PREON®marine: Foundation system based on SEALENCE-project

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Introduction Vallourec

Presentation PREON®marine-technology

Summary Benefits/values PREON®marine
Introduction Vallourec
**SOLUTION-MAKERS**

<table>
<thead>
<tr>
<th><strong>The benchmark reference of tubular solutions</strong></th>
<th><strong>The largest portfolio on our markets</strong></th>
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<td>The benchmark reference of tubular solutions for the energy sector and other applications that present the most demanding challenges</td>
<td>Products and services for every segment, from standard to premium</td>
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<th><strong>Close to our customers</strong></th>
<th><strong>Highly innovative</strong></th>
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<td>~19,000 employees*</td>
<td>6 advanced R&amp;D and 4 connection test centers in France, Germany, Brazil and the U.S.A.</td>
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<td>50 production facilities</td>
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<td>in more than 20 countries</td>
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<th><strong>A trusted partner</strong></th>
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<td>ping our customers to meet their challenges in all areas of business, from technology to supply chain, value creation and local production</td>
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*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 provides a highly competitive low-cost and low-noise solution for jacket installations.

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

PREON®marine solution components

- **Steel design**
  - Design
  - Calculations
  - Basic engineering

- **Pile production**
  - Steel pipes (pre mat)
  - Pile manufacturing

- **Pile Design**
  - Geotechnical engineering
  - Installation parameters

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

- **Offshore Services**
  - Offshore logistics management
  - Management of installation process
Funded Project ‘Sealance’ (10/2015 – 01/2019)

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
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

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<th>Benefit</th>
<th>Description</th>
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<tr>
<td><strong>Low-noise push/rotation technology</strong></td>
<td><em>(without bubble curtains)</em></td>
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<td><strong>High flexibility</strong> in terms of soil conditions – from sandy to mid-hard</td>
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<td><strong>Risk mitigation</strong> thanks to minimized influence on seabed (no special scour protection)</td>
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<td><strong>Efficient installation</strong> thanks to “one-heavy-lift” and also opening windows for the use of smaller vessels for parts of the installation</td>
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<td><strong>Savings</strong></td>
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MANY THANKS FOR YOUR ATTENTION!

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