



Increase Cable Laying Speed and Length with Watucab™

Willem Griffioen



Cable in pipe installation method with water

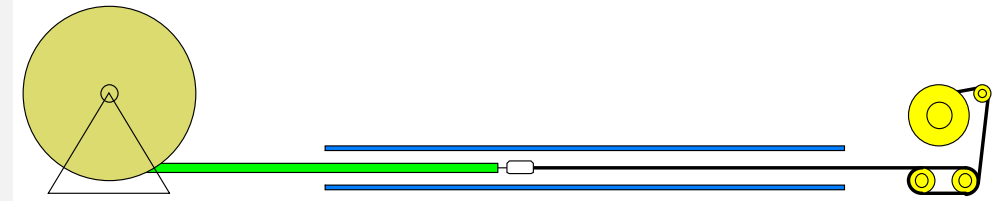
Advantages cable in pipe installation techniques using water

- Longer installation length
- Lower force on cable
 - About half of that of winch pulling for WaterPushPulling
- Less (no) wear of cable and pipe
- Extra step to install winch line not needed (saves time)
- All labor, material and equipment at one side of the pipe
- No synchronization problems
- Higher daily production
- Option to launch cables from convenient location and FreeFloat to any desired location
 - No limit of FreeFloating length

Introduction

Cables in pipe can save a lot of time and inconvenience for the environment

- Can we also save of time and labour (and money) installing the cables into the pipes?
- Traditional: winch pulling



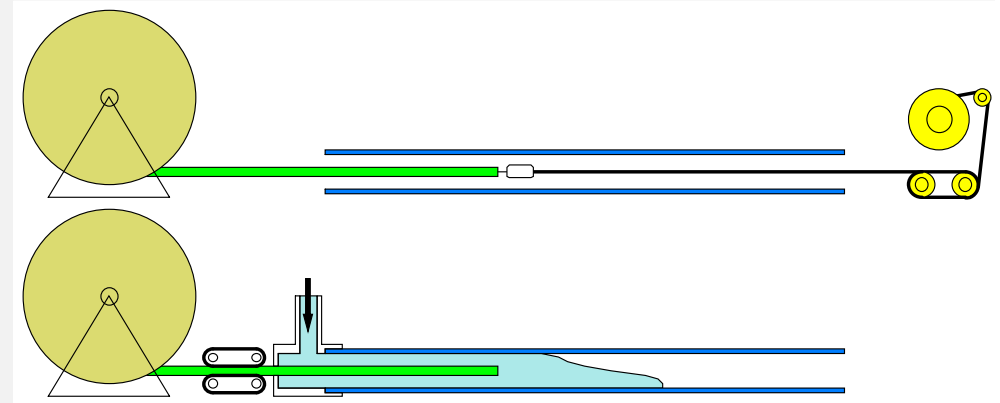
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Alternative installation methods

- Floating (pipes ID up to 100 mm)



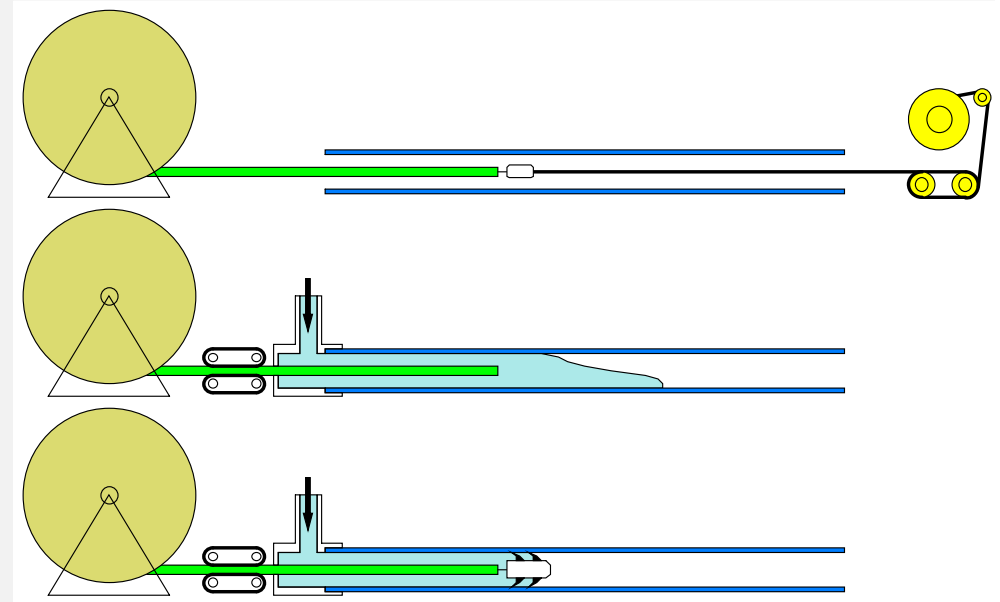
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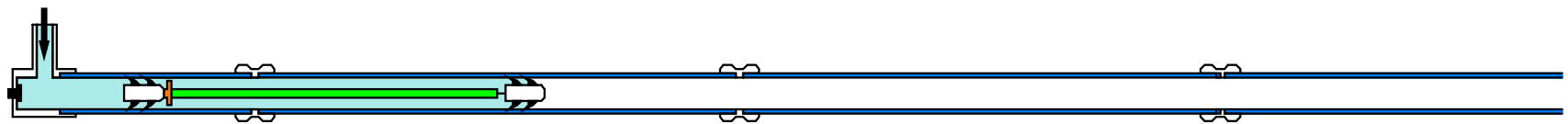
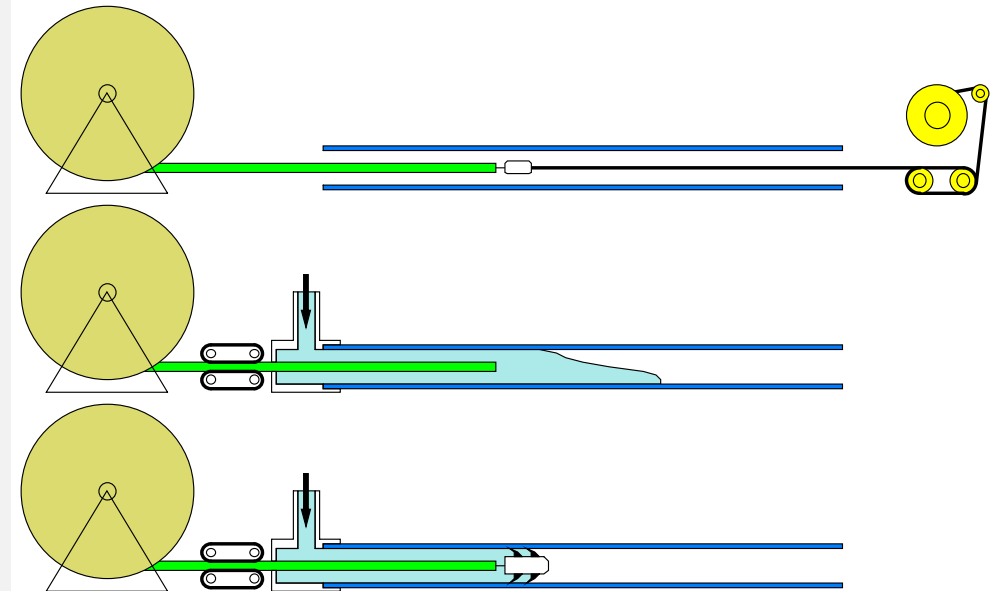
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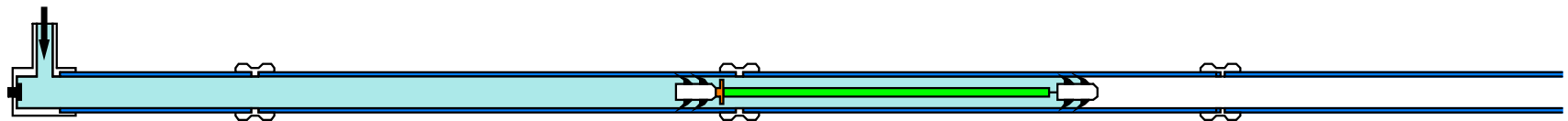
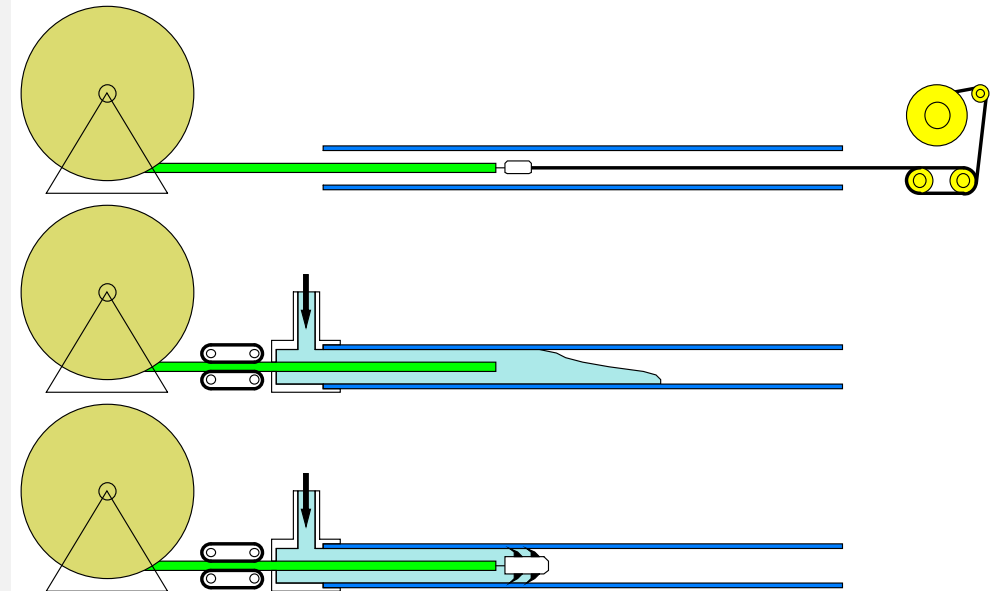
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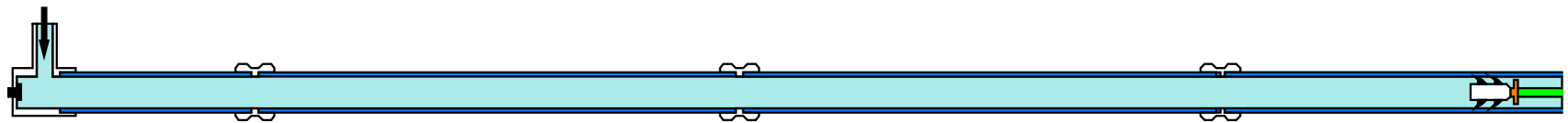
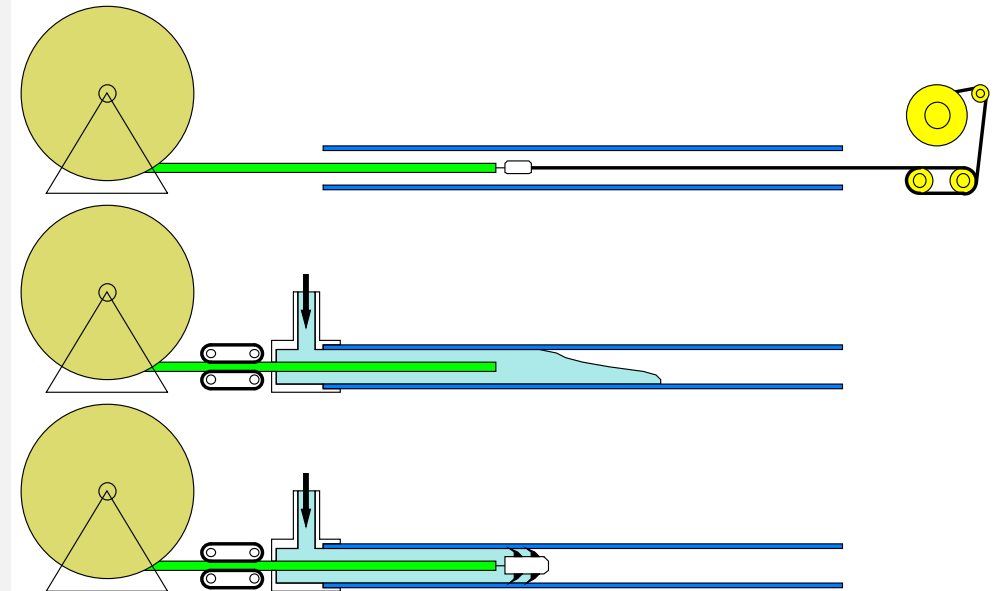
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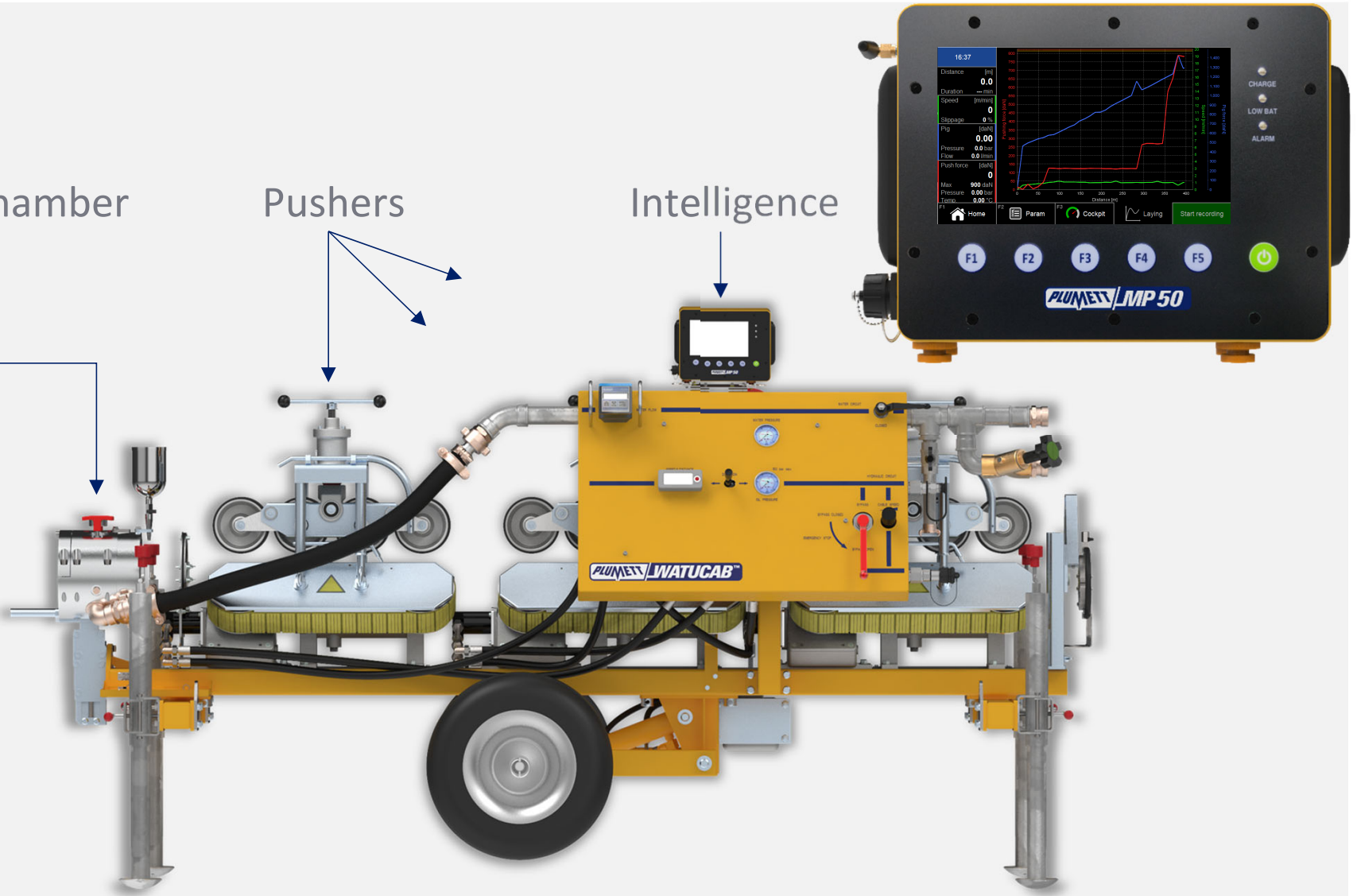


Machinery

Water injection chamber

Pushers

Intelligence



Projects

All over the world:

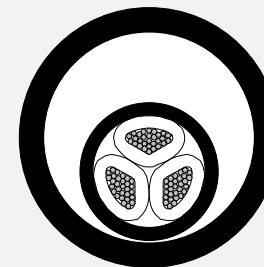
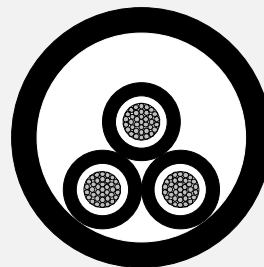
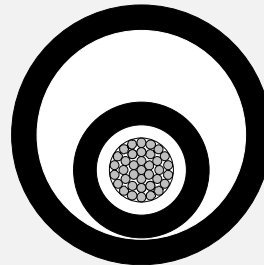
- FR, CH, AT, NL, DK, SE, RS, PL, JP

All cable sizes:

- 35-111 mm (current machine up to 160 mm, but can be upgraded to any size)

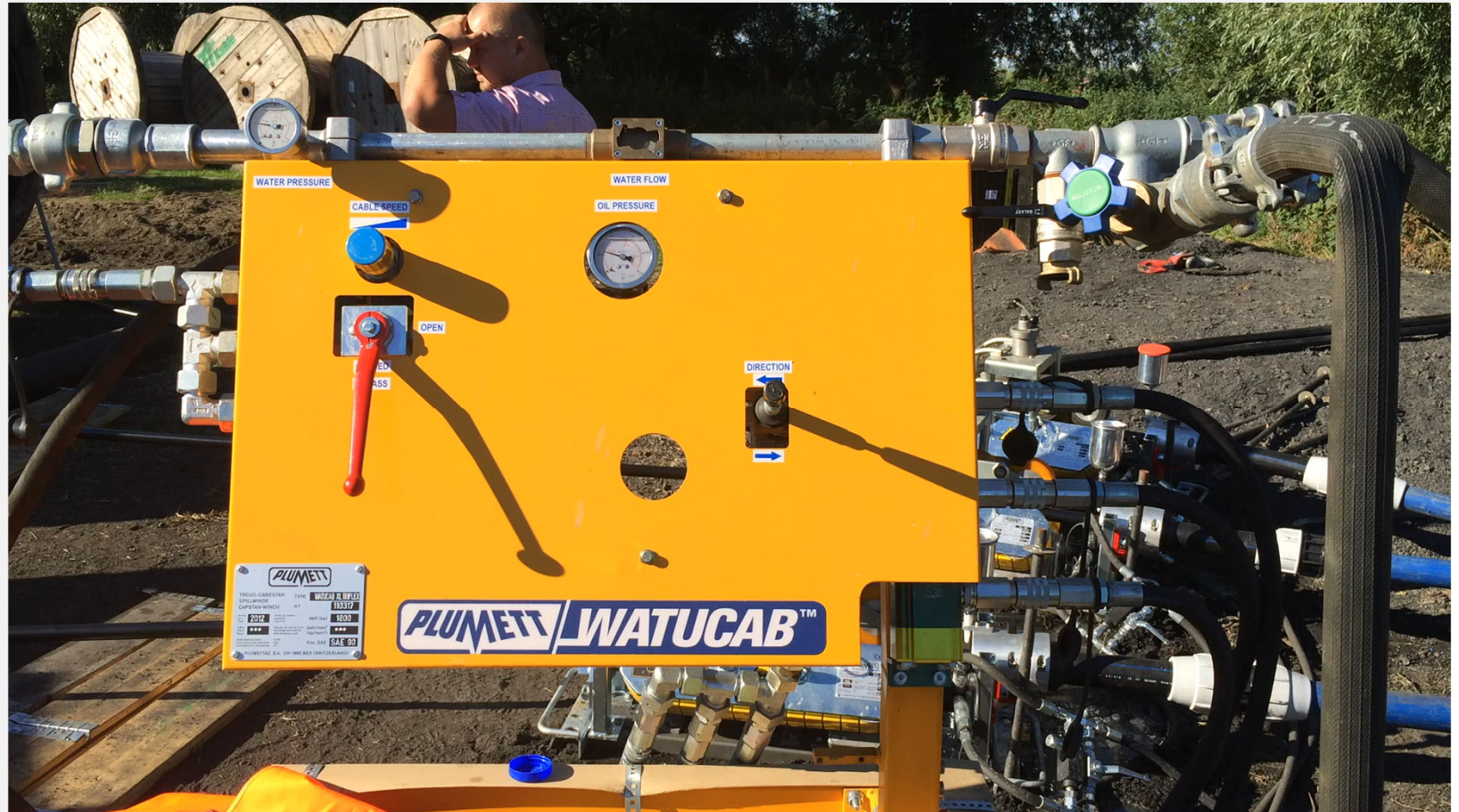
All types and configurations:

- Offshore and on land
- 3 single cables in 3 individual pipes
- Three loose cables in one pipe
- 3 stranded cables in one pipe
- Jacketed 3-core cable in one pipe



Projects

3 cables in one pipe
(Szczecin, Poland)



Fachtreffen der Übertragungsnetzbetreiber, 12-13 November 2024

Projects

Example

Fleac (FR)

- **90 kV** cable
- 1200 mm² Alu conductor
- 84.3 mm, 7.5 kg/m
- 3 PE pipes 160/135.4 mm SDR 13.6
- **18.5 km** long, **50 m** elevation difference
- Longest cable length **3.3 km**
- WaterPushPulling max force **15 kN**



Projects

Example

Copenhagen (DK)

- **145 kV** cable
- 2000 mm² Milliken Alu core
- 111 mm, 12.7 kg/m
- 180/158 PE pipes SDR 17
- Multiple HDD drills
- Length ≈ **700 m** each
- WaterPushPulling
- **FreeFloating (only 1.5 bar!)**
 - From convenient location
 - To busy street with no access for cable reels
 - **3 x 3 sections**
 - **3 cables per day** (including rebuilding from WaterPushPulling to FreeFloating)

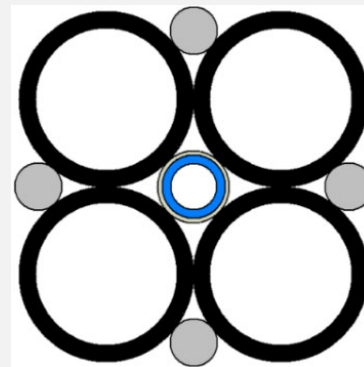
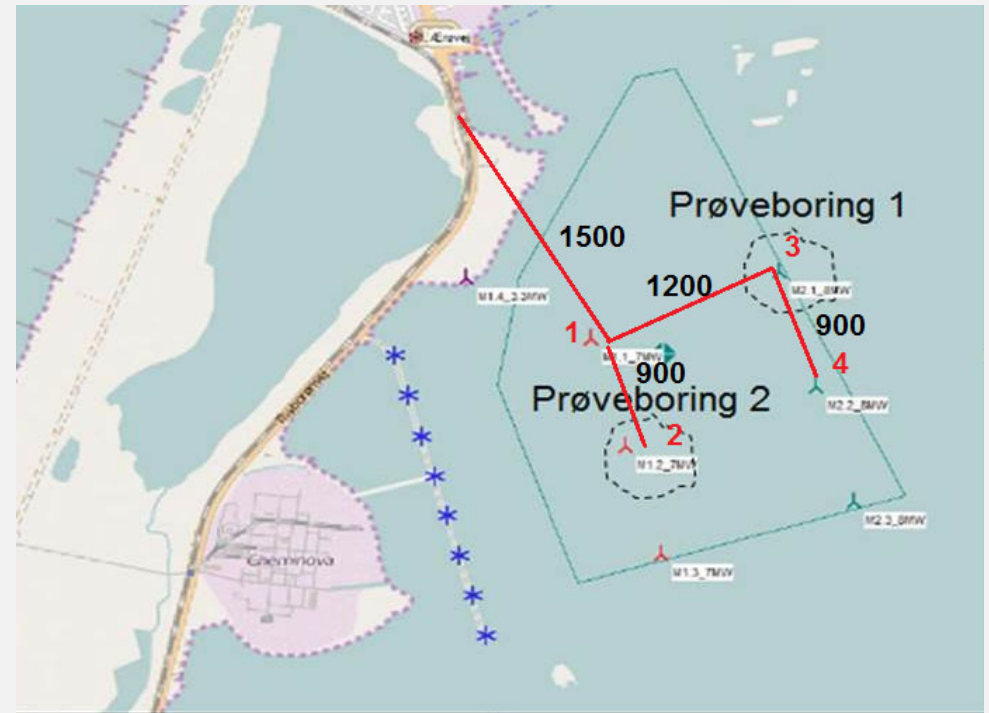


Projects

Example

Nissum Bredning offshore windfarm (DK)

- 4 offshore wind turbines 7 MW
- 72 kV export and array cables
- 630 mm² solid Al
- Single cables in individual 110/90 mm PE pipes
- Pipes in bundles of 4 with ballast steel wires
- All cables could be installed from land
 - WaterPushPulling
 - FreeFloating
 - Also with Beaufort windforce 8!



Projects (Nissum Bredning offshore wind farm)



Fachtreffen der Übertragungsnetzbetreiber, 12-13 November 2024

Projects

Example

Utrecht (Tennet)

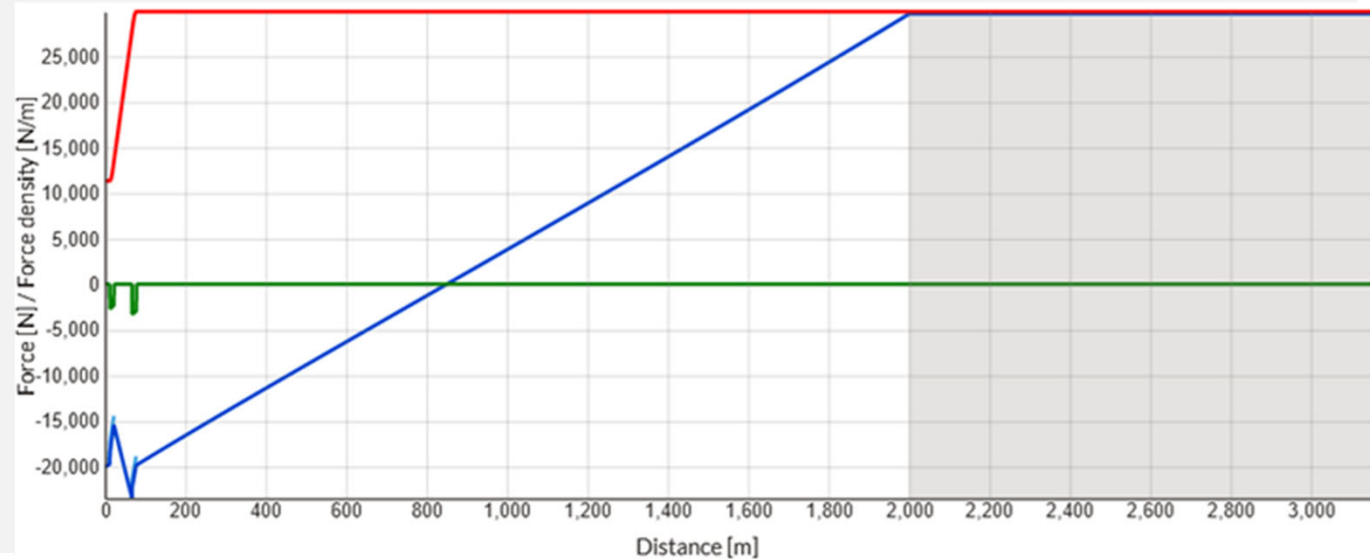
- **150 kV** cable
- 1200 mm² solid Alu conductor
- 93 mm, 8.8 kg/m
- 2 x 7 PE pipes 200/163.6 mm SDR 11
- 6 cables pulled with winch
- 6 cables installed WaterPushPulling
- **1090 m** long HDD drill
- At end **130 m** overlength (for tower)
- WaterPushPulling max force **7 kN**



Options for Tennet

Calculations with JetPlanner 4.0

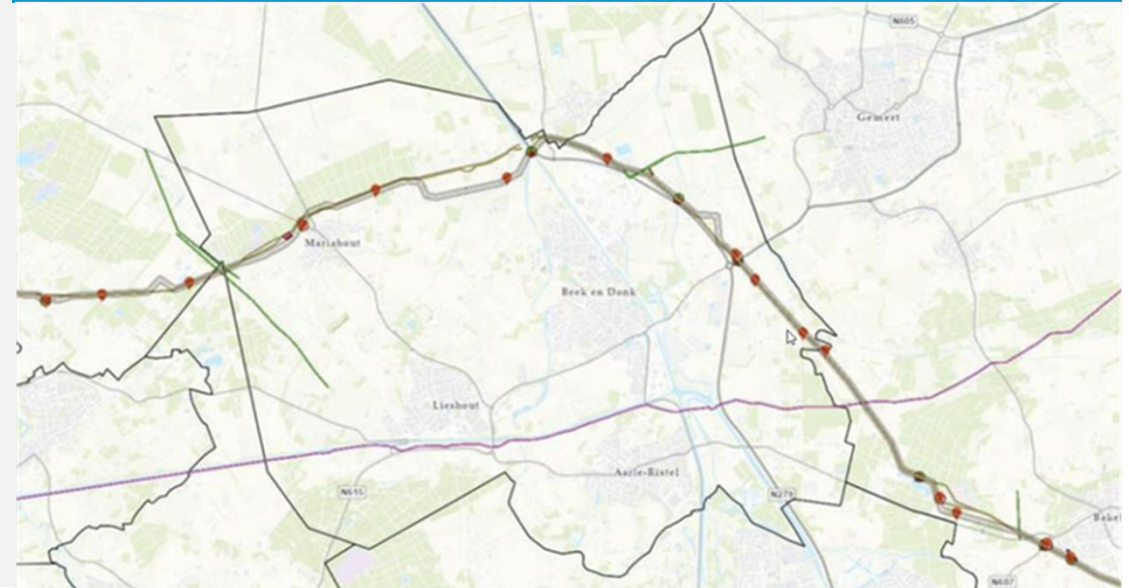
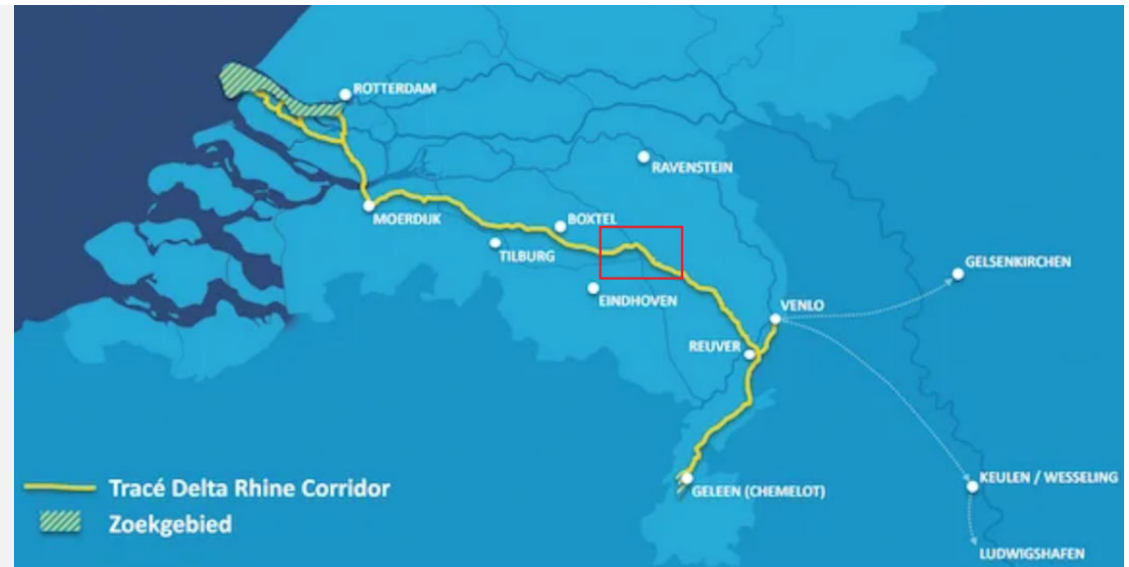
- Just an exercise to get an idea
- For Delta-Rhine corridor
 - Workshop “Accelerating cable installation, how to do this?”
 - Tennet, 29 February 2024
 - Consensus about
 - Long cable lengths (avoid joints)
 - Cable in pipe
 - Water (current rating)
 - WaterPushPulling
 - Standard
 - With brine (or Cebo Conduct-Gel?)
 - FreeFloating
 - Floating (brine, Cebo Conduct-Gel?)



Delta Rhine Corridor

Rotterdam – Frankfurt (NL part)

- Pipelines for
 - Hydrogen
 - Ammonia
 - Carbon-dioxide
- HV cables
 - 3 x 3 cables (in individual pipes)
 - 525 kV DC
 - 3000 mm² Cu, 152 mm, 41.2 kg/m, 40000 Nm²
 - 4000 mm² Al, 160 mm, 26 kg/m, 50000 Nm²
- Example section Laarbeek (22 km)
 - HDPE pipes 280/228 mm SDR 11
 - COF = 0.12 (assumed)

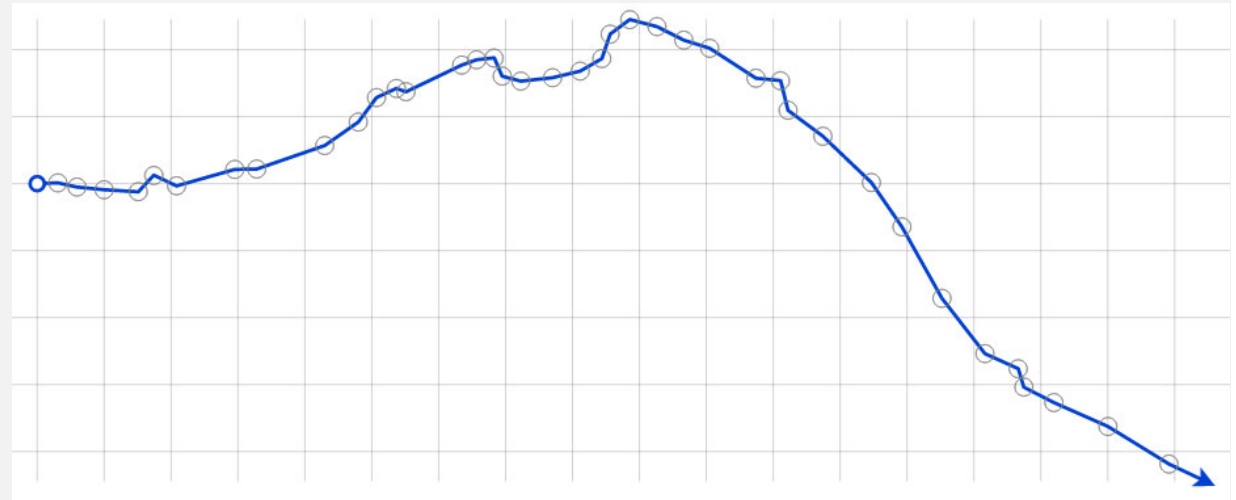


JetPlanner 4.0 calculations

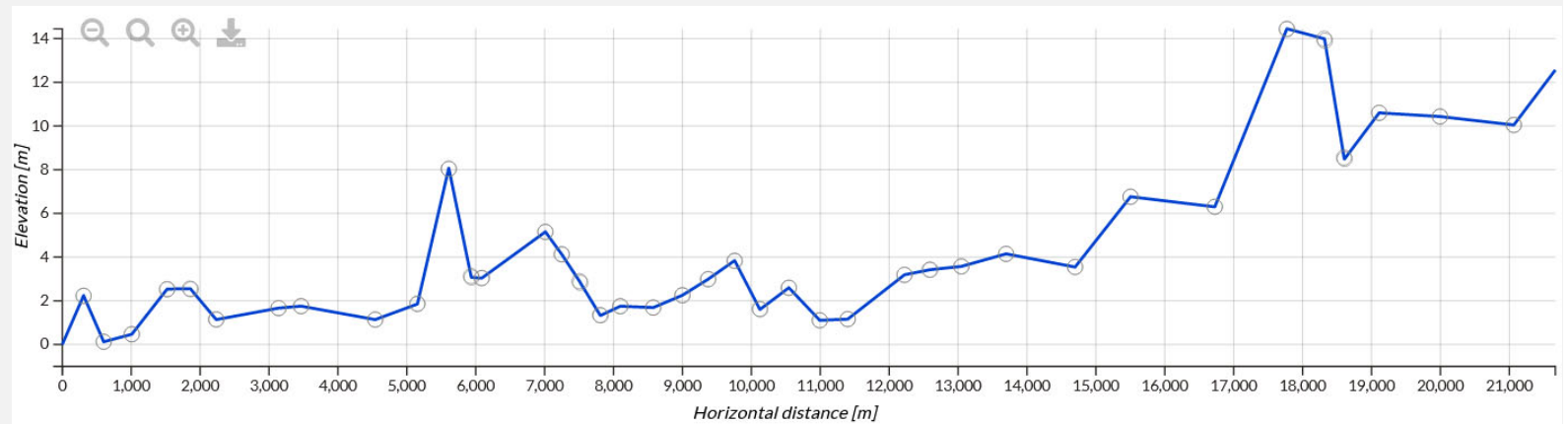
Laarbeek section (22 km)

- Imported with Google Earth
- Minimum bend radius 10 m (important)

Top view



Elevation profile

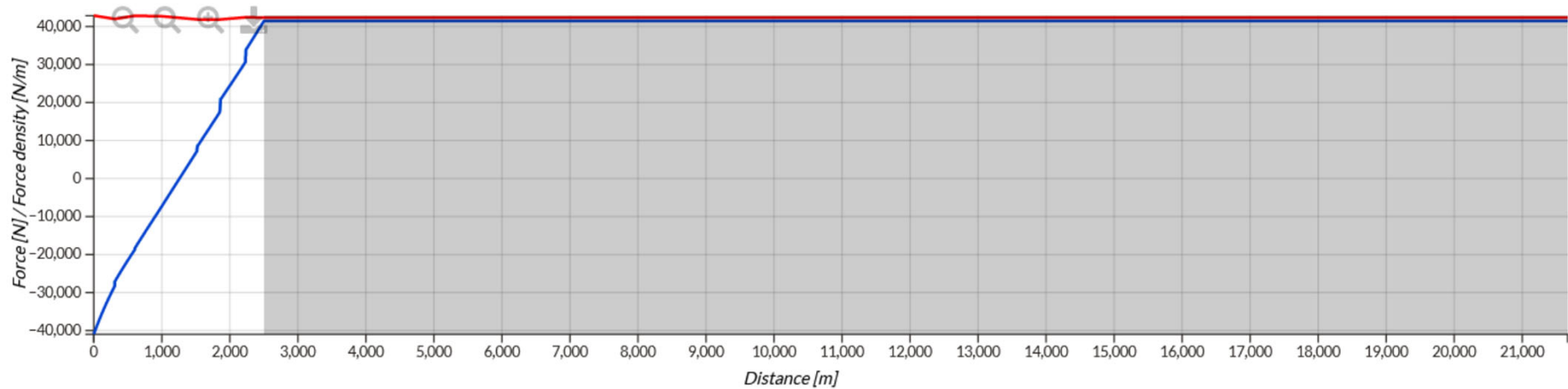


JetPlanner 4.0 calculations

WaterPushPulling 3000 mm² Cu conductor cable

- 2.5 km
- 10.5 bar water pressure (43 kN pulling on cable head)
- 60 kN pushing force (effective 41 kN after insertion into pressure zone)

Results chart

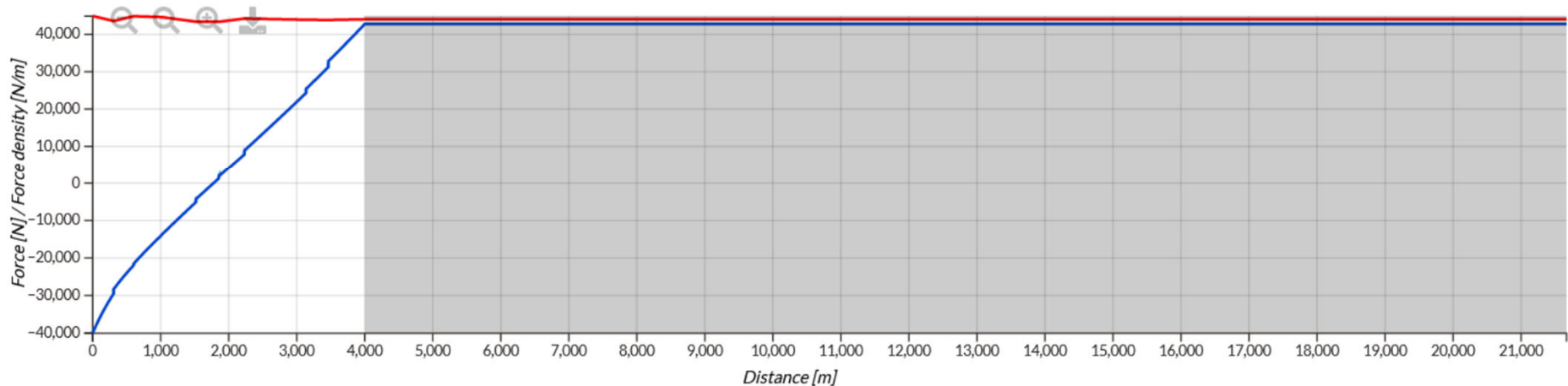


JetPlanner 4.0 calculations

WaterPushPulling 3000 mm² Cu conductor cable with K₂CO₃ solution (density 1.5 g/cm³)

- 4 km Cebo Conduct-Gel 2.0 (density 1.52 g/cm³)
- 11 bar water pressure (45 kN pulling on cable head)
- 60 kN pushing force (effective 40 kN after insertion into pressure zone)

Results chart

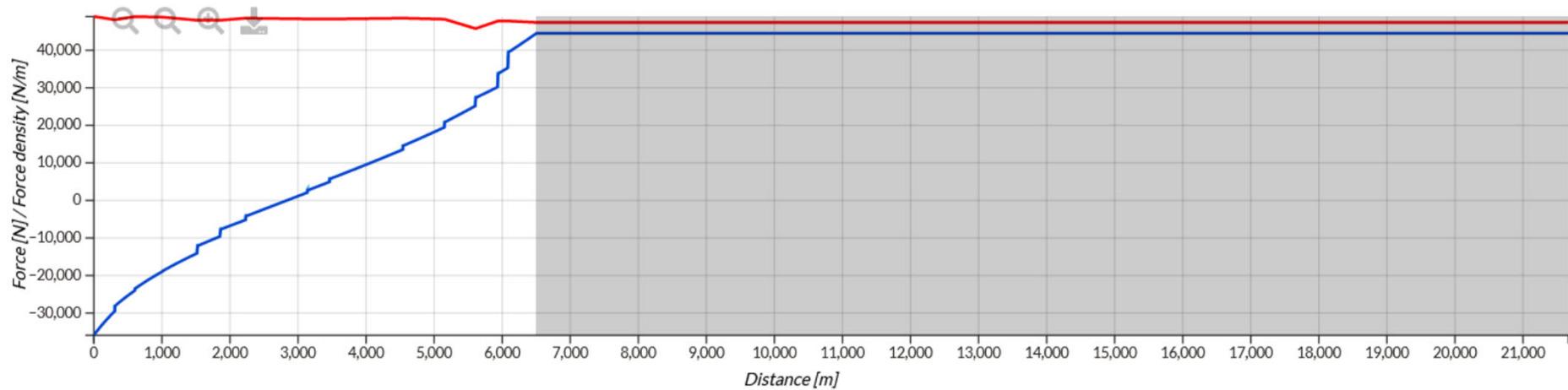


JetPlanner 4.0 calculations

WaterPushPulling 4000 mm² Al conductor cable

- 6.5 km
- 12 bar water pressure (49 kN pulling on cable head)
- 60 kN pushing force (effective 36 kN after insertion into pressure zone)

Results chart

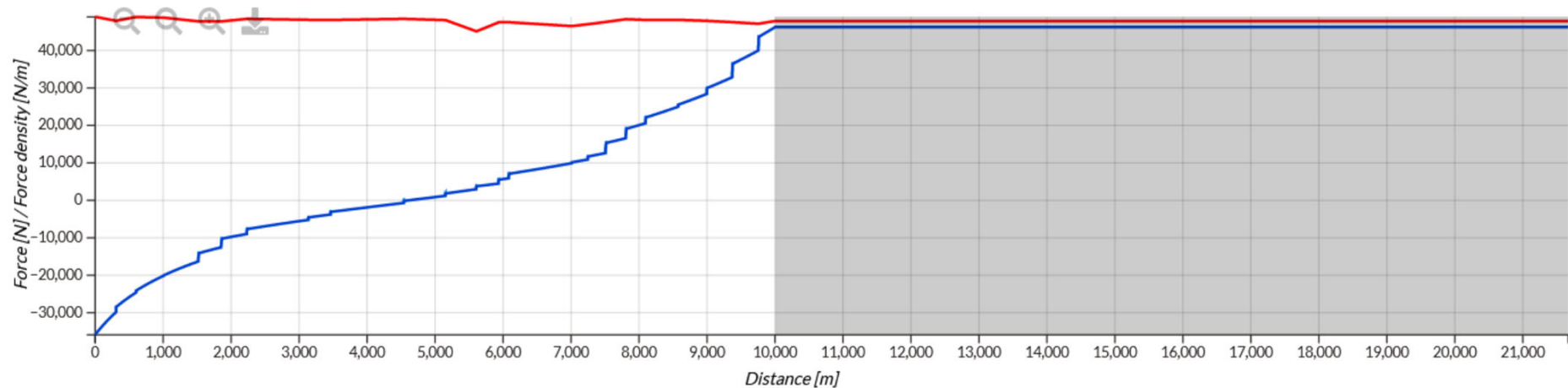


JetPlanner 4.0 calculations

WaterPushPulling 4000 mm² Al conductor cable with NaCl solution (density 1.2 g/cm³)

- 10 km
- 12 bar water pressure (49 kN pulling on cable head)
- 60 kN pushing force (effective 36 kN after insertion into pressure zone)

Results chart

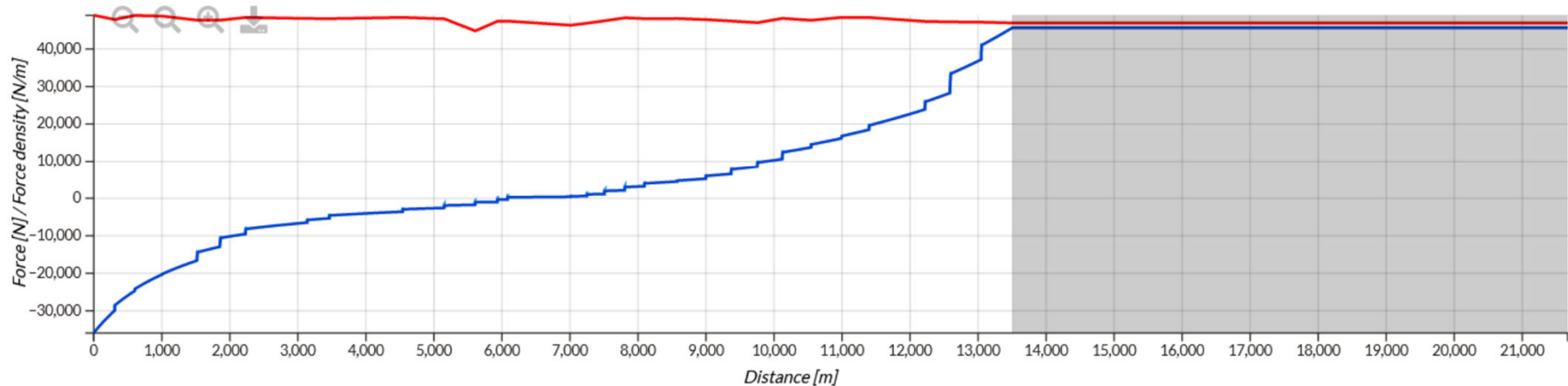


JetPlanner 4.0 calculations

WaterPushPulling 4000 mm² Al conductor cable with K₂CO₃ solution (density 1.29 g/cm³)

- 13.5 km Best match
- 12 bar water pressure (49 kN pulling on cable head)
- 60 kN pushing force (effective 36 kN after insertion into pressure zone)

Results chart





JetPlanner 4.0 calculations

FreeFloating

- All WaterPushPull installations can be done with FreeFloating
- After installation with WaterPushPulling
- Over entire trajectory (unlimited length)
 - Provided that no big elevations occur
 - No big elevation differences in NL part
 - We can even benefit when we go from slightly uphill in reverse direction (slightly downhill)
 - Select a start point near a river (Maas) and connect with pipe to river
 - Long cable lengths can be installed from a vessel

Floating

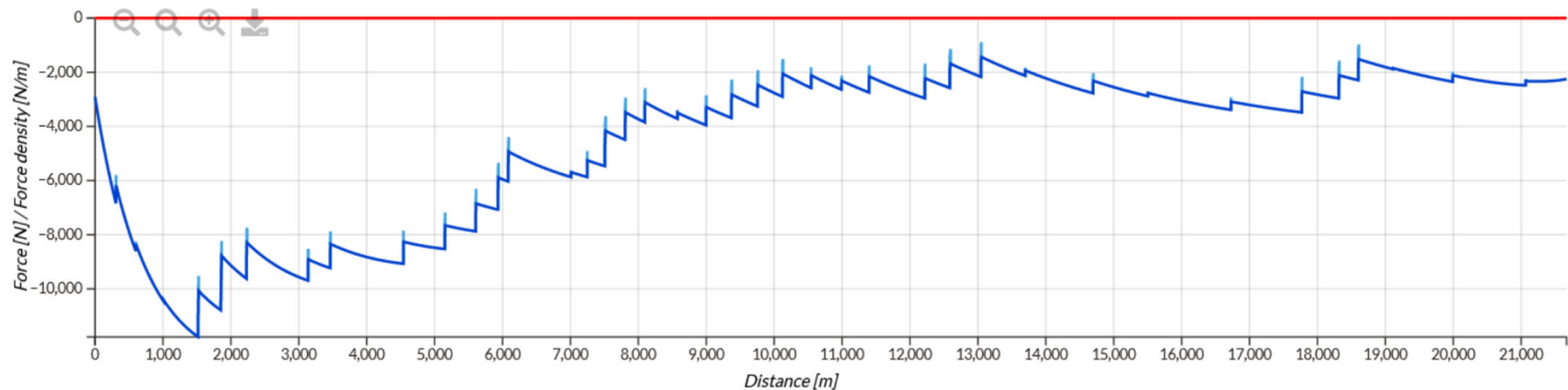
- With optimized density tuning even Floating is possible with this pipe size (and small pumps)
- Astronomical lengths in theory (and already 12 km reached with low voltage cable)!

JetPlanner 4.0 calculations

Floating 4000 mm² Al conductor cable with K₂CO₃ solution (density 1.29 g/cm³)

- Full 22 km
- 8.5 bar water pressure (small force distributed over cable). So 40 km possible with 16 bar!
- 20 kN pushing force (effective 3 kN after insertion into pressure zone)

Results chart

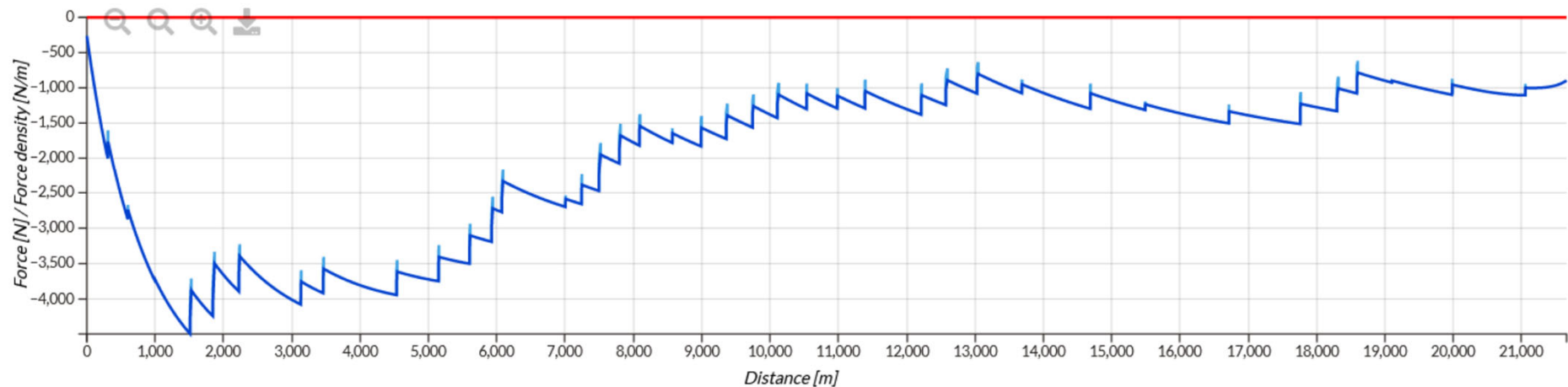


JetPlanner 4.0 calculations

Can we do more?

- Pipe minimum bend radius 10 → 20 m
 - Helps for all cases, but spectacular for Floating AI-conductor cables with 1.29 g/cm³ brine
 - 22 km with 7.5 kN pushing force and 3.6 bar water pressure (option for 96 km with 16 bar!). Flow 393 l/min.

Results chart





JetPlanner 4.0 calculations

Still more?

- Up-jacketing cable with low density material, e.g. foam PE with density 0.8 g/cm^3
 - Contra-productive for Cu-conductor cables
 - Density goes down, weight in water only a bit. Effect increasing backpressure force wins.
 - But, when using K_2CO_3 brine there is little gain
 - For Al-conductor cables it is easier to use brine than up-jacketing
 - But, after up-jacketing full density match becomes possible with NaCl instead of K_2CO_3 (is less costly)
- But, do we want up-jacketing at all
 - Current rating becomes worse

Conclusions

- Installation methods to install cable in pipes with water under pressure presented
- Advantages of these methods shown
- Some projects highlighted (until now 3.3 km “per shot” reached for HV cables)
- Tricks to increasing cable installation length discussed (theoretically)
- Calculated for Delta Rhine Corridor section Laarbeek for 280/228 mm HDPE pipes with COF 0.12
 - Change conductor from copper to aluminum. From 2.5 km to 6.5 km
 - Use brine solutions (or bentonite)
 - For Cu-conductor cables from 2.5 km to 4 km when using K_2CO_3 solution (density 1.5 g/cm³)
 - For Al-conductor cables from 6.5 km to 10 km when using NaCl solution (density 1.2 g/cm³)
 - For Al-conductor cables even further increase to 13.5 km when using K_2CO_3 solution (density 1.29 g/cm³)
 - All cases FreeFloating cable from convenient (river) location to desired destination possible (unlimited length)
 - Spectacular lengths for “brine tuned” Al-conductor cable when Floating
 - 40 km with 16 bar for minimum pipe bend radius 10 m
 - 96 km with 16 bar for minimum pipe bend radius 20 m (and flow < 400 l/min)



Thank you for your attention!

