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TBM 1 BREAKTHROUGH  
21 กุมภาพันธ์ 2567



HERRENKNECHT AG

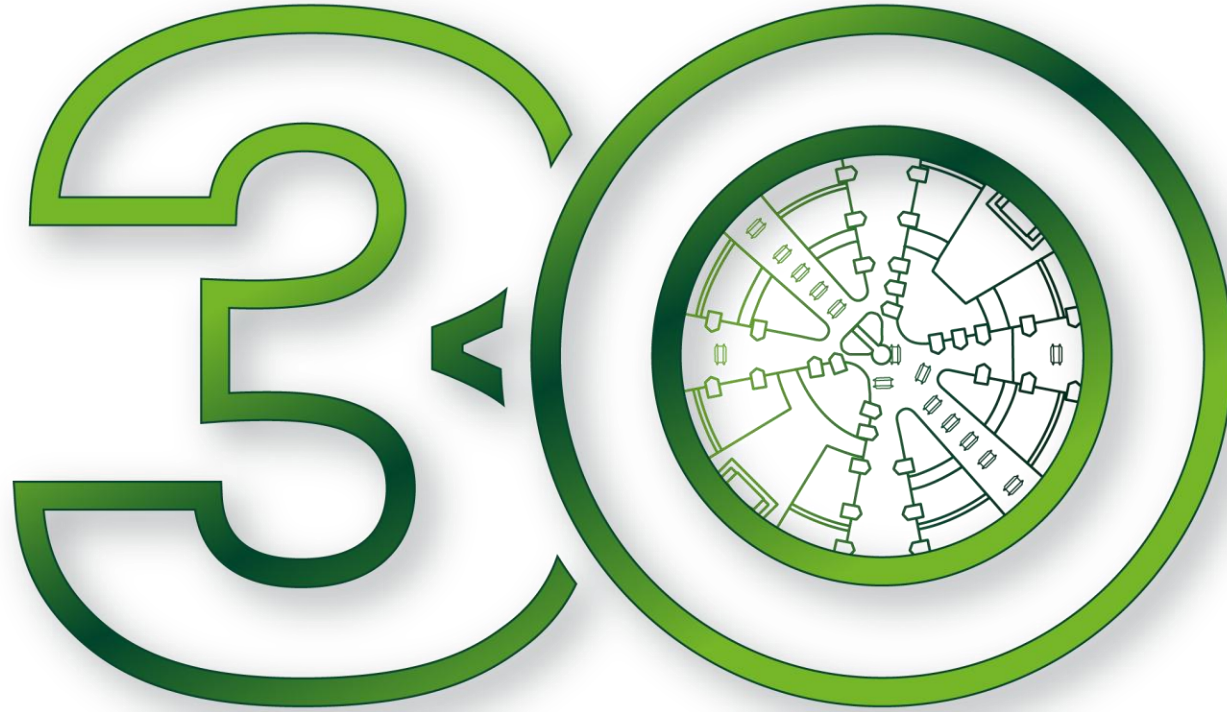
# SMALL-DIAMETER TUNNELLING IN THAILAND

## CASE STUDIES IN TUNNEL AND PIPELINE CONSTRUCTION

Trenchless Asia 2026

Ben Hayes

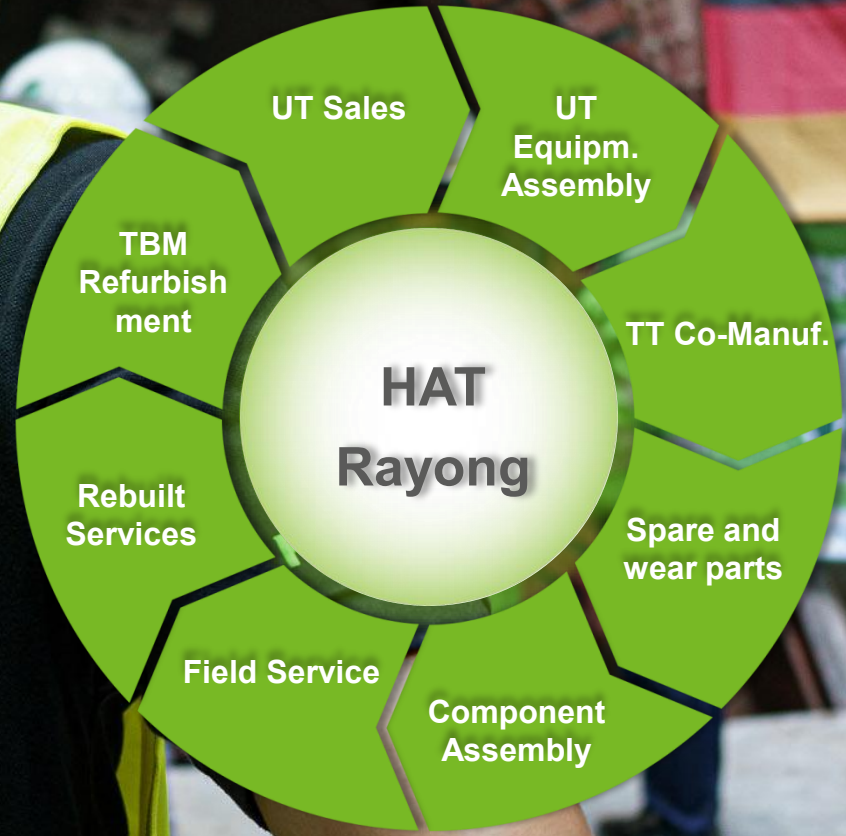




**YEARS OF  
HERRENKNECHT  
THAILAND**

Presence on site

# HERRENKNECHT (ASIA) LTD.



HERRENKNECHT

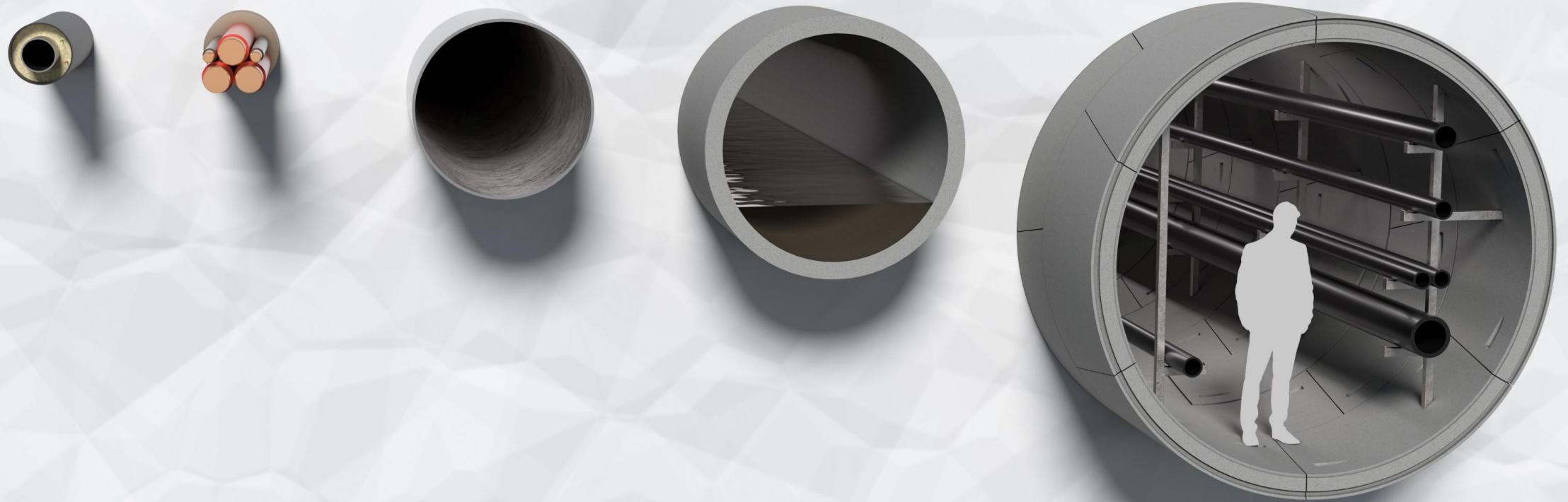


Tunnelvortriebstechnik



Herrenknecht Utility Tunnelling

# TRENCHLESS TECHNOLOGIES FOR UNDERGROUND INFRASTRUCTURE



## Business Unit Utility Tunnelling

# UT PRODUCTS AND TECHNOLOGIES

## Microtunnelling

- › Pipe Jacking
- › Direct Pipe
- › E-Power Pipe

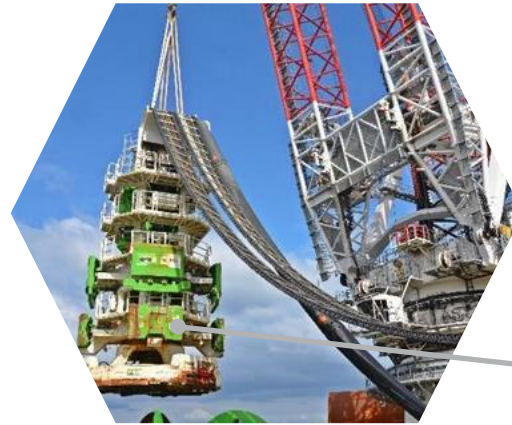


## Segment Lining



## Shaft sinking (VSM)

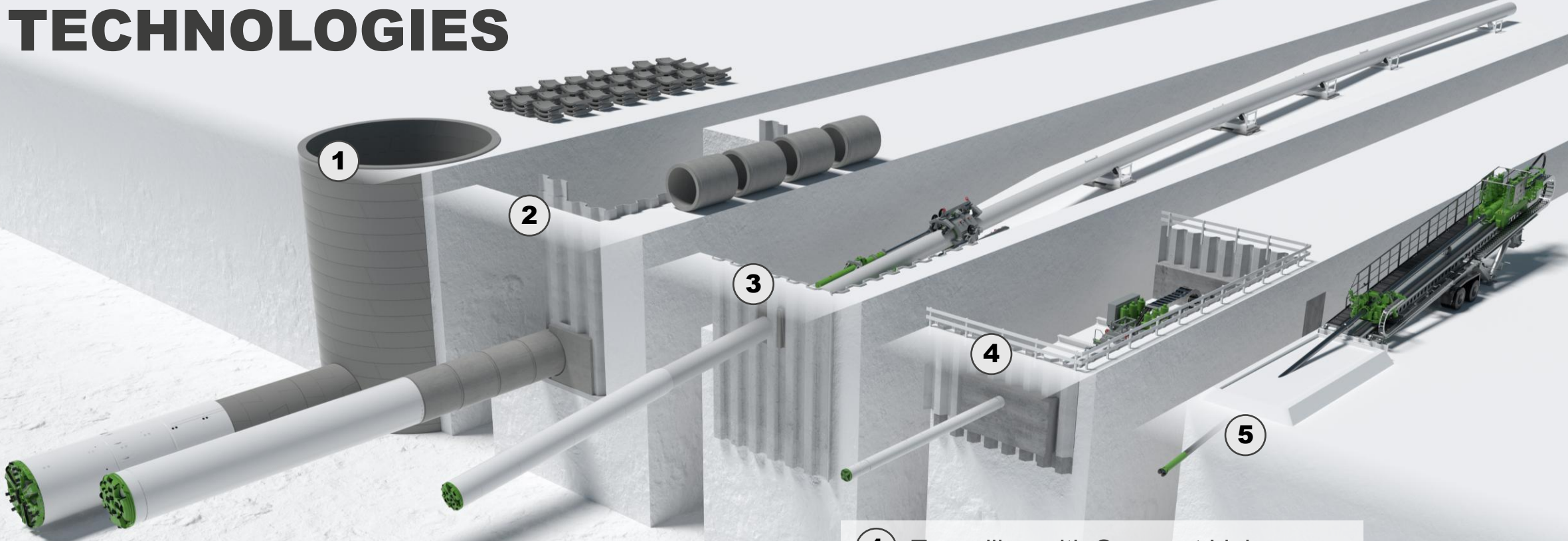
## Horizontal Directional Drilling (HDD)



## Offshore Foundation Drilling (OFD)

Herrenknecht Utility Tunnelling

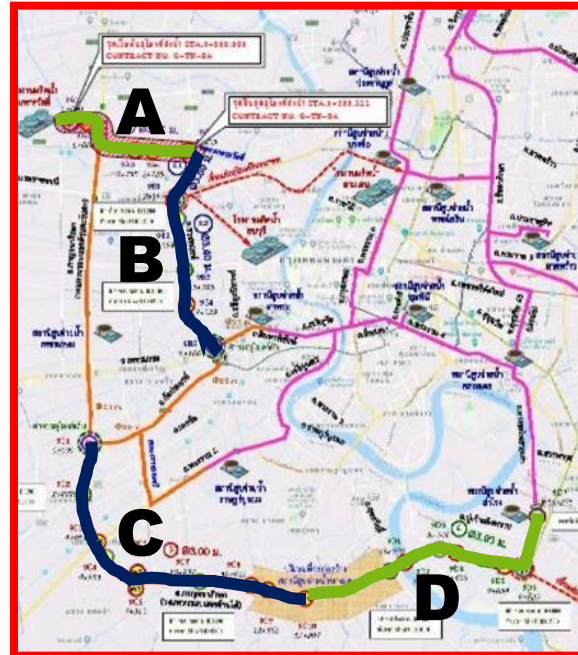
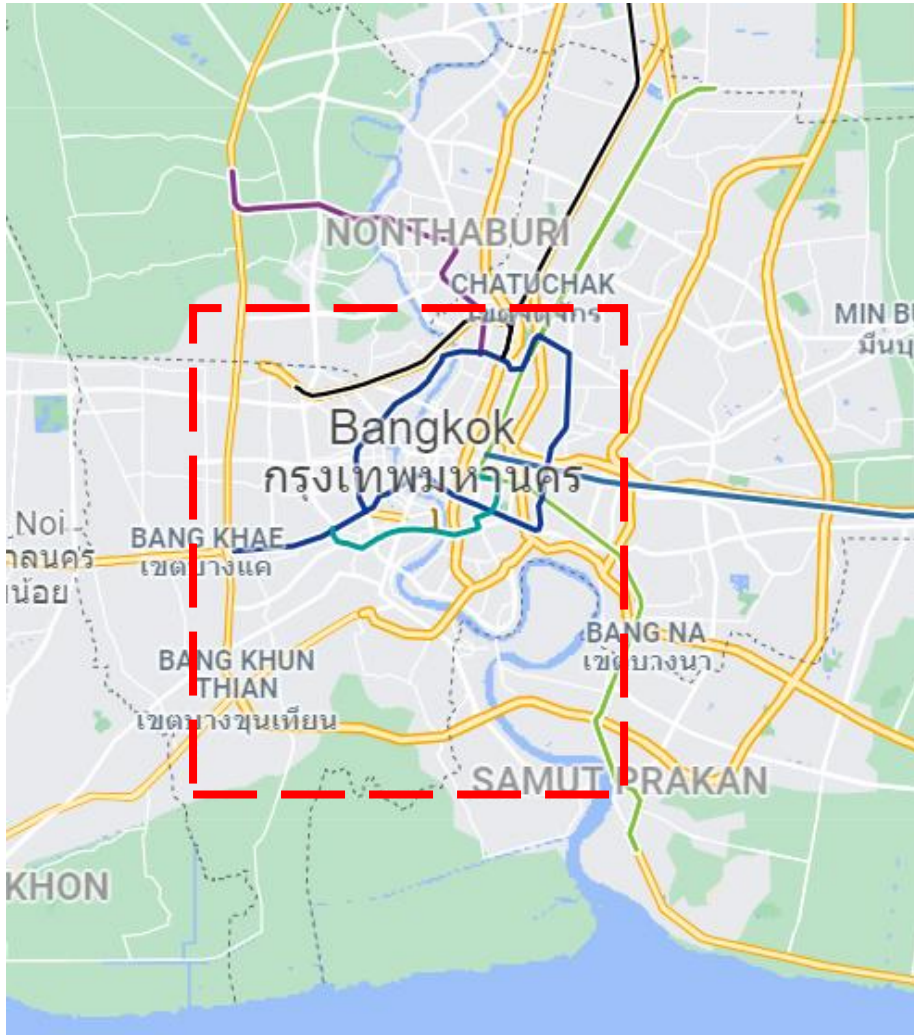
# TUNNEL AND PIPELINE TECHNOLOGIES



- ① Tunnelling with Segment Lining
- ② Pipe Jacking
- ③ Direct Pipe
- ④ E-Power Pipe
- ⑤ Horizontal Directional Drilling (HDD)

HK in Thailand | Segment Lining Project

# MWA WATER TRANSFER TUNNEL PLAN 9 | BANGKOK



METROPOLITAN WATERWORKS AUTHORITY

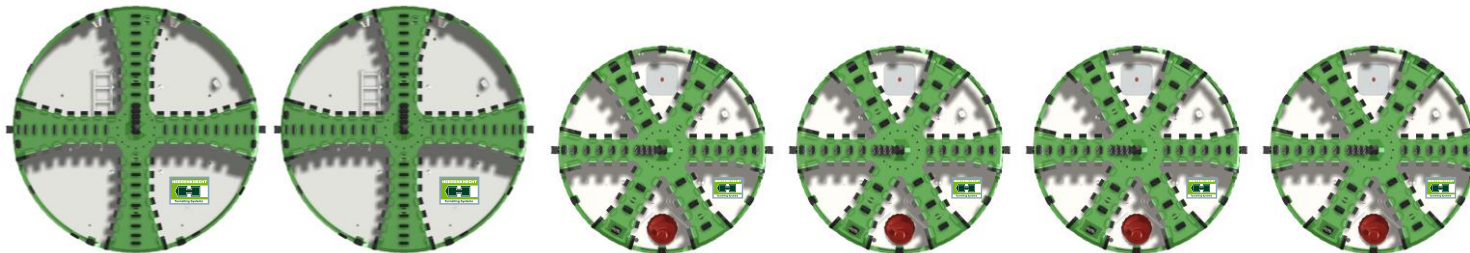


- › Overall tunnel length of project: 43.5 km
- › Share with 6 HK TBMs: 54 % | 23,4 km
- › 7 drives, completed ahead of time by HK TBMs

HK in Thailand | Segment Lining Project

# MWA WATER TRANSFER TUNNEL PLAN 9 | BANGKOK

	9A	9C	9D
Contractor	Summit Grade Limited Partnership	Seesang Karn Yotah	CH. Karnchang Public Company Ltd.
HK TBMs involved	2 x EPB ID 4244   OD 4809	1 x EPB ID 3396   OD 3756	4 x EPB ID 3396   OD 3921
Tunnels completed with HK TBMs 23.4 km	5,493 m 2 drives max. 2,753 m	2,640 m 1 drive	15,246 m 4 drives max. 4,078 m



27.05.2026

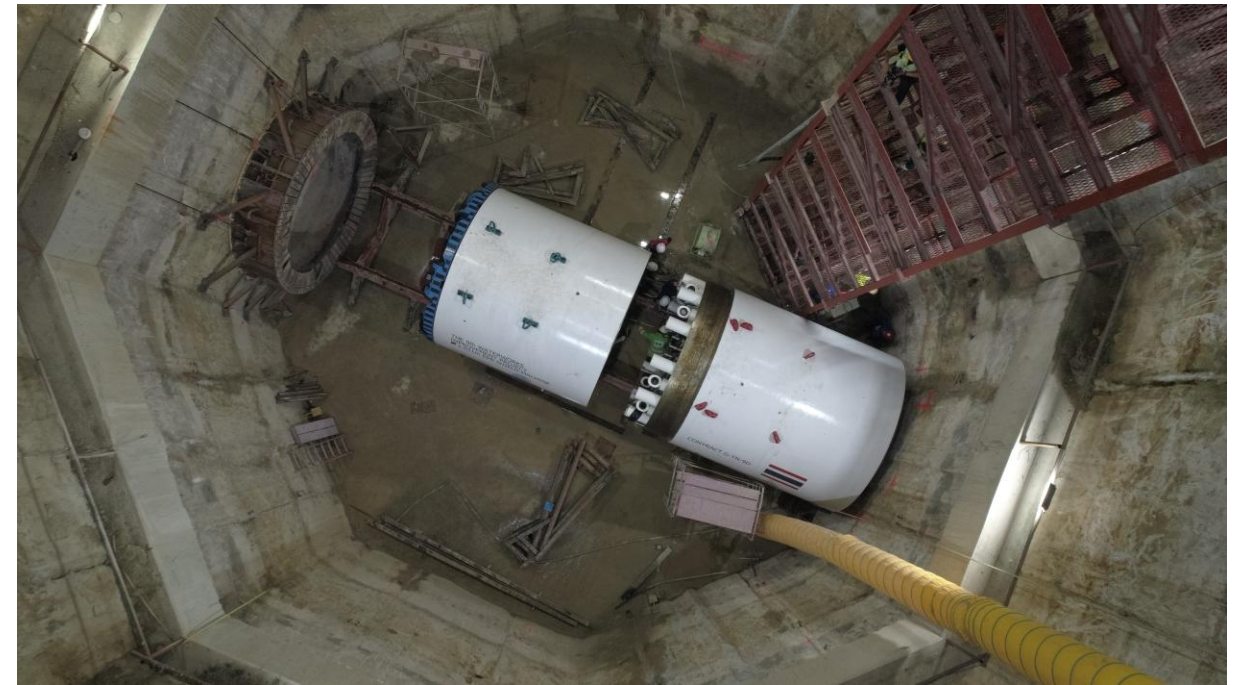
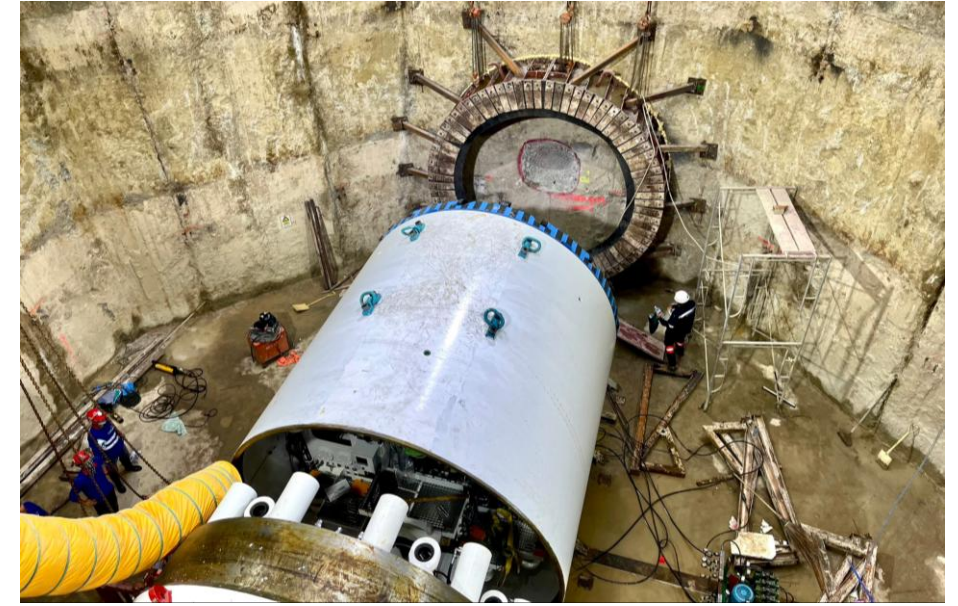
HK in Thailand | Segment Lining Project

# MWA WATER TRANSFER TUNNEL PLAN 9 | BANGKOK

- › Tight curves on all drives
- › Curve radius: **60 – 100 m**

HK in Thailand | Segment Lining Project

# MWA WATER TRANSFER TUNNEL PLAN 9 | BANGKOK



## Sea Outfall with Pipe Jacking

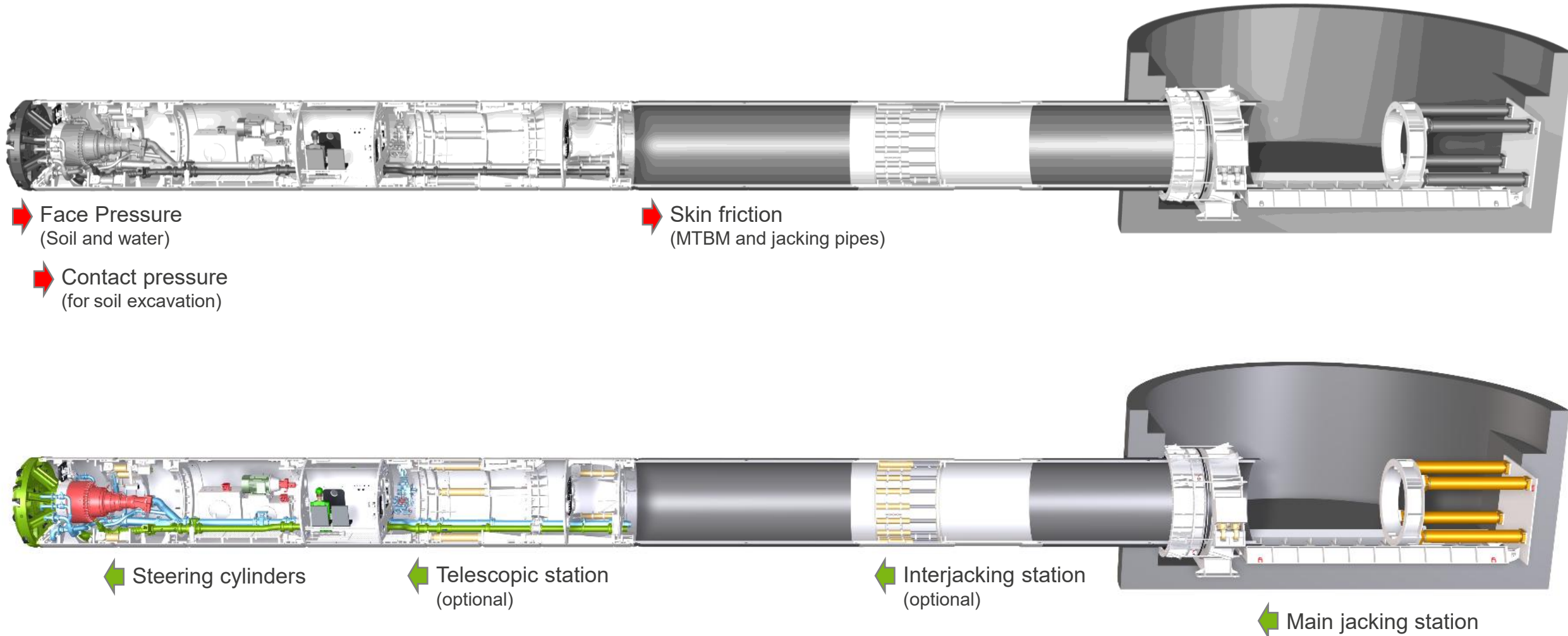
# LONG-DISTANCE PROJECT RAYONG, THAILAND

- › Nong Fab LNG Receiving Terminal Project – water cooling system
- › 2 x AVN 3200 for **OD 3945 mm**
- › Drive lengths:
  - › 2 x **1,350 m** onshore, 2 x **1,150 m** Sea Outfall tunnel



Pipe Jacking

# PIPE FRICTION ACTING FORCES



Pipe Jacking

# JACKING FORCES

## INTERMEDIATE JACKING STATIONS



### Inter(mediate) jacking stations

- › Used in regular, predetermined intervals for additional jacking force (**every ~125 m**)
- › **reduce jacking forces of main jacking station**
- › dismantled when finished

Pipe Jacking

# BENTONITE LUBRICATION REDUCE SKIN FRICTION



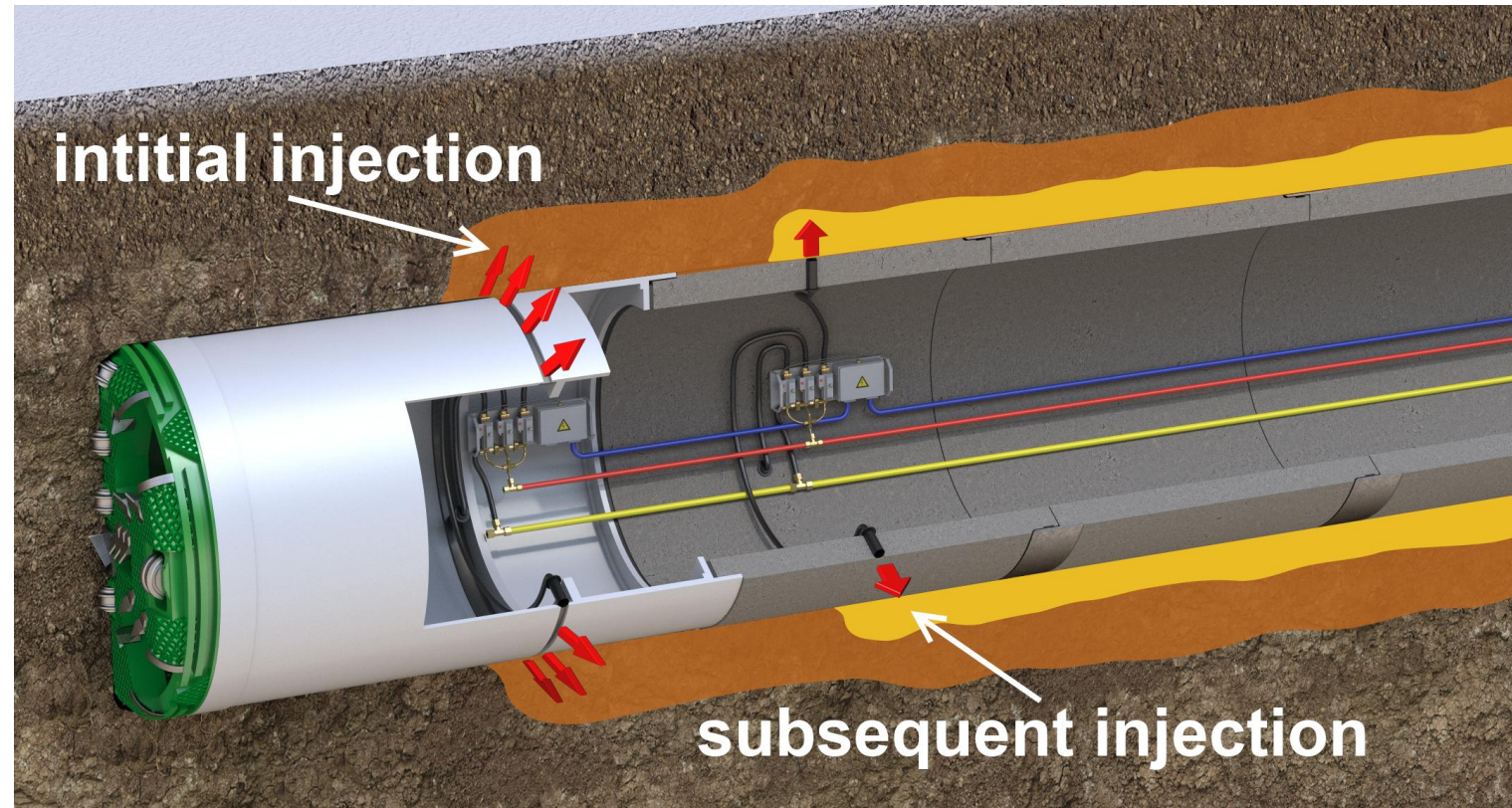
Instead of applying one single lubrication fluid various adapted lubrication fluids can be applied

› Initial injection:

- “thick” bentonite mixture
- supporting of the wall
- plugging of the pores
- establishing a filter cake

› Subsequent injection:

- “thinner” bentonite mixture
- enhanced properties regarding the lubricity

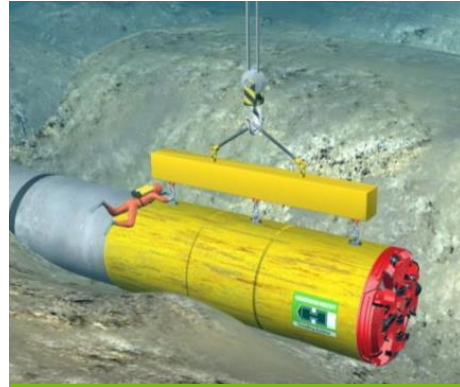


## Sea Outfall with Pipe Jacking

# MTBM SUBSEA RECOVERY PROCEDURE WITH RECOVERY MODULE

**01**

Tunnelling machine is prepared for release from pipestring; bulkhead is closed

**02**

Divers fix the crane to lifting eyes of machine

**03**

Divers connect hydraulic supply lines to machine for the telescopic cylinders

**04**

Cylinders are extracted to release machine from the pipestring

**05**

Tunnelling machine is recovered and lifted up to the surface

Pipe Jacking

# MTBM SUBSEA RECOVERY PROCEDURE

- › Machine equipped with **recovery module**
  - › Hydraulic cylinders to release machine from the pipestring
  - › Connection of hydraulic supply at outer skin of module by divers
  - › Steel can with bulkhead to close the machine hermetically

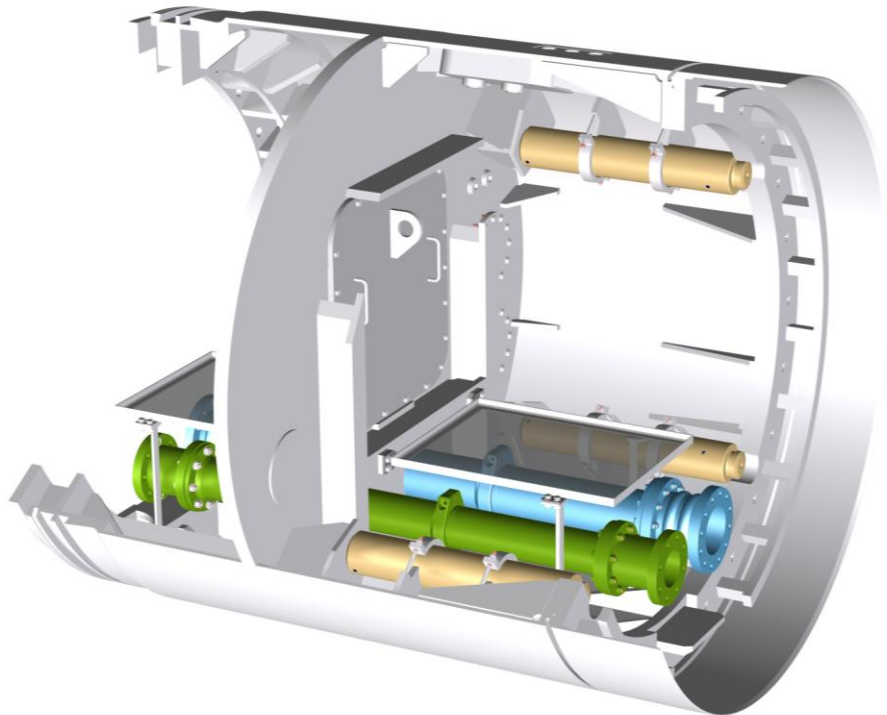


Pipe Jacking

# MTBM SUBSEA RECOVERY BULKHEAD OPTIONS

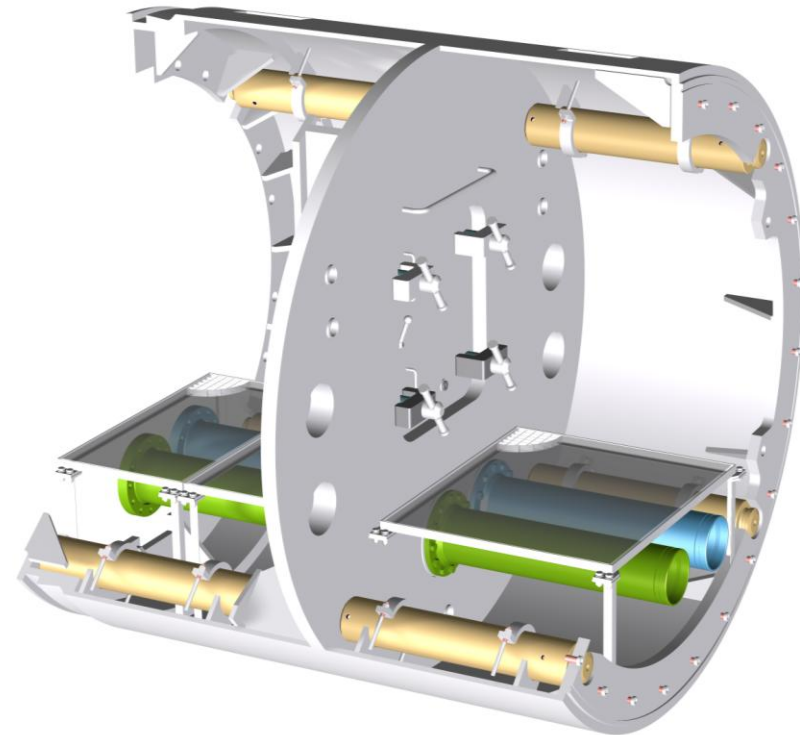
## › Bulkhead for machine

- › To close machine for recovery
- › Optional bulkhead to close tunnel, if required



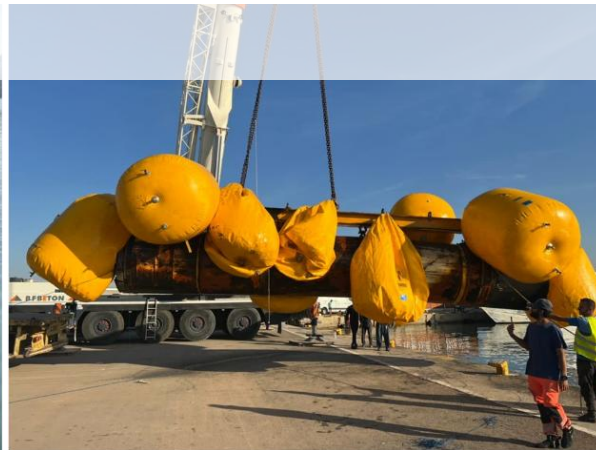
## › Bulkhead for tunnel

- › To close tunnel, before machine recovery
- › Separate bulkhead for machine required



Sea Outfall with Pipe Jacking

# MTBM SUBSEA RECOVERY LIFTING OPTIONS



Expertise overview

# PIPE JACKING OVER LONG DISTANCES



- › More than **110 long-distance projects  $\geq 1000$  m length** since early 1990s
- › Whereof **> 20 projects of  $\geq 1.5$  km length**
- › **> 90% with Slurry** machines (AVN, AVND, Mixshield)

## 2,535 m, Germany

- › Europipe, OD 3820 mm



## 2,246 m, Mexico

- › Altamira landfall, OD 3200 mm



## 1,960 m, Kuwait

- › WWTP Outfall, OD 2665 mm

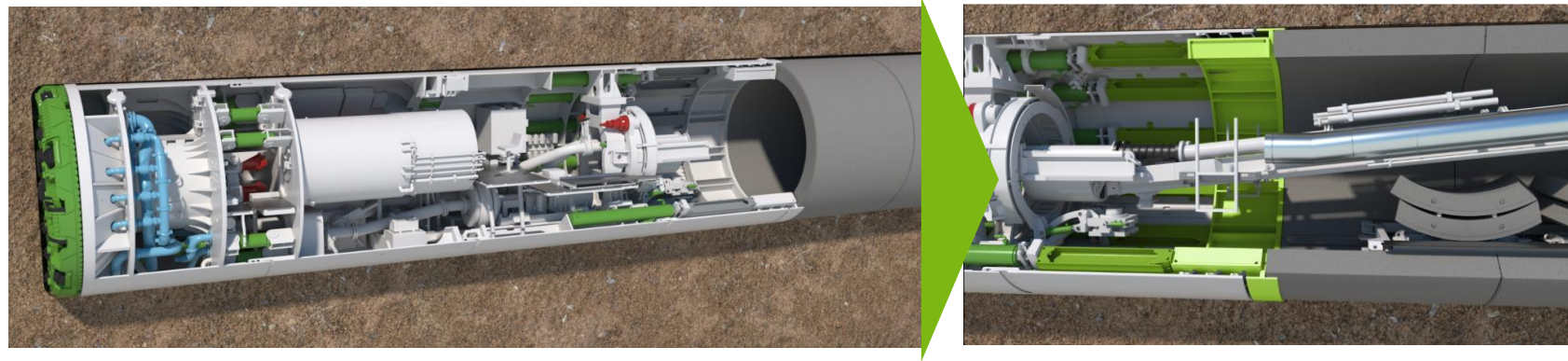


Pipe Jacking

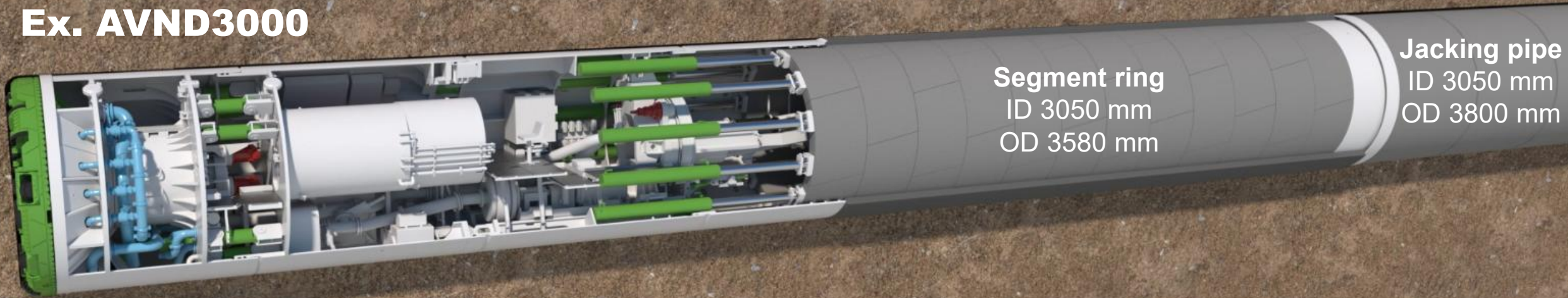
# RISK MITIGATION ON LONG-DISTANCE DRIVES

## STANDBY PUSH MODUL

- › For safety and flexibility in pipe jacking
- › Launch in pipe jacking mode -> conversion to segment lining possible



**Ex. AVND3000**



Segment ring  
ID 3050 mm  
OD 3580 mm

Jacking pipe  
ID 3050 mm  
OD 3800 mm

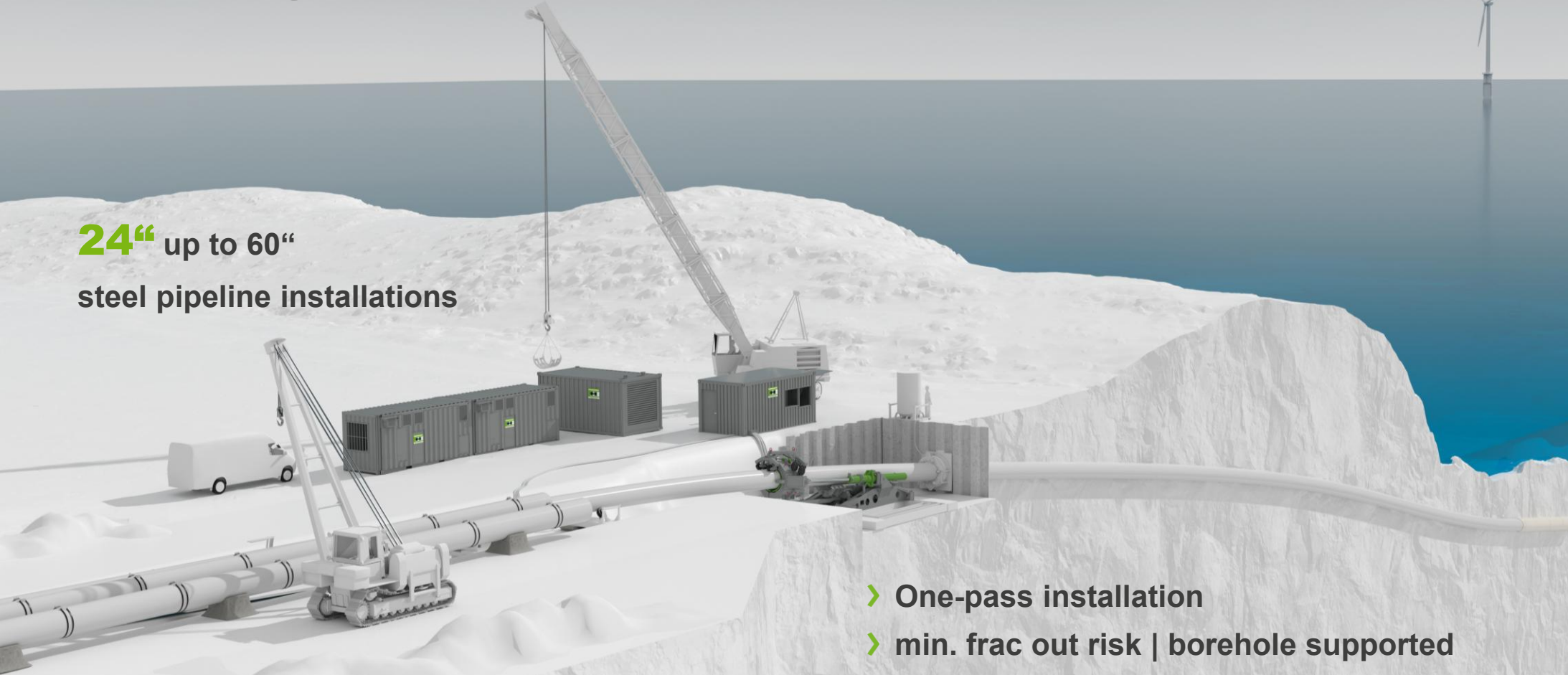
# CONCLUSION

- › Pipe Jacking and Segment Lining are proven technologies in certain diameter ranges
- › The stand-by push module provides a technical solution to bridge the gap in the transitional diameter range for longer tunnel drives
- › Equipment can be adapted and utilized across multiple projects which also reduces environmental impact
- › Challenging projects require cooperation between all partners to maintain the positive reputation in the market



# DIRECT PIPE® TECHNOLOGY

**24"** up to 60"  
steel pipeline installations



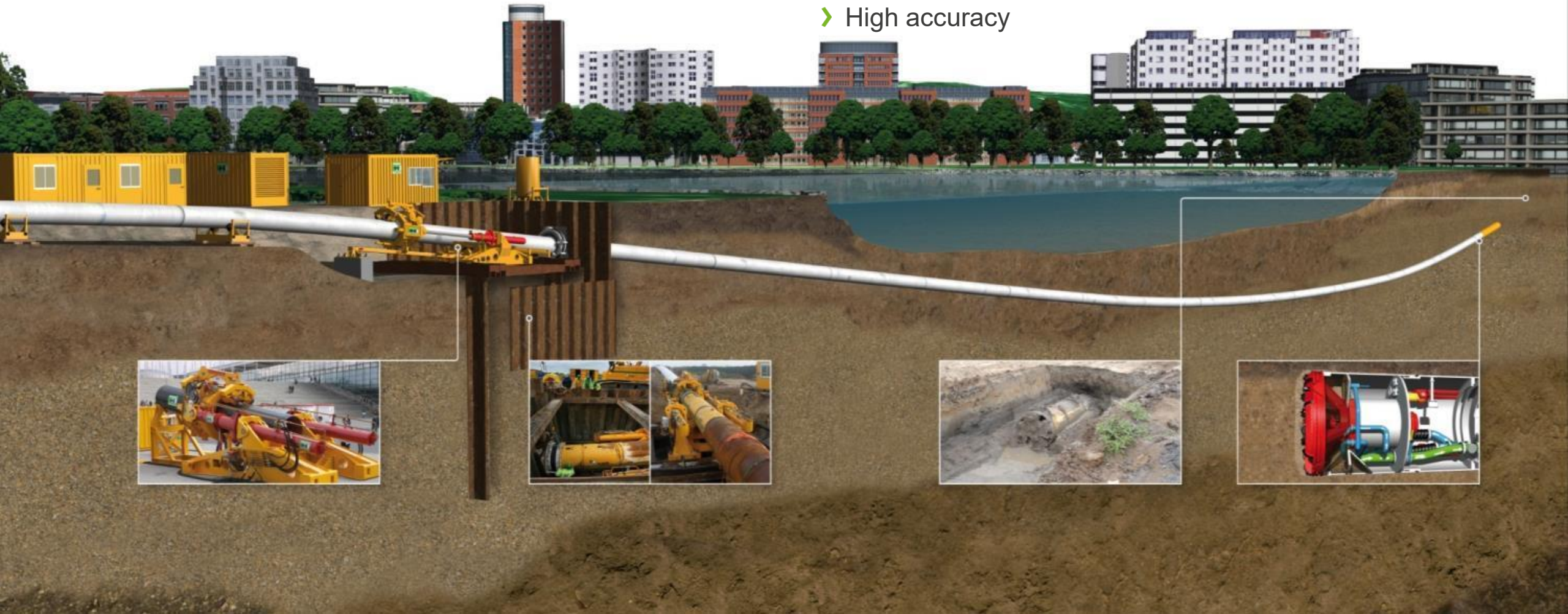
- › One-pass installation
- › min. frac out risk | borehole supported
- › High accuracy

Utility Tunnelling | Microtunnelling technologies

# DIRECT PIPE® TECHNOLOGY

24" up to 60" steel pipeline installations

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



# DIRECT PIPE® APPLICATION RANGE

## DIAMETER

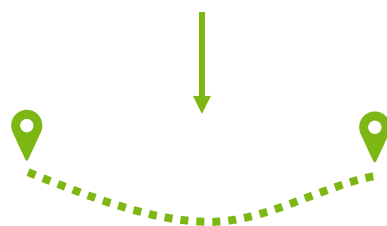


**24" / 600mm**

**60" / 1500mm**



**~ 1000 m**  
**~ 3300 ft**



**~ 2000 m**  
**~ 6600 ft**



- > **Safe & Fast**
  - > on-surface or near-surface launch & exit pits
  - > high advance rates
- > **Flexible**
  - > almost all conditions up to 150 MPa (21750 psi)
- > **Precise**
  - > guided & controlled drilling, incl. spatial curves and uphill/downhill elevation changes

# DIRECT PIPE®

## PIPELINE DIAMETERS AND MTBM

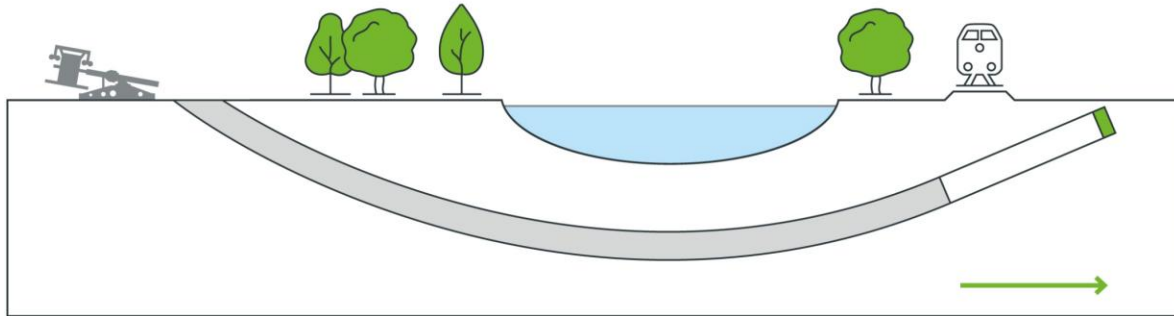
Minimum pipeline diameter	22" (560 mm)	26" (660 mm)	30" (762 mm)	34" (864 mm)	38" (965 mm)	44" (1,118 mm)	50" (1,270 mm)	58" (1,473 mm)
Maximum pipeline diameter	24" (610 mm)	28" (711 mm)	32" (813 mm)	36" (914 mm)	42" (1,067 mm)	48" (1,219 mm)	56" (1,422 mm)	60" (1,524 mm)
Direct Pipe® MTBM	AVNS500 AVNS500 HR	AVNS600 AVNS600 HR	AVNS700 AVNS700 HR	AVN800 (B) AVN800 (B) HR	AVN800 (A) AVN800 (A) HR	AVN1000 AVN1000 HR	AVN1200 (standard)	AVN1200 (upsized)
Torque of MTBM	22 kNm	33 kNm	40 kNm	55 kNm	90 kNm	150 kNm	260 kNm	260 kNm
Excavation diameter	680 mm	805 mm	890 mm	990 mm	1,140 mm	1,325 mm	1,540 mm	1,640 mm
Types of MTBM	AVN, AVNS (jet pump), AVN HR (hard rock)							
Max. borehole / drilling distance	600–1,000 m	700–1,000 m	800–1,000 m	900–1,000 m	1,000–1,200 m	1,200–2,000 m	1,500–2,000 m	1,500–2,000 m

# DIRECT PIPE® APPLICATION FIELDS

## INSTALLATION OF STEEL PIPE

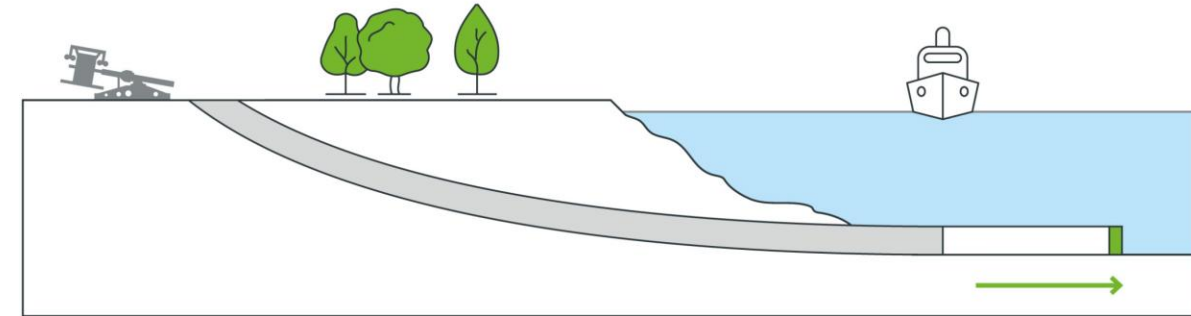
Simultaneous excavation of borehole and installation of steel pipeline.

### RIVER CROSSING



- › one-pass / single-step installation
- › permanent borehole support
- › high accuracy
- › minimum risk of inadvertent fluid returns (i.e. frac-outs)
- › less cover resulting in shallower crossings
- › less soil excavation compared to HDD or Pipe Jacking (Microtunnelling)

### SEA OUTFALL



- › single side entry means land-based operation
- › launch side = pipe side
- › independence from marine conditions at all times
- › minimum fluid release to marine environment

Direct Pipe

# DIRECT PIPE<sup>®</sup> PROJECT, THAILAND

## SOUTH BANGKOK POWER PLANT TRANSMISSION

- › Pipeline Operator: PTT Public Company Limited
- › Main Contractors: CPP-CPPB JV & Sinopec
- › Pipeline Length: 57 km
- › Trenchless work: 15 km → 8,8 km with Direct Pipe
- › Diameter: 36" Steel Pipe & FOC





# TUNIS.PIPELIGHT

Precise navigation for small-diameter Direct Pipe<sup>®</sup> drives



TUNIS.PIPELIGHT

# FIELDS OF APPLICATION

- **Direct Pipe<sup>®</sup>** drives in general, and small-diameter pipelines ( $\leq 42"$ ) in particular, where men-entry is difficult or even impossible
- Non-accessible standard pipe jacking drives ( $\leq ID 1200$ ) with complex alignment and drive lengths of up to 300 m

## *System accuracy vs drive length*

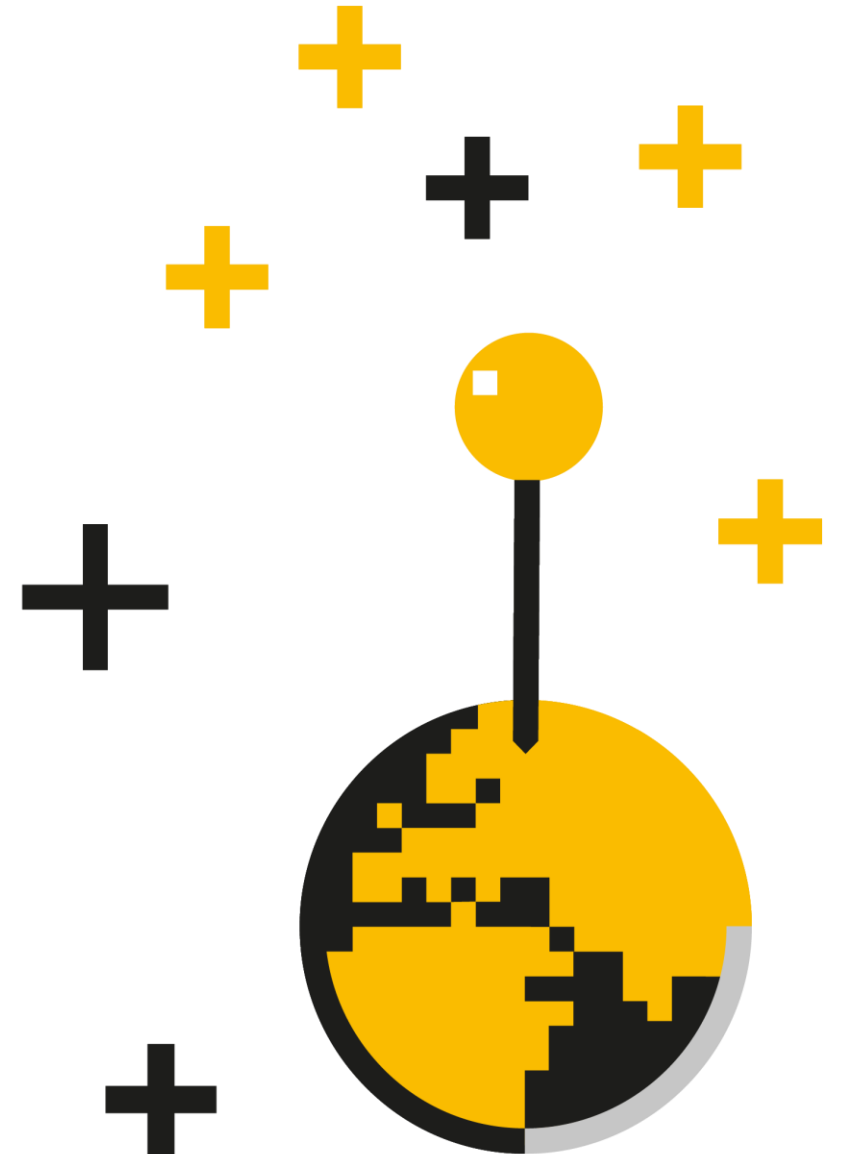
Drive length	System accuracy
300m	$\pm 150\text{mm}$
500m	$\pm 300\text{mm}$
800m	$\pm 600\text{mm}$
1000m	$\pm 800\text{mm}$



## TUNIS PIPELIGHT

# BENEFITS

- Enables the performance of control measurements in non-accessible tunnel sections
- Reduces the effort required for control surveys by **up to 90%**
- Opens up new possibilities for alignment planning in non-accessible tunnel diameters (longer straight sections, curved sections, less intermediate shafts)
- No personnel inside the tunnel for control surveys



**HERRENKNECHT**



**Tunnelling Systems**