

# **A Direct Assessment Module for Pipeline Integrity Management at Gasunie**

Menno van Os

Piet van Mastrigt

23<sup>rd</sup> World Gas Conference  
Transmission, WOC 3  
Safety; Incident Databases

# Overview

- Introduction PIMSlider
- External Corrosion Direct Assessment (ECDA)
- DA-module PIMSlider
- Conclusions
- Acknowledgements

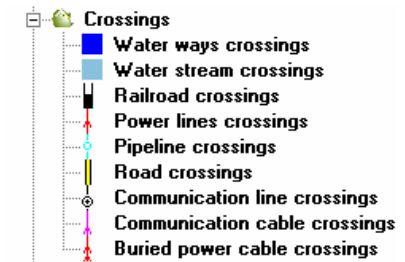
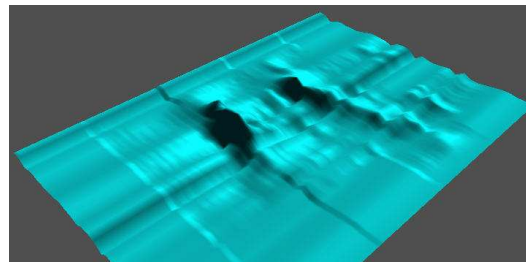
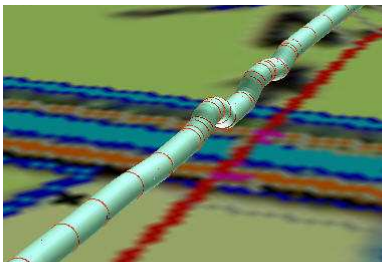
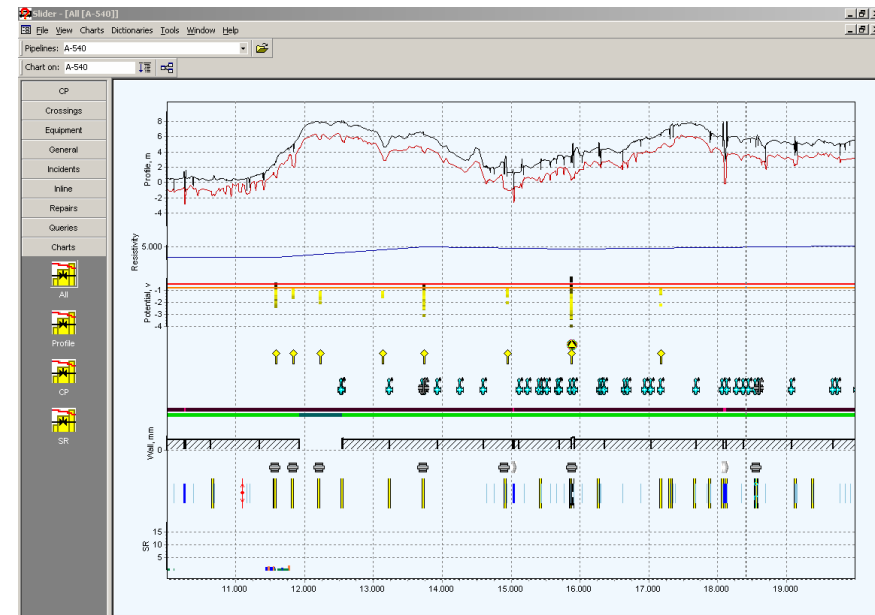
# Introduction PIMSlider

- Datamanagement

# Introduction PIMSlider

Full integration of all essential pipeline data:

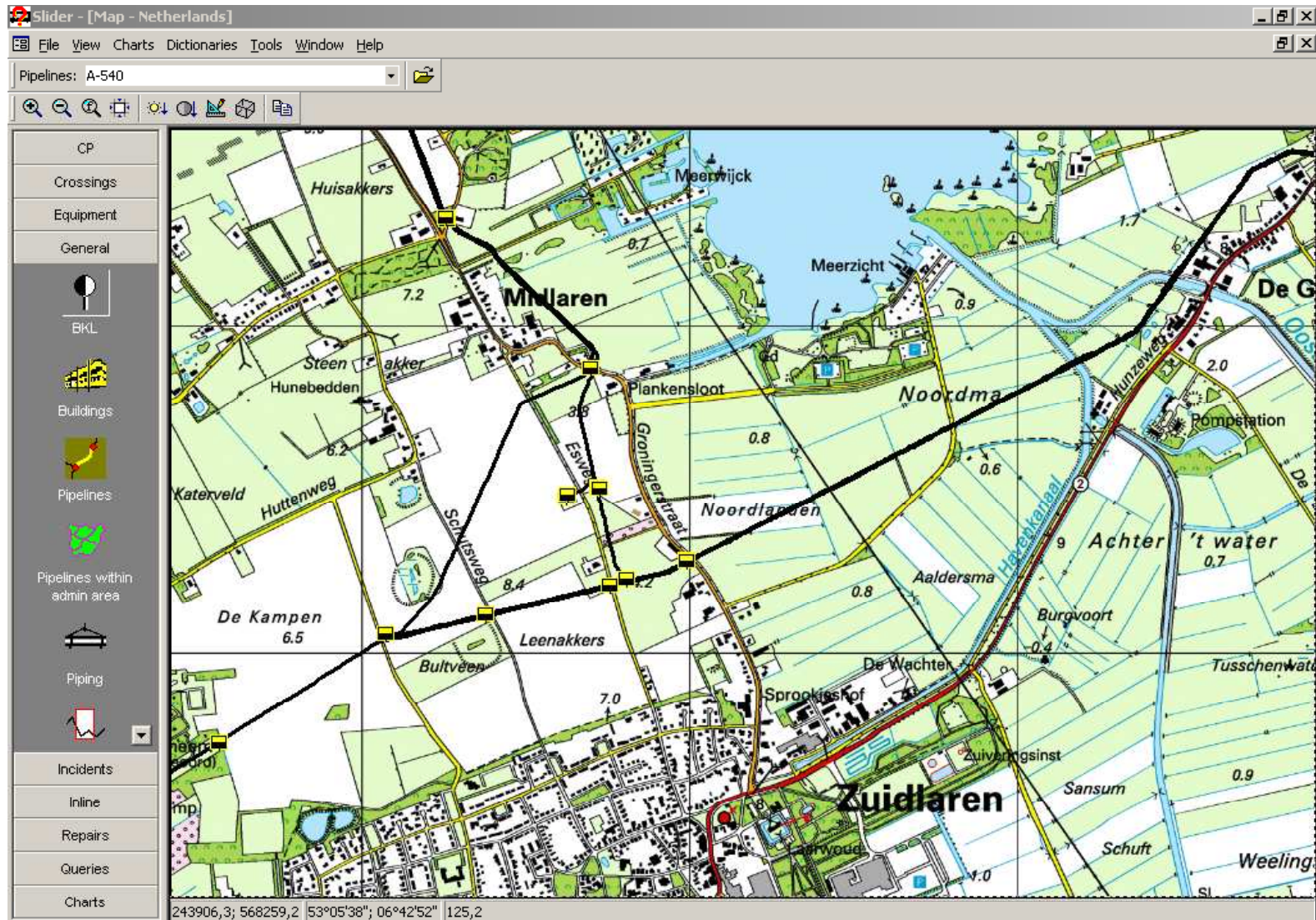
- Earth profile, depth of cover
- CP posts and trend graphs
- Pipeline characteristics at any point
- Crossings
- Nearby objects
- Inspection data (MFL runs, surveys)
- Linked to GIS environment
- Raw data strength calculations
- Pipeline view (3D)



# Introduction PIMSlider

- Datamanagement
- Presentation of topology

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# Introduction PIMSlider

Rehabilitation Expert: Pipeline Sappemeer-Oldeboorn - [Runs comparing]

Pipelines Compare Defects ADC Repairs Settings Mode Reports Window

Run #1 SAPPMEER-OLDEBOORN (Rosen) (main, 0-70000) Run #2 SAPPMEER-OLDEBOORN (Tuboscope) (main, 0-70000)

Distance(m)	#	Description	Length(mm)	Distance(m)	#	Description	Length(mm)
13.85	30	weld	1360	0.22	2	weld	1360
15.21	40	weld	4225	0.88	3	weld	790
19.43	50	weld	232	8.86	4	weld	1360
19.67	60	weld	8033	10.23	5	weld	4225
27.70	70	weld	903	14.32	6	weld W/T Transio	1360
28.60	80	weld	8297	15.62	7	weld W/T Transio	4225
36.90	90	weld	767	19.75	8	weld W/T Transio	232
37.67	100	weld	12029	20.02	9	weld W/T Transio	8033
49.70	110	weld	11926	28.29	10	weld 3D Bend	903
61.62	120	weld	8331	29.02	11	weld	8033
69.95	130	weld	12253	37.29	12	weld 3D Bend	903
82.21	140	weld	12159	38.01	13	weld	12029
94.36	150	weld	8235	50.11	14	weld	11926
102.60	160	weld	8194	62.05	15	weld	8331
110.79	170	weld	3555	70.39	16	weld	12253
114.35	180	weld	9781	82.67	17	weld	12029
124.13	190	weld	11682	94.83	18	weld	3555

Features comparison

SAPPMEER-OLDEBOORN (Tuboscope) (main, 0-70000)

SAPPMEER-OLDEBOORN (Rosen) (main, 0-70000)

Features

- #23: Metal loss [circ. grooving, corrosion]  
ext  
Length(mm): 28  
Width(mm): 139  
Angle: 105  
Loss(%): 16
- #20: Metal loss [general, corrosion]  
ext  
Length(mm): 65  
Width(mm): 85  
Angle: 115  
Loss(%): 14
- #16: Metal loss [circ. grooving, general, corrosion, further indi.]  
ext  
Length(mm): 83  
Width(mm): 722  
Angle: 35  
Loss(%): 19

Records total: 6230

Start Verzonden i... Slider Microsoft Po... Archives 2 Microsoft Outlook Projectspec... Rehabilitat... 14:26

# Introduction PIMSlider

- Datamanagement
- Presentation of topology
- Monitoring, analyses and modelling of CP
- Analyses of MFL pigrun results, pigrun comparison
- Risk calculations (individual and group risk)

# Introduction PIMSlider

The screenshot displays the PIMSlider software interface. The main window shows a map of Workum, Netherlands, with a pipeline route highlighted in red. The map includes labels for 'Strand', 'Workum', 'N359', 'Westerein', 'Polde', 'Wm', 'Gden Sl', 'Nijhuizur', and 'Mor'. The pipeline route is marked with various values such as 0.3, 0.4, 0.5, 1.2, 4.5, and -1.2.

On the right side, there is a table with the following data:

Diameter (mm)	914	
Residents/workers	RQ_10	RQ_35
Radius (m)	389	177
Residents	576.0	34.0
Workers	252.0	9.0
Victims	Day	Night
Total	34.1	34.2
Indoors	30.5	33.7
Outdoors	3.6	0.5

Below the map, there is a 'What if... [A-545, 34136m]' window with four plots:

- Individual risk (year<sup>-1</sup>)**: A log-linear plot showing risk vs. distance (m).
- Lethality**: A log-linear plot showing lethality vs. distance (m).
- Heat radiation (kW/m<sup>2</sup>)**: A linear plot showing heat radiation vs. distance (m).
- Societal risk F(N)**: A log-log plot showing societal risk vs. distance (m).

At the bottom right, there is a parameter table:

Diameter (mm)	914	914
Wall thickness (mm)	12,86	12,86
Depth of cover (m)	2,41	2,41
Pressure (bar)	66,2	66,2
Material grade	56,0	56,0
Type of pipeline protection	Concrete barrier + Warning types	
None		
<input checked="" type="checkbox"/> Wall thickness depend on Diam		
Mean outflow (kg/s)	4985,1	4985,1
Failure frequency	2,03e-8	6,1e-7
Number of victims	34,1/34,2	34,1/34,2
Relative societal risk	0,00	0,08

The bottom status bar shows 'Start', 'PipeSafe Lite', 'PSL-6 - Paint', and the time '16:52'.

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- Datamanagement
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- Risk calculations (individual and group risk)
  
- Direct Assessment
- Optimization of business economics

# External Corrosion Direct Assessment

- Total length gas transmission grid 11,600 km
  - HTL: 40-66 bar, > 18", piggable 6,000 km
  - RTL: 8-40 bar, ≤ 18", not piggable 5,600 km
- NACE RP0502-2002
- Goal: to prevent external corrosion defects from growing to a size large enough to impact the structural integrity of a pipeline
- The ECDA process consists of 4 steps:
  1. **Pre-Assessment:** collect and review historical and current data of pipeline
  2. **Indirect Inspection:** perform aboveground surveys to determine where threats to pipeline integrity exist
  3. **Direct Examination:** excavate locations identified in step 2 to determine and characterize the extent of corrosion anomalies
  4. **Post Assessment:** determine mitigation activities and future inspection intervals

# External Corrosion Direct Assessment

- Data collected in ECDA is subject to uncertainties:
  - Number of defects (DA-techniques versus ILI)
    - Probability of detection
    - Probability of false indication
  - Corrosion rate / size of defects
  - Tolerance of pipeline to defects
- Quantitative methodology (SRA) to account for uncertainties associated with ECDA
- Pipeline integrity is quantified by calculating and updating the **failure frequency**
- Cost effective: minimize number of excavations

# DA-module: pre-assessment

## 1. Data collection and visualization

# DA-module: pre-assessment

Category	Data elements
Pipe-related	<ul style="list-style-type: none"><li>• Material and grade</li><li>• Diameter</li><li>• Wall thickness</li></ul>
Construction-related	<ul style="list-style-type: none"><li>• Year installed</li><li>• Year of route change/modification</li><li>• Locations of valves, clamps, supports, taps, couplings, insulating joints etc.</li><li>• Locations and material of casings</li><li>• Depth of cover</li><li>• Underwater sections; river crossings</li><li>• Locations of river weights and anchors</li></ul>
Soils/environmental	<ul style="list-style-type: none"><li>• Soil characteristics/types, including<ul style="list-style-type: none"><li>➢ Type of soil (e.g. presence of peat, anaerobic soils)</li><li>➢ Electrical influence (e.g. proximity of DC railways, AC power lines)</li><li>➢ Pollution</li></ul></li><li>• Drainage</li><li>• Land use (e.g. paved roads)</li></ul>
Corrosion control	<ul style="list-style-type: none"><li>• Locations of rectifiers</li><li>• Test point locations</li><li>• Type of coating</li><li>• CP survey data/history</li></ul>
Operational data	<ul style="list-style-type: none"><li>• Pipe inspection reports, excavation reports</li><li>• Repair history/record (e.g. repair sleeves, repair locations)</li><li>• Data from previous aboveground surveys</li><li>• Inline inspection data</li></ul>



# DA-module: pre-assessment

1. Data collection and visualization
2. Identification of ECDA regions with similar:
  - physical characteristics
  - corrosion history and/or future corrosion conditions
  - indirect inspection tools

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  - defect depth
  - corrosion rate
  - material properties, geometry pipeline etc.

## DA-module: pre-assessment

1. Data collection and visualization
  2. Identification of ECDA regions with similar:
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    - corrosion history and/or future corrosion conditions
    - indirect inspection tools
  3. Estimate prior condition of pipeline by determining prior distributions for:
    - number of coating and corrosion defects
    - defect depth
    - corrosion rate
    - material properties, geometry pipeline etc.
- ☺ Automatic retrieval of data from pipelines with similar specifications or environmental conditions

# DA-module: indirect inspections

## 1. Data storage

- DCVG
- CIPS
- Wenner
- dGPS



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- IR-free potential

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2. Data processing, interpretation and visualization
  - Corrections for depth of cover, soil resistivity etc.
  - IR-free potential
3. Priority list for excavations
4. Update condition of pipeline
  - Number of coating and corrosion defects
  - Bayesian statistics

## DA-module: direct examination

1. Excavate locations identified by DCVG and CIPS to determine and characterize the extent of the corrosion anomalies

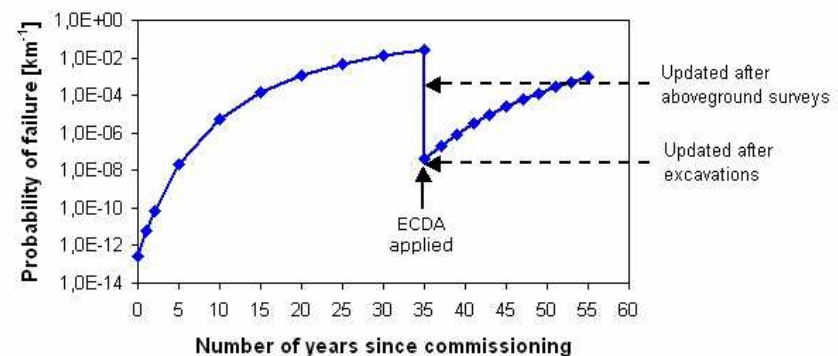
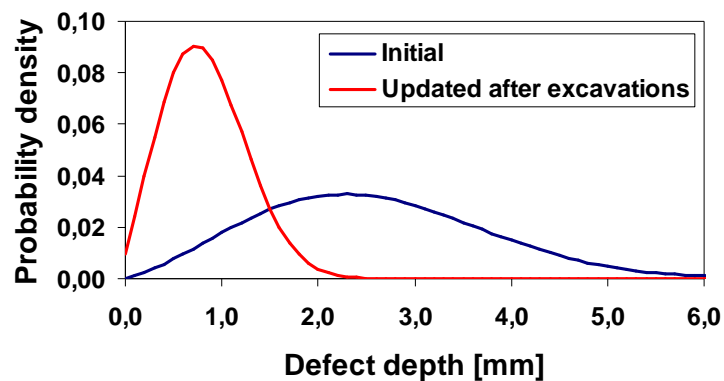


## DA-module: direct examination



# DA-module: direct examination

1. Excavate locations identified by DCVG and CIPS to determine and characterize the extent of the corrosion anomalies
2. Update condition of pipeline
  - Survey characteristics
  - Number of coating and corrosion defects
  - Defect depth and length
  - Corrosion rate
  - Failure frequency



## DA-module: post-assessment

1. Calculate failure frequency for all failure modes considered

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## DA-module: post-assessment

1. Calculate failure frequency for all failure modes considered
2. Assess overall effectiveness of ECDA
3. Define reassessment interval

# Conclusions

- SRA & Bayesian statistics enables quantification of ECDA:
  - Prior knowledge of Integrity
  - Update knowledge based on survey data
  - Update knowledge based on excavations
  - Establish strategy for collection of further data (more excavations) if required
- The DA-module enables automatic updating of numbers and sizes of defects after surveys and excavations
- Updating after each excavation, thus minimizing overall cost
- Implementation finished in December 2006

## Acknowledgements

- Andrew Francis and Associates
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For more information please visit the Gasunie stand...

**3-300/3-301**