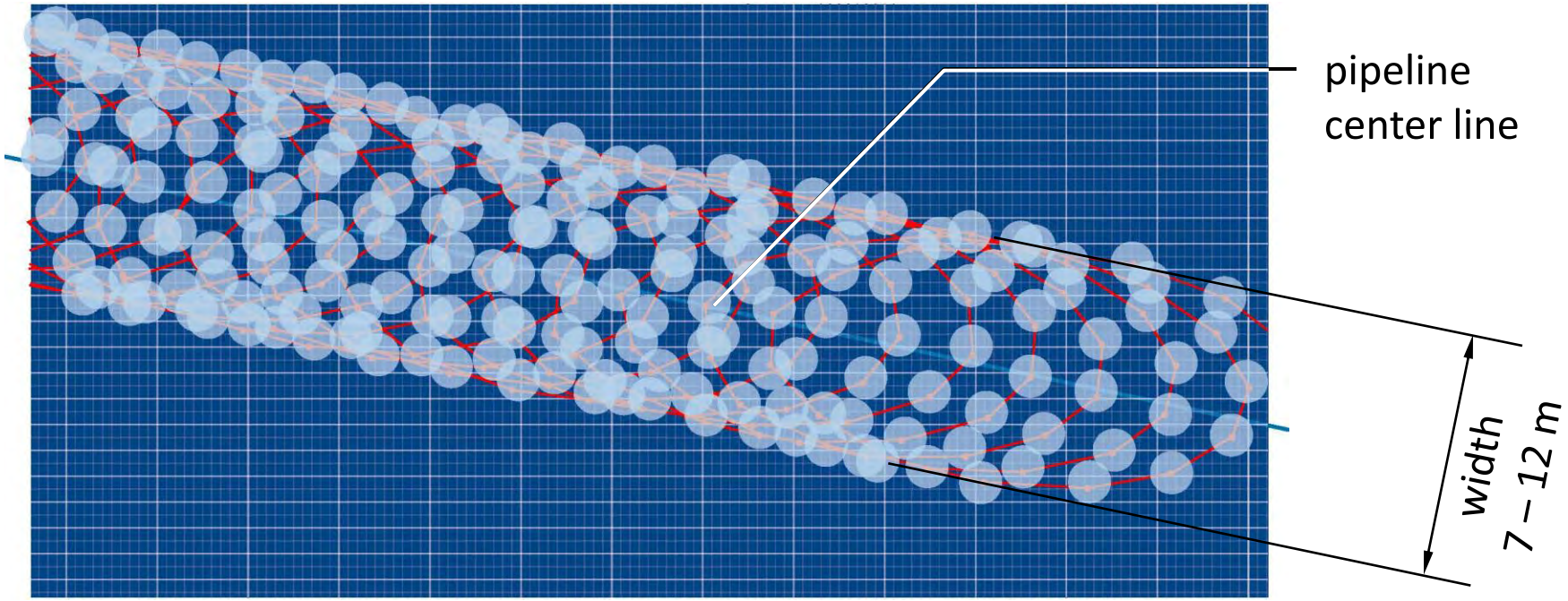
BUT

- Due to the wind the gas emitted by a leak will be diluted
- Higher wind speed requires higher leak rates to optain detectable gas concentrations
- **Detectable leak rate depends on wind speed**
- ➢ **Verification of detectable leak rate requires field test verification under defined conditions**

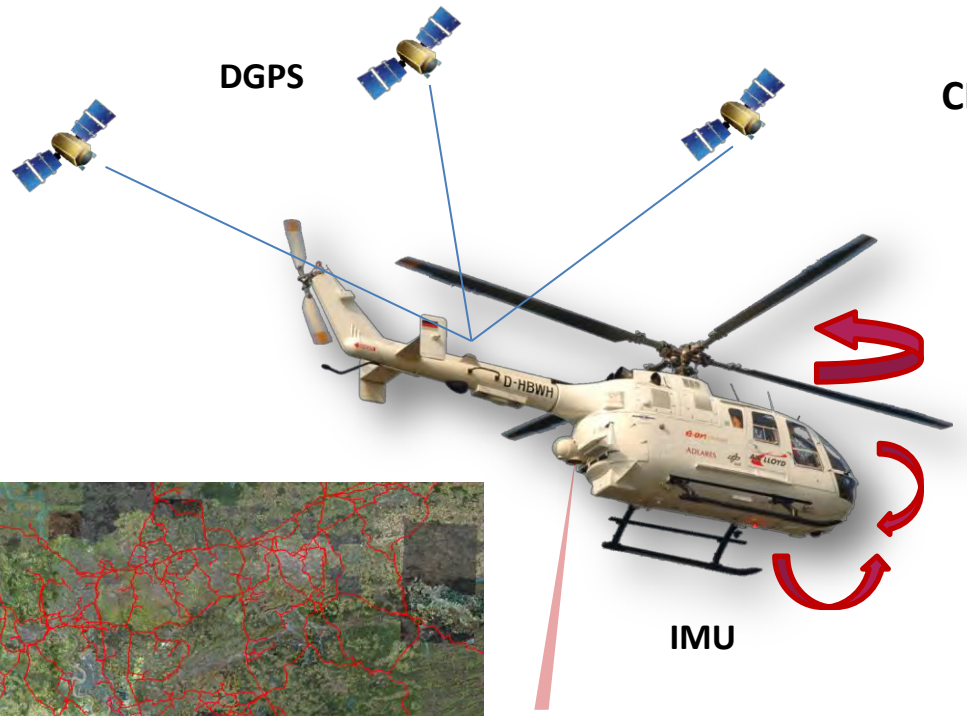


Scanning

100 measurements / s



Navigation

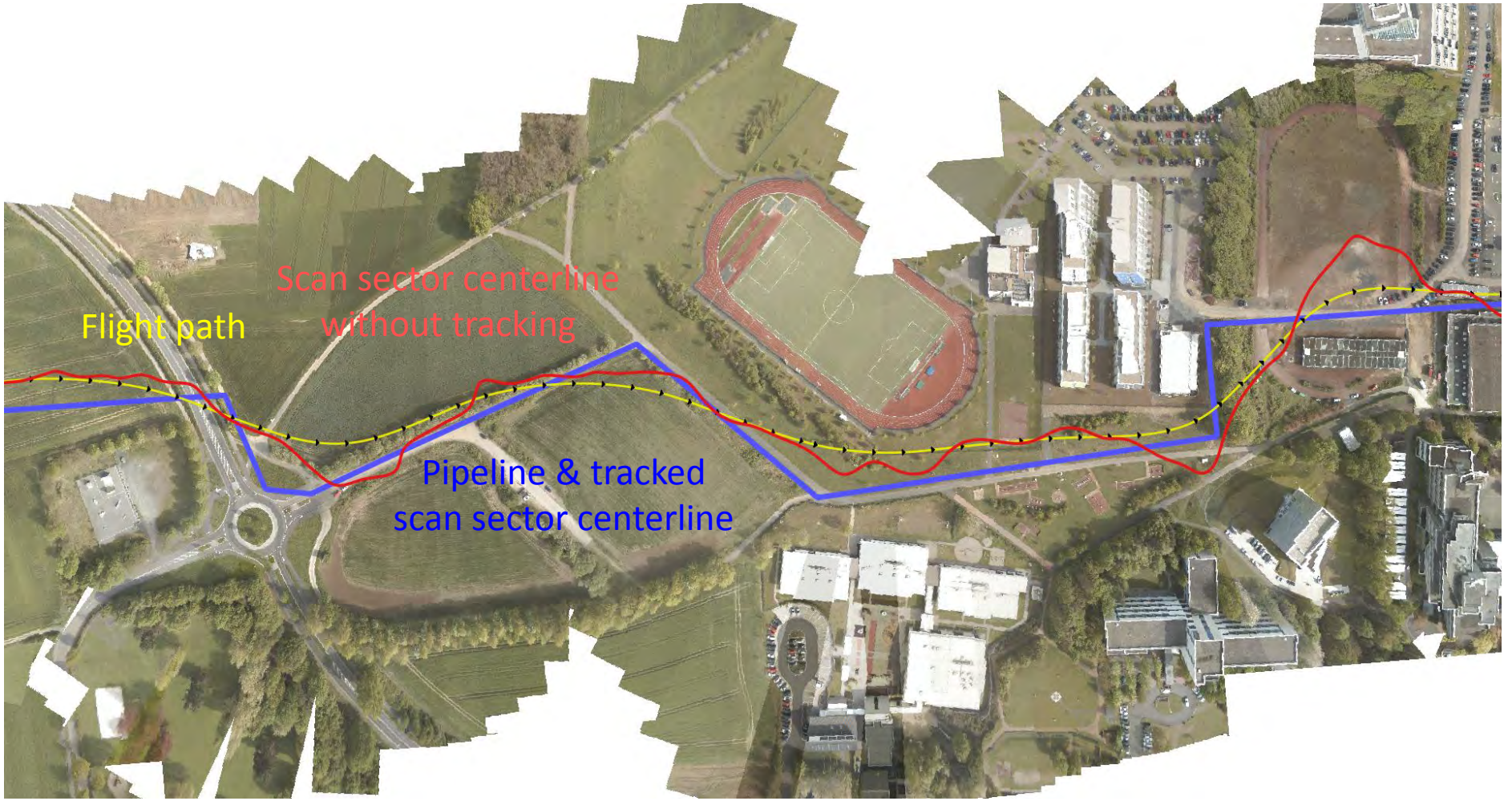


Pipeline-Database

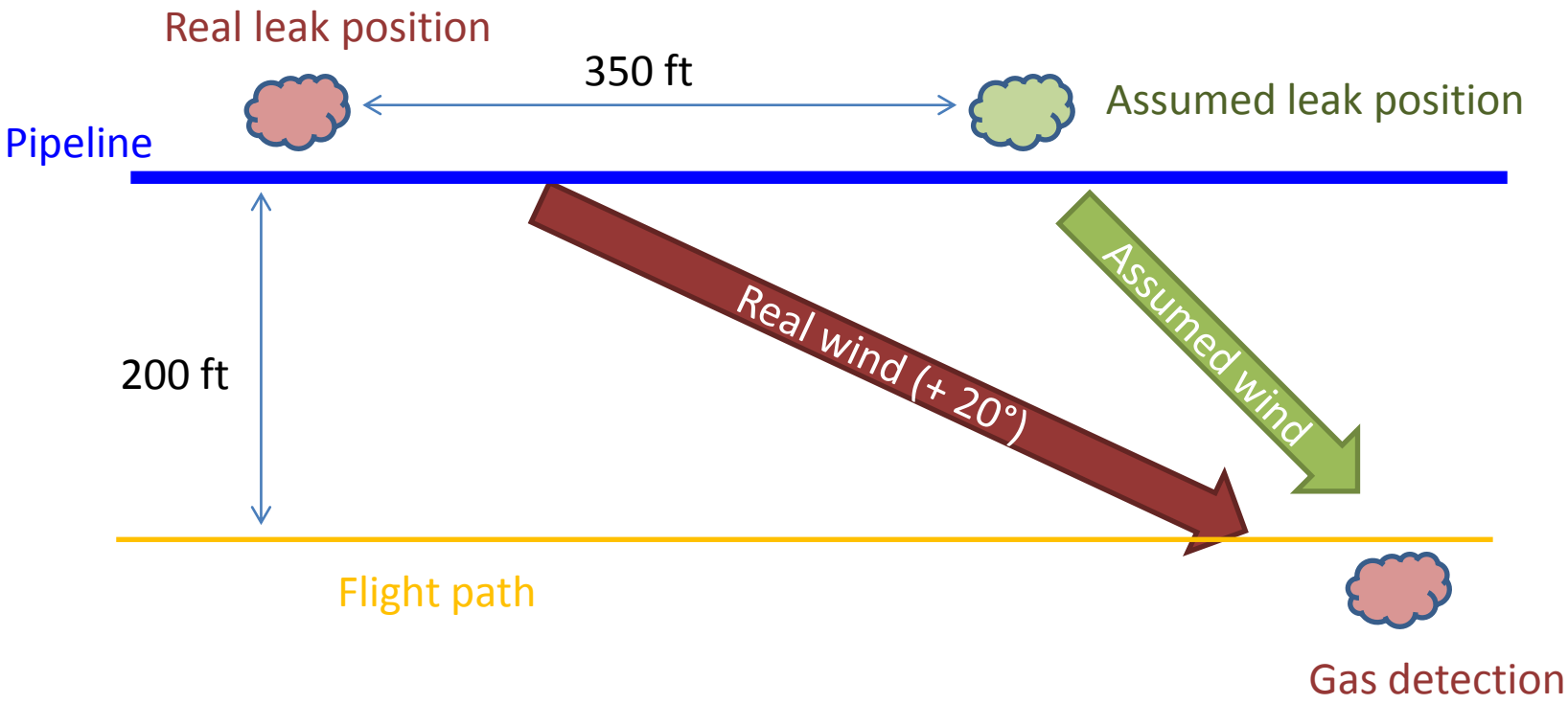
CHARM® - Automatic Beam Guiding

- Differential GPS with worldwide correction service OmniSTAR (via satellite)
- Inertial measurement system to determine the spatial position and movement of the helicopter
- Integrated data base for all pipelines to be monitored
- Real-time-calculation and -control of the laser beam ensure congruence of scan sector and pipeline centerline

Why is pipeline tracking essential?



Downwind Gas Detection?

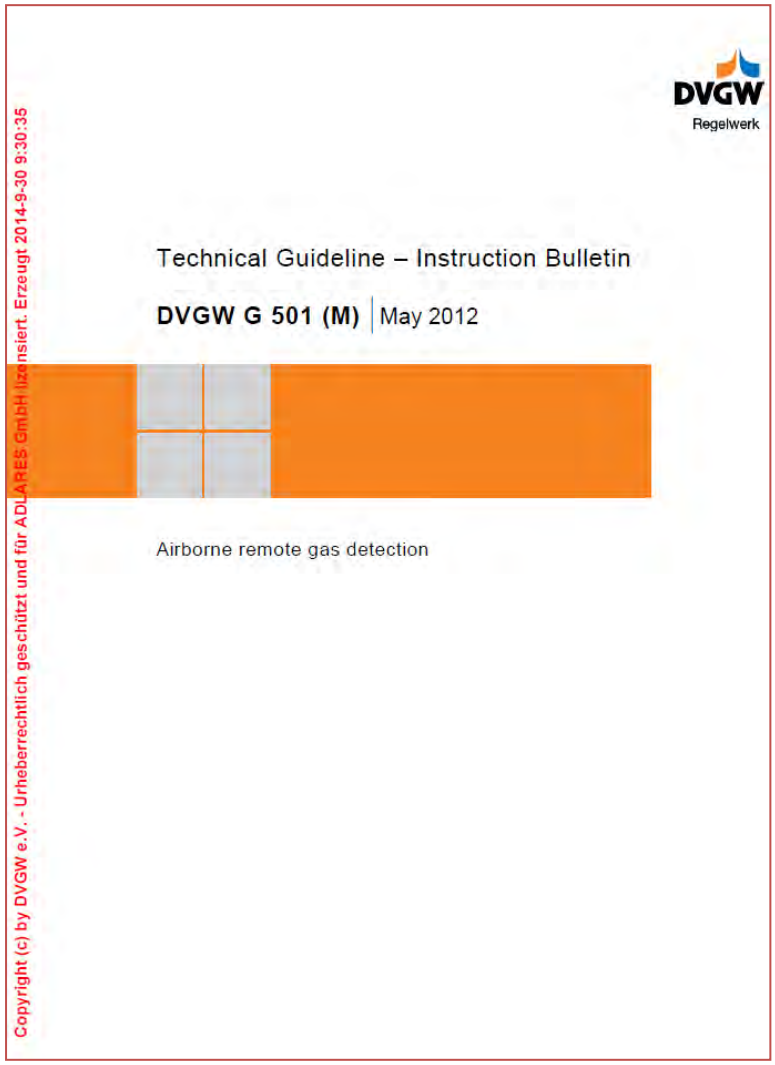


Helicopter in Use

Current Helicopter in Use: BO 105

- Helicopter can follow complex pipeline networks much better than fixed wing aircraft
- CHARM® can be installed within 30 min in the helicopter
- EASA-certification for BO 105
- Flight altitude 250 – 500 ft:
  - High sensitivity
  - Visual survey of pipeline swath
- Survey speed: 30 - 40 kn (35 - 45 mph)
- Small crew: pilot and system operator
- Working on adaptation for different helicopters (EC 135, MD 900)
- **The only remote sensing system with DVGW-certification**

Standardization



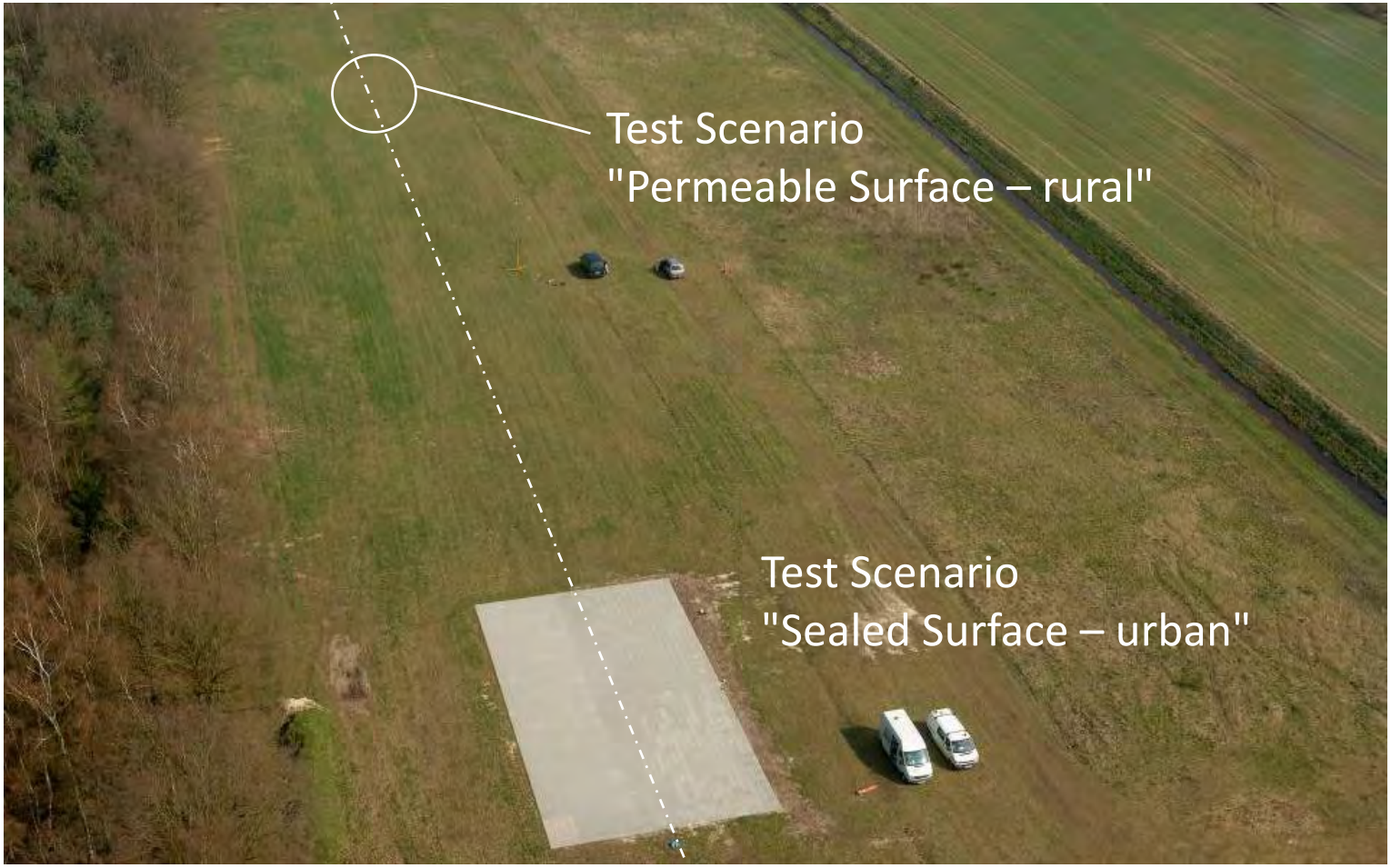
First technical standard for airborne leak detection worldwide

- Is accepted in most European countries
- Compliance to this standard is a critical success factor in Europe
- Makes different systems comparable
- A customer knows what he gets and must not only rely on marketing stories

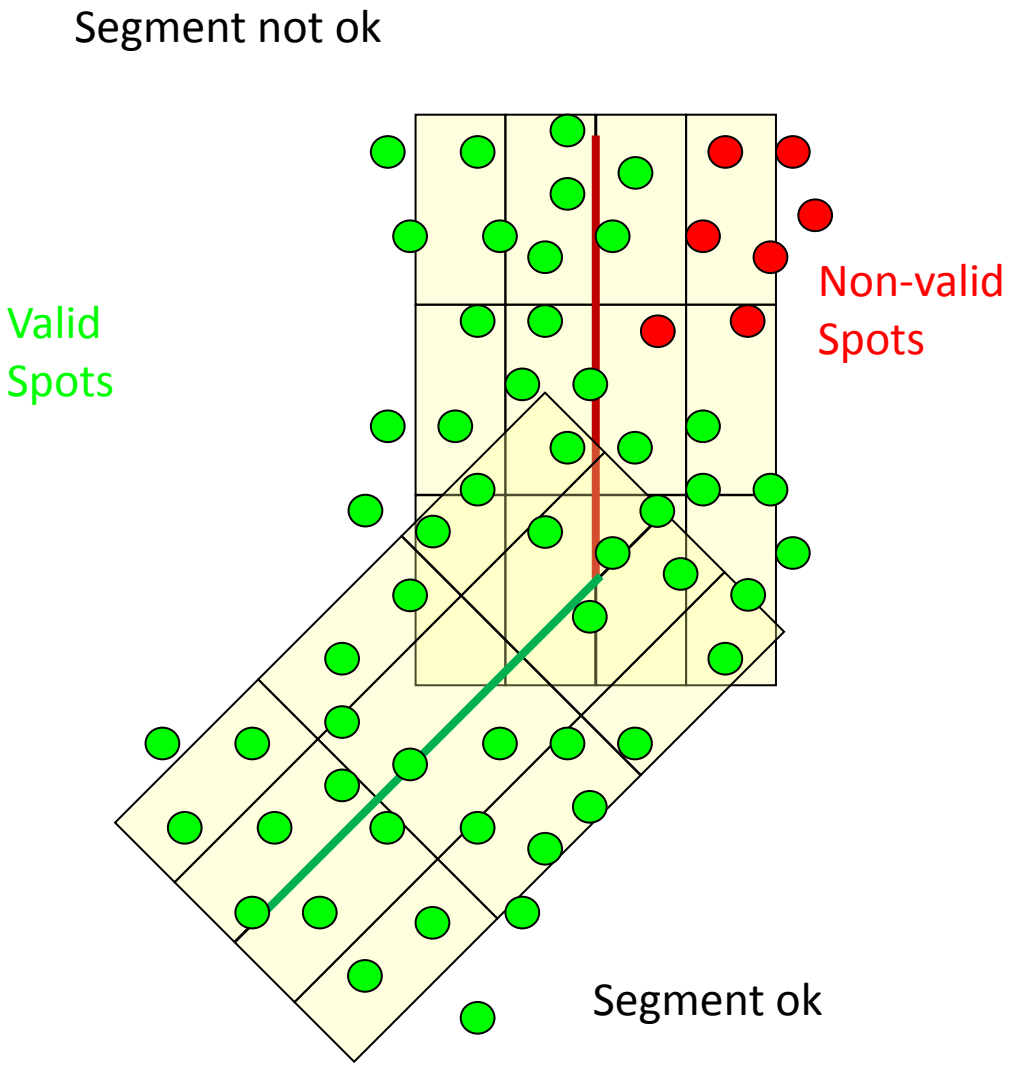
Key criteria for compliance

- Reliable gas leak detection under clearly defined conditions
- Sufficient coverage of the pipeline swath with measurements

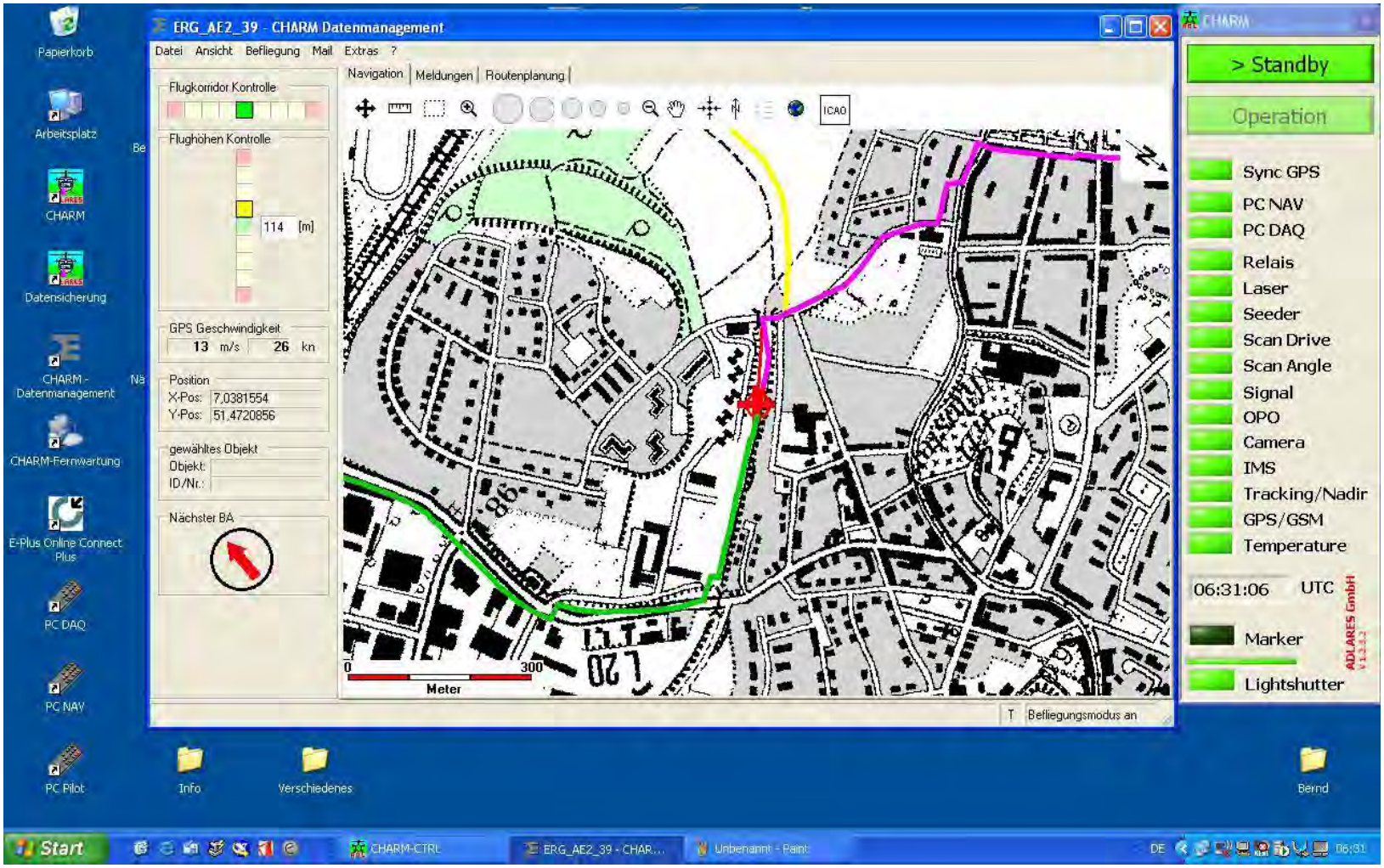
Standardization: Test scenarios



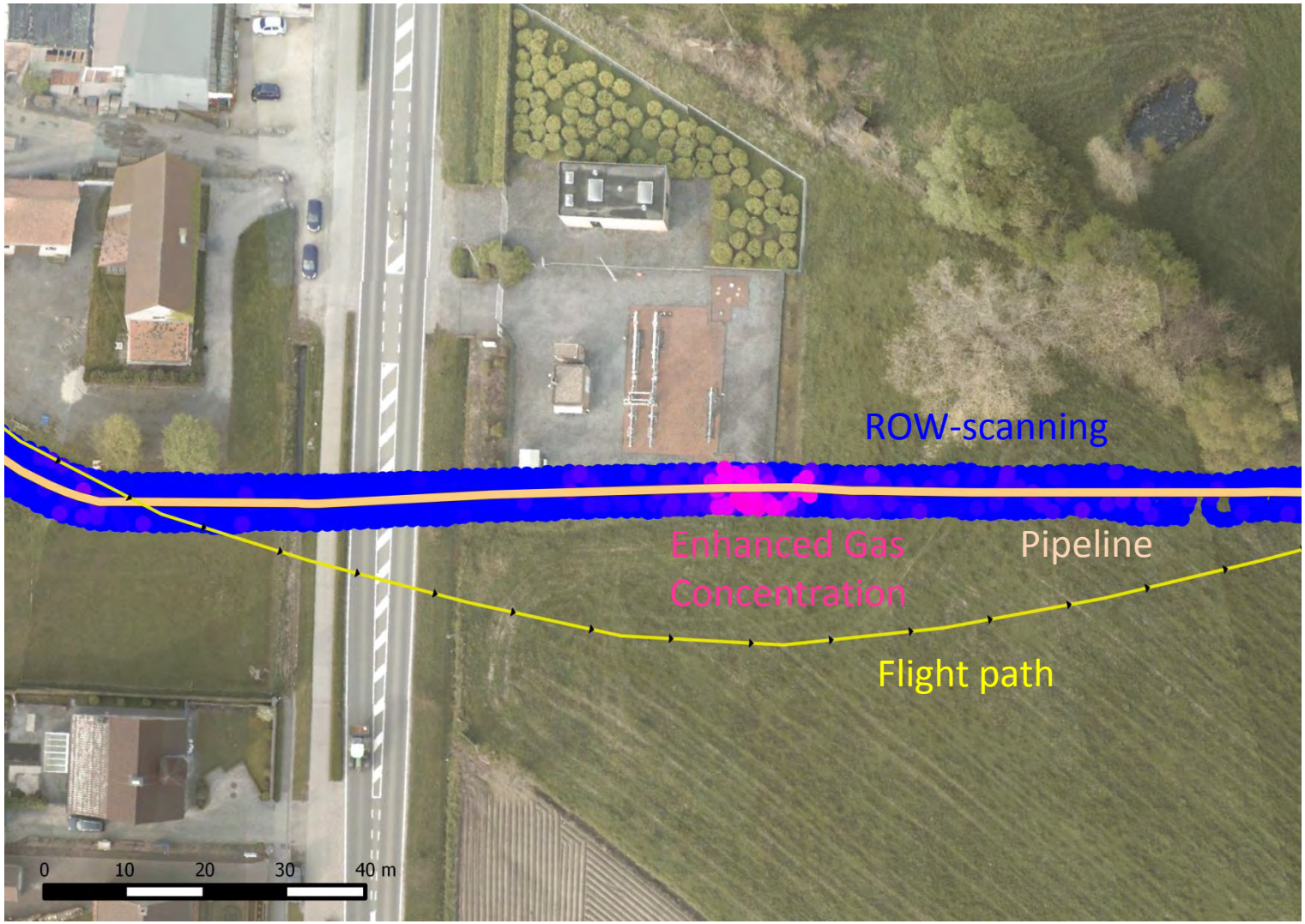
Standardization: When is a pipeline survey ok?



Laptop Operator



Gas Detection Example



Reporting

Indication (Overview)

Indication	CHARM-No. 1	22.07.2011 [redacted]
Coordinates	[redacted]	[redacted]
Type	Gas release	
Status	New	
Relevance	3	Gas release possible, source identified
Methane detection	☐ yes	☐ no
Concentr. at surface		ppm / Vol.%
Concentr. in surface box		ppm / Vol.%
Concentr. after venting		ppm / Vol.%
Repair actions		
Pipeline	☐ tree canopy	☐ subsurface ☐ above ground ☐ permeable ☐ sealed
Soil condition	☐ dry	☐ humid ☐ wet
Wind direction (approx.)		
Remarks (e.g. valves, other components or pipelines, surrounding area characteristics)		
Date / Name		

Indication	CHARM-No. 1	22.07.2011 [redacted]

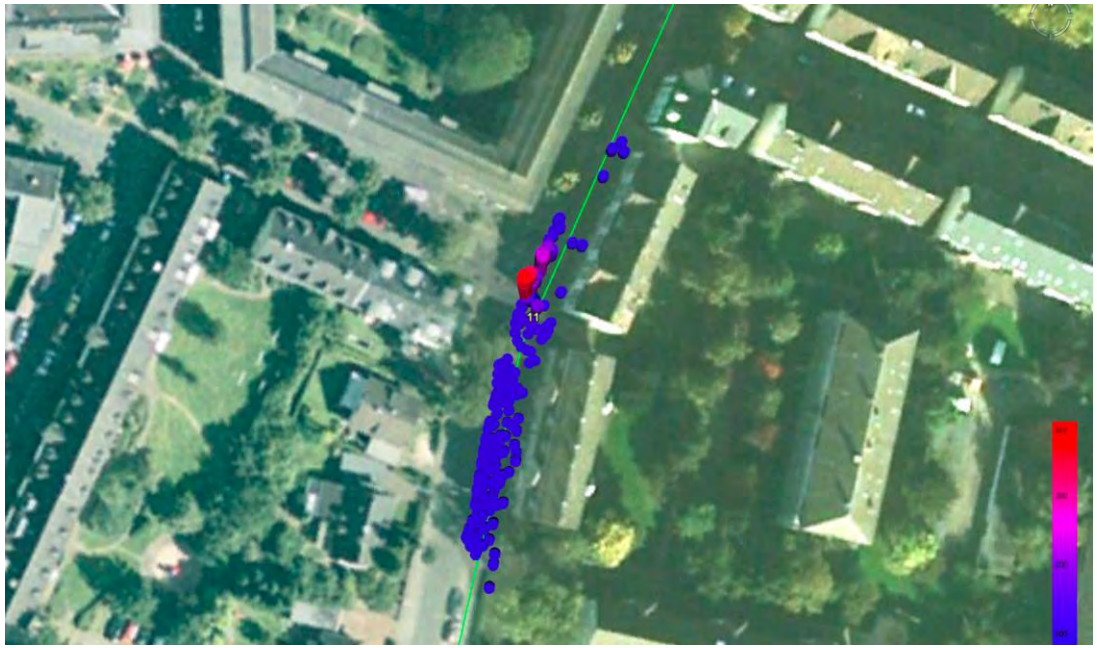
Immediate Messaging

High and very local gas concentration:

- Indication for a dangerous gas release
- Automatic SMS from System to CHARM-team
- Immediate evaluation of local situation
- Alert -> pipeline operator

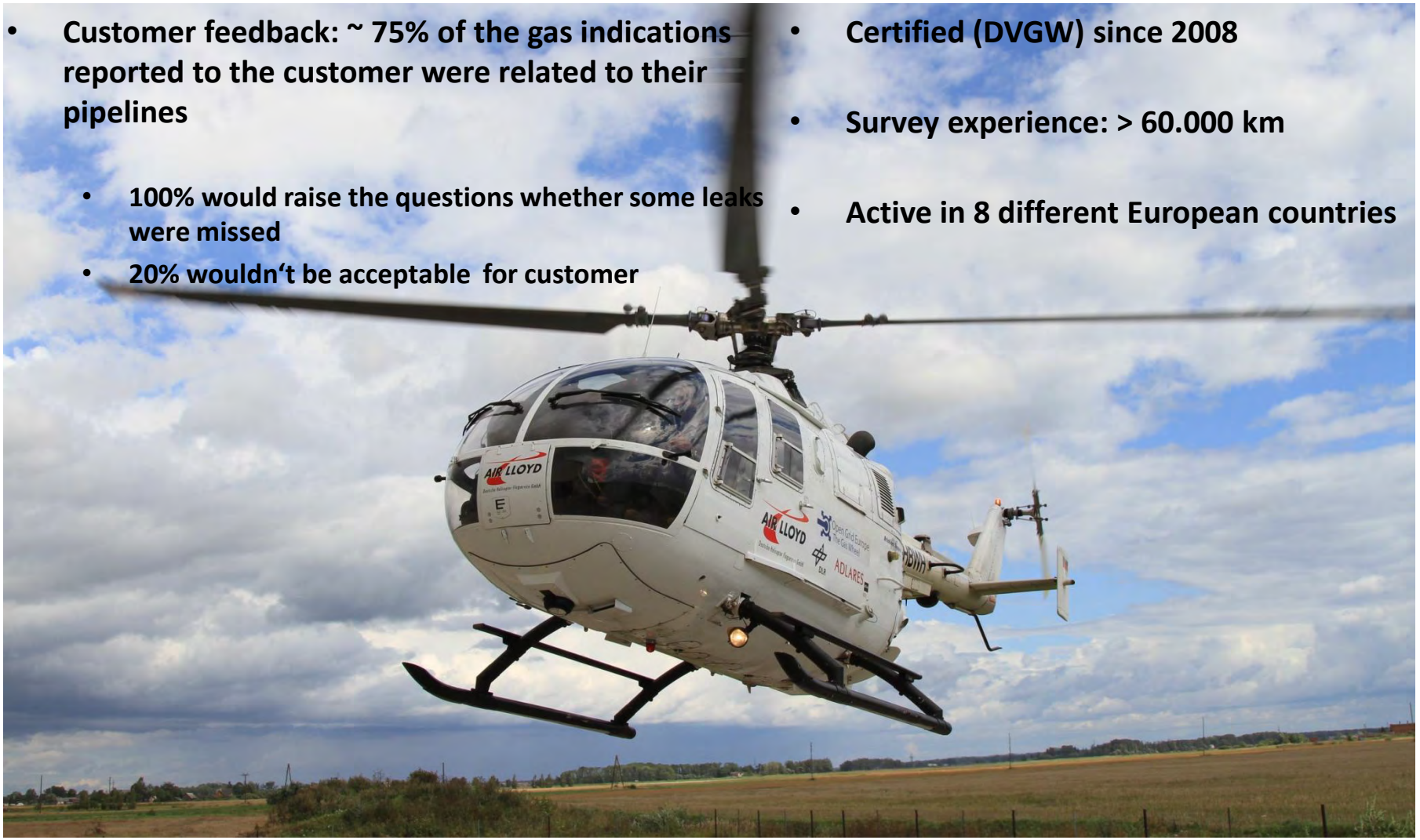
Example:

- Damage of street cover and valve during street work
- Local gas line
- No repair of gas valve
- Only asphalt burying street cover



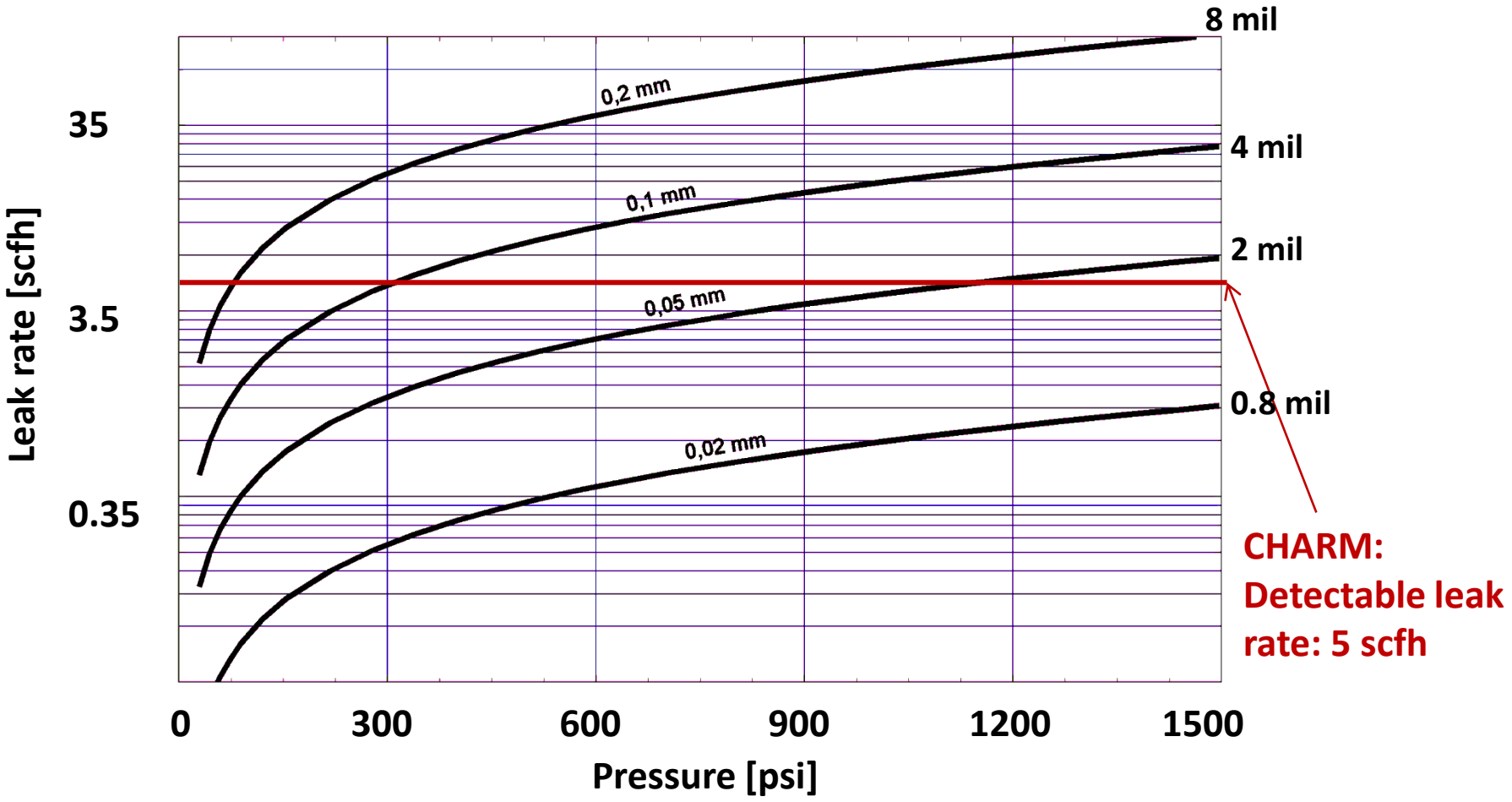
CHARM: Experience

- Customer feedback: ~ 75% of the gas indications reported to the customer were related to their pipelines
  - 100% would raise the questions whether some leaks were missed
  - 20% wouldn‘t be acceptable for customer
- Certified (DVGW) since 2008
- Survey experience: > 60.000 km
- Active in 8 different European countries



Web – Interface for Customer

Detectable Leak Size



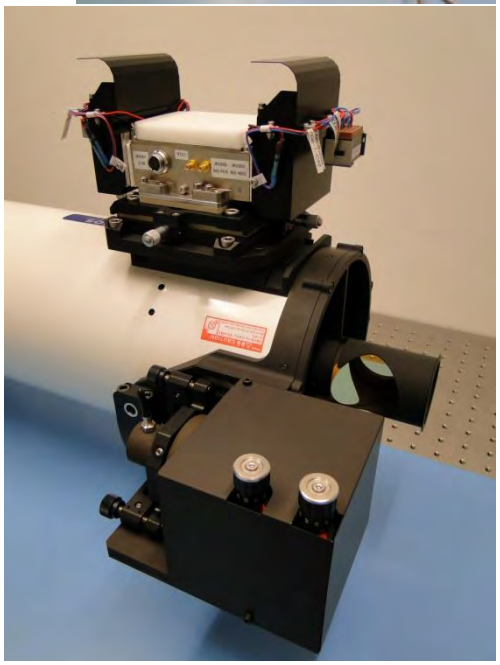
CHARM 2

New Generation of CHARM Technology

- New laser system allows for 1 000 measurements/s instead of 100 measurements/s
- Larger scan sector (up to 25 m) allows for
  - Survey of pipelines with lower geo-data quality
  - Survey of parallel pipelines within the scan sector
- Higher survey speed up to 100 kn
- Can be upgraded for the detection of Propane (LPG-pipelines, Crude oil pipelines)
- **2x better economic performance compared with CHARM 1**

New Helicopter: MD 900

- Longer endurance
- More quiet operation
- Additional passenger possible

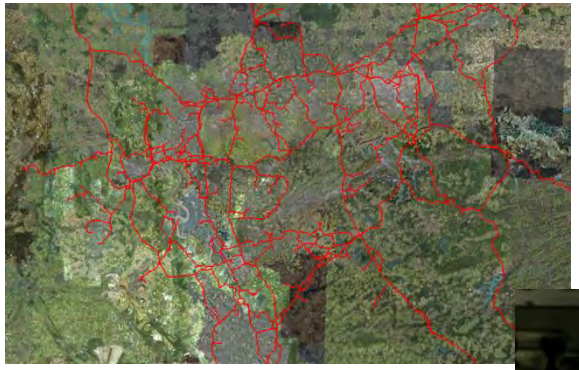


Schedule

- First flights (with BO 105) during next winter
- Integration in MD 900 2016

Service Offering / Business Model

The Service Process



1. Pipeline data input from client
- Conversion from various data formats
- Data processing for flight planning

2. Planning, implementation of flights, and data collection

3. Data analyzing and reporting
- Classification of leak indications
- Verification of leak source
- Compilation of a client specific report
- Data processing for integration with client-GIS