



Trenchless solutions for small-diameter pipeline installations

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TRENCHLESS SOLUTIONS FOR SMALL-DIAMETER PIPELINE INSTALLATIONS









TRENCHLESS INSTALLATION OF SMALL-DIAMETER PIPELINES

	Direct Pipe [®]	E-Power Pipe[®]	HDD
Installation of Pipelines or		000	
underground cable solution	one-step Pipeline/steel casing	two-stage Pipeline/steel casing/HDPE single casings or bundle	multi-stage Cable bundle or steel casing/pipeline
Diameter	24" – 60"	10" – 28" > 18" with backreaming	10" – 60"
Max. installation Length	2,000 m	2,000 m	5,000 m

*The information in this table is intended as an initial guideline; the parameters may vary depending on the project.



UNDERGROUND CABLE INSTALLATION | GRID CONSTRUCTION IN GERMANY

- Offshore wind parks for renewable energies in the North
- Extensive transmission grid construction necessary to bring the electricity to the South





 Open-cut approach for underground cables (Germany)



CLOSING THE TECHNOLOGY GAP FOR UNDERGROUND CABLE INSTALLATION | E-POWER PIPE WITH JET PUMP

		SEPARATE INSTALLATION 250 mm		CASING TUNNELS Ø 1,500 mm		CASING TUNNEL Ø 3,000 mm				
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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® INSTALLATION STEPS





E-POWER PIPE® INSTALLATION STEPS



Installation of jacking frame in launch shaft

1 PILOT BORE with AVNS and temporary jacking pipes



Soil excavation with AVNS and pipe jacking process



Handling and coupling of temporary steel jacking pipes



Breakthrough of AVNS in target shaft

2 PULLIN of protective pipe or piepline



Pullin completed



Pullback process by jacking frame in launch shaft



Connection of prefabricated pipe to pullhead (with sliding formwork)



Dismantling of AVNS and connection of pullhead



TRENCHLESS ALTERNATIVES FOR UNDERGROUND CABLES

Exemplary project setting

Exemplary planning of 3.6 km section for cable protective pipe with method mix



Alternative planning of 3.6 km section for cable protective pipe with E-Power Plpe





E-POWER PIPE® EXEMPLARY PROJECT SETTING

For 4 x 3.6 km cable protective pipe





E-POWER PIPE® EXEMPLARY PROJECT SETTING

For 4 x 3.6 km cable protective pipe | Estimated installation time



Estimated duration of complete installation (8 x 1.8 km)

- > Pilot Bore and Pullin of pipe: 160 days (90m / day)
- > Assembly of equipment in shaft: 10 days
- > Several shifts of jacking frame: 6 days
- > 180° turnaround of jacking frame: 2 days

178 days



E-POWER PIPE® VERSUS HDD





Benefit E-Power Pipe[®]

- Near-surface (shallow) installation and constant depth possible
 - > Min. overburden: 1.5 m | 5 ft

Installation corridor / distance between lines



Benefit E-Power Pipe[®]

> Precise, parallel installation

distance: only min. 1.0 m | 3 ft

 Smaller surface for installation corridor and operation required



E-POWER PIPE® CORE COMPONENTS

- > Jacking frame
- > AVNS Slurry MTBM
- > Jet pump system
- > Temporary steel jacking pipes
- > Pullhead with sliding formwork
- > Navigation system





E-POWER PIPE® CORE COMPONENTS | JACKING FRAME

Dimensions:

- Length: 14.78 m
- Width: 2.1 m (transport) | 2,7 m (operation)
- Height: 2.67 m
- Weight: 31 tons

Jacking frame for PUSH and PULL operation

- > Rack & Pinion system, based on HDD Rig
- > Max. thrust & pull force: 340 tons
- > 6 electric drives, total. 66 KW
- > High performance in both directions: max. 5 m/min
- > Pipe Brake with a 20t brake force (prevents pipe stretch)
- > Combination Push & Pull Unit + Steel Pipes: 9 min coupling time !



E-POWER PIPE® CORE COMPONENTS | AVNS 350 XB



- > Cutting diameter: 505 mm | 20"
- > With jet pump system for transportation of excavated soil to the surface
- > High-pressure water system to prevent clogging of cutting wheel in cohesive soil
- > Hydraulic power pack integrated in machine
- > Main drive: max. torque 10 kNm | rated power 22 kW



E-POWER PIPE® CORE COMPONENTS | JET PUMP IN AVNS 350 XB









E-POWER PIPE® CORE COMPONENTS | JACKING PIPES (REUSABLE)





E-POWER PIPE® CORE COMPONENTS | PULLHEAD & FORMWORK





Sliding formwork

> to stabilize borehole around injection area



Pullhead

- To connect pipestrings and prefabricated pipe
- Integrated pull-force sensor (150 tons)
- > Grout injection nozzle



E-POWER PIPE® CORE COMPONENTS | NAVIGATION SYSTEM

TUnIS navigation system for E-Power Pipe®

- > gyrocompass-based system
- allows ongoing position determination and high-precision control
- combined with magnetic field and corresponding sensor





PROJECT REFERENCES IN GERMANY

HDPE protective pipes for underground cables

1 Borken, TSO Amprion

- Sections 3 x 300 m, constant depth
- Geology: silt, sand, clay
- Feb-Mar 2017

2 Conneforde, TSO Tennet

- Sections 6 x 300 m, S-curves r=500m
- Geology: silt, sand, clay, till, boulders
- Nov 2017 Jan 2018

63 Bacharach, TSO Amprion

- Sections 6 x ~ 700 m, curves r=500m
- Geology: silt, sand, sticky clay, schist, quartzite boulders, iron ore
- Nov 2018 Mar 2019

Grossgartach, TSO TransnetBW

- Sections 3 x 455 m, curves r_V =500m, r_H =788m
- Geology: clay
- Feb-Mar 2021





Latest cable project in the Netherlands | Tilburg | TSO Tennet

- > Location: Eindhoven, NL
- > High-voltage cable line (150 kV)
- > Installation length:
 - > 2 x 400m | **2 x 2,000m**
- > Cutting diameter: 505mm
- bundle 3xDN200 + 2xDN90 (HDPE)
- > Geology: sand, silt, clay, peat
- Contractor: Denys | Client: Tennet NL















Latest cable project in the Netherlands | Tilburg | TSO Tennet









Latest cable project in the Netherlands | Tilburg | TSO Tennet



17

2000 m

Best daily performance m/Day



Days per Drive push and pull





Latest cable project in the Netherlands | Tilburg | TSO Tennet

- > Advance rate: 200 mm/min to 1.500 mm/min
- > 223 temporary jacking pipes are connected for 2,000 m
- > 74 Hybrid cable are installed in the jacking pipes to cover 2,000 m
- > 200 high-pressure hoses are installed in the jacking pipes to cover 2,000 m
- > 3 specially designed lubrication pipes for reducing friction







E-POWER PIPE® FURTHER DEVELOPMENTS

New cutting wheel designs for AVNS 350 XB | Ø 505 mm

for expanded geological application fields



Standard cutting wheel

- > for soft ground
- proven up to 50 N/mm²





Mixed ground cutting wheel

- for mixed ground conditions, containing sand, gravel, boulders, soft rock, non-cohesive soil
- > To be tested, up to 100 N/mm²

Rock cutting wheel

- for rock with high compressive strengths of up to 150 MPa
- > for boulders up to Ø 600 mm
- > To be tested*, over 100 N/mm²
- *) proven in AVN 400/500/600 series



E-POWER PIPE® FURTHER DEVELOPMENTS

Borehole extension

For larger product pipe diameters

Conventional E-Power Pipe:

1 Pilot Bore with temporary steel jacking pipes



E-Power Pipe with backreaming

1 Pilot Bore with temporary steel jacking pipes



2 Product pipe pull-in



Product pipe OD ≤ 457 mm / 18"

2 Backreaming and product pipe pull-in



Product pipe OD ≤ 711 mm / 28"



DIRECT PIPE® TECHNOLOGY

24⁴⁴ up to 60⁴ steel pipeline installations

- + One-pass installation
- + min. frac out risk | borehole supported
- + High accuracy





DIRECT PIPE® TECHNOLOGY



- > one pass installation
- > min. frac out risk
- > borehole supported
- > highly accurate
- > less soil excavation
- > shorter crossing distance



DIRECT PIPE[®] | REFERENCE PROJECT I | WORLD RECORD LENGTH, NEW ZEALAND

- > M-2170M, AVN1000 + HK750PT Pipe Thruster
- > 48" Casing Snells Algies Wastewater Pipe and Outfall Replacement (Watercare, Auckland)
- > Drilling length: 2,021m
- > Shore approach with offshore recovery
- > Performance:
 - > Best daily performance: 42.5 m
 - > Best weekly performance: 211 m







DIRECT PIPE® | REFERENCE PROJECT II | SMALL-DIAMETER, POLAND

- M-2596M, AVNS600 with jet pump + H-144, > HK500PT Pipe Thruster
- **GIPL-Gas Interconnector Poland-Lithuania** >
- 2 river crossings executed: >
 - > # 1 River Czarna Hancza: 320 m
 - > # 2 River Narew: 884 m





DIRECT PIPE® TECHNOLOGY

Small 28" Direct Pipe with AVNS 600, with jet pump system

Integration of jet pump in 28" AVN → AVNS machine:

- > modular design
- > one size jet pump for all diameters



Jet pump for **28**⁴⁴



- interchangeable power pack for different pipe diameters
- different sizes of power packs for larger or smaller AVNS
- > expandable powerpack for standard or rock AVN
- > standard RPM versus high RPM



DIRECT PIPE® TECHNOLOGY

Smallest reference project: 28" Direct Pipe with AVNS 600, with jet pump system







DIRECT PIPE[®] | REFERENCE PROJECT III | SMALLEST DIAMETER, ITALY

- M-2801M, AVNS600 with jet pump + HK500PT Pipe Thruster
- > SNAM-Gas Network Adriatic Coastline
- > 2 crossings planned:
 - > # 1 Crossing 310 m (completed March 17th, 2023)
 - > # 2 Crossing: 521 m (started May 2023, ongoing)







HDD | HORIZONTAL DIRECTIONAL DRILLING METHOD









TRENDS IN HDD PROJECTS

GREENER operation >> all-electric HDD Rigs to use renewable energies
>> Minimize frac-out risks with smart tooling concepts

- > Focus of the drilling industry on grid construction
- > Smaller drilling diameters in grid construction \rightarrow Smaller HDD Rigs





HDD RIG RANGE AND EQUIPMENT





HDD RIG RANGE AND POWER SOURCES





HDD RIG RANGE COMPARISON

	CONVENTIONAL HDD RIG	HYBRID HDD RIG	ALL-ELECTRIC HDD RIG
Power source	Generator	Generator / Grid	Generator / Grid
Efficiency	+	+	+++
Emissions / Noise		_ = = = =	
Investment Costs			
Maintenance Costs			



HYBRID HDD RIG | HK80CK HYBRID

- > Compact crawler rig with electric engine
- > Small footprint for jobsites in urban areas
- > all components can be mounted directly on the rig
- > Low in emissions and noise



HYBRID RIG HK80CK

Rig

- > Installed power: 324kW (434hp)
- > Power transmission: Rack & Pinion
- > Drilling angle: 9°-21°
- > Drill pipe length: 6,000 mm (20 ft)
- > Pipe support system on mast: 2





ALL-ELECTRIC HDD RIG | HK300TE

Rotary drive: Torque: 120 000 Nm Rotation speed: 0-60 rpm Carriage system: Pull force: 3 000kN Push force: 1 000kN Speed: 0 - 35 m/min Breakout unit: Clamping range: 4 – 14 inch Breakout torque: 146 000 Nm Make up torque: 100 000 Nm



ALL-ELECTRIC HDD RIG | HK300TE





ALL-ELECTRIC HDD RIG | HK300TE

- > Electric Motors directly on carriage
- High efficiency by elimination of hydraulic power losses
- > Low in emissions and noise
- High availability: sensitive electronic parts located off the HDD Rig







INSTALLATION OF CABLE BUNDLE WITH HDD

HK250T – 250to Trailer Rig in Denmark

- > H-395, HK250T
- > Crossing of Eastern Limfjord
- > Installation length: **1,551 m**
- > Cutting diameter: 1,200 mm
- bundle 3xDN400 + 1xDN355 (HDPE)
- > Geology: soft soil, dense chalk with flint



- > Client: Energinet, Denmark
- > Contractor: Leeuwen Sleufloze Technieken (VLST)





INSTALLATION OF CABLE BUNDLE WITH HDD

HK250T – 250to Trailer Rig in Marseille, France







GREENER HDD | MINIMIZING FRAC-OUT RISK

Tooling concepts for HDD



WEEPER SUB

Reduces the risk of frac-outs significantly by gradually increasing the volume flow in the borehole. Less drilling fluid required at the drill bit.

TOOL DATA

 Operation diameter: 8 ½"-12 ¼"
Adjustable jet volume: 20 gpm-105 gpm (75 l/min-400 l/min)

2 DOWN HOLE JET PUMP

Installed directly behind the Full Face Hole Opener. Cleans the borehole and removes the cuttings directly inside the drill string.

TOOL DATA

 Operation diameter: 20" – 72"
Operation flow rate: 475 gpm (1,800 l/min) at 65 bar



SAFER HDD OPERATIONS

Pipe Thruster for HDD assist





HK500PT Push/Pull: 1,100,000 lbs HK750PT:

Push/Pull: 1,650,000 lbs



