Offshore TIMES
Analysis and optimization of O&M concepts for offshore wind farms

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Operation and Maintenance - Motivation

“… we can [not] operate a zero-subsidy wind farm using methods that were adequate for a 100€/MWh” Clym Stock-Williams
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Operation and Maintenance - Motivation

Energy based O&M

Revenue based O&M

Energy yield [MWh]

Energy price [EUR/MWh]
Approach – requirements for O&M assessment

We require a tool that considers

- **Environmental conditions**, like sea states
- **Resources**, vessels, staff and other tools
- **O&M strategies**, like predictive or corrective maintenance
- **Reliability models** for WT and BoP
- **Wind farms** and **clusters**, flexible and extendible
- **Energy production** and **remuneration**

=> Offshore TIMES -
Transport, Inspection and Maintenance Software
Approach – Offshore TIMES

Transport, Inspection and Maintenance Software

ENVIRONMENTAL AND BOUNDARY CONDITIONS

VESSEL RESTRICTIONS
ENVIRONMENTAL CONDITIONS
LOCALIZATION
HARBOR CONDITIONS

RISKS
MARINE OPERATION
RESOURCES
REGULATORY REQUIREMENTS

Project area
OWF – Components
Wind turbine
Substructure
Converter
Inner array cable

Harbor A
Harbor B

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Approach – Offshore TIMES

OFFSHORE WIND FARM

WTG
- NACELLE
- BLADES/ ROTOR
- MECHANICAL

OFFSHORE MAINTENANCE

STRUCTURE
- FOUNDATION/ TOWER
- SCOUR
- MECHANICAL

CABLE
- DAMAGE
- SCOUR
- MECHANICAL/ ELECTR.

DEMAND O&M

SUBSTATION
- TOPSIDE
- SUBSTRUCTURE
- MECHANICAL/ ELECTR.

O&M CONCEPT

OPERATOR

FINANCIAL MODEL
- FINANCING
- REVENUE
- COSTS

MAINTENANCE
- CORRECTIVE
- PREVENTIVE
- CONDITION

CLUSTER/POOLING
- WIND FARMS
- EQUIPMENT
- PERSONNEL

INFRASTRUCTURE

SPARE PARTS
- OEM
- STORAGE

PERSONNEL
- QUALIFICAT.
- OWN/ CONTR.

EQUIPMENT
- ACCESS
- VESSELS

STRATEGY

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Approach – time series based simulation

- Reliability model
- Wind turbines etc.
- Faults
- Availability
- Control center
- Ressources
- Schedule
- Maintenance
- Sea states

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Scenarios

Two Wind farms (6 x 5MW, 80 x 3.6MW)
1) 1+2 CTVs, staff 36 persons
2) 1+3 CTVs, staff 48 persons
3) 1+4 CTVs, staff 60 persons

Remuneration
- Fixed 18€ct, 10€ct and 6€ct fixed tariffs
- European Energy Exchange (EEX) prices from 2002 to 2016
Monthly revenue, scenario 1)

Monthly and seasonal fluctuations
Monthly revenue loss, scenario 1)

Monthly and seasonal fluctuations

- Seasonal O&M strategies?
Annual revenue loss, scenario 1)
Comparison of revenue loss, all scenarios

Effects of different strategies

-> Does higher costs for O&M result in lower energy losses?
Results

- Analysis of simple O&M strategies for a cluster wind farm using Offshore TIMES
- Considering different failure models
- Direct comparison between strategies and remuneration systems, e.g. fixed tariffs and EEX
Outlook

- Implementing more complex maintenance strategies (seasonal, cluster, …)
- Considering operational strategies
- Revenue or production based strategies
- Include further topics, like SHM

- Project for assessing O&M for future Multi-MW wind turbines.

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Thank You For Your Attention

Any questions?

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