SMART TUBULAR SOLUTIONS

PREON®marine: Foundation system based on SEALENCE-project

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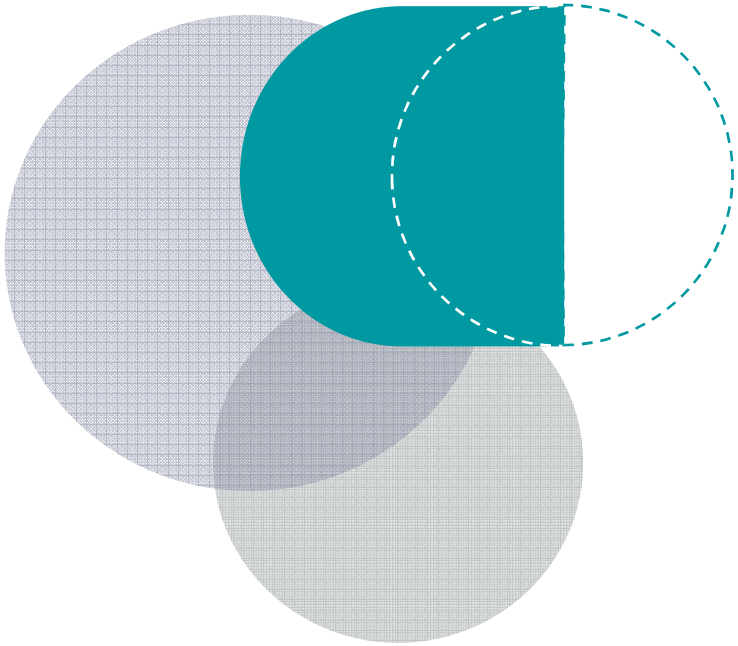
Agenda

- Introduction Vallourec
- Presentation PREON®marine-technology
- Summary Benefits/values PREON®marine



Introduction Vallourec

SOLUTION-MAKERS

The benchmark reference of tubular solutions

for the **energy** sector and other applications that present the **most demanding challenges**

The largest portfolio on our markets

products and services for every segment, **from standard to premium**

Close to our customers

~19,000 employees*
50 production facilities
in **more than 20** countries

Highly innovative

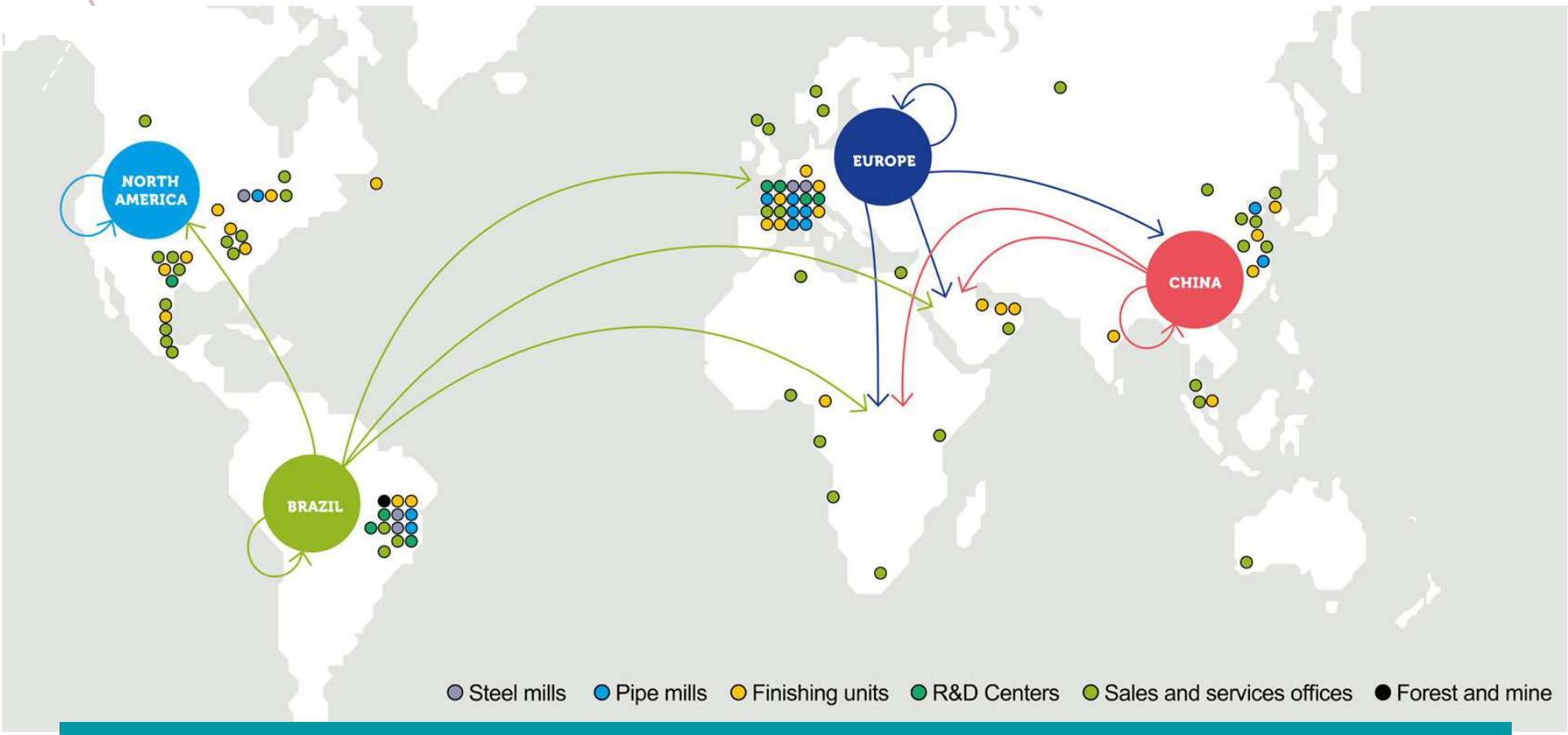
6 advanced R&D and **4** connection test centers
in **France**, **Germany**, **Brazil** and the **U.S.A.**

A trusted partner

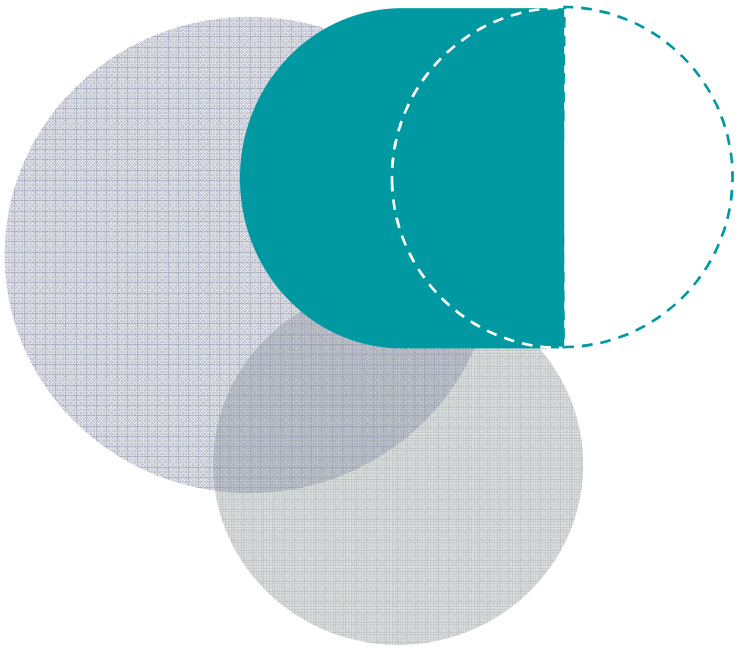
ping our customers to meet their challenges in all areas of business,
from technology to supply chain, value creation and local production

** Permanent and temporary contracts*

WHEREVER OUR CUSTOMERS NEED US



VALLOUREC'S NEW INDUSTRIAL FOOTPRINT FEATURES EQUIVALENT CAPACITIES IN FOUR REGIONS. EACH SERVES ITS MARKETS THROUGH ROUTES OPTIMIZED FOR COST AND TIME, FROM PRODUCTION TO DELIVERY.

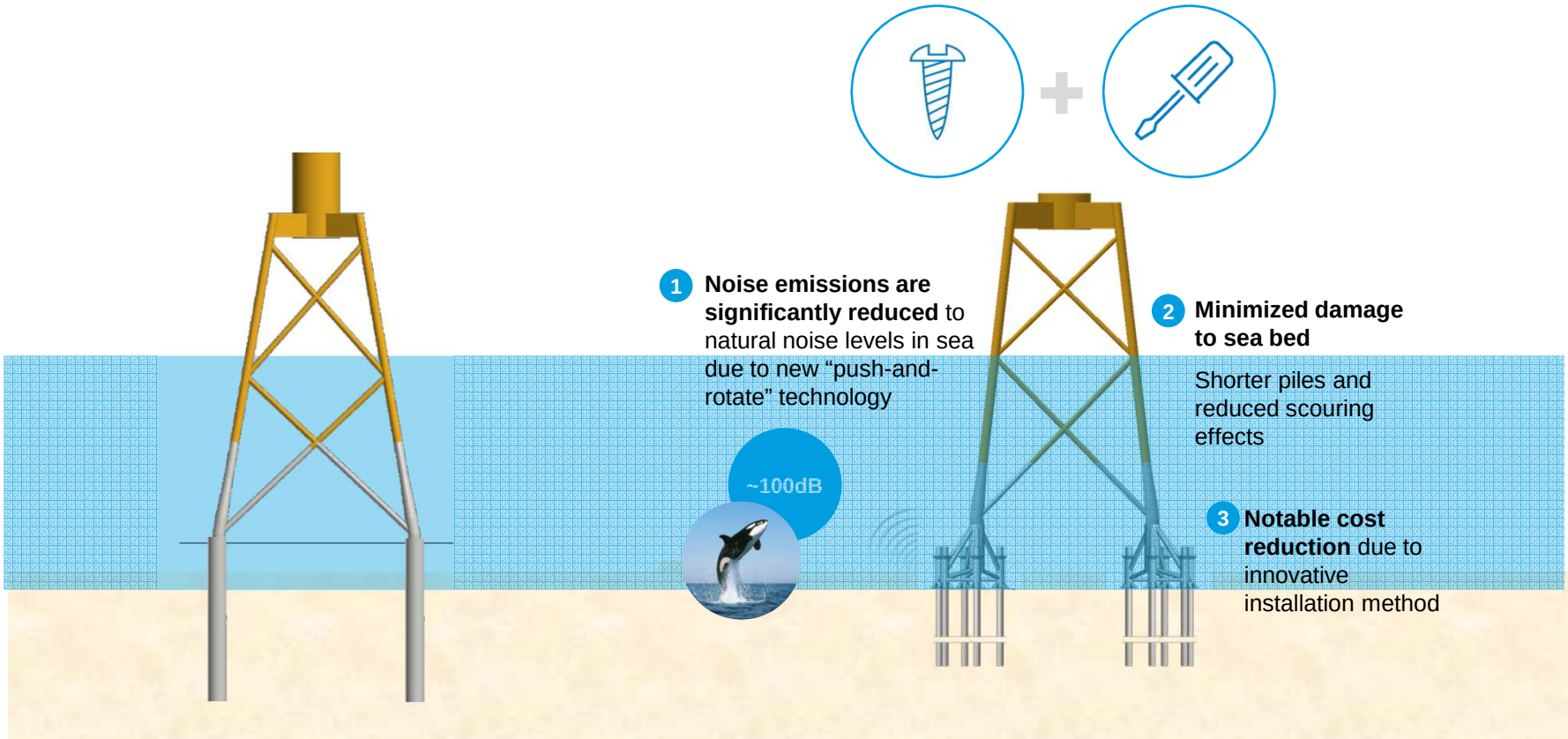


PREON®marine technology

PREON®marine provides a highly competitive low-cost and low-noise solution for jacket installations

Jackets installed with driven piles

Jackets installed with PREON®marine



1 **Noise emissions are significantly reduced** to natural noise levels in sea due to new “push-and-rotate” technology

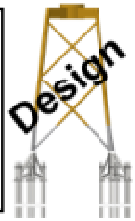
2 **Minimized damage to sea bed**

Shorter piles and reduced scouring effects

3 **Notable cost reduction** due to innovative installation method

General concept, components

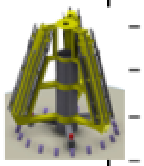
Steel design
- Design
- Calculations
- Basic engineering



Pile production
- steel pipes (pre mat)
- pile manufacturing

Pile Design
- Geotechnical engineering
- Installation parameters

PREON®marine solution components



Installation Equipment
- Design
- Manufacturing
- Training of staff
- Maintenance and repairs

Offshore Services
- Offshore logistics management
- Management of installation process

General concept, partners/subcontractors

Bundesministerium für Wirtschaft und Energie

Projektträger Jülich Forschungszentrum Jülich

PREON®marine
(Vallourec Project Name)

Funded Project 'Sealence' (10/2015 – 01/2019)

	Fraunhofer IWES	vallourec	IGtH Institut für Geotechnik
Joint Project Partners	Fraunhofer-Institut für Windenergie und Energiesystemtechnik **(IWES)**	Vallourec Deutschland GmbH **(VAD)**	Institut für Geotechnik **(IGtH)**

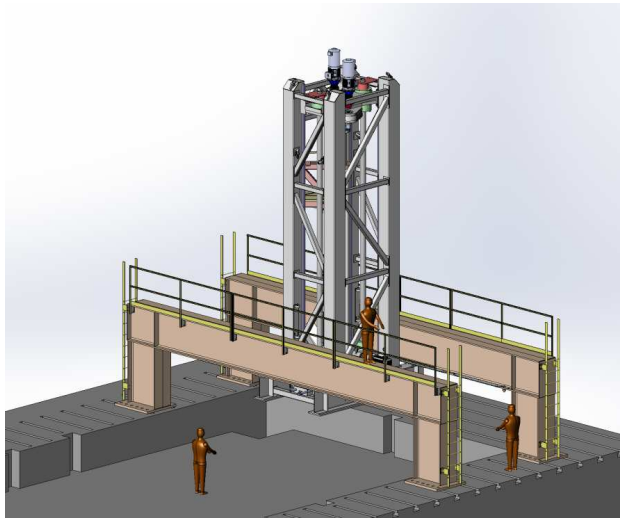
Subcontractors								
Installation Equipment	Steel design	Pile design	Offshore Services	....			

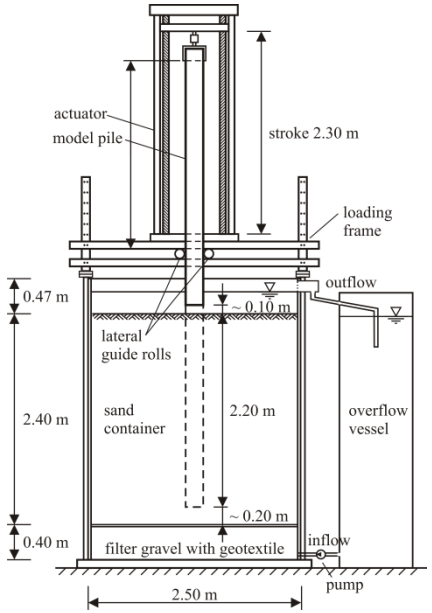
PROJECT OBJECTIVES

Development of an environmentally friendly**, low-noise** and **low-cost** foundation structure, including

(i) a new **pile system**,
(ii) an **adapter solution**,
(iii) necessary **installation technologies** and **equipment,**
(iv) a comprehensive **installation concept**

Push/rotation technology – scaled model tests IGtH/IWES





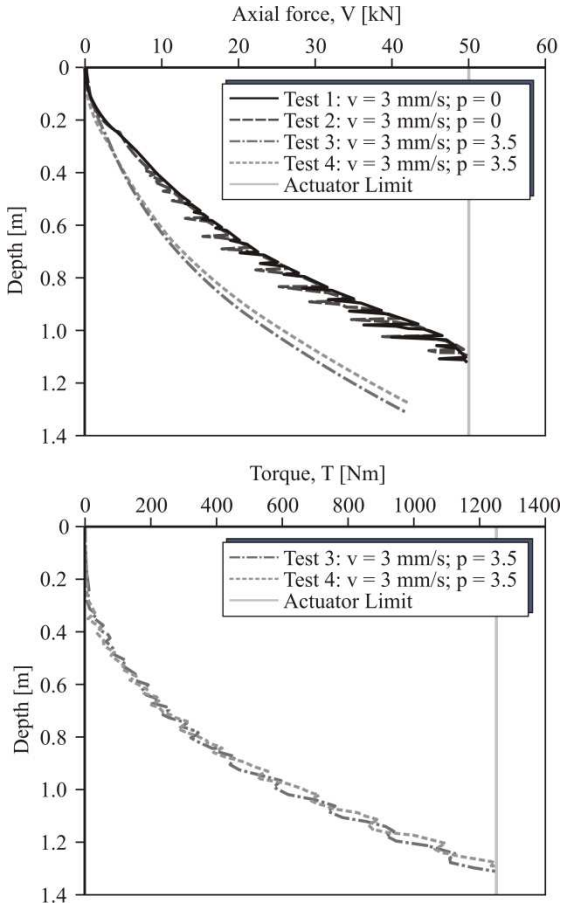
- **Model tests push/rotation technology:**
  - Knowledge pile behavior/ pile capacity of pushed/rotated piles
  - Comparison with hammered piles (e.g. noise measurement)
  - Investigate degradation of pile capacity under cyclic loading

Push/rotation technology – scaled model tests IGtH

- Main outcomes of small-scale model tests

  - Effects of rotary jacking to the installation forces:
    - Reduction of axial jacking force due to additionally applied rotation
    - Relatively high torques required
    - Enhanced pile plugging due to rotation

  - Beneficial effects of rotary jacking to the pile bearing behavior compared to driven piles:
    - Higher axial stiffness
    - Higher compressive capacity
    - Same or slightly higher tensile capacity (scale effect)



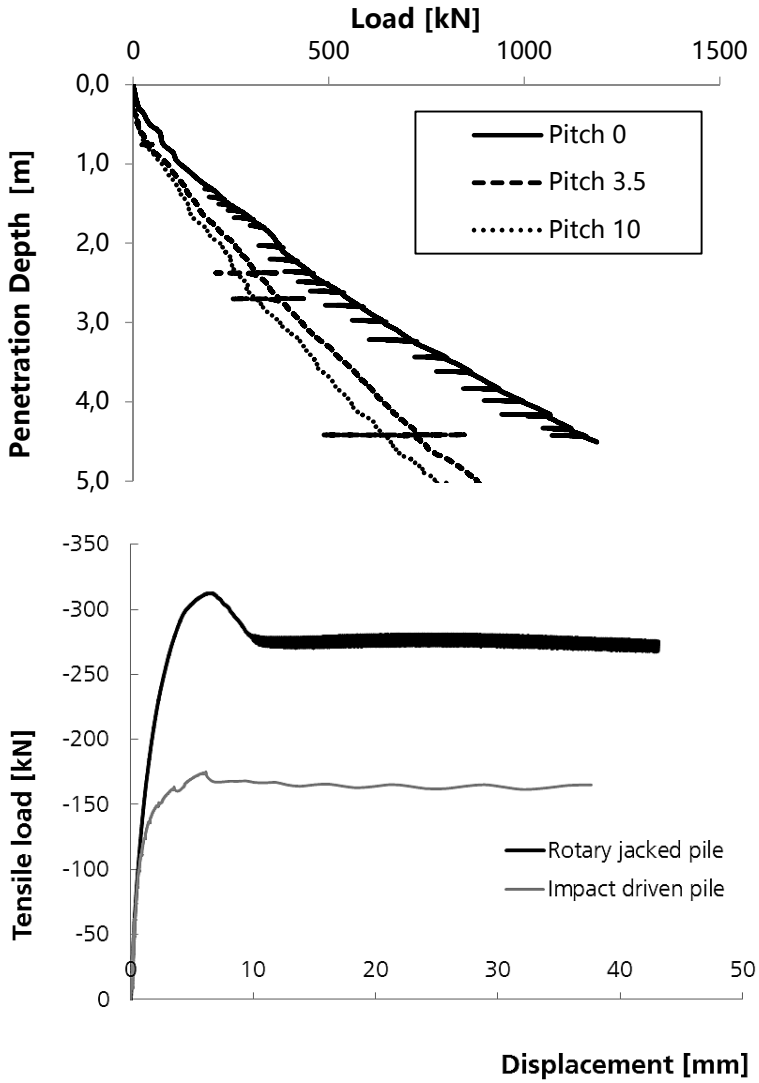
Exemplary model test results: jacked vs rotary jacked installation (D=101.6 mm)

Push/rotation technology – scaled model tests IWES

- Main outcomes of large-scale model tests

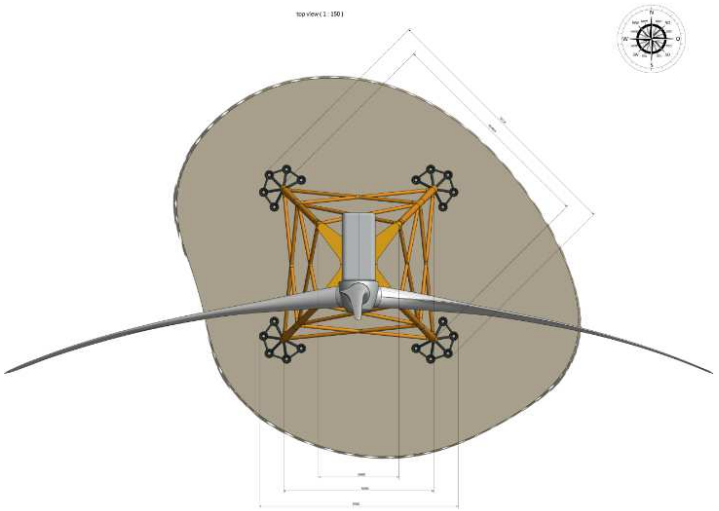
  - Effects of rotary jacking to the installation forces:
    - Reduction of axial jacking force due to additionally applied rotation by nearly 50%
    - Pile plugging is not affected (i.e. is nearly identical to push only mode) by rotation; inner pile model diameter = 277.5 mm

  - Beneficial effects of rotary jacking to the pile bearing behavior compared to driven piles:
    - Higher axial stiffness
    - Higher compressive capacity
    - Higher initial tensile capacity



Push/rotation technology – advantages (general)

- Pushed or pushed and rotated piles
  - Low noise
  - Less vibration
  - Possibility to confirm pile capacity after installation
  - Limited risk of pile damaging during installation
  - Reduced steel fatigue during installation

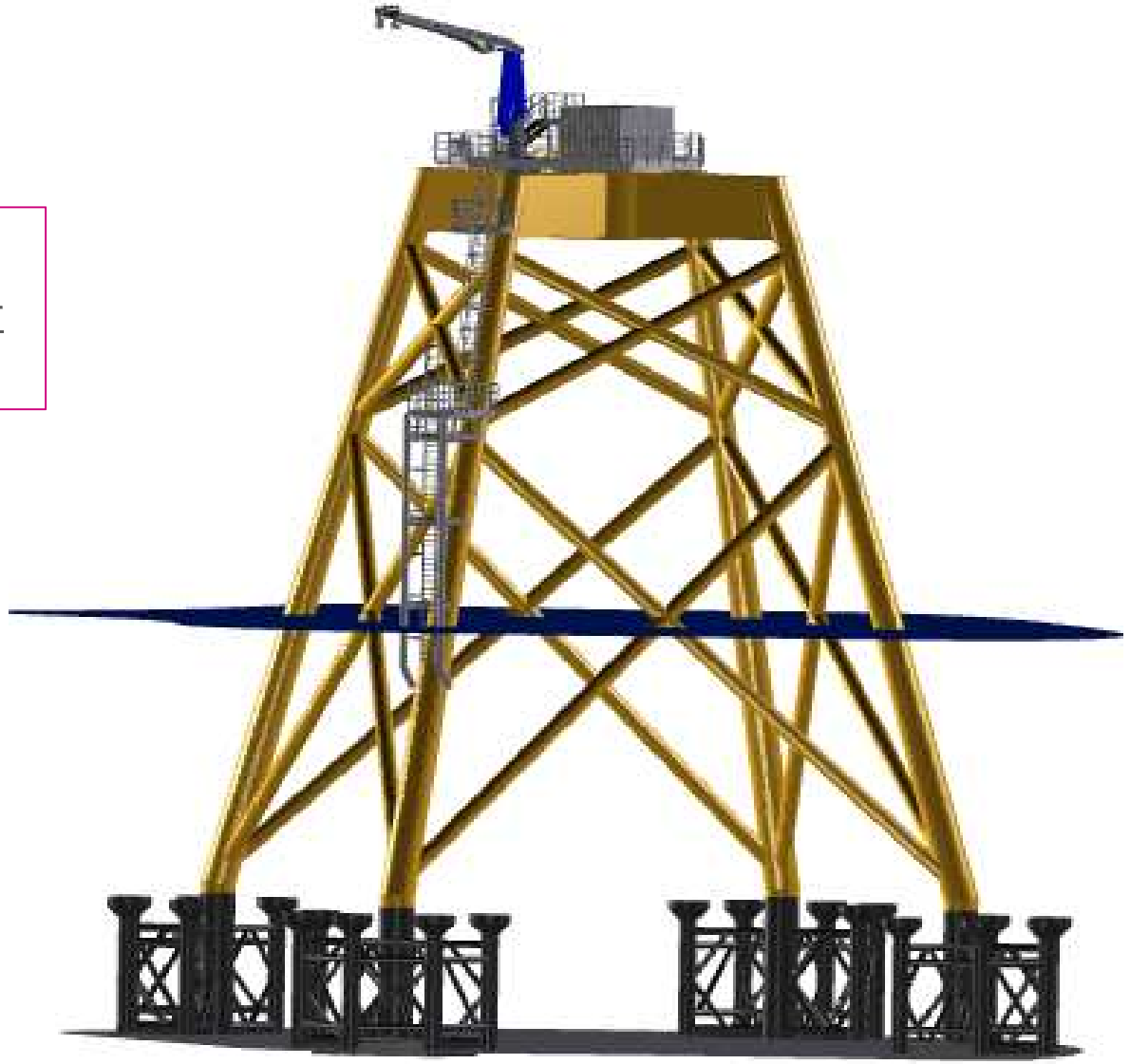


- Multiple piles of smaller diameter:
  - Retrievable
  - Limited scour effect
  - Reduced pile weight per lift
  - Contingency in case of installation failure for a single pile

Push/rotation technology, steel structure (example)

steel structure design

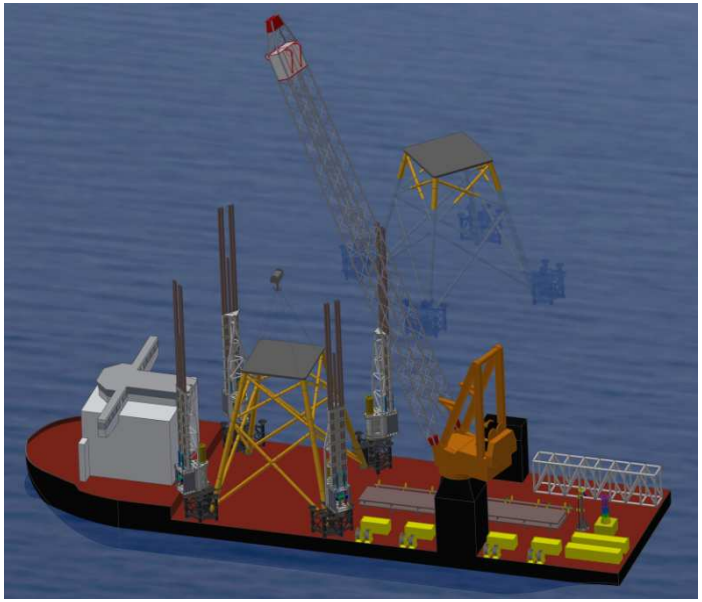
- Adapter flexible for other structures like Tripod



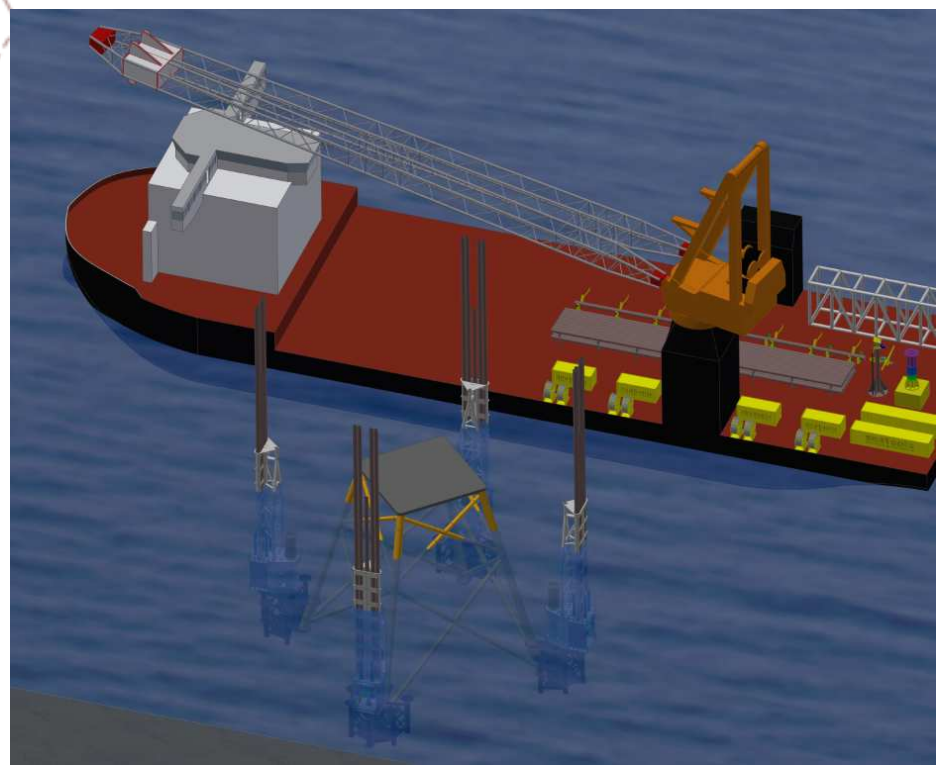
Push/rotation technology – Installation process

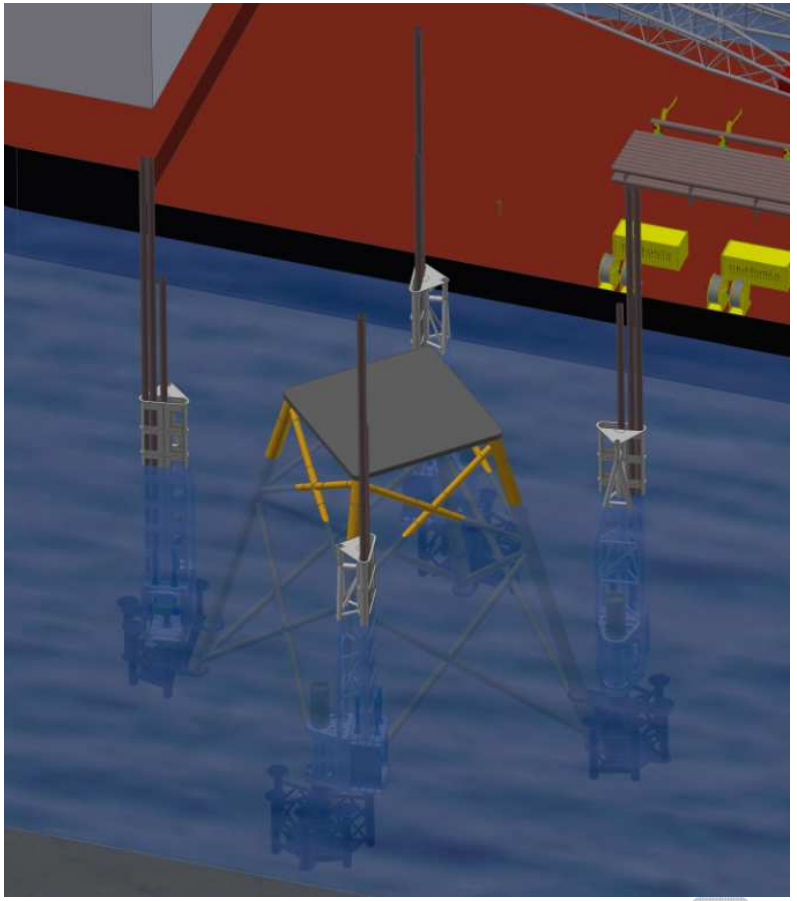
Arrangement for a one crane lift to lower the structure:

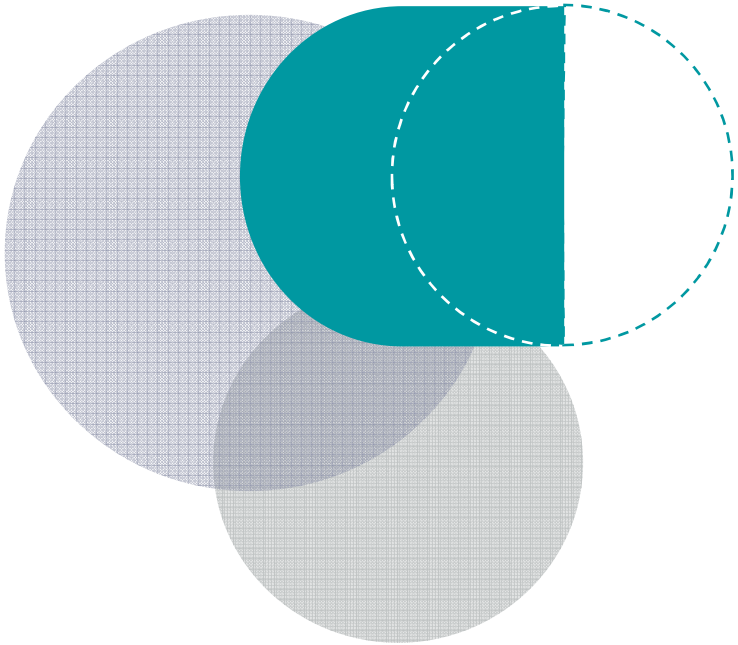
- Pre-assembly of:
  - Levelling tool
  - Pile installation tool
  - Piles
- Flexibility due to reduction to one heavy lift for the steel structure



Push/rotation technology – Installation process

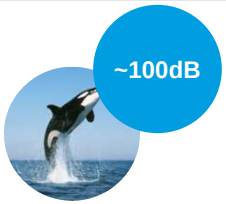






BENEFITS AT A GLANCE

Main Benefits of PREON® Marine Technology

	**Low-noise** push/rotation technology (without bubble curtains)	**Savings**
	**High flexibility** in terms of **soil** conditions – from sandy to mid-hard	**Savings**
	Risk mitigation thanks to **minimized influence on seabed** (no special scour protection)	**Savings**
	**Efficient installation** thanks to “one-heavy-lift” and also opening windows for the use of **smaller vessels** for parts of the installation	**Savings**

MANY THANKS FOR YOUR ATTENTION!

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