
Innovation

The added value to pipeline integrity
Agenda

- Gastransport Services (GTS)
- Gasunie Research (GUR)
- Mission of GTS with respect to pipelines
- The added value of innovation


Gastransport Services

- Total length of gas transmission grid: 11,600 km
- Compressor stations: 8
- Blending stations: 9
- Metering and regulating stations: 75
- Gas delivery stations: 1,100
- Export stations: 10
- Storage plant of LNG: 1
- Calibration systems: 2
- Nitrogen plant: 1
Gasunie Research

- **The** Natural Gas Lab in the Netherlands
- Located near the Groningen field, the largest Natural Gas Field in western Europe
- 40 years of research and consultancy experience as a part of the Gasunie organisation
- 100 researchers/consultants on different working fields
- Approx. € 13 million turnover
Gasunie Research: Added Value

Added Value:
- Cost reduction
- Emission Reduction
- Quality Improvement
- Improvement of Safety
- Improvement of operations reliability

In the fields of:
- Gas transmission and distribution
- Gas combustion
- Energy Conversion
- Energy transmission and distribution

Via:
- Consultancy
- Innovation
- Trouble shooting
- Project Management

Mission of GTS

Preservation of a safe and reliable gas transmission network at the lowest (life-cycle-) cost

= Preservation of integrity!

Past trust  

Future proof

Public Employees Environment

Cost

Stakeholders

P(I)MS

Reliability

Customers & Suppliers
Concerns (threats)

- **Technical**
  - Older pipelinen materials
  - Appr. 50 % non-piggable
  - No digital Asset register
  - Bacterial corrosion
  - Coating degradation
  - ...

- **Societal**
  - Re-routing because of land use planning
  - Third party damage
  - Infrastructural works
  - New rules and legislation
  - Regulatory restrictions
  - ...

Measures and innovation

• Pipeline inspections
  – Walking/driving
  – Helicopter flights

• Trace management
  – One-call system
  – Land-use planning (safety zones)

• CP
  – Regular checks on testposts / rectifiers / drainages

• Diagnostics
  – Pigging
  – Coating surveys

• Pipeline management

• Presense

• Risk assessment: modelling

• CP modelling

• Nopig

• PIMS

• Naturalhy

Innovation

- Presense
- Pipesafe klein
- Nopig
- P(I)MS
- Naturalhy
- Cost
- Reliability
- CP-modelling
Innovation examples

- Presense [2001 – 2004]
- Risk assessment modelling
- CP modelling
- Nopig
- PIMS
- Naturalhy

Presense

Pipeline Remote Sensing for Safety and the Environment

A 17 partner EU consortium – part funded by the EU

2001 - 2004
The vision for European gas/oil pipeline operators

To develop and integrate the elements of a pipeline management system

- to improve safety,
- reduce survey costs using remote monitoring techniques.
A broad European consortium

Pipeline operators
- Advantica-Transco
- BP
- Fluxys
- Gasunie
- Gaz de France
- Ruhrgas
- VNG

Flight campaigns & new sensor technologies
- DLR
- Intermap
- NPA

Imagery data analysis
- CS
- Definiens
- TNO

System integration
- ISS
- NLR

Geological & environmental
- BGS
- Univ. Nott

GUR contribution to Presense:

A cost benefit model:

balancing techniques & economics
### a combination of measures

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*) Boolean summation


Cost Benefit Model
searching for the optimum

![Graph showing inspection, damage cost, and benefit with POD [%] on the x-axis and k€ on the y-axis.]

- Inspection
- Damage cost
- Benefit

G A S U N I E R E S E A R C H
Innovation: examples

- Presense
- CP modelling [2000 - ...]
- Risk assessment modelling
- Nopig
- PIMS
- Naturalhy
CP-modelling: why?

- **Design check/optimisation existing CP-system**
  - Number and locations of
    - anodes
    - drainages
    - CP test posts
  - Setpoints rectifiers

- **Re-evaluation against changing conditions**
  - HVAC powerlines
  - AC/DC Traction (e.g. railroads)
  - Pipeline network modifications

- **Troubleshooting**
CP-modelling

CP modelling tool
- CatPro (Elsyca)
- Elsy (Elsyca)
  (alternatives: BEASY or University of Florida)

Output
- Potential distribution
- Current distribution
- Current density distribution
- 2D and 1D Graphs
  - Colour schemes
  - Vectors (current distribution)
- Numerical tables
a model

Examples of modelling:

- Railroad crossing: Load relieve construction
- Casing: Coating defect
Innovation examples

- Presense
- CP-modelling
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Probabilistic approach in NL

IR (10^{-6}) / SR (FN^2 < 0.01)

Revision of NEN 3650

Pipeline risk contours applicable for pipelines and for installations

Risk assessment tools

- Tables
- Rules of thumb
- Pipesafe klein
- Pipesafe
- Tracé engineer
  Pipeline engineer
- Safety Engineer
- Risk Assessment Engineer
• Result of international cooperation

• Well validated by numerous experiments on large diameter, high pressure gaslines

• Complicated to handle
Individual risk (1)

1. failure frequency;
2. gas outflow;
3. heat radiation;
4. lethality;
5. Find distance to $10^{-6}$ risk
6. Repeat for each configuration

Individual risk (2)
Societal risk (1)

1. FF of segment
2. gas outflow;
3. heat radiation;
4. lethality;
5. risk
6. number of casualties
7. repeat step 1-6 until end of 1 km of pipe
8. table with victims per FF
9. sort table
10. draw FN-curve
Societal Risk (2)
Innovation examples

- Presense
- CP modelling
- Risk assessment modelling
- Nopig [2001 – 2003]
- PIMS
- Naturalhy
Nopig®

an above ground inspection technique for detecting metal loss on (non-piggable) lines

Scope

• determination of the performance of the instrument

Organisation

• Multi-sponsor project (9 partners)
• Laboratory tests (appr. 1000 measurements)
• Fieldtests (in combination with pigruns and coating survey techniques)
Nopig: system

Detector Module: backpack with processing unit and battery

Monitor with keyboard

Current Source Module

Peg

Area with metal loss

Sensor array

Pipeline

Source: FINO AG

Nopig: the equipment

Source: FINO AG


Nopig: detection principle

Pipe with 12 o'clock defect

Pipe without defect

Magnetic flux lines

HF-current

LF-current

defect

shift

Nopig: signal analysis

The influence of parameter settings

Source: FINO AG
Concept of inspection techniques

- Performance technique
- Corrosion distribution
- Corrosion tolerance
- Coherence
Nopig
technical specifications per 28/10/2002

- Nominal pipediameter: 3” – 12”
- Maximum wall thickness: 10 mm
- Depth of pipe: 1.5 meter
- Distance between connecting points: 500 meter
- Inspection length per day: 500 meter

Reference defect dimensions
- Cup shaped defect: 50 mm
- Peak wall loss: 50 %
- Pipeline depth: 1.2 mtr
- POD: 92 %
- Defect sizing tolerance: 20 %

- Minimum defect size: 30 %
- Defect sizing: >40 % ML

Source: FINO AG
Innovation examples

- Presense
- CP modelling
- Risk assessment modelling
- Nopig
- PIMS [2002 – 2004]
- Naturalhy
PIMS: balancing the system

Design & construction
Operations & maintenance

Integrity status

DANGER
OK

Threats

Not efficient
Innovation

Measures


**PIMS system hierarchy**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Functionality</th>
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<tbody>
<tr>
<td>Decision</td>
<td>Economics</td>
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</table>
| Decision | Integrity  
Remnant life  
Inspection intervals  
Repair/rehabilitation |
| Add-on tools | CP expert  
Corrosion growth  
Risk contours  
Statistics |
| Standard tools | GIS-viewer  
Document retrieval |
| Interface | EAI-bizz talk |
| Database(s) | SAP-Plant Maintenance  
SAP-Business Warehouse |

**GASUNIE RESEARCH**
PIMS: add-on Tools

**Economical assessment**

- **Remnant Life**
- **Integrity Assessment**

**Pigrun data**
- Analysis
- Defect-assessment

**Inspection data**
- Surveillance
- Surveys
- Mech. strength

**Corrosion**
- CP-modelling
- Coating surveys
- CP-data

**Risk Assessment**
- IR / SR
- Hazard consequences
- zoning

Integrity

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Naturalhy

- Presense
- CP modelling
- Risk assessment modelling
- Nopig
- PIMS

- Naturalhy [2004 – 2008]
Smooth and cost effective introduction of hydrogen into the society by using the existing natural gas system
Naturalhy: the H₂-project

- EU-sponsored (6-th framework)
- 30-40 partner program
  - Gas companies
  - Manufacturers
  - Research Institutes and Universities
- Budget: >> 10 M. Euro
- Project coordination: Gasunie Research

Naturalhy
WP: Integrity and Durability

- Improved inspection requirements
  - Probability of detection
  - Inspection intervals
  - Description of defect geometry
  - Sizing accuracy
  - New technologies (EMAT/s, UT, ...)

- Updated repair technique validation
  - Reliability of repair techniques
  - Complete functional specifications

- Integration of new techniques with current practice

- Budget: 4-4.5 M.Euro

- Partners: operators, inspection & pig vendors, others

Innovation: the added value

- Gas transmission lines
  - W-Europe: > 100,000 km
  - World: > 800,000 km
- Oil transmission lines:
  - W-Europe: > 25,000 km

Suppose:
- 400 kE/km invested
- Innovation leads to 1-2% efficiency improvement (increased lifetime, reduced OPEX, etc)

Total: > 1,000,000 km large transmission lines

Added value
www.gasuniereresearch.nl

P.O.-Box 19
9700 MA Groningen