A decision support tool for best possible coating selection during trenchless pipe installations

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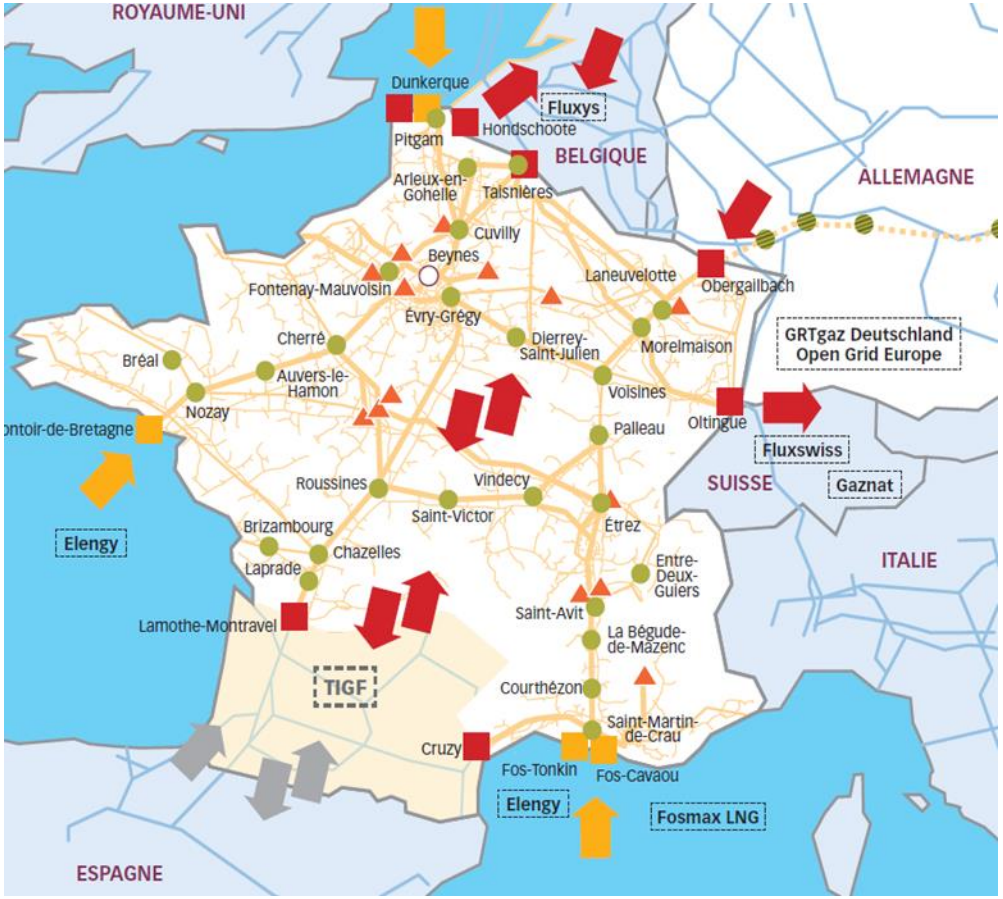
GRTgaz in brief

The longest high-pressure transmission network in Europe:

- 32 000 km of pipelines
- 26 compressor stations
- 9 interconnections with foreign networks

Figures (2016):

- 2916 employees
- Transported gas 463,5 TWh
- € 1,993 billion net sales
- € 0,6 billion investment



GRTgaz in brief

New routes in France

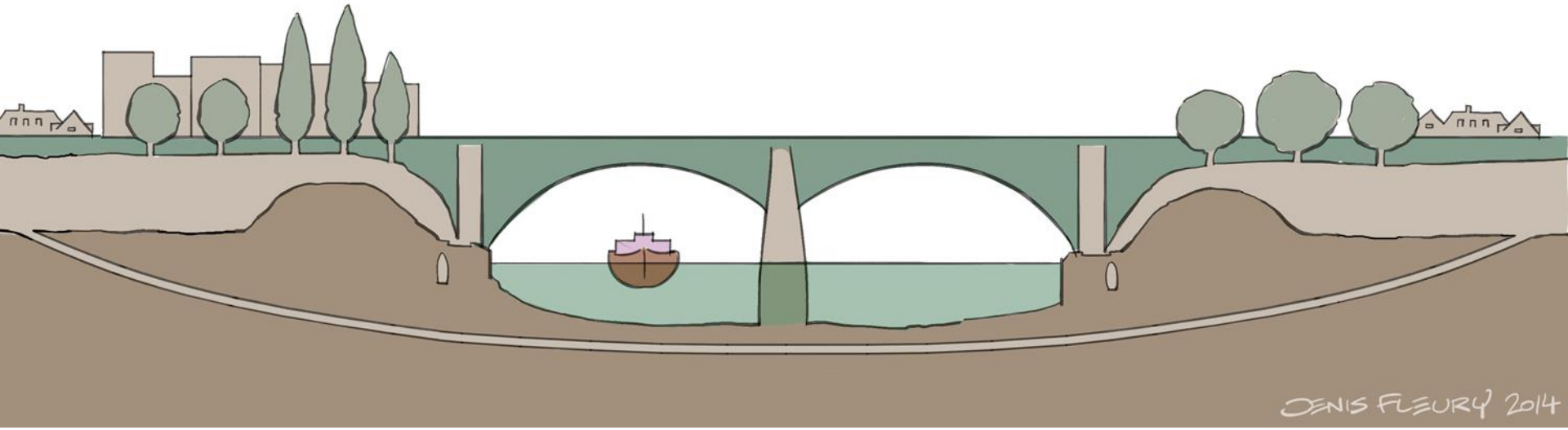
GRTgaz conducts its development and modernisation programmes in close collaboration with all parties involved and endeavours to ensure the region receives as many of the economic and social benefits as possible.

Planning routes with the least possible impact and optimising local integration

Purpose of trenchless techniques

During construction, it is not always possible to use conventional techniques for laying a pipeline. Therefore, a trenchless technique is used to cross some obstacles such as:

- Rivers, canals,
- Highways,
- Railways.



Purpose of trenchless techniques

Drilling Process

Pilot Hole
- Small diameter
- Along a designed directional path

Pre-reaming
- Enlarging the pilot hole according to the pipeline diameter

Pull back
- Pulling the pipeline back into the enlarged hole

Purpose of trenchless techniques

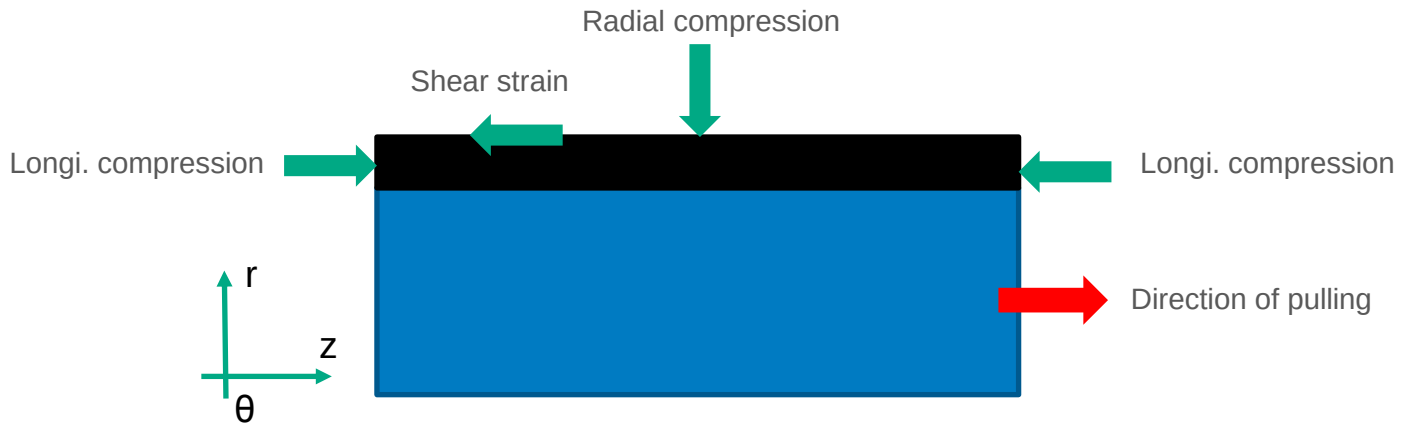
GRTgaz feedback

- In the past, GRTgaz used a conservative method assuming that the more coating you apply, the more resistance you achieve.
- This method doesn't take in account stresses coming from drilling path and soil characteristics.
- Several failures observed onsite → Loss of money

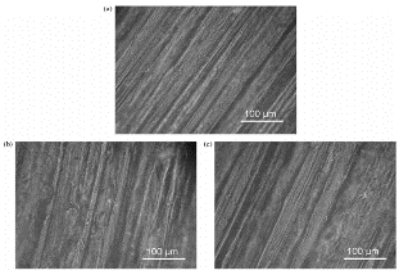
Risks associated

Type of failures

- Failure at the interface due to shear stress while pulling



- Abrasion while pulling



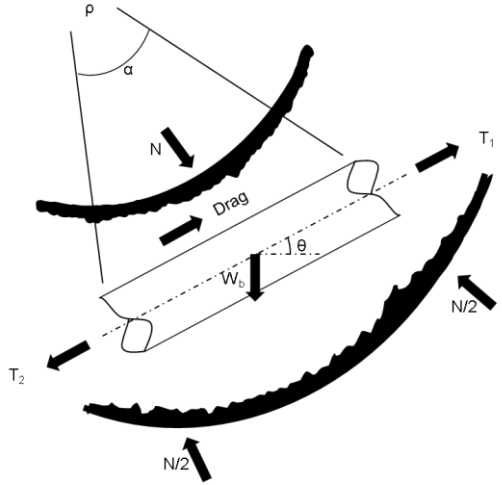
Risks associated

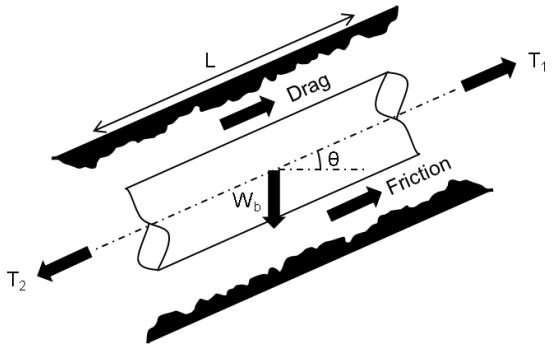
Type of failures

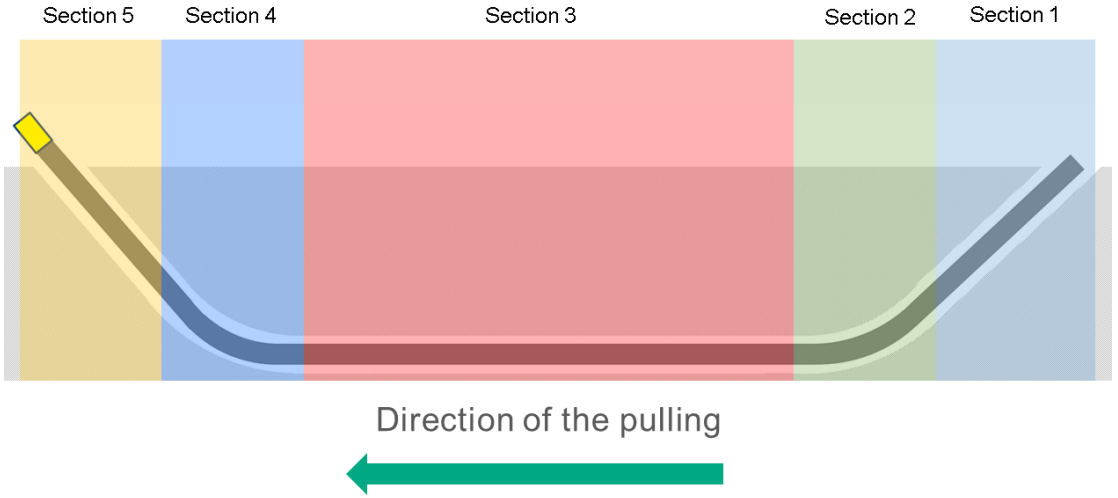
- Cracking due to high internal stresses due to:
  - Internal residual stresses from the coating mill
  - Traction/compression stresses coming from the drilling path: **Bending of the pipe and contacts with the hole walls**
- Defects at field joint due to the geometry of the coating

Analyses of stresses

- Discretization of the drilling path
- Calculation for each section







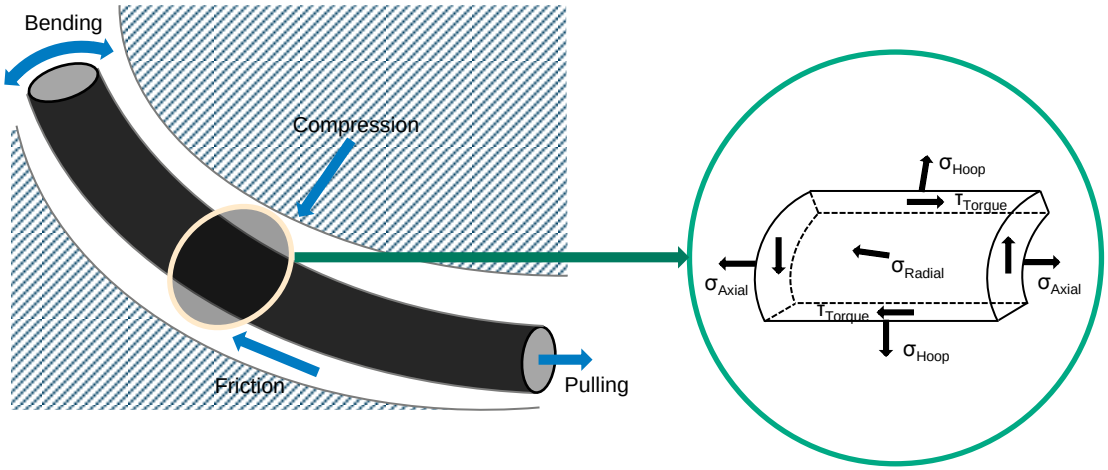
Analyses of stresses

- Each step of the pipeline lifetime is evaluated:
  - Installation
  - Hydraulic test
  - Operation
- For each step, all stresses involved are reported

Stress	Scenario			Comments
	Installation	Hydraulic test	Operating	
Traction	✓	✘	✘	Due to pulling force
Bending	✓	✓	✓	Due to the drilling path
External pressure	✓	✓	✓	Pressure due to fluid density
Internal pressure	✓	✓	✓	Hydrostatic pressure due to ballast
Thermal expansion	✘	✘	✓	Temperature variation

Loads and stresses

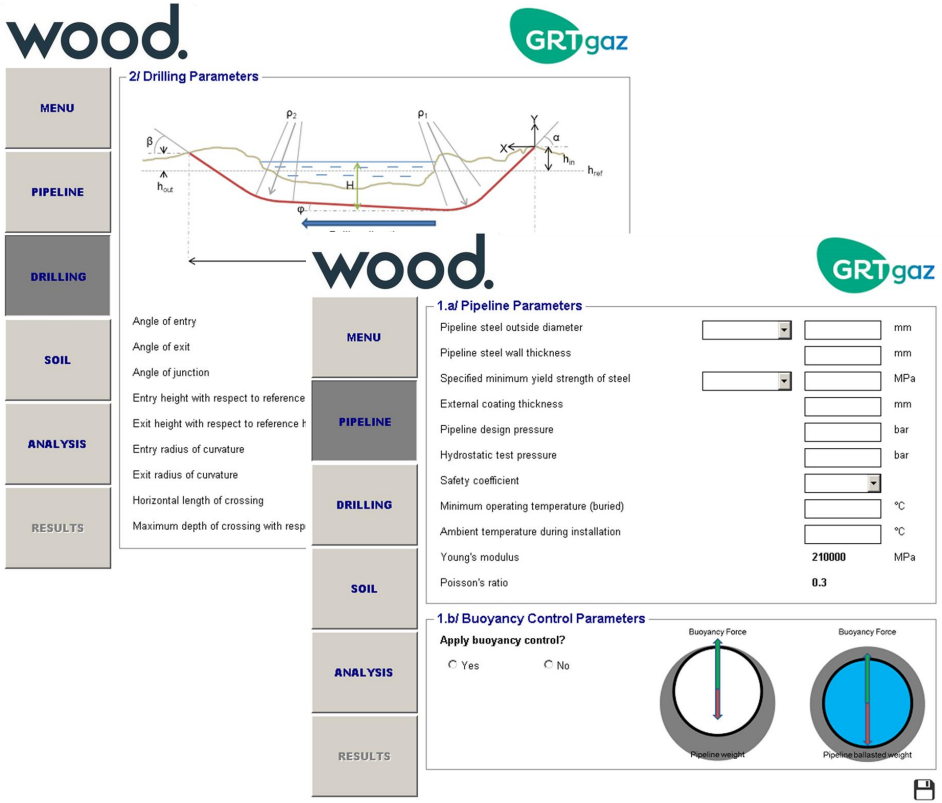
Tension	Type of loads	Key parameters
External pressure	Pressure between the soil and the pipe	Fluid density, ballast, diameter, wall thickness, length
Friction	Created by tension loads associated with compressive strength	Type of soil, Length, radius of curvature, diameter, compressive loads
Longitudinal traction/compression	Created by bending	Length, radius of curvature, diameter



Opti'Drilling tool

Opti'Drilling is a software developed by Wood to help users select the appropriate coating for Horizontal Directional Drilling (HDD) operations.

Opti'Drilling relies on **cross-database analysis** coupled with appropriate codes and standards commonly used by drilling operators. Opti'Drilling allows the user to capitalize on experience through an interactive database.

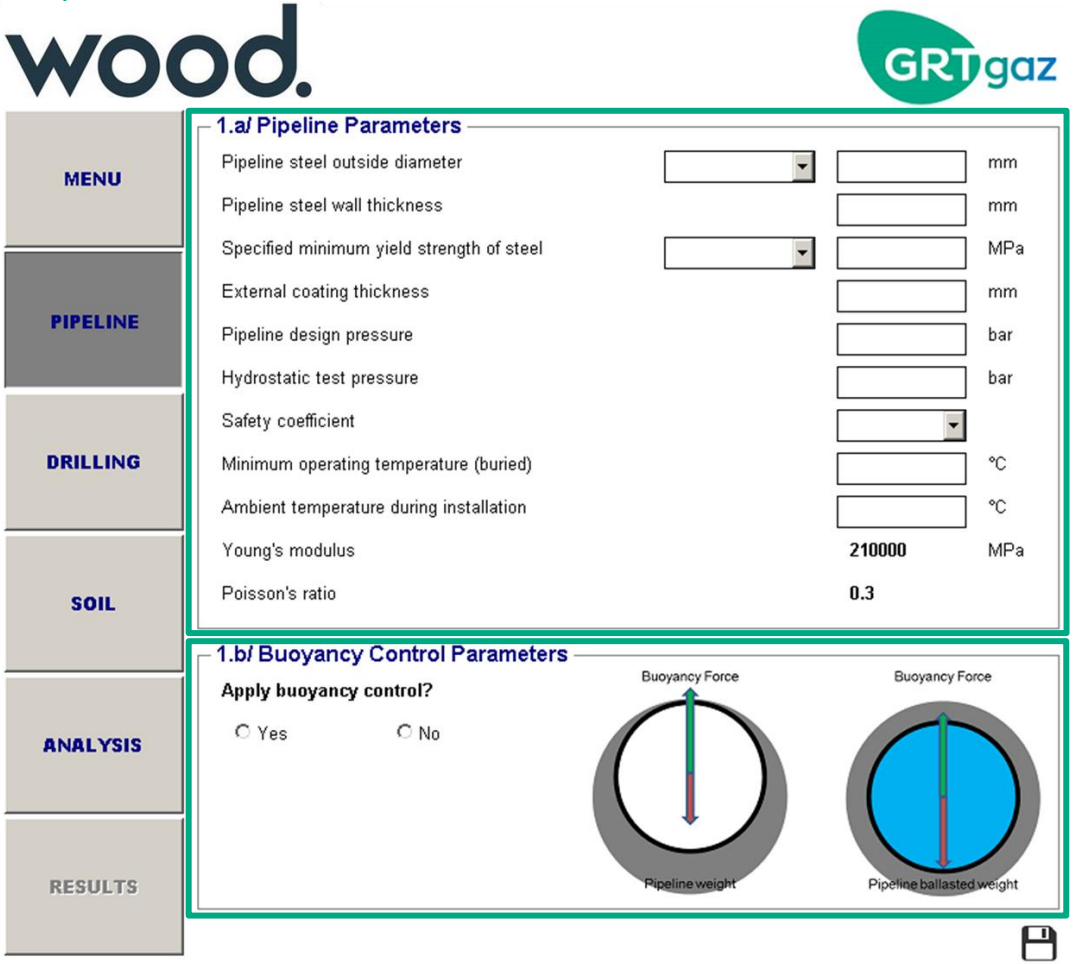


Outcomes and benefits:

- User-friendly interface, accessible to all
- Better understanding of coatings failure modes associated with HDD operations
- Simplified assessment of coating suppliers
- Reduced cost and time

Opti'Drilling tool

Pipeline and Buoyancy Control Parameters

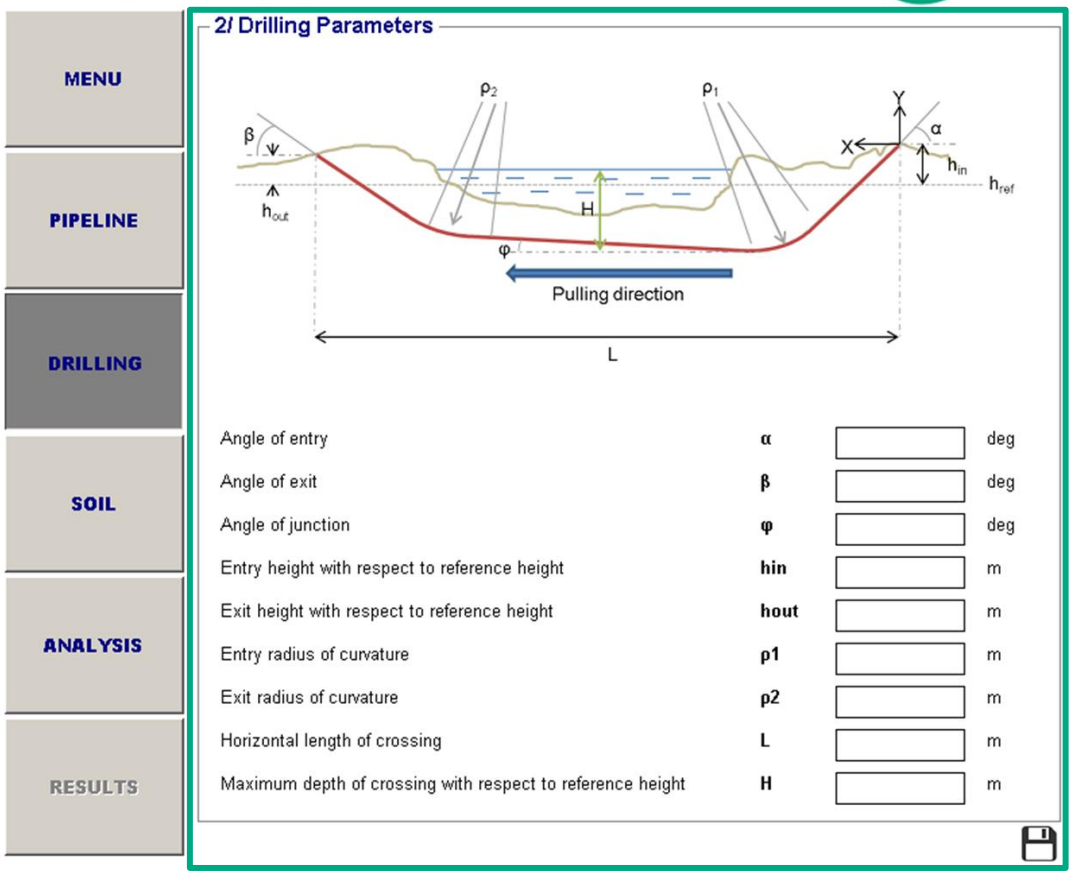


Pipeline input:
OD, Wall thickness, SMYS, etc.

Possibility to add **buoyancy control parameters**

Opti'Drilling tool

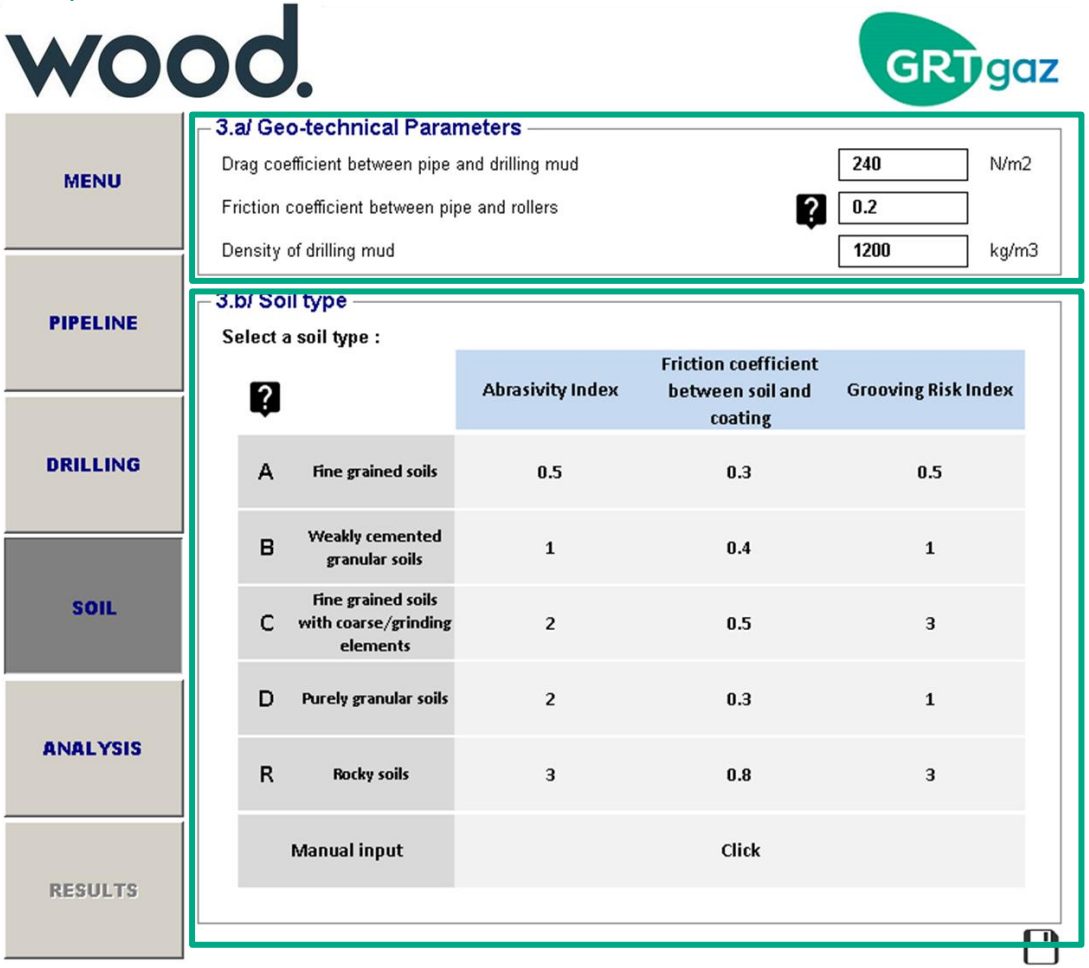
Drilling Profile Parameters



Drilling profile input:
Angles of entry and exit, Entry and Exit radius of curvature, etc.

Opti'Drilling tool

Drilling Profile Parameters



Geo-technical input:
Angles of entry and exit, Entry and Exit radius of curvature, etc.

Soil type input:
5 default soil classes from fine grained to rocky soils plus one manual input soil class

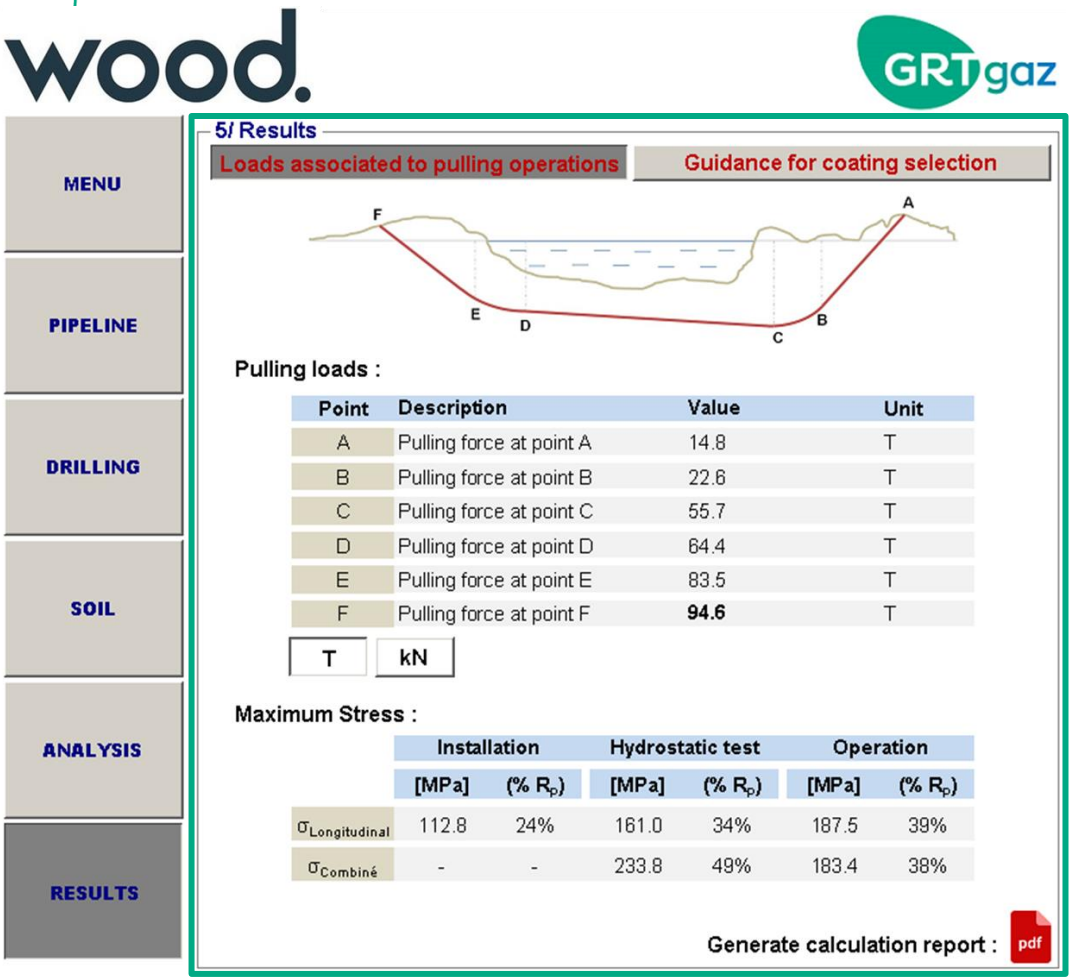
Opti'Drilling tool

Coating Database

- The user can test different types of coating: FBE, 3LPE, 3LPP, PU.
- Each calculation tests one coating thickness → Iterative Approach
- Possibility of creating new coating inputs with the relevant data
- Field joint coating are not tested → need more calculation..
- When sufficiently detailed REX is available, contractors processes for coating set up will be taken into account

Opti'Drilling tool

Pulling loads and maximum stress



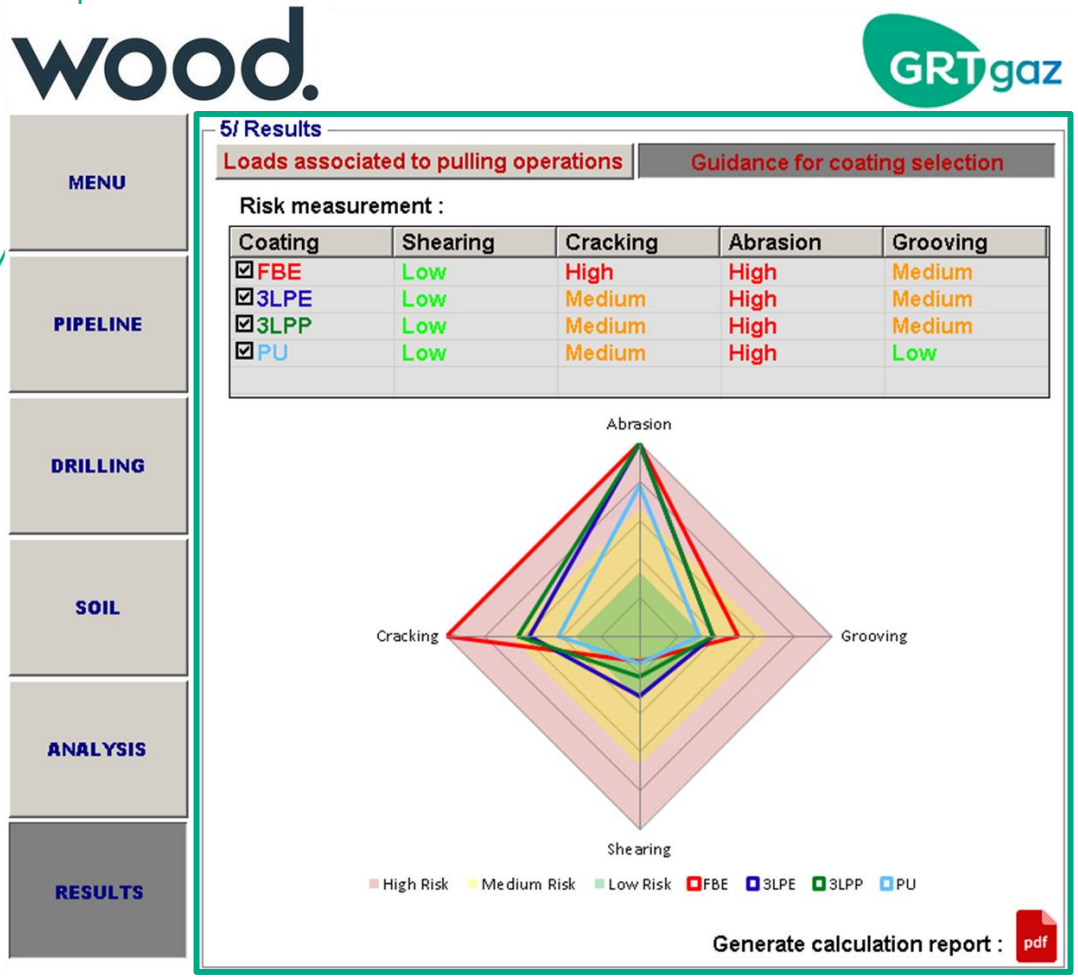
Pulling loads and maximum stress results:

Opti'Drilling calculates maximum pulling loads during installation and maximum stress for the three following scenarios:

- Installation
- Hydrostatic test
- Operation

Opti'Drilling tool

Pulling loads and maximum stress



Guidance for coating selection:

For each coating stored in the coating database, Opti'Drilling evaluates the risk associated to the four failure modes:

- Shearing
- Cracking
- Abrasion
- Grooving

Conclusion

- **A user friendly software with two objectives**:
  - Review of the drilling design:
    - Loads,
    - Drilling path.
  - Selection of the pipeline coating with the optimal thickness according to four parameters: Abrasion, Cracking, Grooving and Friction,
- **Perspective**:
  - Possibility to offer the service to other operators and contractors.
  - In the future, the aim is to take into account the quality of the set up processes and environment

Questions?

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