Offshore meets Onshore:
Trenchless solutions for pipeline landfalls.

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**Outfalls** ›››› Sewage | Stormwater | Brine | Telecommunication

**Water Intakes** ◀ ◀ ◀ ◀ Desalination | Cooling

**Pipeline Landfalls/Shore approaches** ◀ ◀ ◀ ◀ Oil & Gas | Cables
Why going trenchless in coastal areas?
Sea Outfalls, Intakes and Landfalls.
Advantages of trenchless technologies.

- Minimized impact on **environment**: protection of wildlife and sea water quality
- Minimized impact on **surroundings**
  - Small jobsite footprint
  - Tourism and shipping not affected
  - Independent of rock or soil condition and shape of coastline
Pipeline Landfalls.
Trenchless installation methods.
# Tunnelling technologies for marine installations.

Overview Pipe Jacking versus Segment Lining.

<table>
<thead>
<tr>
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<th>Segment Lining</th>
<th>Pipe Jacking</th>
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<tbody>
<tr>
<td><strong>Diameter in mm</strong></td>
<td>&gt; ID 2500</td>
<td>up to ID 3500 state-of-the-art</td>
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<tr>
<td><strong>Drive length</strong></td>
<td>up to 10 km</td>
<td>up to ~1.5 km or longer</td>
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<tr>
<td></td>
<td>depending on diameter</td>
<td>depending on diameter and geology</td>
</tr>
<tr>
<td></td>
<td>and logistics</td>
<td></td>
</tr>
<tr>
<td><strong>Interjacking stations</strong></td>
<td>not needed</td>
<td>necessary for longer drives</td>
</tr>
<tr>
<td><strong>Machine recovery</strong></td>
<td>Release of machine</td>
<td>Recovery module needed</td>
</tr>
<tr>
<td></td>
<td>with jacking cylinders</td>
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Tunnelling technologies for marine installations.
Offshore recovery of tunnelling machine.

- Preparation of the “wet” machine recovery from the seabed
- Lifting the tunnelling machine to the surface (by crane and/or airbags)
Tunnelling technologies for marine installations.

Segmental Lining.
Reference Project: Sydney, Australia.
Sydney Desalination Plant.

- M-1214M + M-1215M, 2x TBM3400, OD4340 Segment Lining
- Outfall length: 2 x 2,579m
- Min. curve radius: 500m
- Geology: sandstone, approx. 70Mpa
- Contractor: John Holland Pty. Ltd.
Tunnelling technologies for marine installations.

Pipe Jacking.
**Turkstream Outfalls, Anapa, Russia.**

2 x 1.4km into the Black Sea.

- M-1890M + M-1892M, 2 x AVN 2000 AH, OD 2475
- Tunnel length: 2 x 1.430m long distance pipe jacking
- Height difference vom launch to target: 80m
- Max. gradient: -11,5%
- Geology: clay with layers of sandstone and limestone
Turkstream Outfalls, Anapa, Russia.
2 x 1.4km into the Black Sea.
Turkstream Outfalls, Anapa, Russia.

Safety first – The communication system HADES

- Access control/locating
- CCTV
- Data transmission
- Emergency alert system
- Gas monitoring
- Telecommunication
Nord Stream 2 Landfall Lubmin, Germany.
Trenchless Shore Crossing for 48“ twin gas pipeline.

- M-1890M + M-1892M, 2 x AVN 2000 AH, OD 2475
- Location: Lubmin, Germany
- Tunnel length: 2 x 715m, 5 Interjacking stations installed, but not used
- Geology: sand, marl, boulders
- Max. gradient: -5,2%
- Machines launched: March 30th, 2018 | End position: May 13th, 2018
- Best daily performance: 42.4m
Nord Stream 2 Landfall Lubmin, Germany.
Trenchless Shore Crossing for 48“ twin gas pipeline.
Pipe Jacking and Direct Pipe® methods on one project. Sur de Texas – Tuxpan Pipeline, USA-Mexico.

OUTFALLS FOR SUR DE TEXAS-TUXPAN PIPELINE

1. Direct Pipe® Sea Outfall
   - Port Isabel, Brownsville, Texas, USA
   - M-1491M, AVN1000DP (48") + HK750PT
   - 1,495 m, 42" pipeline
   - End position: December 02, 2017

2. AVN Sea Outfall
   - Altamira, Mexico
   - M-1275M, AVND2000, OD3200
   - 2,246 m Pipe Jacking, tunneled casing
   - End position: July 27, 2018

3. Direct Pipe® Sea Outfall
   - Tamiahua (Tuxpan), Mexico
   - M-2250M, AVN1200DP (56") + HK750PT
   - 698 m, 56" casing
   - End position: July 18, 2018
Record Pipe Jacking Outfall.
Altamira Landfall, Sur de Texas – Tuxpan Pipeline.

- M-1275M, AVND2000, OD3200
- Tunnel length: **2.246m Sea Outfall, World Record for „wet“ recovery**
- Geology: sand, silt, clay
- Groundwater pressure: up to 3 bar
- Contractor: Eurohinca
- End position reached: July 27th, 2018

- Best daily performance: 25,5m
- Best weekly performance: 111,2m
Record Pipe Jacking Outfall.
Key to success – advanced lubrication

- Without Volume control: constant lubrication along the alignment.
- With advanced Volume control: Adjusted Lubrication amounts in changing geological formations.
Pipe Jacking and Direct Pipe® methods on one project.
Sur de Texas – Tuxpan Pipeline, USA-Mexico.

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Tunnelling technologies for marine installations.
Direct Pipe®.
Direct Pipe® 48“ Shore approach.
Port Isabel Landfall, Sur de Texas - Tuxpan Pipeline, USA.

- M-1491M, AVN1000DP + HK750PT
- Location: Port Isabel, TX, USA
- **Length: 1,495m | 4,900ft**
  - Record North America
- Use of Pipeline: 42“ Gas Pipeline
- Client: Enbridge-Spectra Energy
- Contractor: Laney Directional Drilling Inc.
- Best Performance: 120m in 12 hours
- Push Forces: 90 tons
- Breakthrough: December 2nd, 2017
Direct Pipe® 48" Shore approach.
Port Isabel Landfall, Sur de Texas - Tuxpan Pipeline, USA.

World´s first “dry” recovery
Direct Pipe® 56“ casing Shore approach.
Tamiahua Landfall, Sur de Texas - Tuxpan Pipeline, Mexico.

- M-2250M, AVN 1200DP + HK750PT
- Location: Tamiahua, Mexico
- Use of Pipeline: 42“ Gas Pipeline
- Drilling length: 698m (2,290 ft)
- Max. section length: 650m (2,130 ft)
- Client: TransCanada
- Contractor: HDI Latam (J.V. GDI - HDI)
- Best Daily Performance: 82m
- Push Forces: 190 - 440 tons
Direct Pipe® Shore approach. Leviathan Gas Field, Israel.

32“ Gas Pipeline with 56” Direct Pipe®.

- M-2246M, AVN1200DP + 2 x HK750PT Pipe Thruster (one standby)
- Location: Dor, Israel
- Drilling length: 1,123m | 3,690ft
- Pipe section length: 60m
- Geology: sands, clays, Kurkar
- Client: Noble Energy
- Contractor: A. Hak Drillcon B.V.
- Best daily performance: 61.8m
Direct Pipe® Shore approach. Leviathan Gas Field, Israel.
32” Gas Pipeline with 56” Direct Pipe®.

Remote-controlled subsea recovery
World Record Direct Pipe® Project.
48“ Shore Approach with wet recovery.

- M-2170M, AVN1000DP + 1 x HK500PT & 1x HK750PT Pipe Thruster
- Use of Pipeline: Army Bay Wastewater Treatment Plant Outfall Replacement
- Location: Auckland, New Zealand
- **Drilling length: 1,930m World Record**
  - Geology: sandstone, mudstone
  - End position reached: August 02, 2018
  - Client: Water Care
  - Contractor: McConnell Dowell

Performance:
- Best daily performance: 42.5m
- Best monthly performance: 210.7m
World Record Direct Pipe® Project.
48” Shore Approach with wet recovery.
Marine pipeline and landfall installation with HDD.
Horizontal Directional Drilling.

Step 1: Pilot Drill
Step 2: Roaming
Step 3: Pipeline Pullback

HK400M
HK250T
HDD Assist: HK750PT
HDD Shore approach: Barrow Island, Australia.
Gorgon gas fields.

- 2 HDD Rigs: HK400CM, HK250T | HK500PT Pipe Thruster
- Pipeline Ø: 2x8”, 2x10”, 3x18”, 2x34”
- Pipeline length: 9x between 450-520m
- Geology: Limestone, Calcarenite (fractured) 60-70 MPa
- Contractor: AJ Lucas
- Client: Chevron
HDD Shore approach: Tangguh LNG Expansion Project.

- H-123; HK400M
- Location: Bintuni Bay, Papua Barat, Indonesia
- Pipeline Ø: 24”
- Pipeline length: 3 x 2,065m
- Contractor: Lucas
Sea Outfalls, Intakes and Landfalls.
Project references with Herrenknecht technology.

- ~100 tunneled outfall projects
  - 2,6 km Pipe Jacking: Longest Outfall in 1994 | still world record
  - Up to 6 bar groundwater pressure handled successfully
- 6 Direct Pipe® outfall projects
- ~100 HDD outfall projects
Thank you!

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