Modeling the Installation of Offshore Wind Farms
Outline

Contents of slide

- Cost modelling
- The software ECN Install
- What can it do?
- Who is it for?
Offshore Wind Energy

Cost modelling

- ECN’s O&M Tool is the industry standard
- Methodology is now used for installation
- ECN Install developed in cooperation with major industry players (Van Oord, Royal IHC)

Example Users of ECN O&M Tool
ECN Install

The Tool – dissemination of the installation process
Inputs - Outputs

Framework

• Input
  – Wind turbine
  – Components
  – Operational bases
  – Vessels
  – Equipment
  – Climate data
  – Permit restrictions
  – Crew working shifts
  – Fixed costs

• Planning
  – Steps
    • (de)Mobilization
    • Loading
    • Travelling
    • Installation
  – Select from input
  – Planning
    • Grouping
    • Ordering
    • Iterating

• Pre-processor
  – Weather
  – Workability

• Outputs
  – Time
  – Resources
  – Cost
ECN Install

*The Tool*

- **Input**
  - Wind turbine
  - Components
  - Operational bases
  - Vessels
  - Equipment
  - Climate data
  - Permit restrictions
  - Crew working shifts
  - Fixed costs
The user of ECN Install decides the detail of the planning and the accuracy of the results.
Installation modelling

*Calculating impact of delays - scenarios*

The model calculates project delays caused by:
- Permit or contractual restrictions
- Lack of resources
- Working shifts
- Bad weather
- Harbour locks

**Outputs**
- Planning with delays
- Breakdown of resources and costs
- Export results to Graphs, MS Excel and MS Office
- Gantt chart
### Possible Outputs

**Results – planning with delays (export Gantt chart)**

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Duration</th>
<th>2015</th>
<th>2016</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Jan</td>
<td>Feb</td>
</tr>
<tr>
<td>1</td>
<td>Scour protection</td>
<td>29.38 days</td>
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<tr>
<td>2</td>
<td>Foundations - Aeolus</td>
<td>83.75 days</td>
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<tr>
<td>3</td>
<td>Infield cables</td>
<td>105.08 days</td>
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<td>4</td>
<td>Export cables</td>
<td>165.75 days</td>
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<tr>
<td>5</td>
<td>Foundations - P. Osprey</td>
<td>55.83 days</td>
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<tr>
<td>6</td>
<td>Substations</td>
<td>11 days</td>
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<td>7</td>
<td>Turbines - Aeolus</td>
<td>106.4 days</td>
<td></td>
<td></td>
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<tr>
<td>8</td>
<td>Turbines - P. Osprey</td>
<td>106.4 days</td>
<td></td>
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</tr>
</tbody>
</table>

**Project:** Gemini  
**Date:** October 26, 2015 9:49 AM  
**Weather Delay**  
**Harbour Delay**  
**Shift Delay**
The user can create 22 standard graphs using ECN Install
Example Outputs

Results - graphs

Time overview - Step Duration and Average Delays

Resources Variable Costs overview
Example Outputs

Results - graphs

Number of Working and Non-Working Hours per Vessel

Average Cost Breakdown per Resource

Average Cost Breakdown per Vessel

Average Cost Breakdown per Harbour

Average Cost Breakdown per Equipment
Installation modelling

What can it do?

- Design and optimize installation strategy for offshore wind farm
- Determine project planning, delays, costs and risks
- Monitor progress during installation
Installation modelling

What can it do?

- Commercial proof of new and innovative installation concepts
  - Installation methods
  - Support structures & wind turbines
  - Vessels and equipment

Source: Royal IHC

Source: Bugsier and Wärtsilä
Installation modelling

Where are biggest LCOE gains to be achieved?

<table>
<thead>
<tr>
<th>Potential user</th>
<th>Added value</th>
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</thead>
<tbody>
<tr>
<td>Developers</td>
<td>Procurement strategy, marshalling harbour strategy, procurement evaluation</td>
</tr>
<tr>
<td>Contractors BOP / WTG</td>
<td>Execution strategy, logistical strategy, workability analysis</td>
</tr>
<tr>
<td>Investors</td>
<td>Risk scenarios, contingency levels</td>
</tr>
<tr>
<td>Vessel &amp; Equipment designers</td>
<td>Added value of a new design at site specific circumstances</td>
</tr>
<tr>
<td>Port authorities</td>
<td>Added value of the port location for project logistics</td>
</tr>
</tbody>
</table>
Innovative solutions to lower the cost of energy