Who's well protected, feels secure
Prevention is better than cure

Oil and Gas event "**New eMMergy**"

May 27, 2015 Emmen

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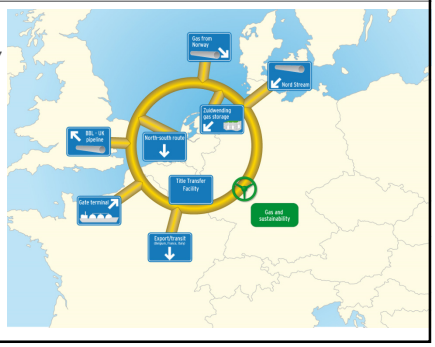

Outline

- **Introduction**
  - About (natural) gas
  - Gasunie Transport Services (GTS)
- Branch standard CEN EN 16348
- Pro-active approach: the iceberg surpassed?
  Determining the effectiveness of protection: barrier performance indicators (bPI's)
- Differences in failure modes
- Impact of "new" gas
- Third party interference
- Conclusions

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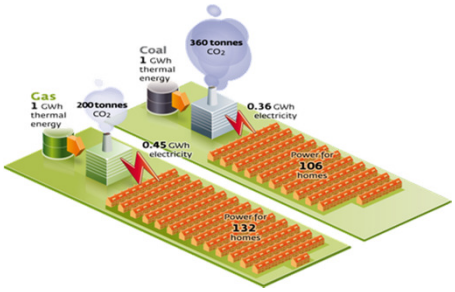
Natural gas: Clean and efficient

- Natural gas is the cleanest fossil fuel
- Less CO^2 emission in the past 10 years thanks to natural gas
- Gas powered plants are cleaner than coal powered plants and produce more energy



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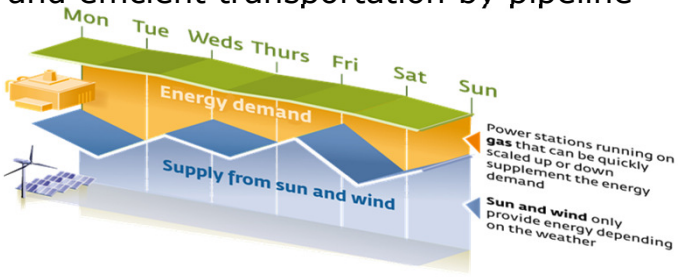
(Natural) gas is part of the sustainability mix

- Energy supply of sun and wind is sustainable, yet volatile
- (Natural) gas can keep the energy supply stable
- Safe and efficient transportation by pipeline



Natural Gas and Electricity Transmission

Gas pipelines offer:

- Lower losses and lower costs of large volume and/or long distance energy transmission
- More energy transportation capacity for different customers in different segments of the energy consumption
- Lower visual impact
- Better and more economic storage options

Source: Clingendael International Energy Programme (CIEP), 2012

Marcogaz members

marcogaz

Technical Association of the European Natural Gas Industry

26 Member Organisations in 21 countries

Missions and Objectives of MARCOGAZ

- Mission
  - To be a major European voice concerning any technical issue of interest for the Gas Industry.
- Main objectives
  - To promote safety, reliability, cost effectiveness, environmental advantages of natural gas systems and appliances.
  - To represent the European Natural Gas Industry towards EU Commission, Parliament, CEN and CENELEC and other European Organisations active in gas, for all technical issues related to transport, distribution, utilisation and environment.
  - Identify, take actions in terms of regulation and technical harmonisation (including standardisation) at European level.

Main topics for Working Group Transmission Pipelines

- Asset management
  - Legal and regulatory developments
  - Application and synergy Q-systems
  - Ageing of pipelines
- Pipeline safety
  - Sharing the evaluation of incidents: causes as well as the way they are dealt with
  - Sharing of policies and practices
    - A.o. Third party interference
  - Sharing of emergency approaches
- Environment
  - Developments regarding external safety
  - Prevention of gas emission

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Gas transmission network

- Total length 12.000 km
- Compressor stations 11
- Blending stations 11
- Metering & regulating stations 84
- Interconnection points 13
- Gas delivery stations 1,300
- Nitrogen installation 1
- Nitrogen storage 1

gasunie transport services April 9, 2015 Screen_10

Mission

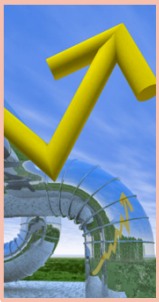
Gasunie is a leading European gas infrastructure company.

We serve the public interest, offer integrated transport and infrastructure services to our customers and adhere to the highest safety and business standards.

We focus on short and long term value creation for our shareholder(s), other stakeholders and the environment.

Strategic pillars

Optimise value of existing assets



Strengthen leading position as cross-border gas infrastructure company

Enable transition towards more sustainable energy usage

Vision

We believe in a sustainable future with a balanced energy mix and a lasting role for diversified gas. We believe that we serve our customers best with innovative gas infrastructure solutions.

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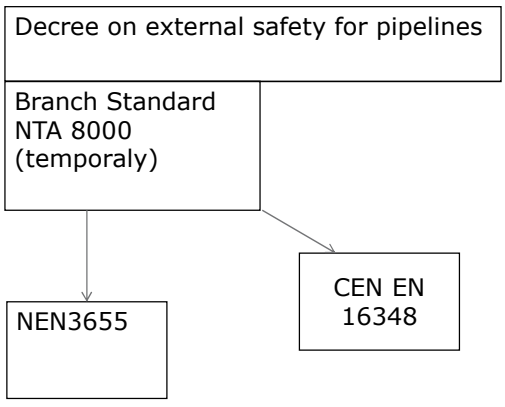
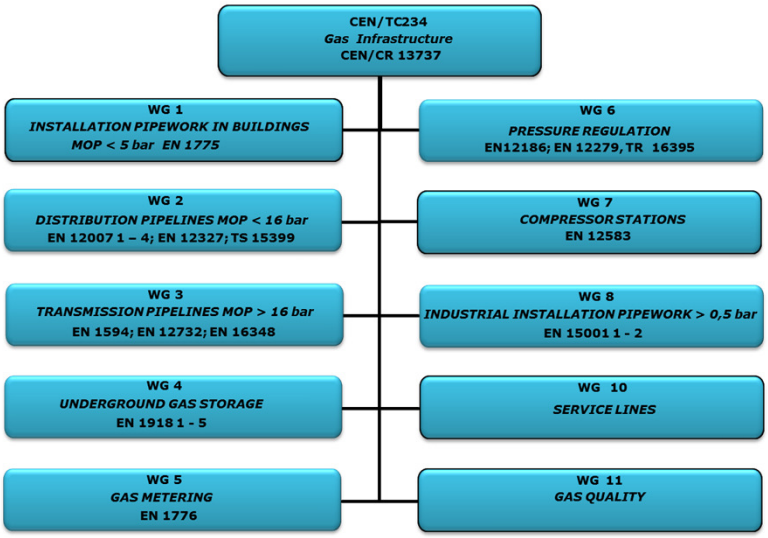
Legal Context and Standardisation



CEN/TC234 working groups



Why EN 16348?

- Pipeline Directive of the EU ⇒ Network Codes for natural gas
- Self regulation
- Obsolete EN TS 15173 and TS 15174.
- CEN Technical Committee 234 ¨Gas Transmission¨, Working Group 3 ¨Pipelines¨ decided to draft an European Standard.
- Participating companies:
  - Desfa, Greece
  - Enagas, Spain
  - Fluxys, Belgium
  - Gasunie, Netherlands
  - GRTgaz, France
  - National Grid, United Kingdom
  - Open Grid Europe, Germany
  - Snam Retegas, Italy
  - Swissgas, Switzerland
  - Marcogaz


EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 16348

June 2013

English Version

Gas infrastructure - Safety Management System (SMS) for gas transmission infrastructure and Pipeline Integrity Management System (PIMS) for gas transmission pipelines - Functional requirements

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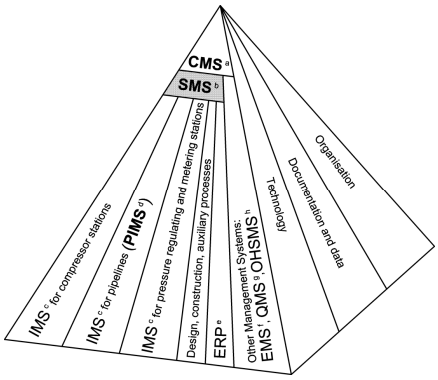
CEN/TC234/WG3 standards related to ISO/TC67/SC2 : PIMS

- Safety management system described in EN 16348 with PIMS as integral part of of the SMS covers the full life cycle of gas infrastructure:
- Design
- Construction
- Operation
- Maintenance
- Abandonment



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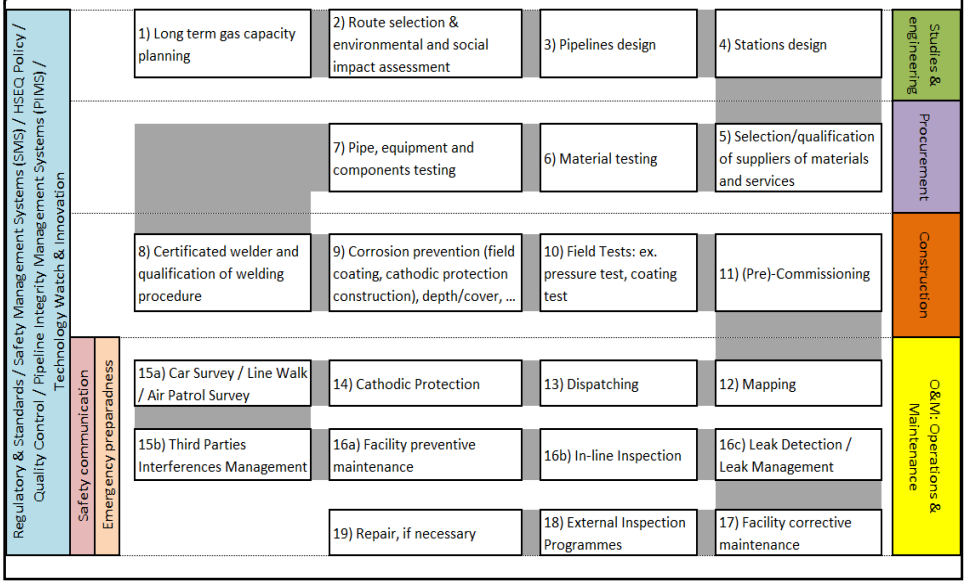
Life cycle insight



Structure of Safety Management System

- Based on existing quality system, e.g. ISO 14001
- Not limited to pipelines, since pipeline organizations usually manage stations/plants as well.
- General structure:

Policy and commitment

Planning (Plan)

Implementation and operation (Do)

- Responsibilities, resources
- People
- Documentation
- Operational control
- Emergency response
- Purchasing
- Innovation

Checking and corrective action (Check)

Management Review (Act)

Implementation and operation of the SMS 4.4

Structure, responsibilities and resources 4.4.1

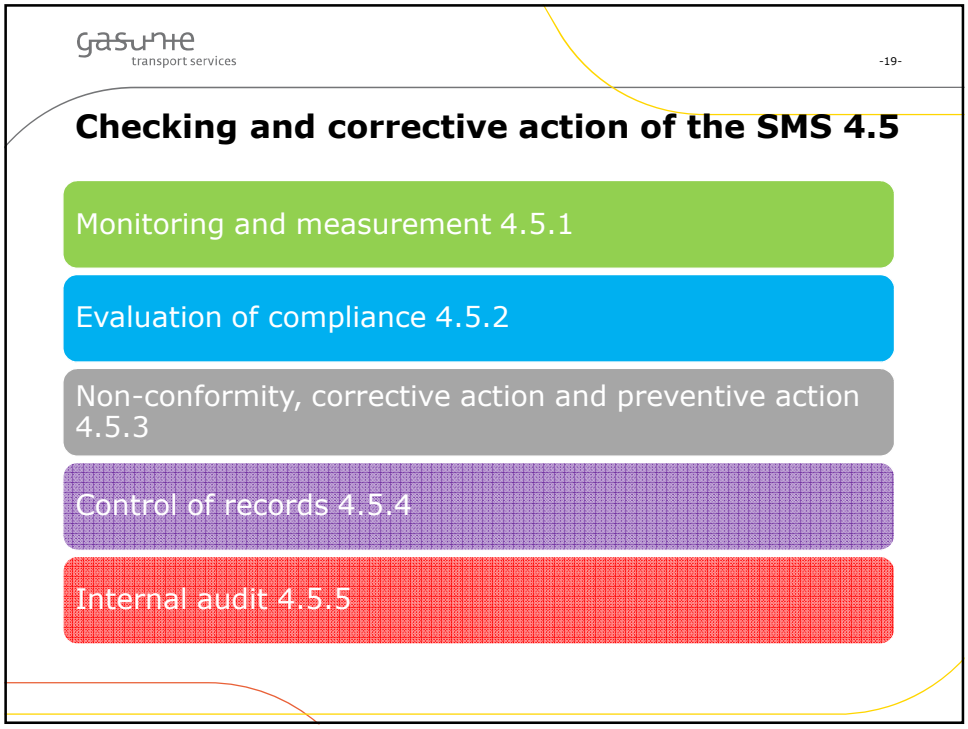
Awareness, training and competence 4.4.2

Communication of the SMS 4.4.3

Documentation of the SMS 4.4.4

Control of Documents 4.4.5

Operational control of the SMS 4.4.6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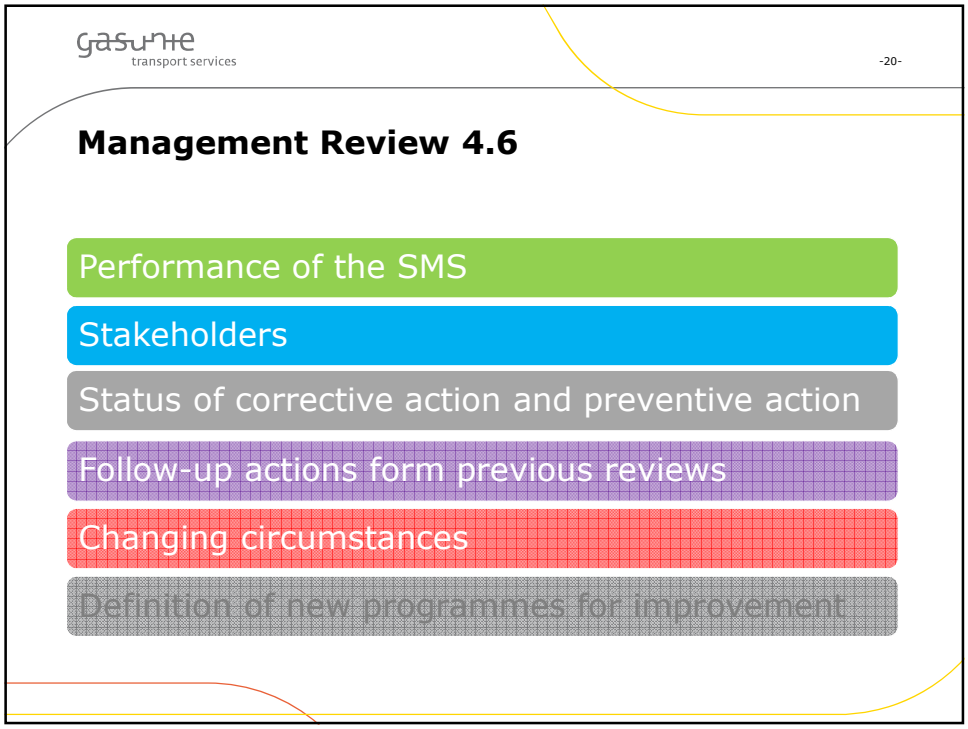
Checking and corrective action of the SMS 4.5
Monitoring and measurement 4.5.1
Evaluation of compliance 4.5.2
Non-conformity, corrective action and preventive action 4.5.3
Control of records 4.5.4
Internal audit 4.5.5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Management Review 4.6
Performance of the SMS
Stakeholders
Status of corrective action and preventive action
Follow-up actions form previous reviews
Changing circumstances
Definition of new programmes for improvement

Reason for PIMS - Scope PIMS

What makes pipelines so special that you need a PIMS:

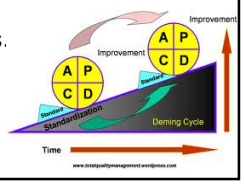
- No direct control of the pipeline route
- No visual inspections possible without excavations.

Scope

- Onshore pipelines
  (but can be under water)
  - Processed natural gas
  - Underground and aboveground
  - Laid in territory of third parties and on own premises.
- PIMS starts after the commissioning of the pipeline
  - PIMS shall take into account the design, materials and construction
  - PIMS shall take into account any shortcomings in the design, materials and construction.

Establish a PIMS

- Pipeline Integrity Management System needs administration.
- Define activities:
  - Gather data and information from your pipelines.
  - List safety aspects/ carry out risk assessements to determine safety aspects.
  - Preparation of PIMS-programmes
  - Application of Integrity programmes
    - *Gathering of integrity data*
    - *Carrying out of methodologies*
  - Monitor results of integrity programmes.
  - Define mitigation measures/ adjustment of integrity programmes.
  - Carry out mitigation/adjust the integrity programmes.



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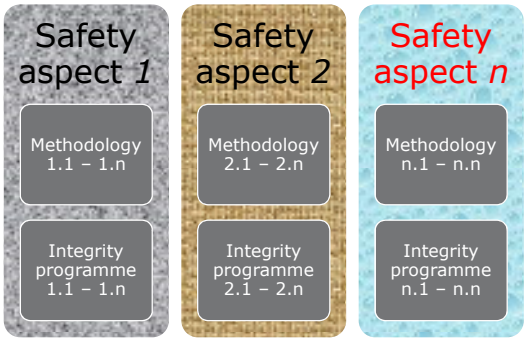
Safety aspects

- Safety aspect is an event which, if not properly managed, can cause a threat to integrity or to safety.
- Systematical approach (QRA, Bow-tie analysis, incident history etc.)



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Deterministic vs. probabilistic

Deterministic approach

- *Sound engineering and applying proper rules is the way to avoid risks. Given this statement risk is no issue.*
- *Detailed safety standards and codes of practices needed.*
- The focus is on good design criteria.
- Residential specific measures are specified in codes of practice.

Probabilistic approach

- *There is always the possibility (probability) of an unwanted effect: zero risk does not exist.* Given this statement the risk is calculated (assessed) as a combination of both the probability of an effect and the consequences of this effect.
- In dense residential areas measures can be taken to make pipelines safer.
- Always additional to deterministic approach.

EU Member States safety regulations use one of both approaches. No EU safety regulations on pipelines.

Within Marcogaz there is no preference and both approaches are considered valuable and "up to (high) standard".

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Deterministic vs. probabilistic

	Deterministic	***Probabilistic***
Transparency	Seems transparent (detailed codes of practices regarding public safety), but what is safe enough?	Looks transparent, but there is a lot of uncertainty in the calculations/methodology
Flexibility	Depends on rules	Good, more safety can be "bought"
Complexity	Detailed codes of practice	Complex calculations
Costs	Depending on design rules	Generally more expensive (additional measures)
Communication	Starting point is "no rist", but accidents do happen	Difficult calculations hard to explain to authorities and public. Victims are "accepted". It can be shown that the risk is very low

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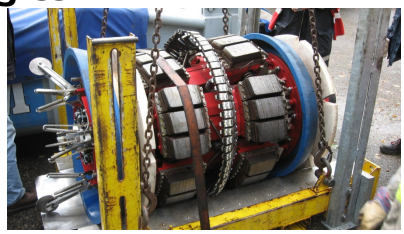
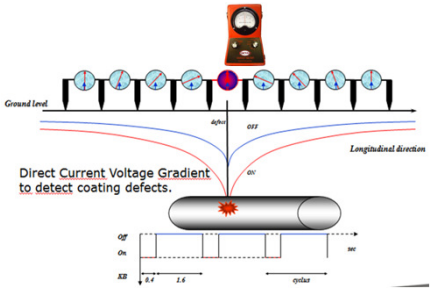
List of common methodologies

- Pipeline route surveillance and inspection 5.4.2.2
- Operational parameter monitoring 5.4.2.3
- Monitoring of cathodic protection performance 5.4.2.4
- Maintenance 5.4.2.5
- Pipeline inspection 5.4.2.6
- Geological surveys 5.4.2.7
- Supervision of activities near the pipeline 5.4.2.8





DCVG switching pattern

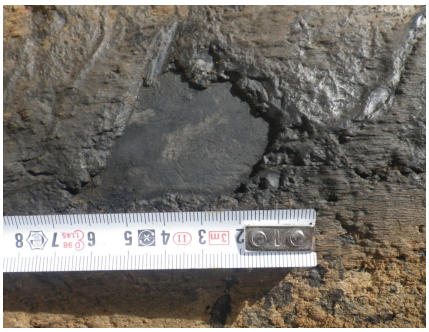
Safety aspects - Integrity programmes, example

Most pipelines are built from carbon steel pipes. Safety aspect is external corrosion.

- Design provides external coating and Cathodic Protection system.
- PIMS methodologies are:
  - coating survey (DCVG)
  - monitoring CP-system
- Integrity programmes are
  - Survey pipeline every five year with DCVG
  - Monitor CP-system continuously.

Safety aspects - mitigation, example

- Integrity assessment (5.5): Coating survey (DCVG) reveals large coating defects.
- Mitigation (5.6). The measure will be: excavate largest coating defects and repair coating.
- Repair of these coating defects reveals lack of quality of field coatings.
- Actions
  - Check repaired field coatings with DCVG one year after repair.
  - Focus future surveys on field coatings of similar quality regime.
  - Improve quality control during construction (future pipeline projects).



Feed back loop

- Findings from incidents, integrity programmes, inspections shall feed back to:
  - Inspection frequencies
  - Integrity programmes (maintenance)
  - Procedures
  - Safety criteria
  - Specification of materials
  - Design and construction specifications
  - Qualification of suppliers and contractors
  - Etc.

LEARNING AND IMPROVING

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The iceberg approach: still very valid

- Top events: KPI's?
- Pro-active PI's? Based on occurrences that could lead to top event, but didn't
- Occurrences are required still!

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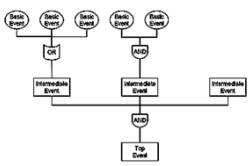
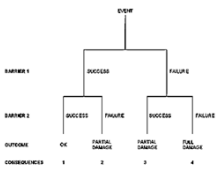
High lighted: Indicators

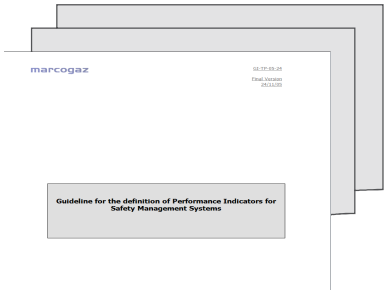
A proper SMS requires the monitoring of (key) performance indicators (ref prEN 16348 par 4.5.1.).

A possible approach is described in Marcogaz "Guidelines for the definition of Performance indicators for SMS".

Failure & Event tree





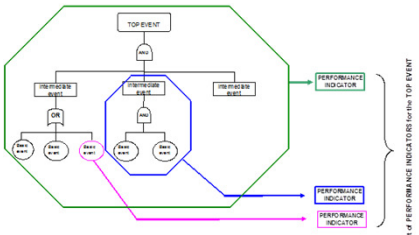


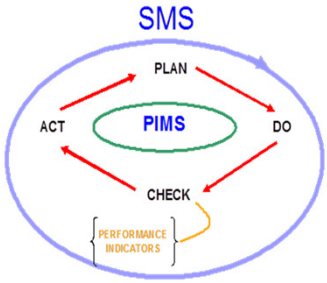
KPI's derived from Fault Tree

KPI's can be derived from several levels in the fault tree;
for example:

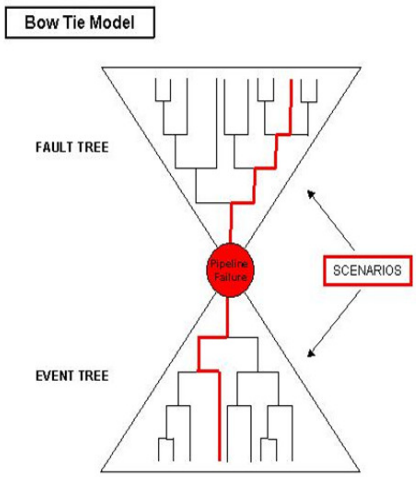
- Global failure rate
- Fail. rate due to several scen.
- Accidents
- Supply interuptions
- Etc.

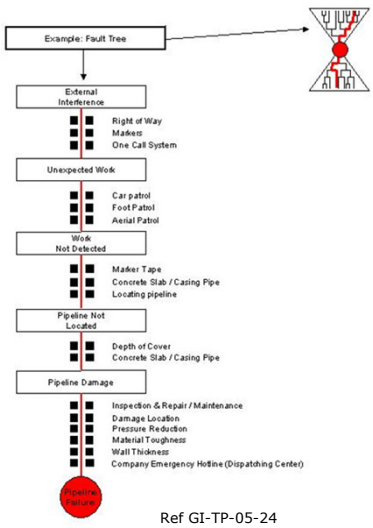
Monitoring, analysing and adjusting accordingly, leads to continuous improvement





Fault and event trees





Ref GI-TP-05-24

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PIMS INTERNATIONAL BV

Background information: The BowTie risk analysis

- Bowtie risk assesment applied on all GTS assets
  - Pipelines (HTL en RTL)
  - HTL sub-surface valves
  - RTL sub-surface valves
  - Compressorstations
  - Blendingstations
  - Exportstations
  - Pressure reduction station (M&R)
  - Gas supply stations (GOS)

Figure 1: Basic Bowtie model

- A BowTie is a diagrammatic illustration of a hazard, the unwanted event, threats and potential outcomes (= consequences)

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PIMS INTERNATIONAL BV

Background information: The BowTie risk analysis

- The basic diagram has been developed (i.e. asset & hazard, the threats and consequences). The effects that have been inventoried are evaluated against the risk topics (e.g. safety, costs, reputation etc.) by using the risk matrix that represents the risk policy of the asset operator.
- The next step in the development of the diagram is the inventory of controls (=barriers, incl. escalations, mitigations and their effectiveness & costs), which will prevent/minimize:
  - The frequency of occurrence of the unwanted event
  - The effect of the consequences that have been inventoried

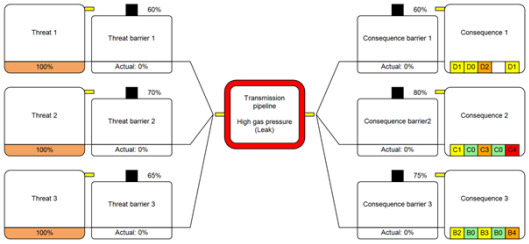

Figure 2: Basic Bowtie model

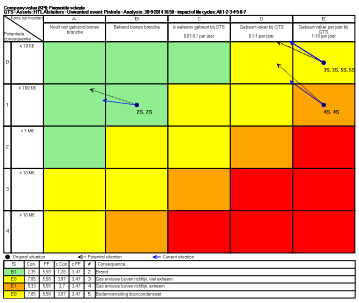

Figure 3: Example risk matrix incl. the potential effect of improvements

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Why use the BowTie

- An obvious performance indicator (usually a KPI) = The frequency of incidents (= unwanted event). However, the frequency of incidents is very low. Measuring these incidents does not provide relevant "control information"
- **Instead:** Finding the triggers that cause the incidents to happen. It requires an in-depth investigation of threats and associated mitigations that are in place to prevent the incident to happen.
- **How:** The bowtie methodology has a special focus on these triggers and as a result might be able to supply all tools to develop a proper set of performance indicators (performance of threat mitigation, that is reduction of the frequency of the unwanted event).

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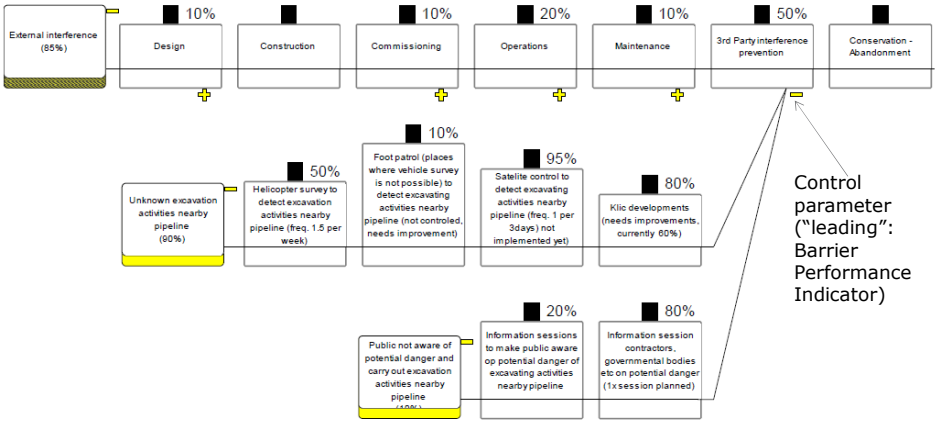
Looking to barriers in more detail

Put control parameters on the barrier values, monitoring the barrier effectiveness instead of the results in terms of event frequency.



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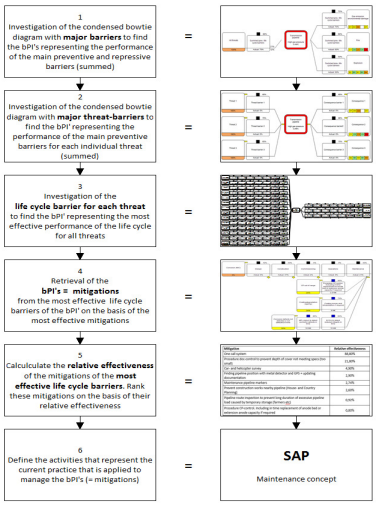
Method BPI derivation from BowTie diagram



Top-down to enable the derivation of high-level Barrier Performance Indicators (BPI's) and to minimize the number of BPI's

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Example derivation process asset: pipeline; unwanted event: leak

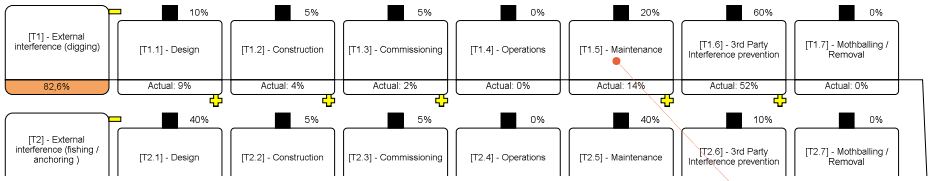
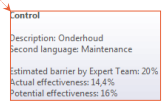


Figure 7: step 3 in derivation process



Life cycle	Barrier value %		
	Actual	Potential	Difference
Design	9,42	9,45	0,03
Construction	4,27	4,87	0,60
Commissioning	1,53	4,25	2,72
Operations	0,00	0,00	0,00
Maintenance	14,4	16,00	1,60
3rd Party interference prevention	52,00	53,93	1,93
Mothballing / removal	0,00	0,00	0,00

Highest improvement potential of all 7 life cycles

Highest improvement potential operational life cycles

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Example derivation process asset: pipeline, unwanted event: leak

Derive the threats and life cycles with highest threat level reduction

Threat	Life cycle	Threat reduction
1. External interference (digging)	3rd Party Interference prevention	42,95%
2. External interference (digging)	Maintenance	11,89%
3. External interference (digging)	Design	7,78%
4. External interference (digging)	Construction	3,53%
5. Corrosion (MIC)	Construction	1,86%
6. External interference (digging)	Commissioning	1,26%
7. Corrosion (MIC)	Maintenance	1,03%
8. External interference (fishing / anchoring)	Design	0,74%
9. Mechanical overload such as subsidence setting etc	Design	0,68%
10. Mechanical overload such as subsidence setting etc	Construction	0,58%
11. Corrosion (Internal corrosion)	Operations	0,50%
12. Corrosion (MIC)	Design	0,45%
13. Corrosion (General)	Maintenance	0,43%
14. Mechanical overload such as subsidence setting etc	3rd Party Interference prevention	0,38%
15. Corrosion (General)	Construction	0,37%

In this example: Focus on operational life phase

	Threat	Life cycle	Threat reduction
1.	**External interference (digging)**	**3rd Party Interference prevention**	**42,95%**
2.	External interference (digging)	Maintenance	11,89%
3.	Corrosion (MIC)	Maintenance	1,03%
4.	Corrosion (Internal corrosion)	Operations	0,50%
5.	Corrosion (General)	Maintenance	0,43%
6.	Mechanical overload such as subsidence setting etc	3rd Party Interference prevention	0,38%

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Example derivation process asset: pipeline, unwanted event: leak

Highest threat level reduction:

- External interference (digging), 3rd Party Interference prevention

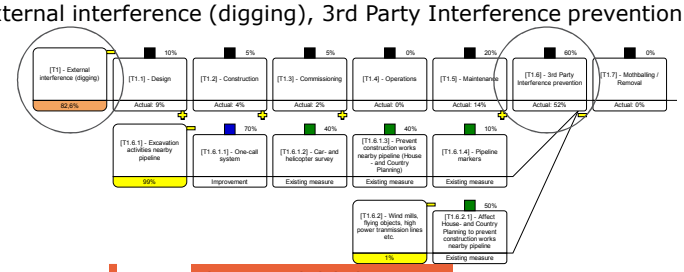

Figure 8: step 4 in derivation process

Sorting the mitigation measures on effectiveness

Mitigation	Relative effectiveness
One call system	88,80 %
Car- and helicopter survey	4,90 %
Prevent construction works nearby pipeline (House- and Country Planning)	2,60 %
Pipeline markers	0,30 %

Values based on total contribution mitigation for all threats and life cycles

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Example derivation process of BPI's External interference Asset: pipeline, unwanted event: leak

BPI = Mitigation	Relative effectiveness BPI
1. One call system	88,80%
2. Procedure doc-control to prevent depth of cover not meeting specs (too small)	21,80%
3. Car- and helicopter survey	4,90%
4. Finding pipeline position with metal detector and GPS + updating documentation	2,90%
5. Maintenance pipeline markers	2,74%
6. Prevent construction works nearby pipeline (House- and Country Planning)	2,60%
7. Pipeline route inspection to prevent long duration of excessive pipeline load caused by temporary storage (farmers, etc.)	0,92%
8. Procedure CP-control. Including in time replacement of anode bed or extension anode capacity if required	0,80%
9. MFL pigrun to detect corrosion defects in time	0,63%
10. ECDA to detect reduced integrity in time	0,62%
11. Pipeline markers	0,30%
12. Cleaning with pig to remove liquid accumulations	0,30%
13. Coating survey and rehabilitation if required	0,23%
14. Gas with deviant composition is either mixed up or closed in upstream	0,08%

The process is iterative for each threat and life cycle

The table gives an overview of the most effective mitigations in the operational phase of the infrastructure of the unwanted event leak

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Example derivation process of BPI's External interference Asset: pipeline, unwanted event: leak

BPI = Mitigation	PI = Activities	Target
1. One call system	Number of incidents due to excavation / ram piling per year with: 1, KLIC Notification: NO 2. KLIC Notification: YES, misinterpretation GTS 3, KLIC Notification: YES, procedure GTS correct	
2. Procedure doc-control to prevent depth of cover not meeting specs (too small)	1. Incidents caused by insufficient depth of cover (number) 2. RTL with depth of cover < 40 cm (km) 3. HTL with depth of cover < 150 cm (km)	
3. Car- and helicopter survey	1. 100* Planned / executed inspections (km)	
4. Finding pipeline position with metal detector and GPS + updating documentation	1. 100* Planned / executed inspections (km) 2. Response time update as built documentation	
5. Maintenance pipeline markers	1. 100* Planned / executed inspections (nr)	
6. Prevent construction works nearby pipeline (House- and Country Planning)	1. Number of changes Development Plan not notified by GTS in time	
7. Pipeline route inspection to prevent long duration of excessive pipeline load caused by temporary storage (farmers etc)	Number of incidents per year with excessive load on pipeline: 1. RTL 2. HTL	
8. Procedure CP-control. Including in time replacement of anode bed or extension anode capacity if required	1. 100* Planned / executed measurements per year 2. Percentage of CP-measurements per year not meeting specs	
9. MFL pigrun to detect corrosion defects in time	1. 100* Planned / executed inspections (km) 2. Number of detected defects with pig requiring repair 3. Number of MIC defects detected 4. Costs pigruns / km 5. Response time execution repair 6. Corrosion rate based on rerun incl. standard deviation	
10. ECDA to detect reduced integrity in time	1. 100* Planned / executed inspections (km) 2. Capacity requirements ECDA (manhr/km)	
11. Pipeline markers	1. 100* Planned /executed marker inspections (wo-orders)	
12. Cleaning with pig to remove liquid accumulations	1. Number of cleaning runs 2. Volume of liquid removed with cleaning pigs	
13. Coating survey and rehabilitation if required	1. Number of coating surveys 2. Number of rehabilitations required per km	
14. Gas with deviant composition is either mixed up or closed in upstream	1. Number of times gas with deviant composition (too wet)	

Operational PI's defined on the basis of the most effective BPI's in the operational phase of the unwanted event leak

Setting targets

Apply PI approach on corrosion (simple representation)

- Top event is loss of containment
  - Can be found using leak detection
- Caused by loss of metal
  - Can be found using ILI
  - And corrected if required
- Due to corrosion
- Enabled by insufficient coating or CP
  - Can be found using ECDA

Outline

- Introduction
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- **Differences in failure modes**
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- Third party interference
- Conclusions

http://www.egig.eu/uploads/bestanden/ba6dfd62-4044-4a4d-933c-07bf56b82383
Figure 18: Primary failure frequencies per cause (5-year moving average)

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Figure 19 Relation primary failure frequency, cause and size of leak (1970-2013)

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Verification excavation ECDA RTL

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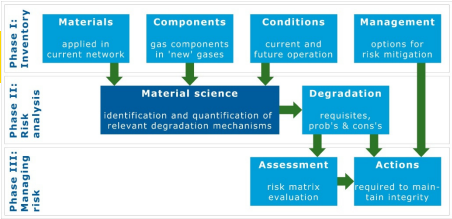
New gas impact on integrity: Project set-up

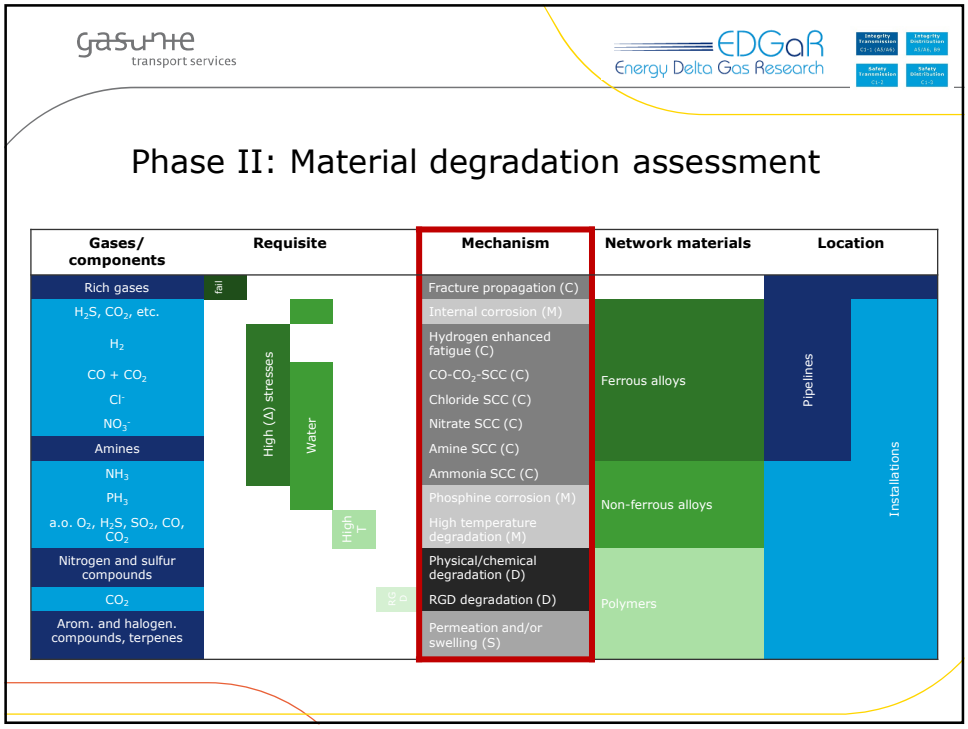
EDGaR Energy Delta Gas Research

- Two-fold approach:
  - Application of existing material science related and industry borne knowledge to the Dutch gas transmission situation
  - Modelling to extend existing knowledge and predict seriousness mechanisms given specific circumstances
- No experiments foreseen
  (but KIWA performed exposure experiments)



Research questions

1. Deterioration of grid and network parts
2. Possible mitigation measures
3. Future gas/energy market changes
4. Admission of hydrogen (t)
5. Underground storage
6. Liquid water (a)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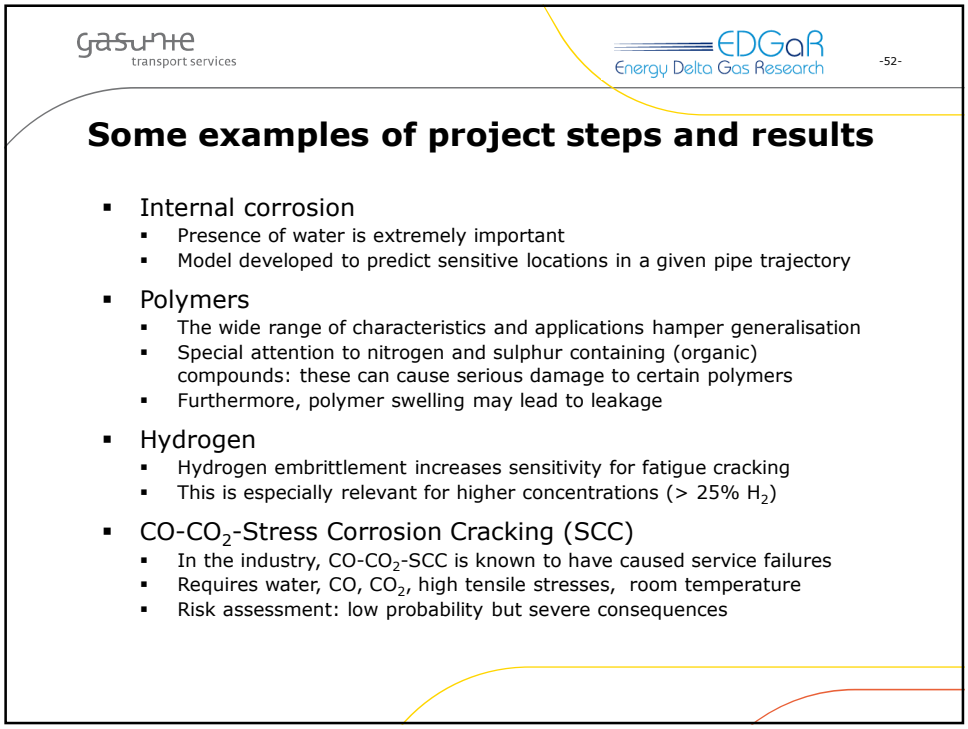
EDGaR Energy Delta Gas Research
Phase II: Material degradation assessment
Gases/ components
Requisite
Mechanism
Network materials
Location
Rich gases
H2S, CO2, etc.
H2
CO + CO2
Cl-
NO3-
Amines
NH3
PH3
a.o. O2, H2S, SO2, CO, CO2
Nitrogen and sulfur compounds
CO2
Arom. and halogen. compounds, terpenes
fail
High (Δ) stresses
Water
High T
inc c
Fracture propagation (C)
Internal corrosion (M)
Hydrogen enhanced fatigue (C)
CO-CO2-SCC (C)
Chloride SCC (C)
Nitrate SCC (C)
Amine SCC (C)
Ammonia SCC (C)
Phosphine corrosion (M)
High temperature degradation (M)
Physical/chemical degradation (D)
RGD degradation (D)
Permeation and/or swelling (S)
Ferrous alloys
Non-ferrous alloys
Polymers
Pipelines
Installations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Some examples of project steps and results
Internal corrosion
Presence of water is extremely important
Model developed to predict sensitive locations in a given pipe trajectory
Polymers
The wide range of characteristics and applications hamper generalisation
Special attention to nitrogen and sulphur containing (organic) compounds: these can cause serious damage to certain polymers
Furthermore, polymer swelling may lead to leakage
Hydrogen
Hydrogen embrittlement increases sensitivity for fatigue cracking
This is especially relevant for higher concentrations (> 25% H2)
CO-CO2-Stress Corrosion Cracking (SCC)
In the industry, CO-CO2-SCC is known to have caused service failures
Requires water, CO, CO2, high tensile stresses, room temperature
Risk assessment: low probability but severe consequences

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Overview of the findings

- The risk of the transporting new gases should be manageable for a prudent transmission operator, though not necessarily at zero cost

- The investigation revealed that with admission of new gases:
  - Knowledge of sensitivities of both metals and polymers to 'new' gas components is vital
  - The amount of integrity monitoring and inspection may possibly need to be increased
  - An increase of repairs and replacements, specifically of polymer parts may be expected
  - Furthermore, putting (local) constraints to operating conditions may not always be ruled out

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Main recommendations

- A general focus on prevention, primarily on inhibiting water (with or without glycol)
- Limiting integrity threatening components to enter the system
- Controlled removal (of water and/or components) by the producer and active monitoring and control by the system operator

Outline

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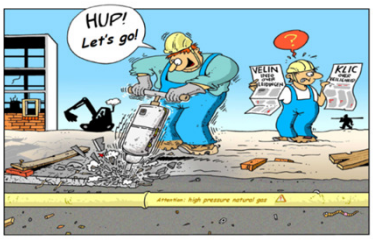
- **Third party interference**
- Conclusions



A lot of effort in prevention of third party interference

The Marcogaz best practices inventory enables the TSO to benchmark itself to best practices in the branch

marcogaz
TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY

GI-TP-07-24
08/05/2015 Final

THIRD PARTY INTERFERENCE BEST PRACTICE SELFASSESSMENT

1. INTRODUCTION

This document has been prepared by as a guide by MARCOGAZ; it is intended to assist pipeline companies in reviewing the systems they have in place to manage the risks associated with third party interference. It is intended for internal use as a benchmarking tool for the prudent gas pipeline operator.

Just over 50 % of all incidents recorded by EGIG are due to third party interference. Although European gas operators already have a number of measures in place to minimise the likelihood of third party interference, third party interference continues to be a major threat to buried gas pipelines. It is therefore appropriate that gas pipeline operators continue to monitor the systems they have in place in order to identify whether there are any further improvements in their management systems that can be made.

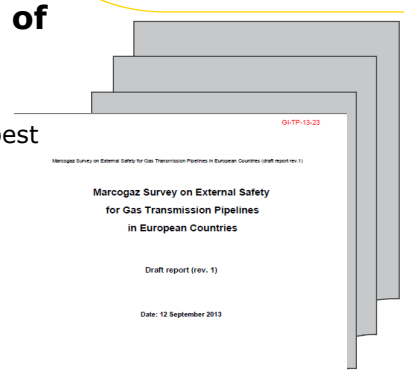
The identified best practices are based on:

a) The output from a benchmarking exercise carried out by MARCOGAZ in 2006;

b) Requirements of relevant current industry standards including EN 1594;

c) Requirements of EN 16348 "Safety Management System (SMS) for gas transmission infrastructure and Pipeline Integrity Management System (PIMS) for transmission pipelines";

d) Initiatives currently being undertaken, in addition to a), b) and c) above, by MARCOGAZ Member Companies.


GI-TP-13-23

Marcogaz Survey on External Safety for Gas Transmission Pipelines in European Countries (draft report rev.1)

Marcogaz Survey on External Safety for Gas Transmission Pipelines in European Countries

Draft report (rev. 1)

Date: 12 September 2013

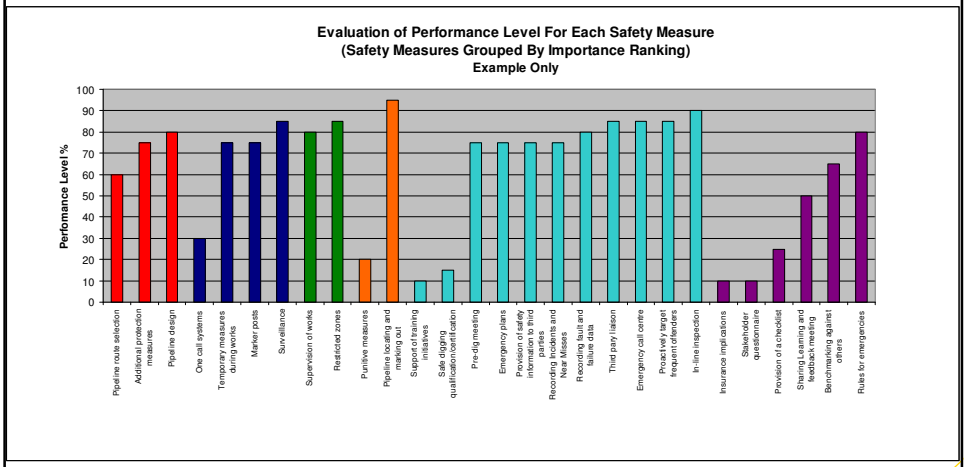
A comparison of regulation and practices in participating countries

Example of safety measures

Type of Measure	Safety Measure	Signifi-cance	Impact	Overall Importance
Monitoring and routine maintenance				
Physical	**Marker Posts** Signs are installed and maintained to indicate the presence of a buried pipeline and include the pipeline operators contact details	1	2	B
Physical	**Surveillance** Pipeline routes are surveyed by air, patrols on foot or by car	1	2	B
Physical	**Satellite Surveillance (not yet in place)** As an alterative for helicopter survey, pilots for satellite surveillance are under construction. No operational application known yet.	3	3	F
Physical	**Acoustic Monitoring** Specifically in close neighbourhood of, or at construction sites, acoustic signalling equipment can detect pipeline damage at the moment of occurance.	3	3	F

Several types of measures:
- Technical
- Managerial
- Physical
- Legal

Example of scoring safety measures

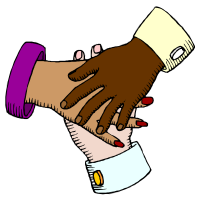


Reducing third party interference further

Cannot be done on our own: This needs to be a joint effort!

Although Gas Pipeline Operators can contribute to tackling the problem of third party interference, a large part of the activities occurring in the vicinity of pipelines are outside of their control.

The focus of any new legislation should therefore be on improving awareness of buried utility infrastructure and controlling the competence of the individuals carrying out excavation work in the vicinity of high-pressure pipelines.



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- Third party interference
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Conclusions

- A comprehensive Safety management System helps the asset manager and operator to manage the integrity of its network transparantly, in a structured way
- Control and improvement of barrier performance do contribute to a proactive risk mitigation. Further development is recommended, danger can be lack of focus (drowning in data)
- ECDA is not a substitute for ILI. It can however, increase the resistance of the pipeline against corrosion significantly.
- The risk of the transporting new gases is manageable for a prudent transmission operator, though not necessarily at zero cost or without restriction
- Third party interference is still the major threat and reducing it is a shared responsibility

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Thank you for your attention

That's hard to catch, getting so tired of it…

I feel fine…

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