37TH INTERNATIONAL NO-DIG FLORENCE 2019

Fortezza da Basso • FLORENCE (Italy)

30th September • 2nd October 2019

Herrenknecht E-Power Pipe®

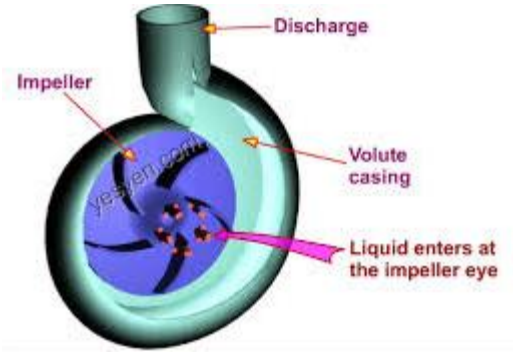
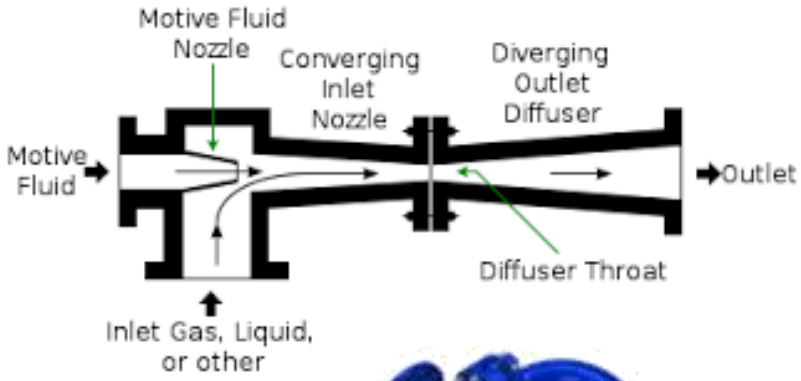
Jet Pump Technology for long-distance drives in small diameters.

Dr. Marc Peters, Herrenknecht AG

HERRENKNECHT Tunnelling Systems

New Jet Pump Technology in Microtunnelling.

Why? – Pumping principles.

	Rotary Pump	Jet Pump
Working Principle		
Execution example		
Characteristics	▸ Design size ▸ Separate power unit ▸ Moving/rotating parts	▸ Small compact size ▸ No power unit ▸ No moving/rotating parts

New Jet Pump Technology in Microtunnelling.

Why? – Pumping principles.

2010

- First test with jet pumps (student study)

2012

- Further test with high pressure jet pumps on Herrenknecht plant

2014

- Test plant for HDD down hole jet pump

2016

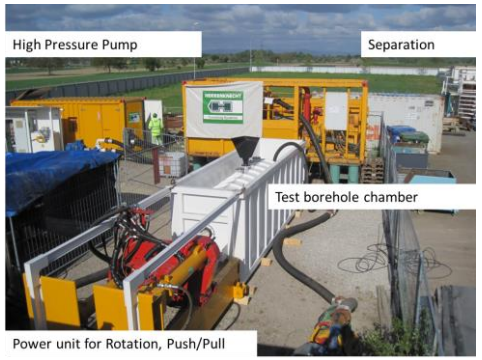
- First pilot in HDD down hole tool
- First pilot test in AVN machine

2017

- First AVNS machine for E-PowerPipe

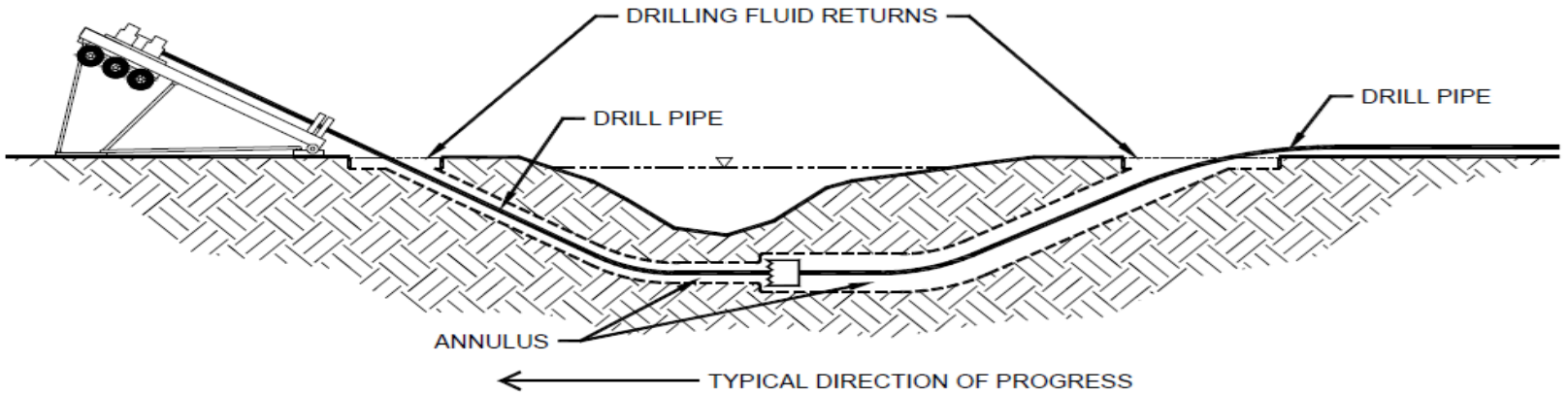
2018

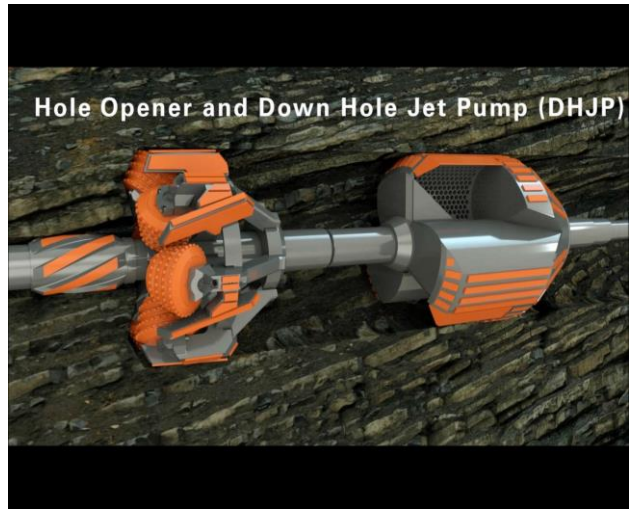
- Jet pump standard tool for HDD and microtunnelling

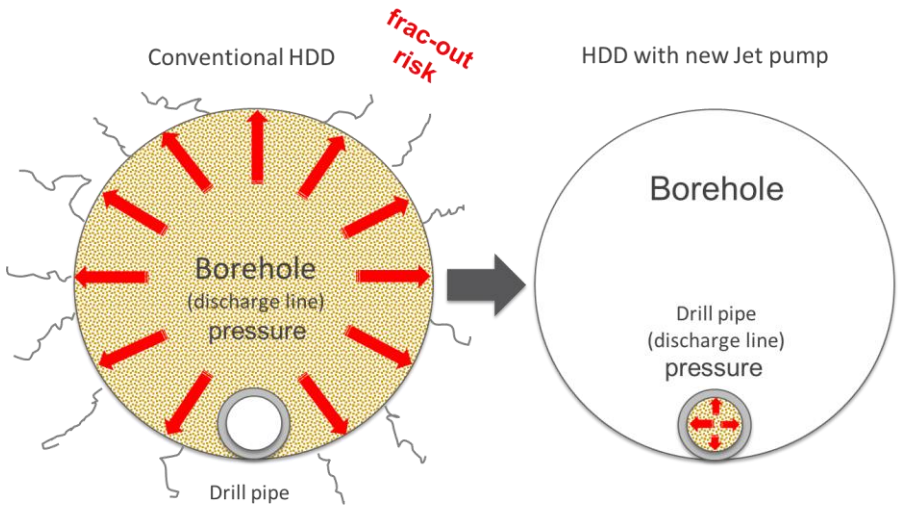


New Jet Pump Technology in Microtunnelling.

First Application – New HDD working principle.



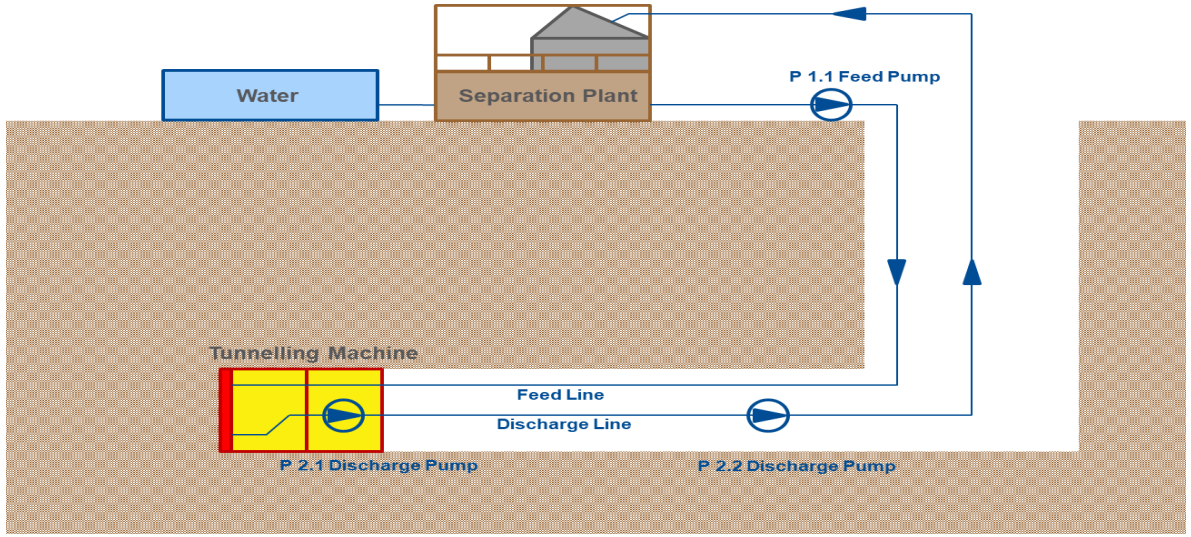




- **Min. Borehole diameter**
  20” (508 mm)
- **Mud- Flow**
  400 gal/min – 530 gal/min (1500-2000 l/min)
- **Mud- Pressure**
  725 psi – 870 psi (50-60 bar)
- **Recycling capacity**
  792 – 924 gal/min (3000-3500 l/min)
- **Recommended Drill Pipes**
  6 5/8”

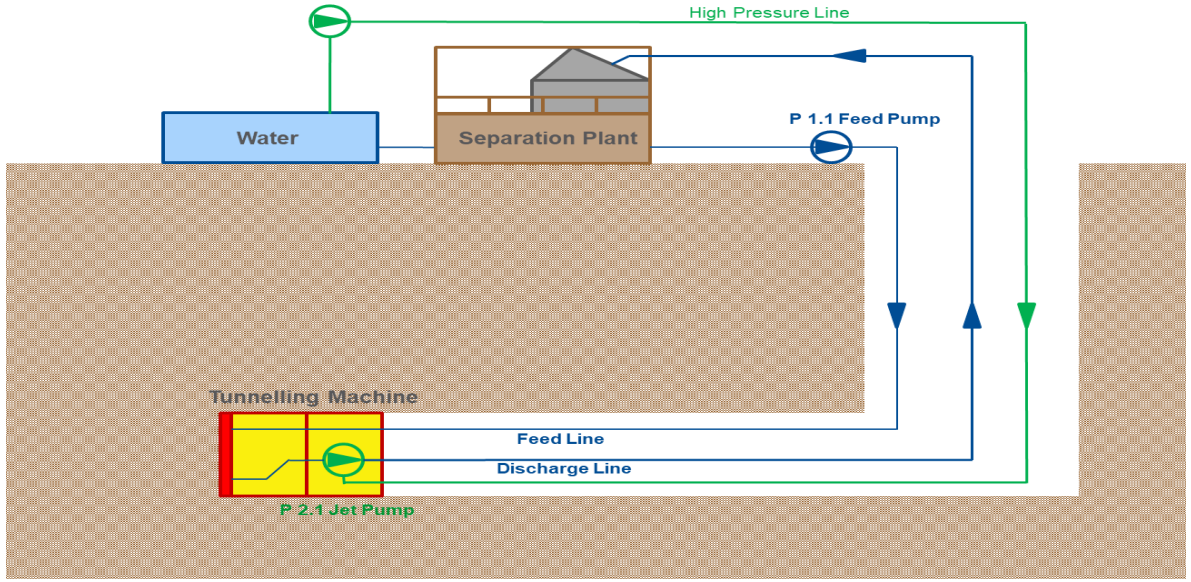
New Jet Pump Technology in Microtunnelling.

First Test in AVN700.



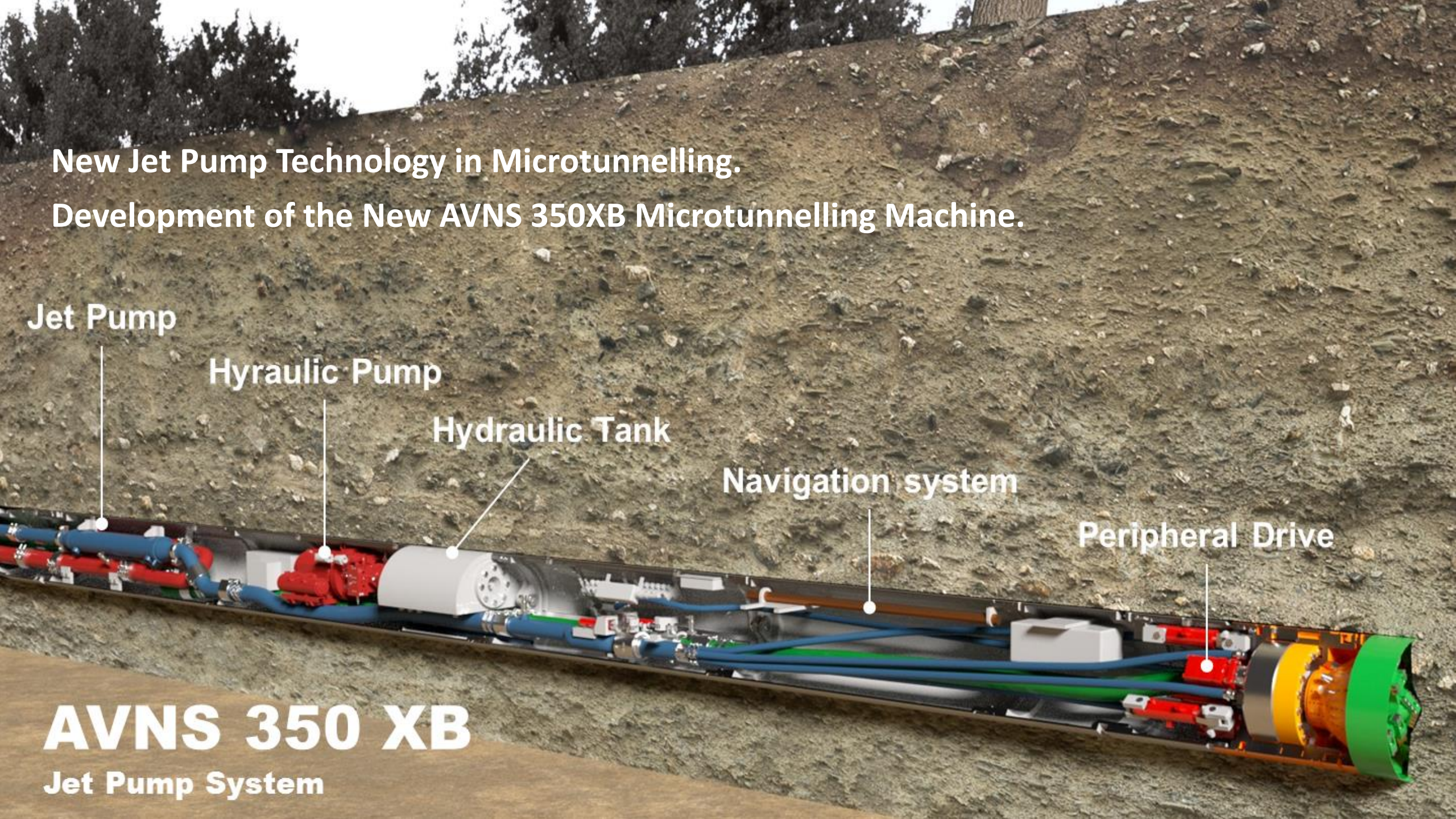
New Jet Pump Technology in Microtunnelling.

First Test in AVN700.



Project: Sewer construction, Hannover, Germany
Customer: Company Sonntag

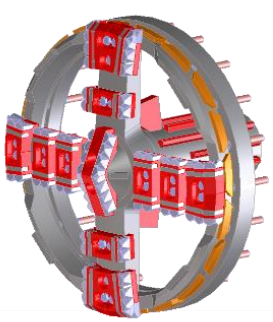
- Machine: AVN 700 with jet pump in machine can no. 3
- Drive length: 120m (394 ft),
- Installation depth: 4.5m (15 ft)
- Geology: Sand, Clay

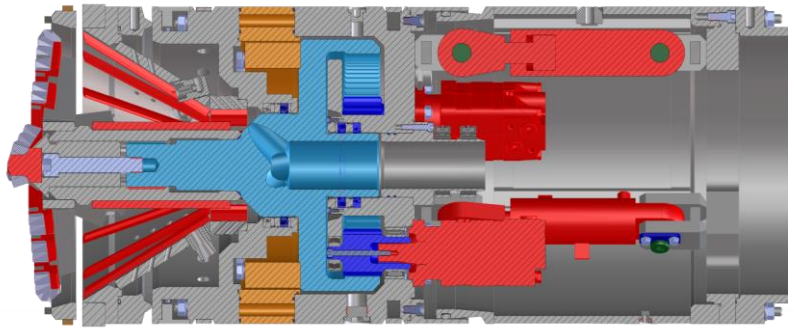

New Jet Pump Technology in Microtunnelling.
Development of the New AVNS 350XB Microtunnelling Machine.
Jet Pump
Hyraulic Pump
Hydraulic Tank
Navigation system
Peripheral Drive
AVNS 350 XB
Jet Pump System

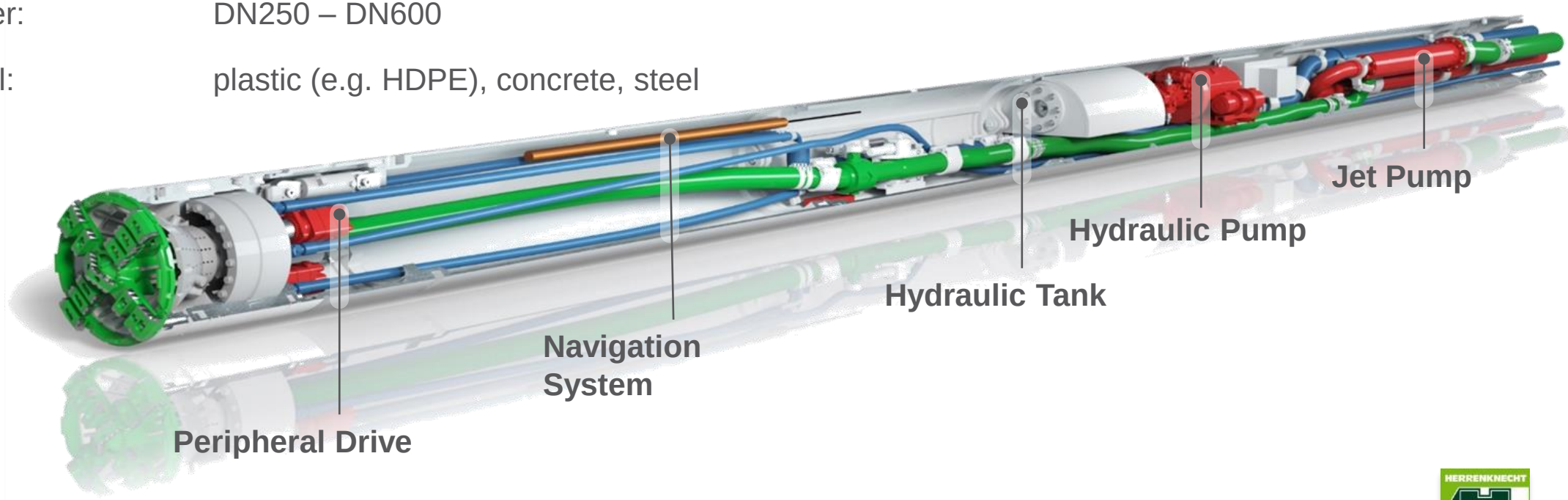
New AVNS 350XB Microtunnelling Machine.

Capabilities.

- Drilling diameter: 500 – 800mm
- Drive length : >1.000m
- Drilling depth: >1,5m
- Pipe diameter: DN250 – DN600
- Pipe material: plastic (e.g. HDPE), concrete, steel







Underground cable construction.

Development of E-Power Pipe®.

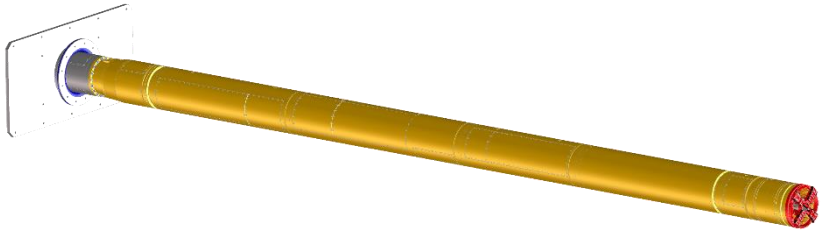
- Intention to replace nuclear power plants by renewable energy until 2025.
- North – South connections (New DC lines) with underground cables
- 1.500 to 2,250km (900 – 1,600 mi.)
- Protests against overhead lines lead to trenchless technology.
- Commissioning of North-South connections in 2025

Underground cable construction.

Working principle.

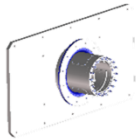
Step 1

Steel pipe pilot from launch to reception shaft



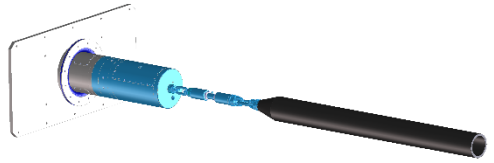
Step 2

Remove of drilling machine and connecting pull-head and plastic pipes



Step 3

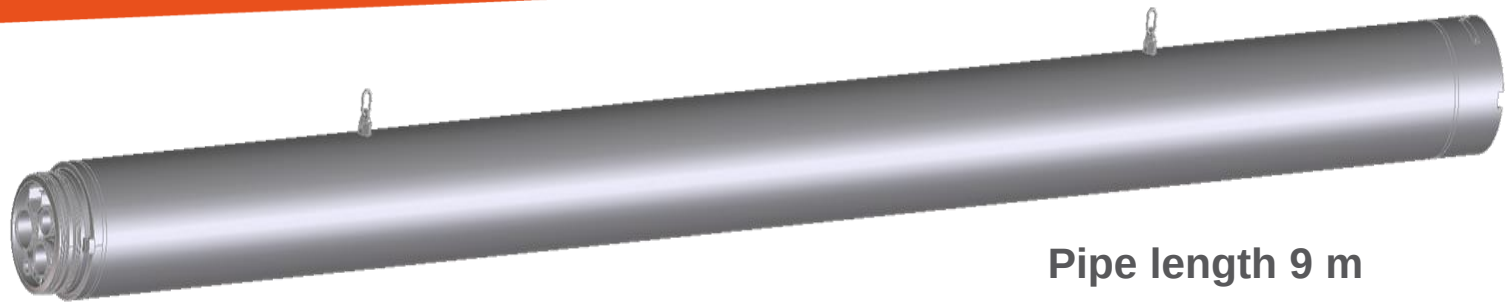
Pull-back steel pilot pipes and pull-in of plastic pipes into borehole



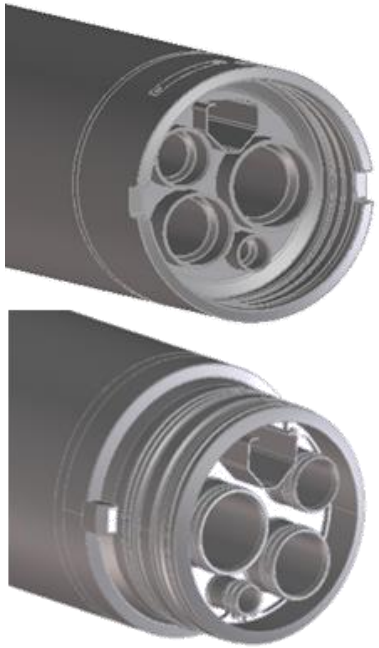
Underground cable construction.

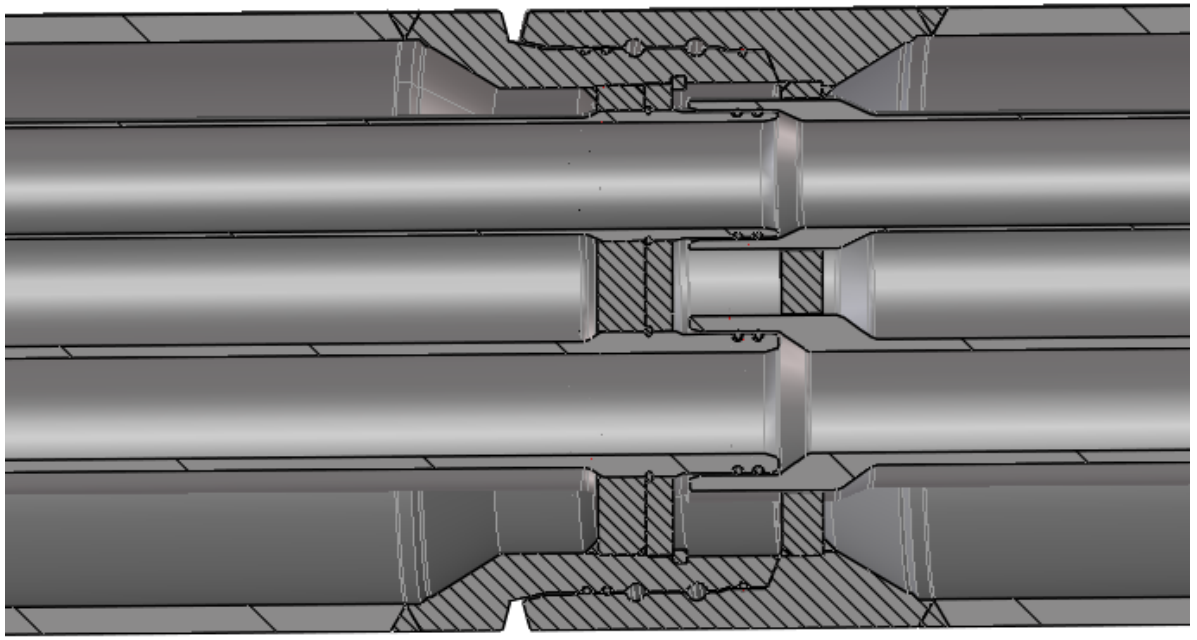
Steel jacking pipes & coupling system - Improvements.

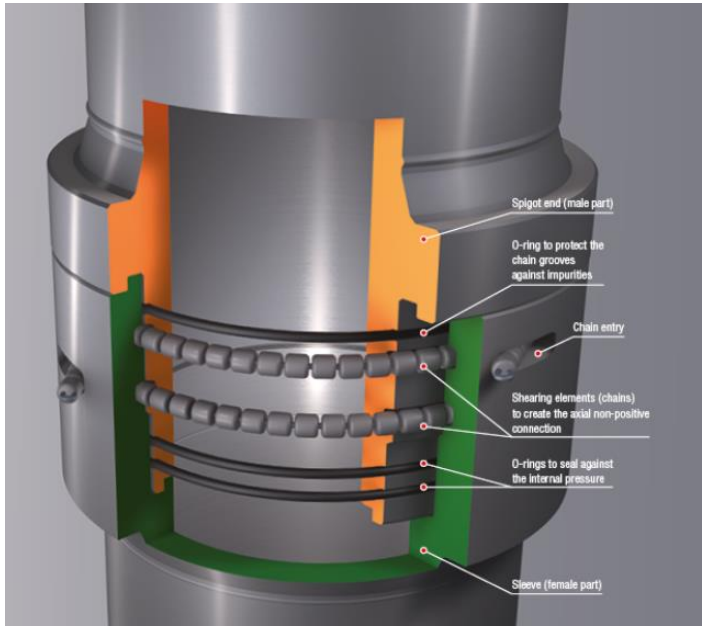
EPOWER PIPE



Pipe length 9 m



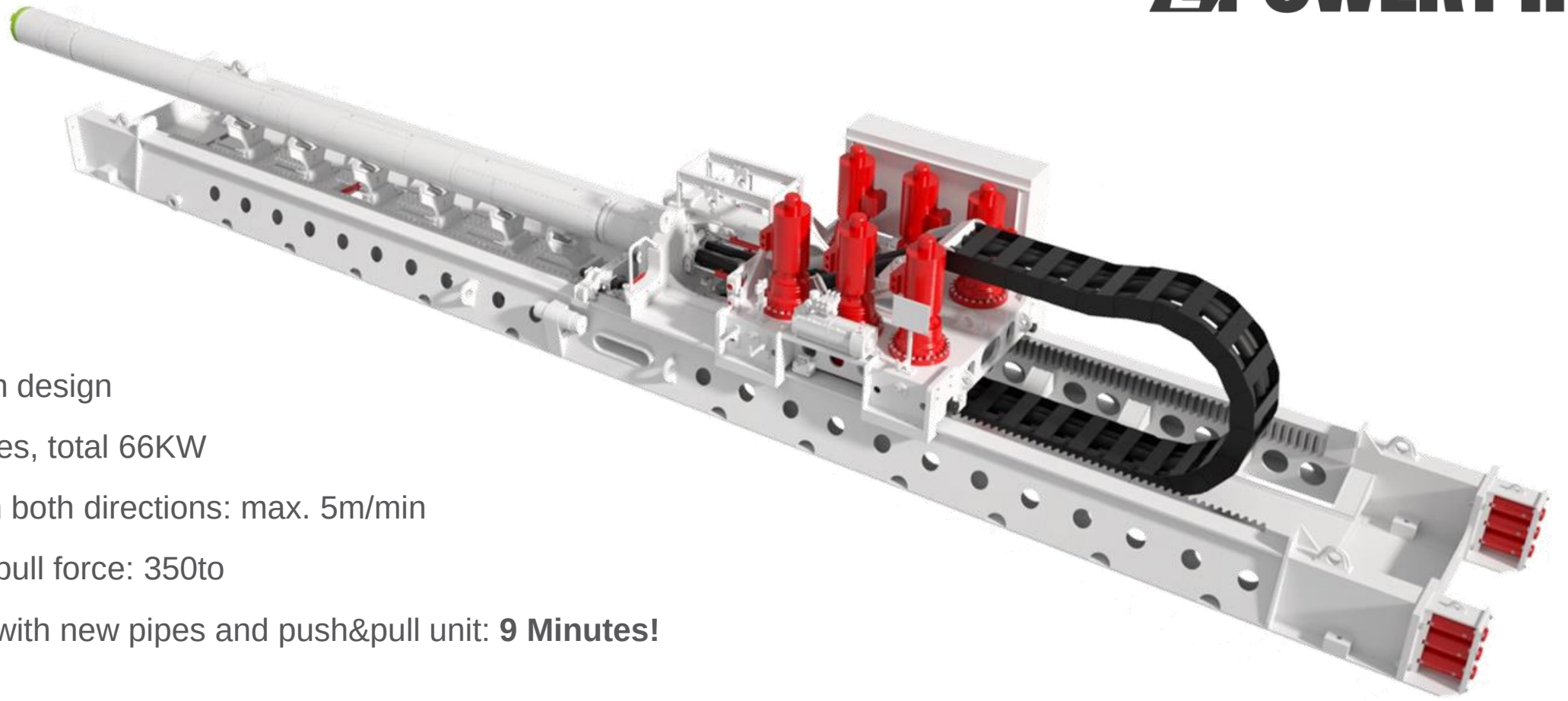




Underground cable construction.

New Push & Pull unit.

EPOWER PIPE



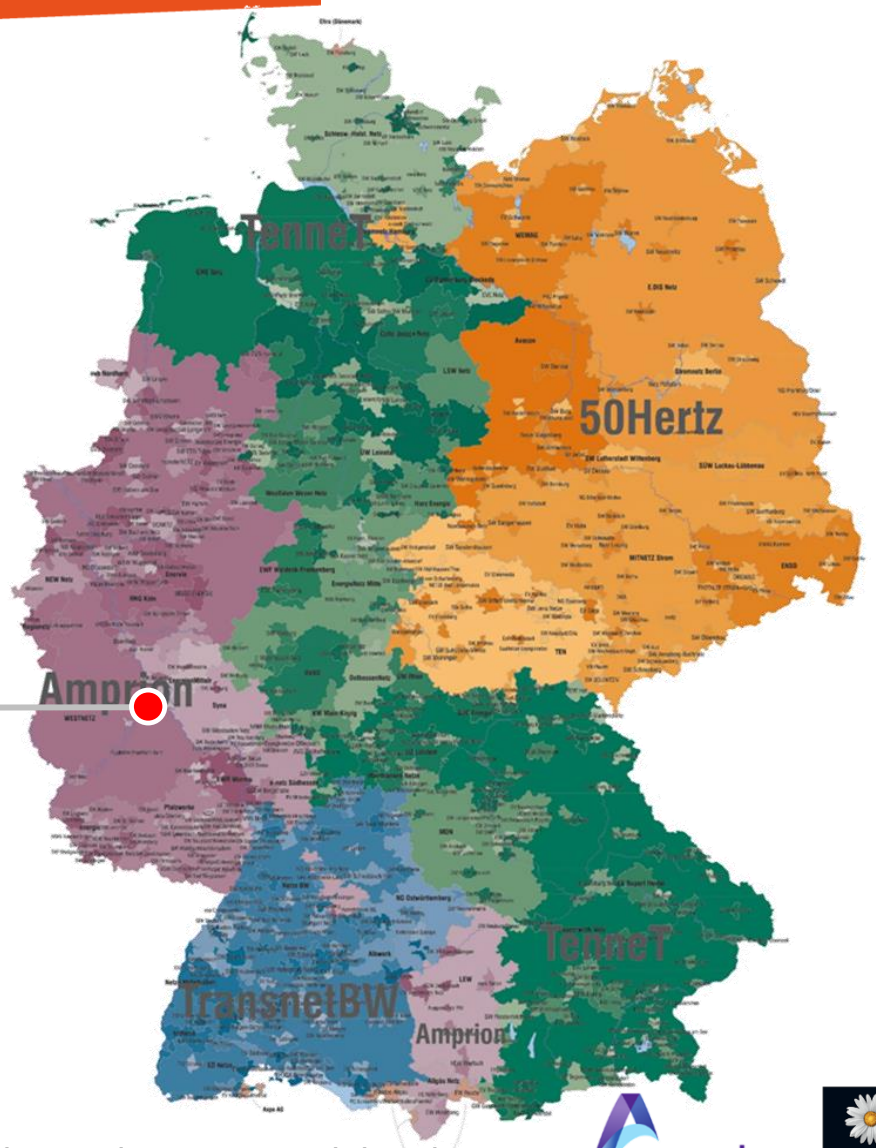
- Rack & Pinion design
- 6 electric drives, total 66KW
- High speed in both directions: max. 5m/min
- Max. push & pull force: 350to
- Pipe change with new pipes and push&pull unit: **9 Minutes!**


Implenia
KOSSEXER
TIEF- U. ROHRLEITUNGSBAU
BAHN- U. INGENIEURBAU
HOCH- U. INDUSTRIEBAU
STAHL- U. METALLBAU
HERRENKNECHT
Implenia
Implenia

Project references.

Project 3: Location Bacharach, TSO Amprion

- Sections with 6 x ca. 700 m (total 4.200m)
- Curves R=500m.
- Geology: silt, sand, sticky clay, schist, bolder (quartz), iron ore
- Time window November 2018 till March 2019



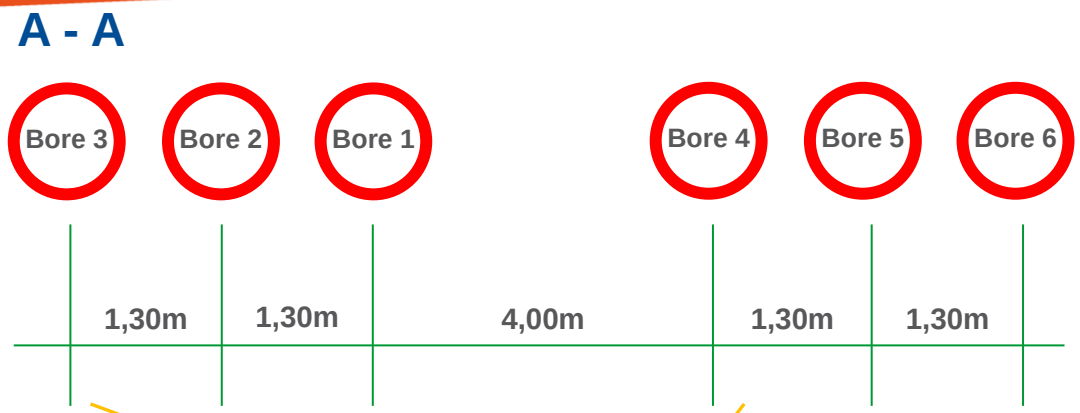
Project 3: Location Bacharach, TSO Amprion

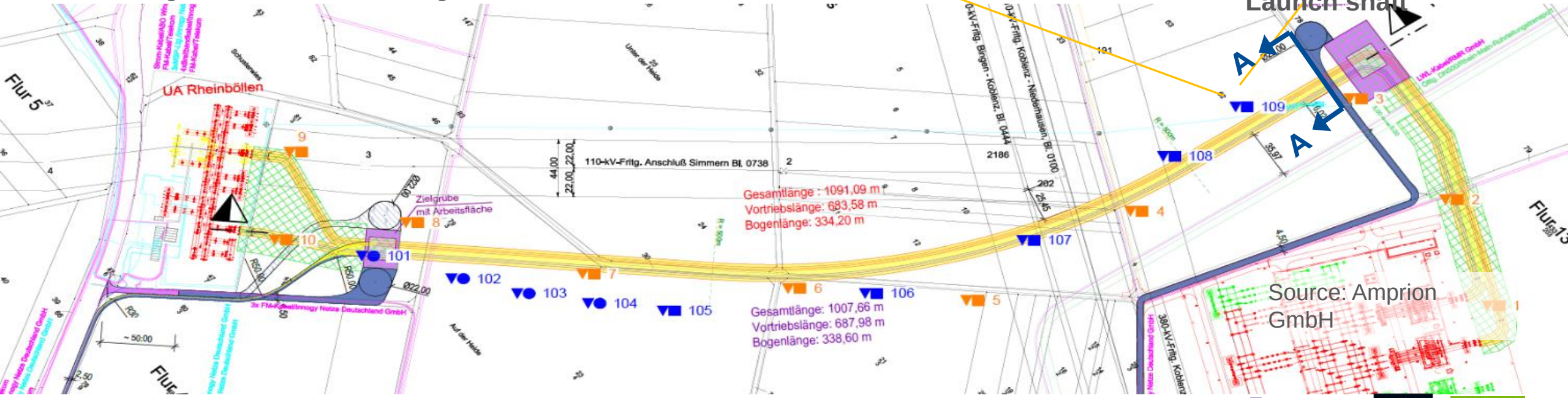
November 2018 - March 2019

Project 3: Location Bacharach, TSO Amprion

Key facts.

- 6 bores of 688 m length each (total: 4.128 m)
- Average coverage of approx. 2 m
- Curve with a radius of 500 m
- Drilling downwards with a height difference of 17 m



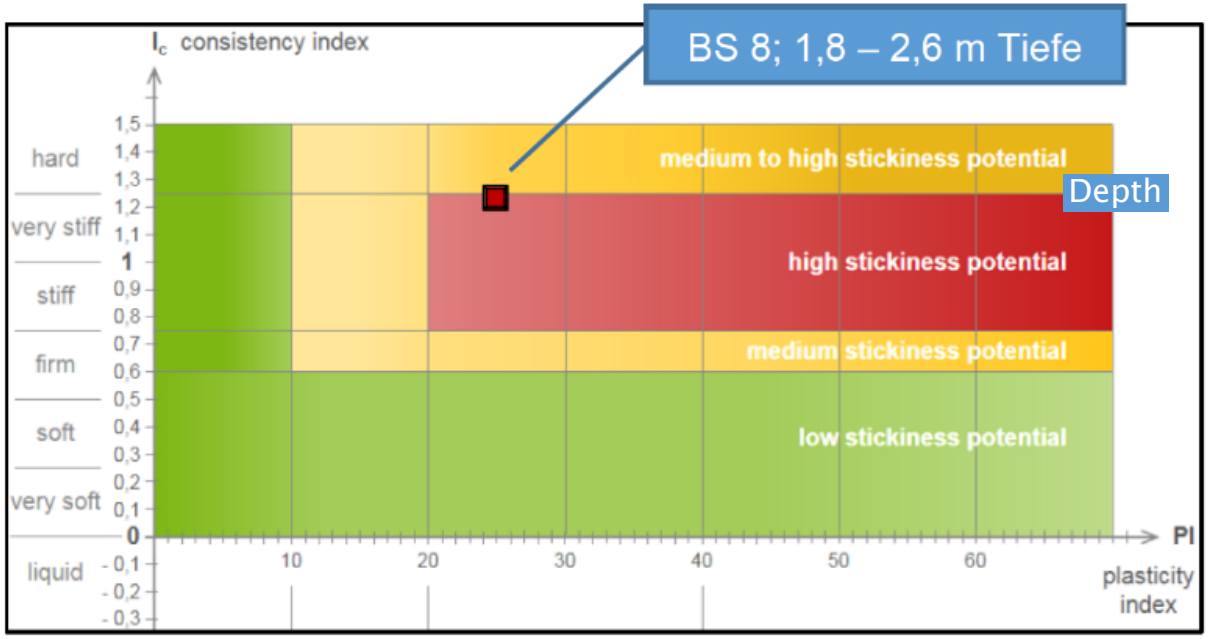



Jacking frame
Jacking pipes
AVNS 350XB
Open trench installation
Separation plant
Bentonite mixing unit
HD-bentonite pump

Project 3: Location Bacharach, TSO Amprion

Ground conditions.

- Schist with clay and quartzite inclusions
- No groundwater
- Medium to high stickiness potential → high pressure nozzles needed



Project 3: Location Bacharach, TSO Amprion

Cutting wheel.

- New external cutting wheel design for the second drive
  - Small annulus
  - Good torque transmission into the ground → no more rolling
  - Aggressive cutting tools
  - High advance rate even in soft soil
  - Able to drill trough quartzite layers
  - No surch shafts needed

New external cutting wheel

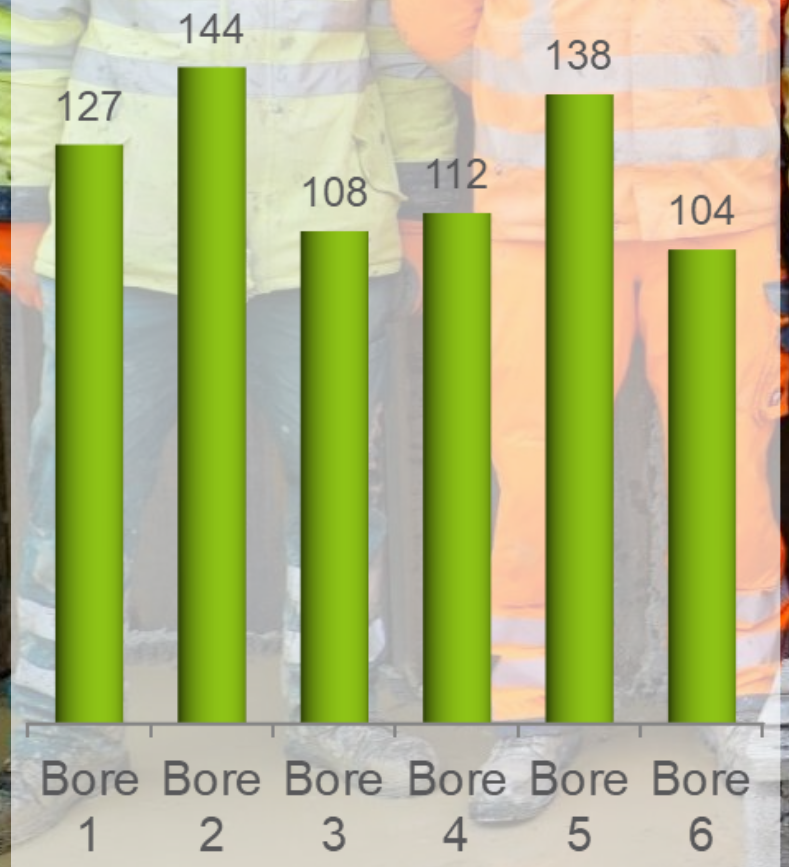
Crushed quartzite stones by the new cutting wheel

E-Power Pipe

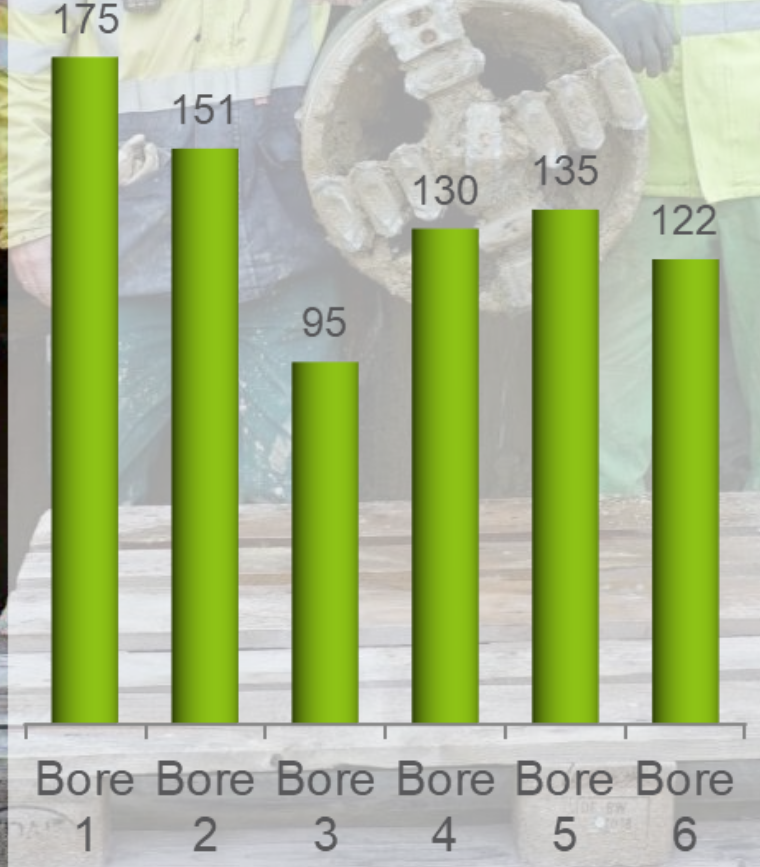
Project in Bacharach: Achievements

Bore 3 | Bore 2 | Bore 1 | Bore 4 | Bore 5 | Bore 6

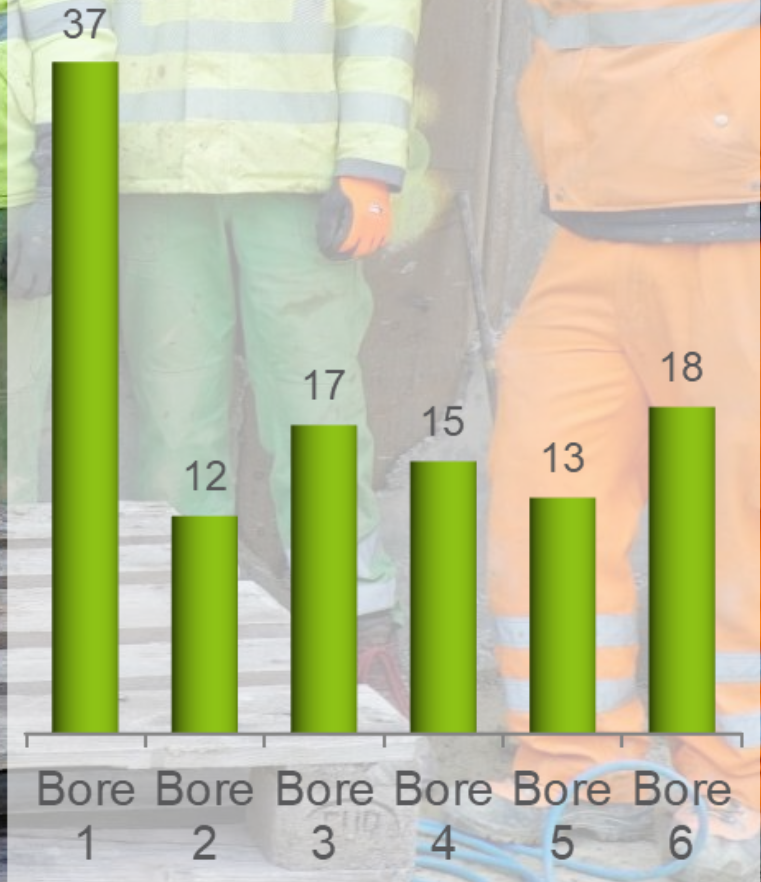
Best daily performance m/day



Average advance rate mm/min



Days per drive



E-Power Pipe®.

Track record.

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July 2016

Machine **in manufacturing**

Herrenknecht plant, Schwanau

Nov / Dec 2016

Equipment in

Test & Measurements

Herrenknecht plant, Schwanau

15.12.2016 Product Launch, Schwanau

13.07.2017

UMWELT TECHNIKPREIS BADEN-WÜRTTEMBERG 2017

Baden-Württemberg

MINISTERIUM FÜR UMWELT, KLIMA UND ENERGIEWIRTSCHAFT

Q1 2017

Pilot 1

Amprion; 3 x 300m

Borken (DE)

Q4 2017

Project 2

Tennet; 6 x 270m

Conneforde, Ostfriesland (DE)

Q4 2018

Project 3

Amprion; 6 x 700m

Bacharach, (DE)

April 2019

Bauma München

Innovation Award

WINNER OF THE: bauma Innovation Award 2019

HERRENKNECHT Tunnelling Systems

PIONEERING UNDERGROUND TECHNOLOGIES

- Thank you very much for your attention.