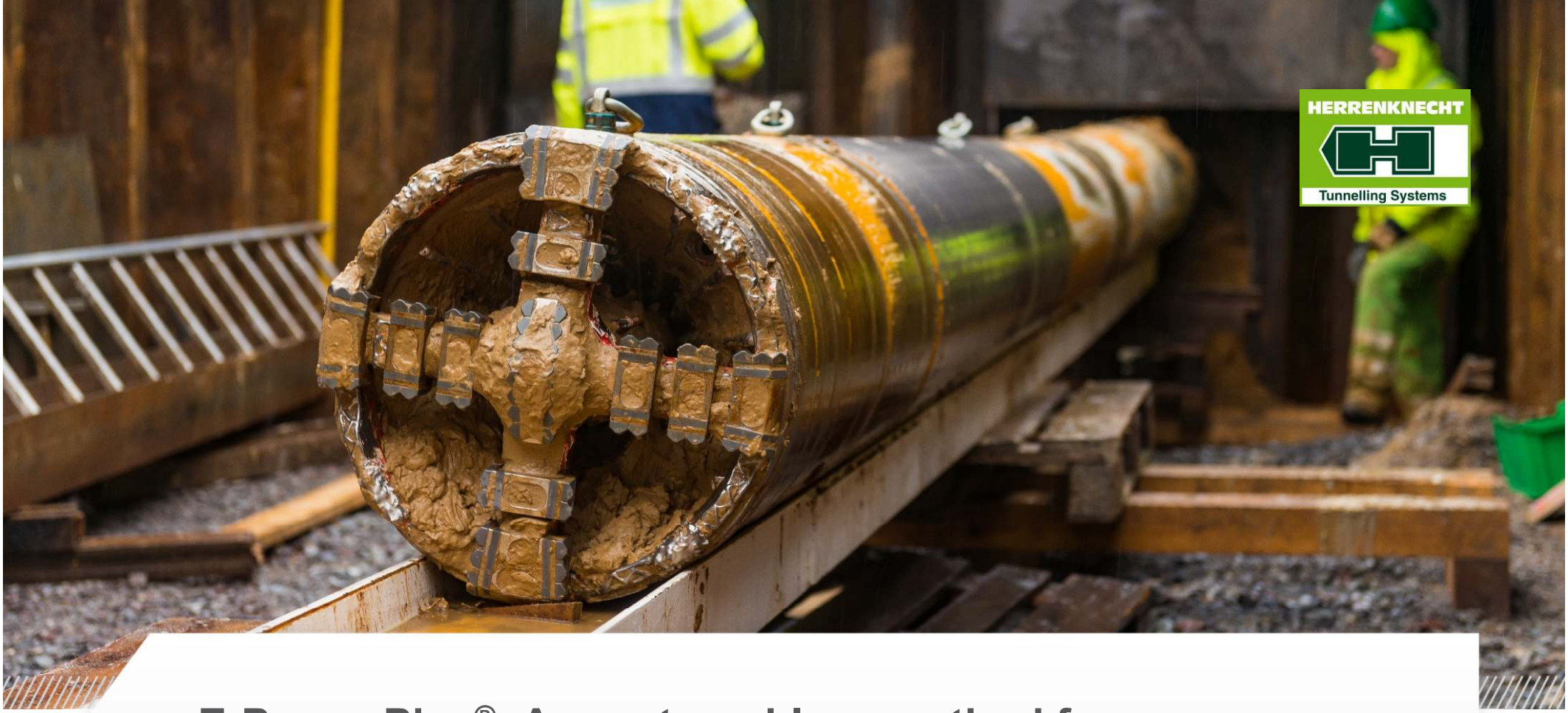


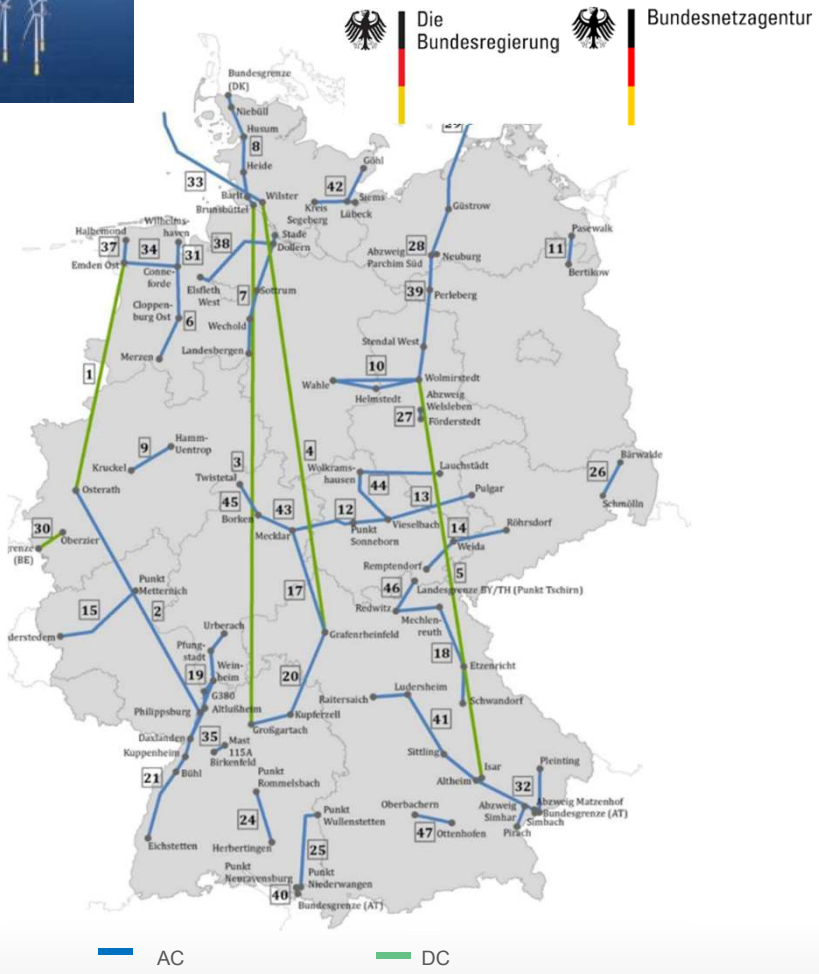
E-Power Pipe®: A new trenchless method for underground cable installation

Dr. Gerhard Lang

Jan 31, 2018 - UCT 2018, Track XI

High Voltage Power Grid in Germany.

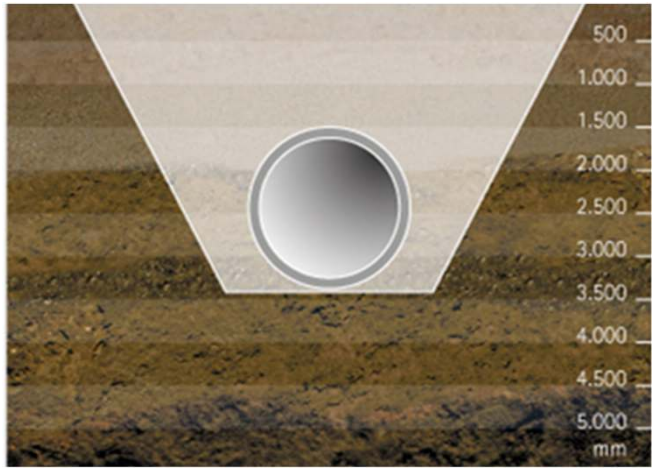
- Intention to replace nuclear power plants with renewable energy until 2025.
- Electrical power grid extension to connect the windfarms in the North Sea with the industry in the south. (underground cable priority for DC)
  - North – South connections (New DC lines) as underground cables
    - 1.500 to 2,250km (900 – 1,600 mi.)
  - Overhead lines use AC technology under special conditions (e.g. distance protected areas), underground lines favor DC.
  - Protests against overhead lines lead to trenchless technology.
  - **Commissioning of North-South connections in 2025 (formerly 2022)**



Underground Cable Installation.

Installation methods.

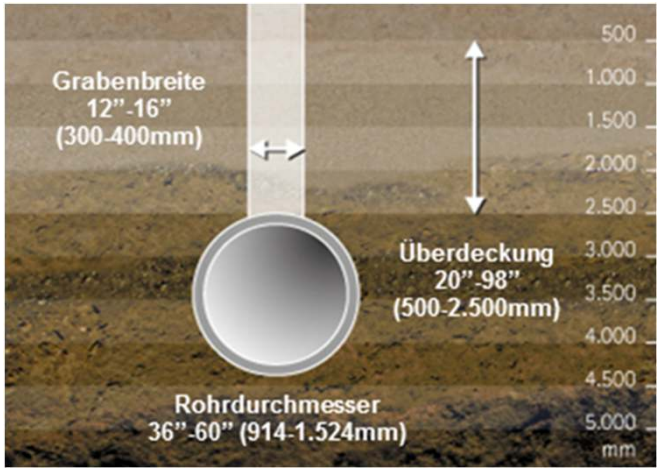
Open Trench



Application

Shallow installation
mostly soft ground
Rural area

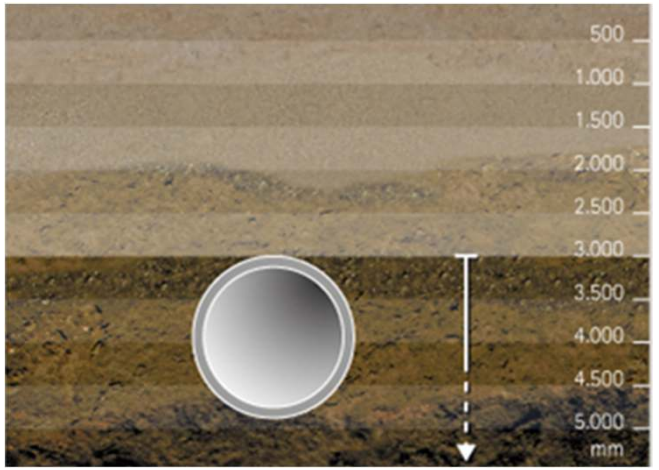
Semi-Trenchless



Application

Shallow installtion
Soft & mixed ground
Rural/less populated area

Trenchless

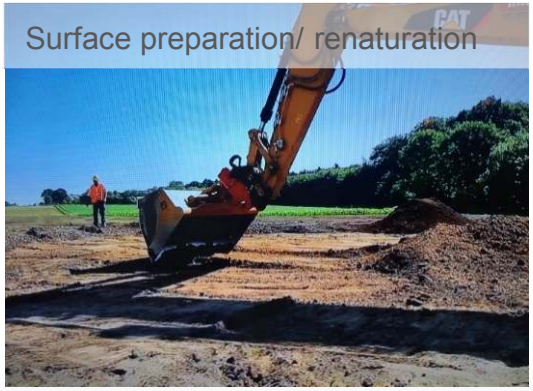


Application

Deep installation
All ground conditions
Urban area/ river crossings

Conventional Open Cut installation method.

Example Project Raesfeld.



Underground Cable Installation.

Existing trenchless and semi-trenchless methods.

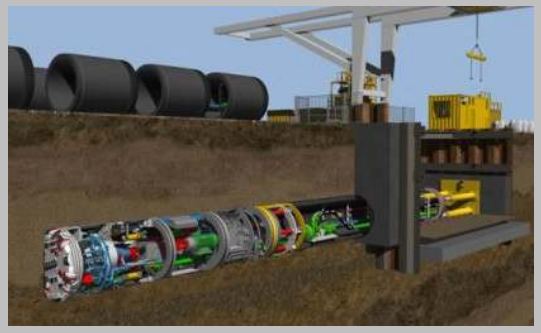
Pipeline construction

Horizontal Directional Drilling

Direct Pipe®

Pipe Express®

Tunnel construction



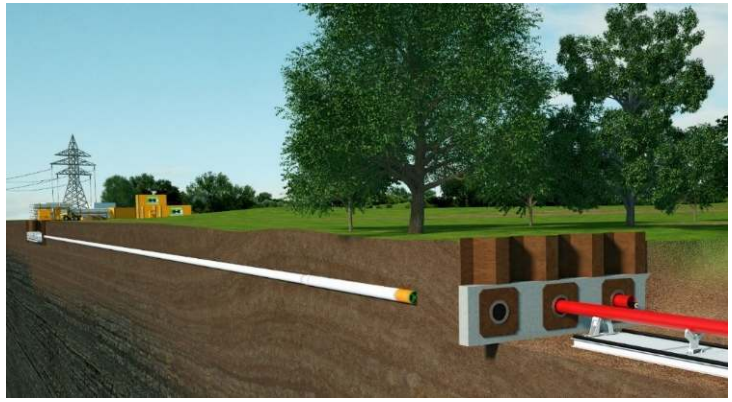
Pipe Jacking

Segmental Lining

Restrictions for cable installation.

by Transition System Operator (TSO).

- Limited job site, construction roads, preparation area
- No heavy equipment between launch and reception point
- Steerable installation of casing pipes for AC & DC lines
- Length: 3,300ft – 4.000ft
- Depth: 5ft m to 13ft, constant
- Diameter casing: ca. DN10” – 16” (250-400mm)
- Casing material : plastic, non-conductive, e.g. PEHD
- Distance between lines: 3ft constant
- Available on market: 2017



Comparison Trenchless and Semi-Trenchless Cable Installation Methods.

Options & Limits.

	Pipe Express® Semi-trenchless	**HDD** trenchless	**Direct Pipe®** trenchless	**Pipe Jacking** trenchless	**Segment Lining** trenchless
Diameter [mm]	ID 900-1500	ID 250-1500	ID 711-1500	ID 250-4000	ID 2300-4000
Pipe material	Steel Concrete Plastic (HDPE)	Steel Plastic (HDPE) Cast iron	Steel (Plastic)	Steel Concrete GRP/Hobas Clay pipe	Concrete segments Combisegments (incl. Inliner) Rib & Lagging
Max. drive length *dep. On Ø	40“ – 60“: 1000m	Ø bis 20“: 4km Ø bis 60“: 1,7km	Ø bis 38“: 300m Ø bis 60“: 1,4km	Ø 250mm: 100 m Ø3000mm: 1.5 km	Ø 2000mm: 2 km Ø 3000mm: 8 km
Geology	all Rock up to 100MPa	stable	all Rock up to 150MPa	all	all
Shaft building	Pit	Pit	Pit with bottom plate and sealing	Shaft with bottom plate and sealing	Shaft with bottom plate and sealing
Access	No	No	No	yes > Ø 3000 mm	yes > Ø 3000 mm

Comparison Trenchless and Semi-Trenchless Cable Installation Methods.

Options & Limits.

		SEPARATE INSTALLATION ~500mm / 20“			CASING TUNNELS Ø 1,500 mm			CASING TUNNEL Ø 3,000 mm		
Technology:	Ø in mm	Shallow	Accuracy	Length > 1,000 m	Shallow	Accuracy	Length > 1,000 m	Shallow	Accuracy	Length > 1,000 m
› Pipe Jacking	250-4,000	■	■		■	■	■	■	■	■
› Segmental Lining	2,300-4,000							■	■	■
› HDD	250-1,500			■			■			
› Direct Pipe®	700-1,500				■	■	■			
› Pipe Express®	900-1,500				■	■	■			

Trenchless underground cable construction.

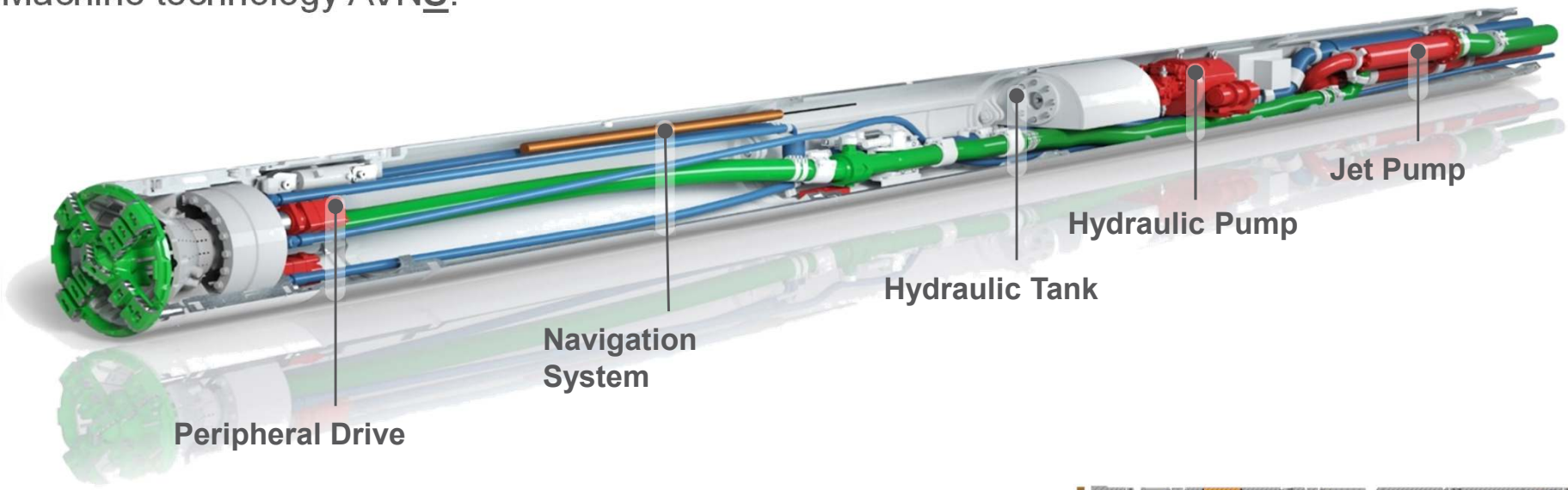
Options & Limits – E-PP meets all requirements.

		SEPARATE INSTALLATION ~500mm / 20“			CASING TUNNELS Ø 1,500 mm			CASING TUNNEL Ø 3,000 mm		
Technology:	Ø in mm	Shallow	Accuracy	Length > 1,000 m	Shallow	Accuracy	Length > 1,000 m	Shallow	Accuracy	Length > 1,000 m
› Pipe Jacking	250-4,000	■	■		■	■	■	■	■	■
› Segmental Lining	2,300-4,000							■	■	■
› HDD	250-1,500			■			■			
› Direct Pipe®	700-1,500				■	■	■			
› Pipe Express®	900-1,500				■	■	■			
E-POWER PIPE	250-700	■	■	■						

Trenchless underground cable construction.

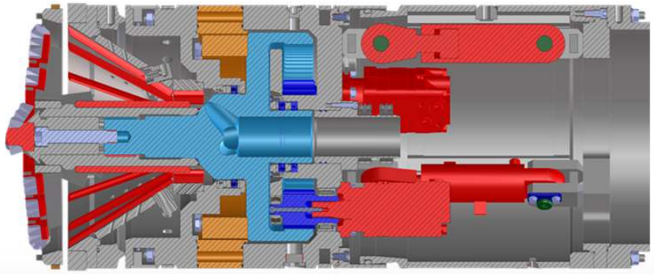
Machine technology AVN**S**.

POWER PIPE



AVNS 350 XB

A- Automatische
V- Vortriebsmaschine
N- Nass
S- Strahlpumpe



Trenchless underground cable installation.

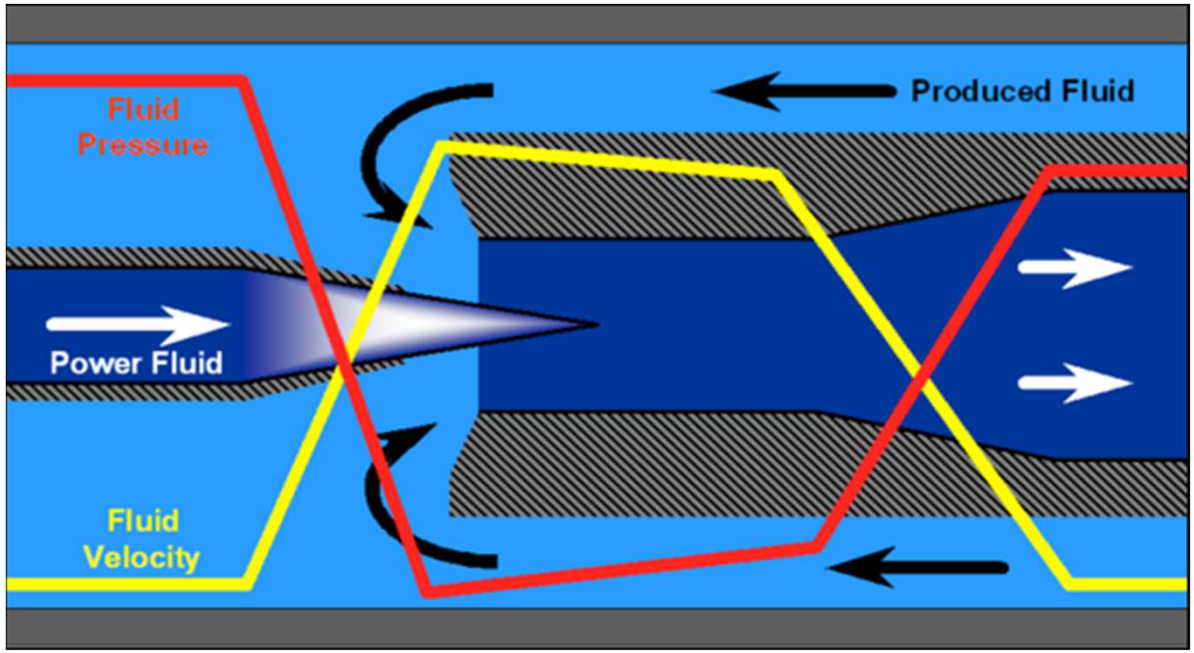
Machine technology AVN**S**.

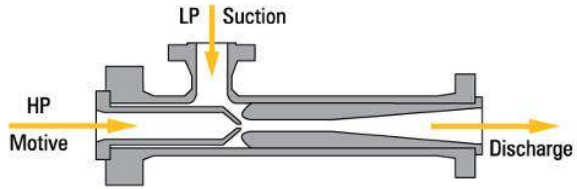





NEW Jet Pump Technology.

Working principle.





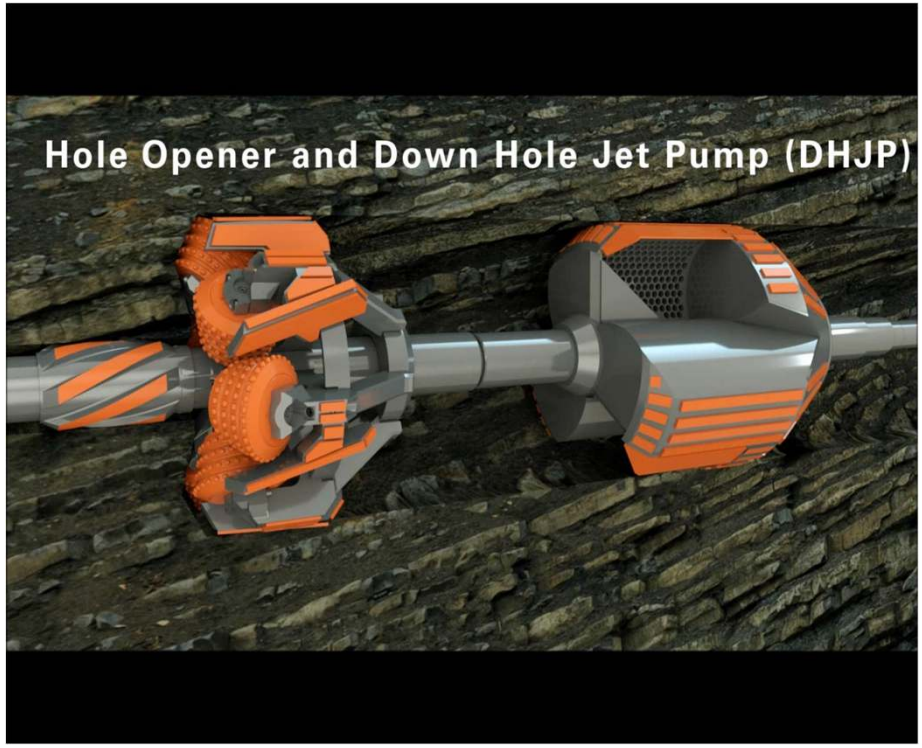
Nozzle:
v = 100 m/s (328 ft/s)
p = 50 bar (725 psi)

Mixing chamber

Diffuser:
v = 3,5 m/s (11,5 ft/s)
p = 20 bar (290 psi)

NEW Jet Pump Technology.

First used in conjunctions with the FF Holeopener in HDD.



Trenchless underground cable installation.

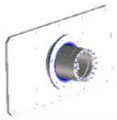
Principle.

Step 1

Plot Bore to target point with preliminary casing pipes

Step 2

Disassembly of pipe jacking machine

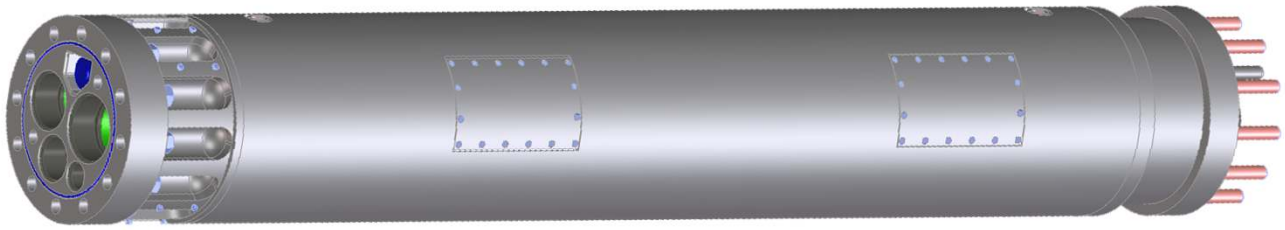


Step 3

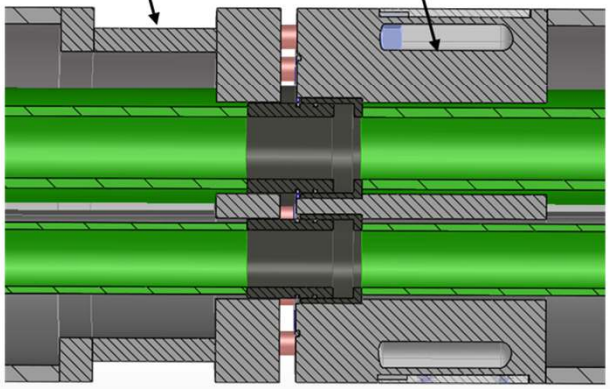
Mounting of pullhead and product pipe and pullback

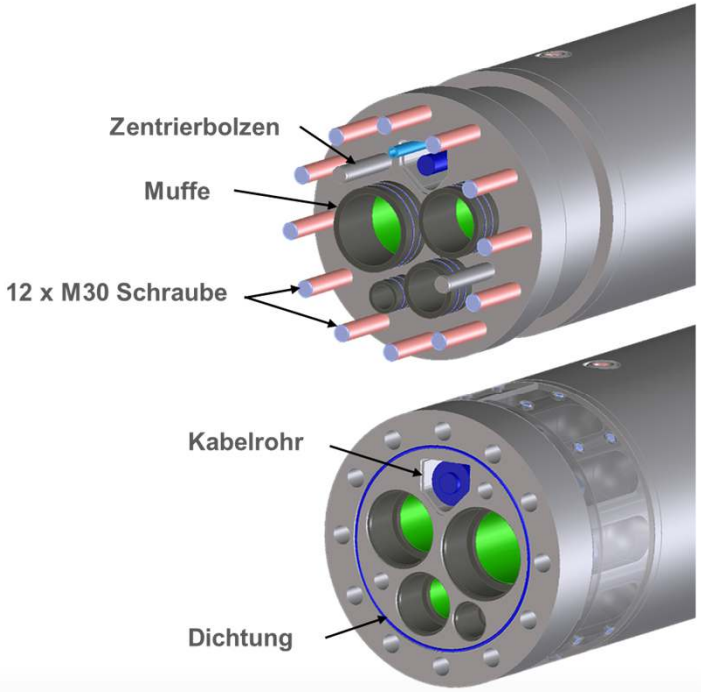
Special installation pipes .

Installation pipes & joint design.



Length 9 m (30ft)

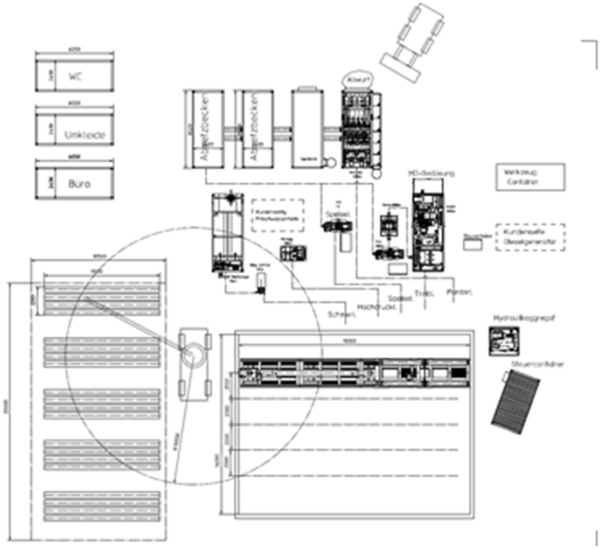


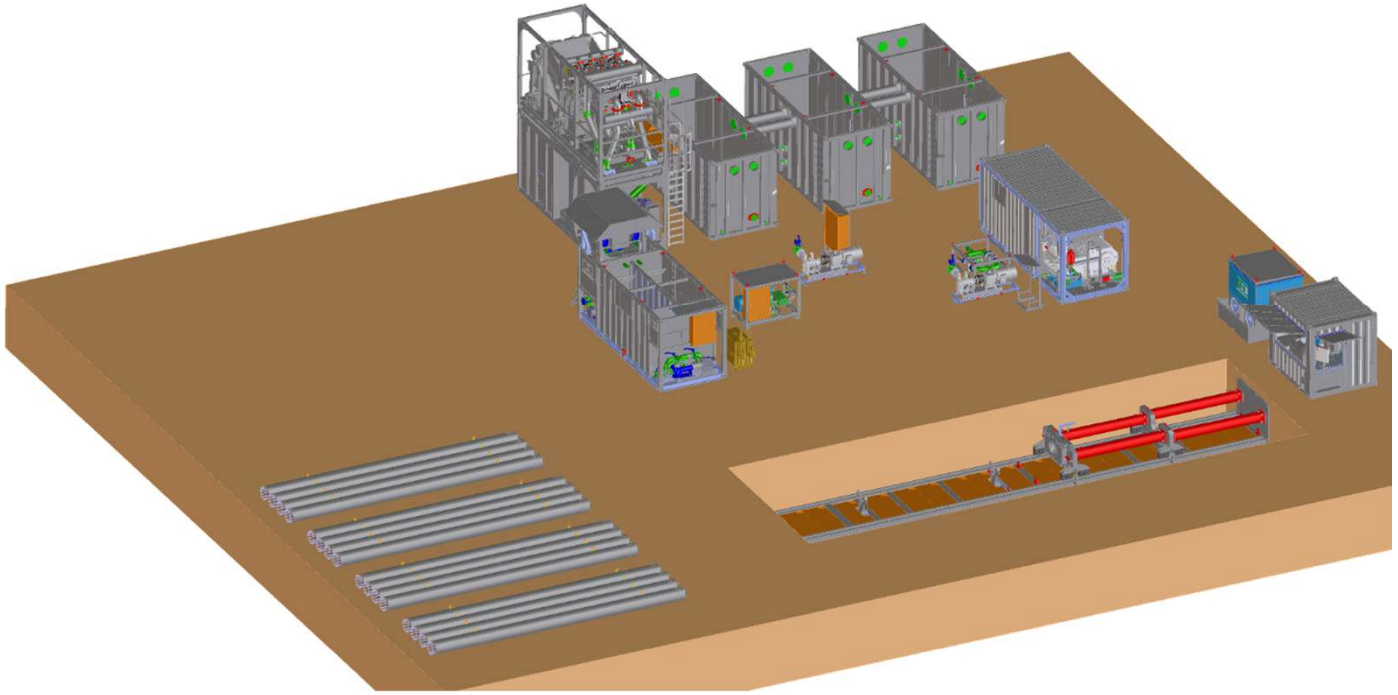


Demo Movie.

Trenchless underground cable installation.

Jobsite setup.





- Current planning: shaft length: ~ 20m | Pilot pipe length: 9m | reduced coupling → high performance
- Adjustable dimensions for pilot pipes, jacking frames and shaft

Trenchless underground cable construction.

Expected installation performance.

Installation step	1.000m casing installation
Pilot Bore 3,300ft (1.000m)	10 days
Rotation of jacking frame 180° and preparation of pull-in	1 day
Pull-in of casing pipes 3,300ft (1.000m)	3 days | 0 days*
Rotation of jacking frame 180° and preparation of pilot Bore	1 day
Total	**15 days | 12 days***

* When using a second jacking frame: pull-in and next pilot bore simultaneously possible
= 3 days saving

Trenchless underground cable installaion.

Development roadmap.

July 2016

Machine manufacturing

Herrenknecht Plant, Schwanau

November/December 2016

Equipment in

Test

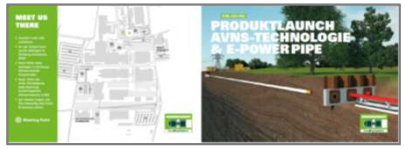
Later

Measurements

Temperature & Magnetic field, IFHT

Herrenknecht Plant, Schwanau

15.12.2016 Product Launch, Schwanau



February/March 2017

Pilot project

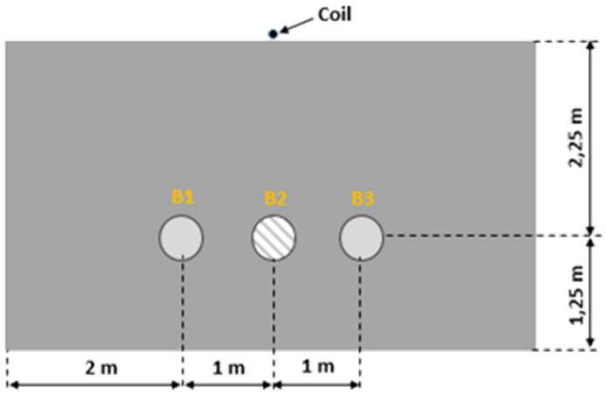
Amprion; 3 x 300m

Q2 2017

Market entry

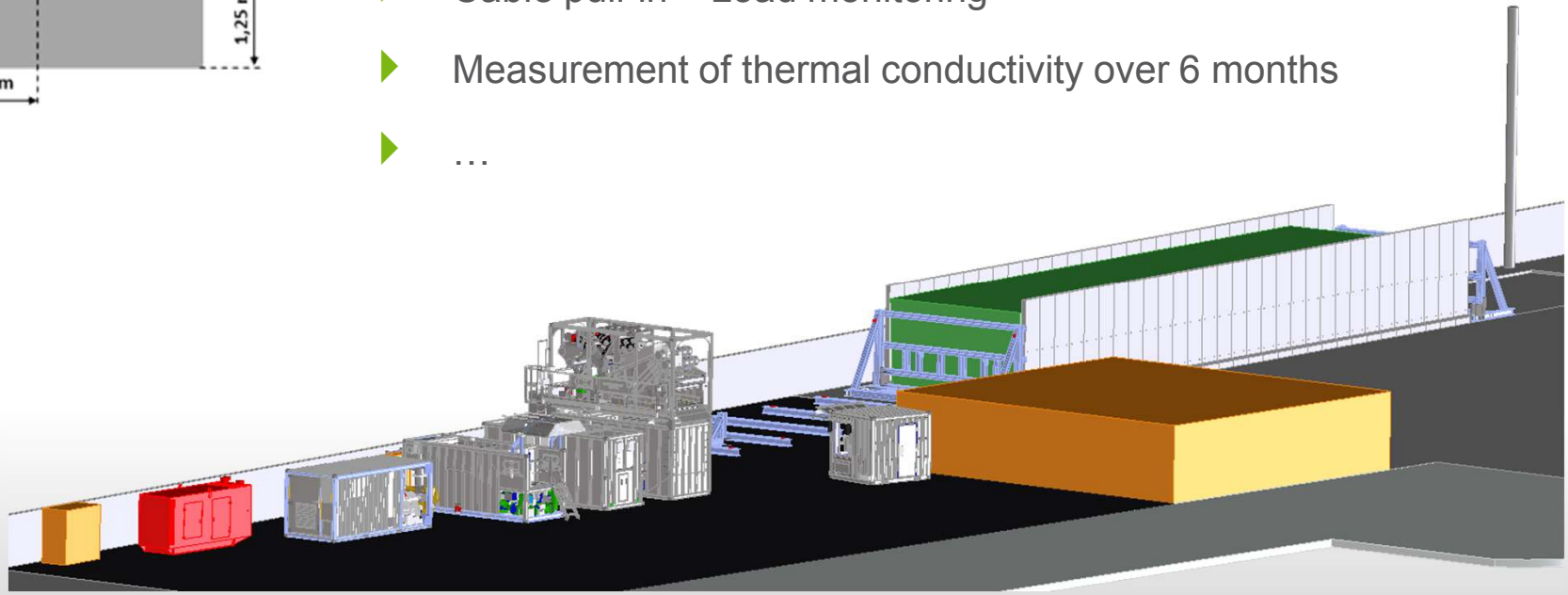
Tests in Schwanau November 2016.

6 Test drills.



Test criteria's:

- Different soil composition, distance, depth
- Construction process
- Cable pull-in + Load monitoring
- Measurement of thermal conductivity over 6 months
- …



Tests in Schwanau November 2016.

Test plant.








Product Launch Dec 15th, 2016.

POWER PIPE





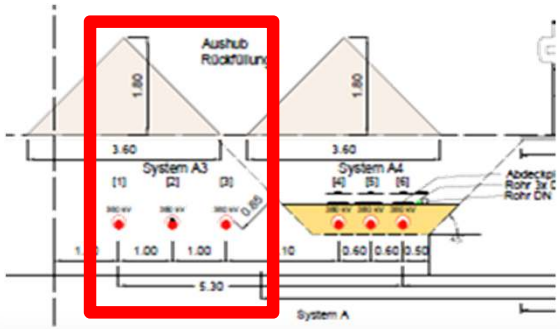


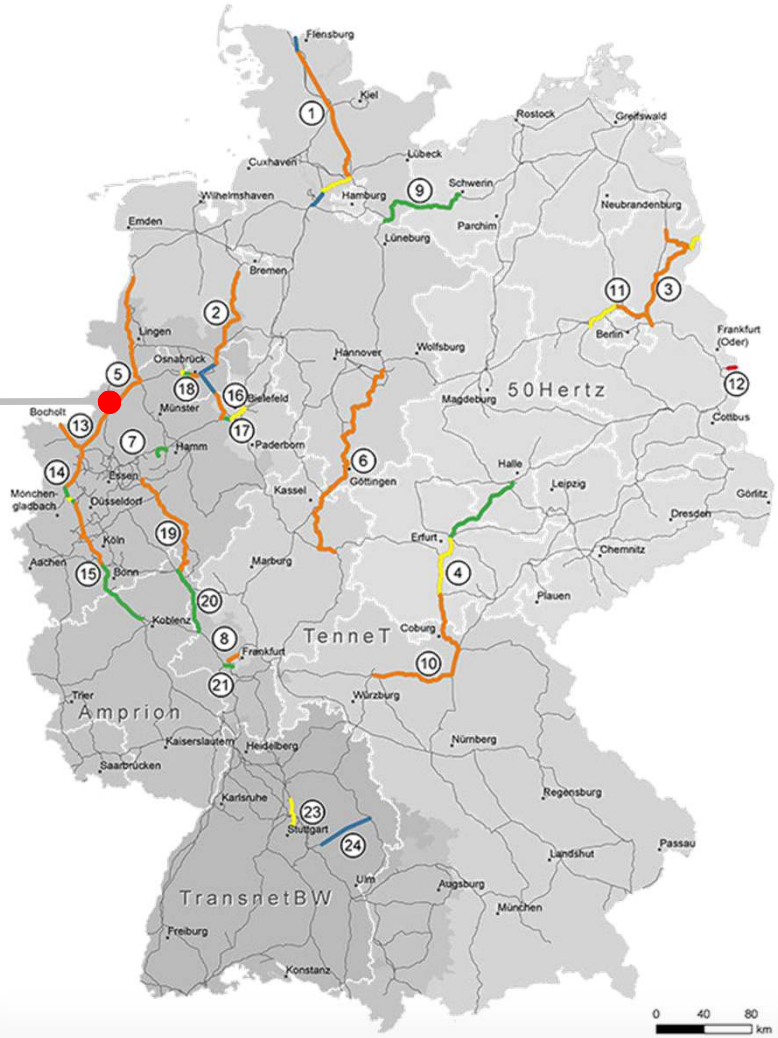



Pilot project February/March 2017.

Amprion – Project Borken

- 3 x 1,00ft (300 m)
- Mostly silt, sand, marl
- Constant depth of 3ft
- Spacing of approx. 30”
- Drilling in February/March 2017





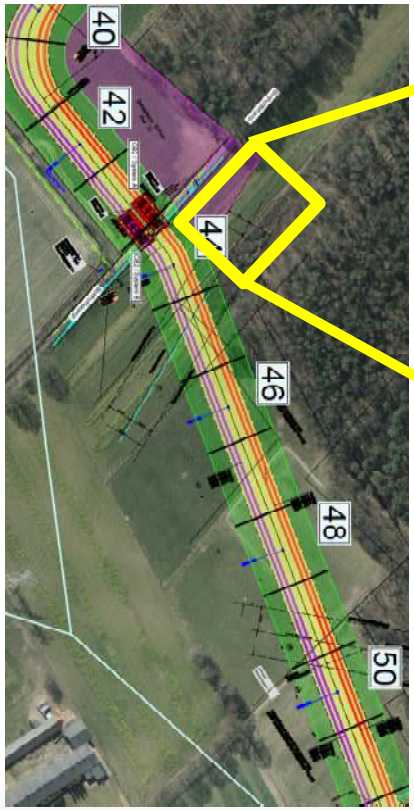
nicht im Genehmigungsverfahren | im Raumordnungsverfahren | vor oder im Planfeststellungsverfahren
genehmigt oder im Bau | realisiert | Übertragungsnetz | ⑦ lfd. Nr. des Vorhabens

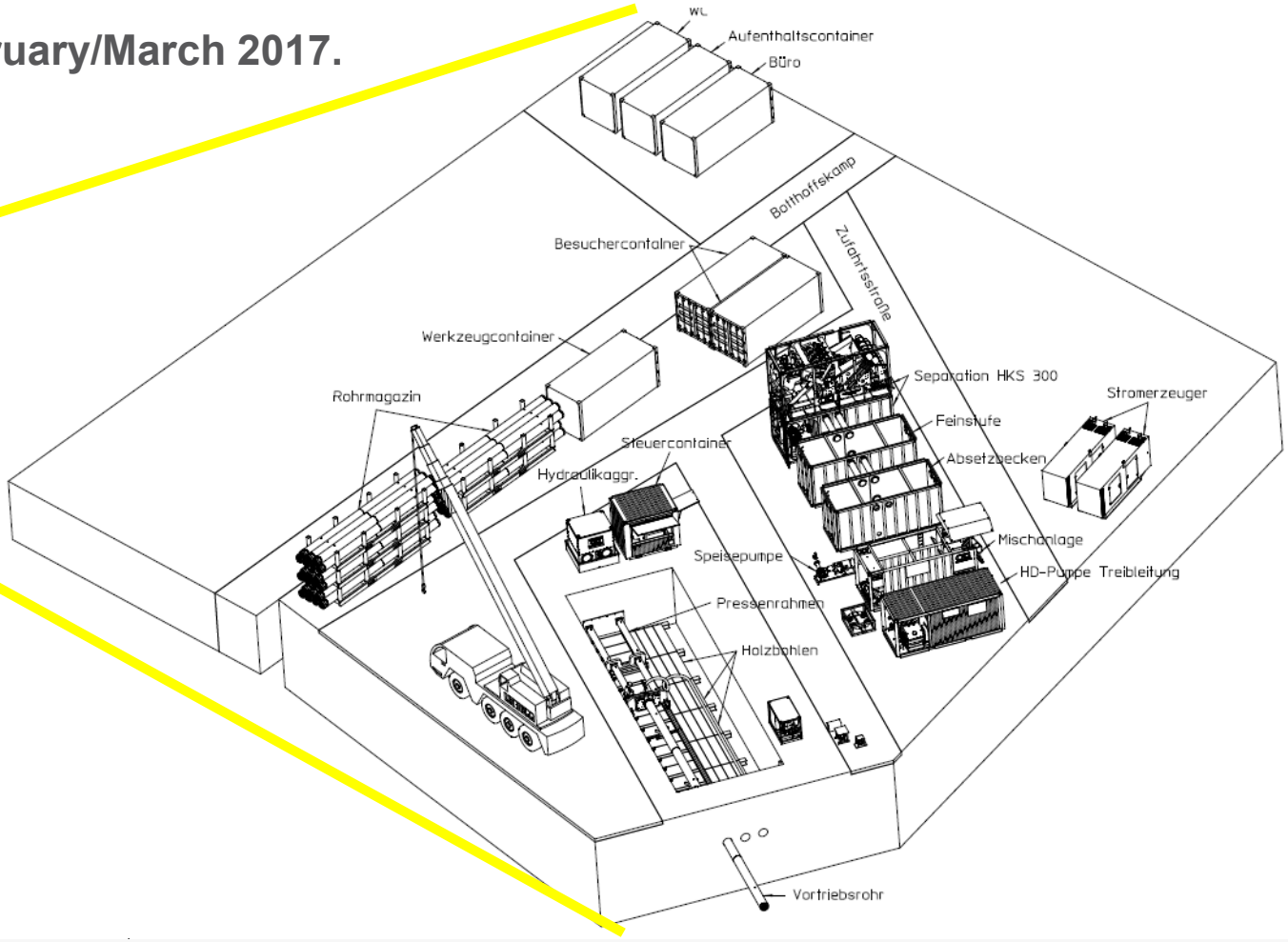
Bundesministerium für Wirtschaft und Energie

amprion

Pilot project Borken February/March 2017.

Amprion – Project Borken.





Bundesministerium für Wirtschaft und Energie

amprion

Pilot project Borken February/March 2017.

Pilot Bore.

Bundesministerium für Wirtschaft und Energie

amprion

Pilot project Borken February/March 2017.

Pull-in of HDPE pipe.

Pilot project Borken February/March 2017.

Overview.

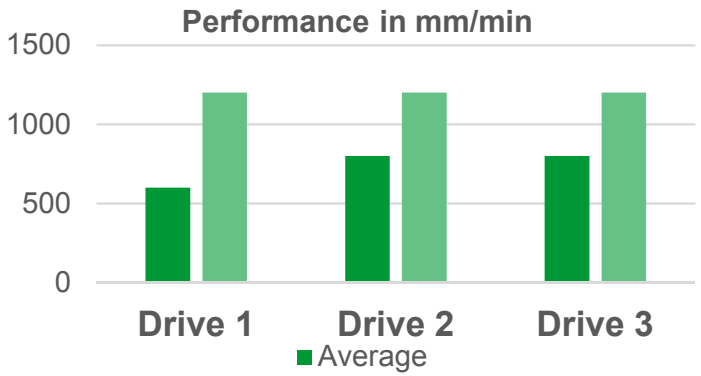
	Drive 1	Drive 2	Drive 3
Pilot Bore			
Duration	36.5h	39h	/
Performance average	600mm/min	800mm/min	800mm/min
Performance max.	1.200mm/min	> 1.200mm/min	> 1.200mm/min
Best daily advance	99m	107m	126m
Pipe handling cycle	40min → 20min	20-25min	20-25min
Pull-in of casing pipe			
Performance max.	1.200mm/min	1.200mm/min	1.200mm/min
Best daily advance	107m	134m	266m
Max. tolerance			
Vertical | horizontal	400mm | 500mm	300mm | 300mm	---* | 50mm

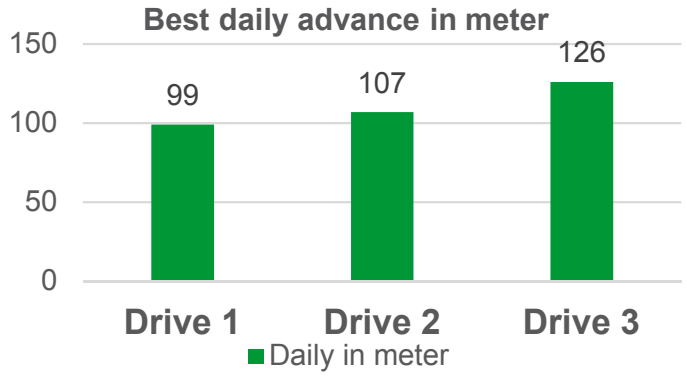
* Installation depth changed

Pilot project Borken February/March 2017.

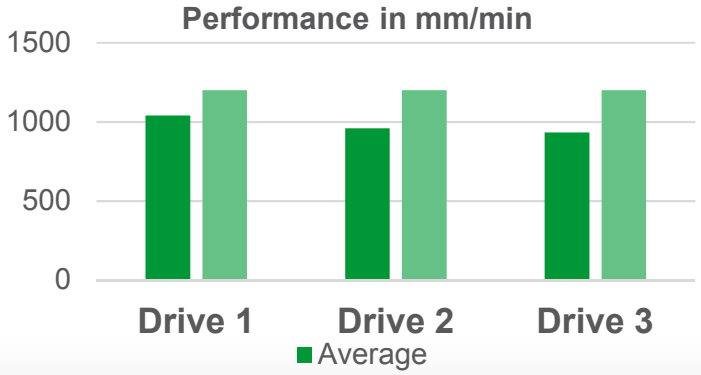
Overview.

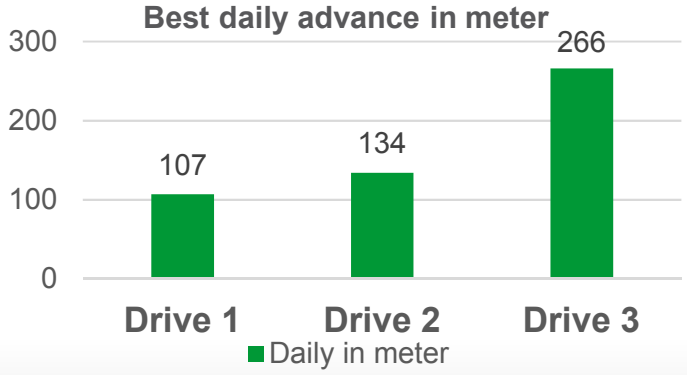
Pilot Bore





Pull–in casing

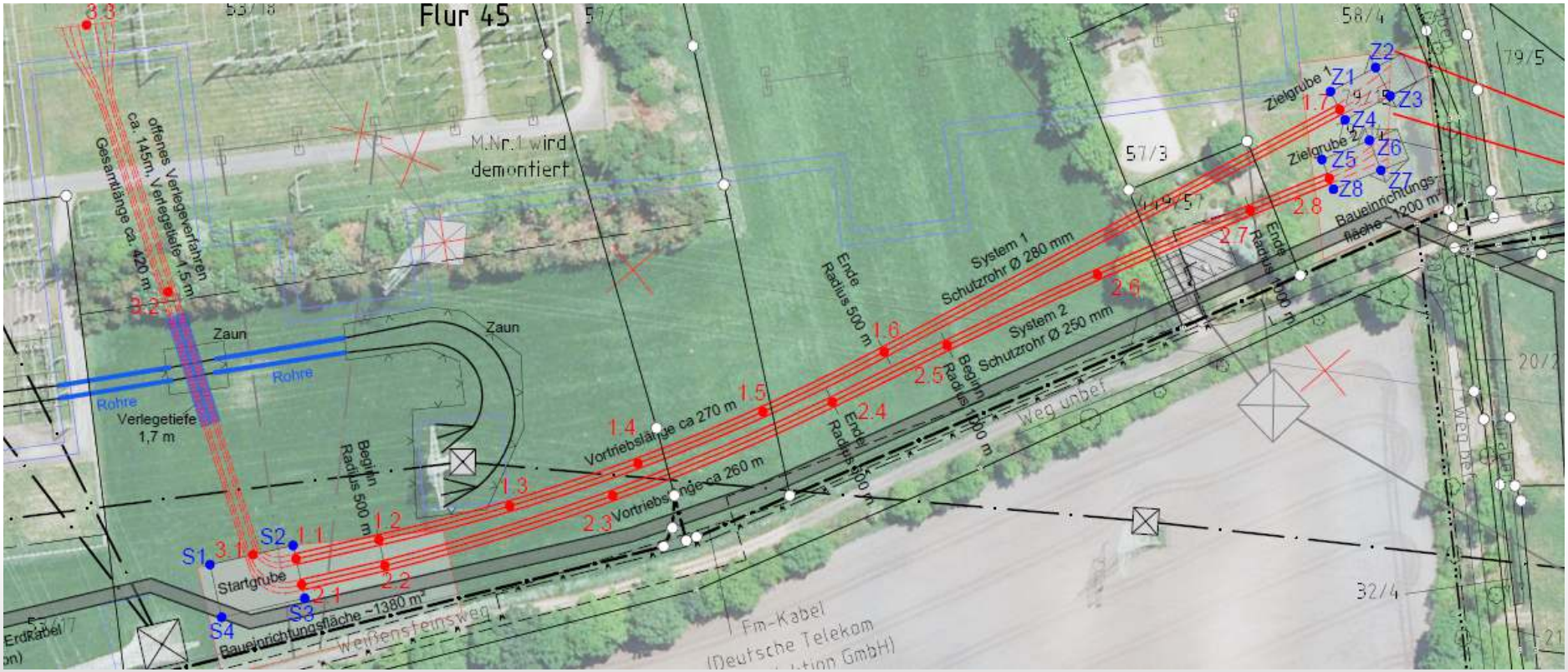




2nd Project Conneforde Jan. 2018.

Jobsite Images.

- Project: 6 x 270m (890ft) drives
- Installation depth: 2.5-4.5m (8-15ft), curve radius : r=500m (1,640ft)




THINK
POSITIVE!
Together we build our future.