Offshore TIMES
Simulation of logistics concepts for O&M of offshore wind farms
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- O&M logistics processes & costs

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The Why?

O&M costs of an offshore wind farm

34% O&M Costs
Significant impact on the profitability of offshore wind projects

O&M Costs
O&M logistics processes and downtimes of the wind turbines are main cost drivers

Offshore Wind Project Costs

- 34% Operation & Maintenance
- 37% Balance of Plant
- 19% Turbine
- 10% Soft Costs

Source: NREI 2019
The Why?
O&M logistics processes

OFFSHORE LOGISTICS

Transport: Equipment, Personnel and Spare Parts

PLANNED MAINTENANCE

- Calendar Based Maintenance
- Preventive Maintenance
- Condition Based Maintenance

DESCRIPTION

DIMENSIONS

incl.

CHARACTERISTICS

- Medium to long term planning
- Small „Loss of production“
- Prediction of remaining component life time
- technology and preventive costs
- Best practice approach

UNPLANNED MAINTENANCE

- Corrective Maintenance

- Short Term reaction required
- Limited planning time
- Waiting time for spare parts
- Medium to High „Loss of Production“
- Depending on failure rates

LARGE COMPONENT REPLACEMENTS

- Action for large component replacements

- Depending on cause planned/unplanned maintenance
- Involve Large/Expensive Equipment/Vessels
- High Potential „Loss of Production“

Source: NREL 2019
The Why?

O&M logistics costs

Cost reduction through the optimization of the O&M logistics

Logistics concept

Costs due to different vessels and numbers, as well as restrictions

WORKBOAT-BASED

- Operating from a port base

HELISUPPORT

- Workboats with support from helicopters

OFFSHORE BASED

- With fixed or floating offshore structure

Uncertainties

Uncertainties about the accessibility, availability and feasibility of work

www.pomaritime.com

\[ H_s = 1.5m; U = 10m/s \]
\[ \text{Wave direction, swell} \]
\[ \text{Costs: } 1.500 \ldots 3.500\ \text{€/d} \]

www.fiberline.com

\[ U = 20m/s \]
\[ \text{Visibility, clouds, daylight} \]
\[ \text{Costs: } 48 \ldots 55\ \text{€/min} \]

www.siemens.com/windpower

\[ H_s = 3.0m, U = 15m/s \]
\[ \text{Wave direction, swell} \]
\[ \text{Costs: } 20.000 \ldots 30.000\ \text{€/d} \]

\[ ^1\text{Please refer to } "A\ \text{Guide to UK Offshore Wind Operation and Maintenance}"\ (2013)\ \text{including the used key visuals} \]
The How?

Offshore TIMES - Offshore Transport, Inspection and Maintenance Simulation

- Virtual test system for O&M concepts
The How?

Schematic principle of simulation of the operation and maintenance phase

- Definition of the Infrastructure
  - Layout, Infrastructure location

Weather and Environmental conditions
The How?

Schematic principle of simulation of the operation and maintenance phase

- Definition of the Infrastructure
  - Layout, Infrastructure location
- Reliability Module
  - OWF – Components
  - Reliability Models
  - Locations
- Normal Operation OWF
  - Wind Turbine Control/Components
- Weather and Environmental conditions
  - Loads
  - Weather Conditions
  - Earnings
The How?

Schematic principle of simulation of the operation and maintenance phase

Definition of the Infrastructure
- Layout, Infrastructure location

Reliability Module
- OWF – Components
- Reliability Models
- Locations

Logistic Concept/Infrastructure
Resources
- Vessels
- Personnel
- Spare Parts

Weather and Environmental conditions

Approach to optimization
The How?

Schematic principle of simulation of the operation and maintenance phase

- Definition of the Infrastructure
  - Layout, Infrastructure location

- Reliability Module
  - OWF – Components
  - Reliability Models
  - Locations

- Logistic Concept/Infrastructure

- Maintenance Works (simulated)

- Weather and Environmental conditions
  - Loads
  - Accessibility
  - Duration

- Normal Operation OWF
  - Wind Turbine Control/Components

- Personnel
- Spare Parts

- Resources
- Vessels

- Executed Work

- Reserve/release Resources/Properties

- Earnings

- Weather Conditions
The How?
Schematic principle of simulation of the operation and maintenance phase
The How?

Schematic principle of simulation of the operation and maintenance phase
The How?

Reference Offshore-Windfarm: Amrumbank West

- Layout: Amrumbank West
- 80 WTG
- Reliability model FhG IEE (WindPool)
- Base port: Heligoland
- Logistic concept: 2 CTVs
The How?

Comparison of energy production of different logistics concepts – example results

Legend:
- 2 CTV
- 4 CTV
- P5 – P95
- P50

Scenario: 2 CTVs

Scenario: 4 CTVs

Failure Example

Project duration

Energy production per turbine [MWh]
The And?
Conclusion & the use of Offshore TIMES

OffshoreTIMES is a modular simulation tool which can be adapted to the customers needs

- Logistics concept optimization of offshore wind farms
- Comparison of logistic concepts
- Innovation assessment and their impact on the O&M processes
Thanks a lot for your attention!
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