



NoordzeeWind



The NSW-MEP Technology

NZW-16-M-10-R02

November 2007

General overview NSW-MEP Technology



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The Offshore Wind farm Egmond aan Zee is the first offshore wind farm project in the Netherlands. In an international context this project is in the forefront of the development of offshore wind energy. The current feasibility of wind farms offshore is enabled by subsidies. To reach a situation where wind energy can compete without additional funding cost reduction is required.

The planning of the OWEZ project was done carefully. Nevertheless it was inevitable to use to a certain extent “on shore” knowledge of effects of wind turbines on the environment. Fundamental knowledge has to be obtained to enable even more environmental friendly designs of offshore wind farms in the future.

Both goals are supported by the NSW-MEP program, part of the OWEZ project. Under this program research will be carried out. The technology research will support cost reduction and efficiency improvement, where the ecology research addresses the local environmental impact above and under the sea surrounding the wind farm.

This presentation provides an overview of the technology part of the research. A similar presentation is available on the ecology part of the research.



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Research institutes working on the Monitoring en Evaluation Program

Environment

- Birds



- Sea mammals, fish and benthos



- Landscape (societal aspects)



- Shipping and Safety



Technology

- Energy production



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- Wind resource



- Technical and economical aspects





Main goal NSW-MEP technology:

To support cost reduction of wind energy generation off shore by:

- Reporting experience from the OWEZ project (text) and
- Measurements (data to be stored in relational data base)
- Results available for third parties





Research topics of the NSW-MEP technology:

- Influence of the off shore environment
- Wind and wave characteristics
- Design, safety and construction logistics
- Dynamics of the wind turbines
- Performance of the wind turbines
- Power quality and predictability of production





Research topics on influence of the off shore environment:

- What are influences of salt water and spray on corrosion on the wind turbines and support structures?
- Will growth of biofouling be different compared to off shore experience in oil and gas platforms?
- Will (risks of) lightning strikes be different compared to on shore?





Influence of the off shore environment:

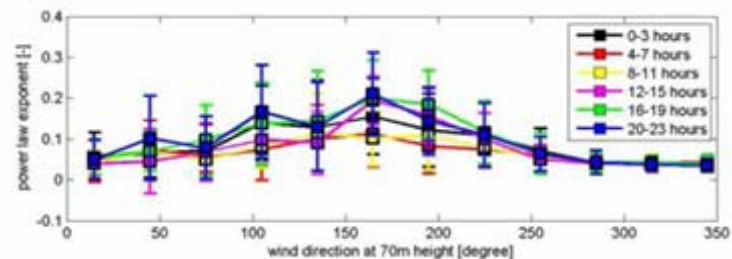
- Salt and spray
 - Corrosion inspection plan as part of regular O&M
 - Findings fed back into O&M
- Biofouling
 - Black and white video footage of bio growth
 - Comparison with existing knowledge (off shore industry)
- Lightning protection
 - Statistics gathered of number of hits
 - Current amplitude will be defined where technical feasible





Research topics on wind and wave characteristics:

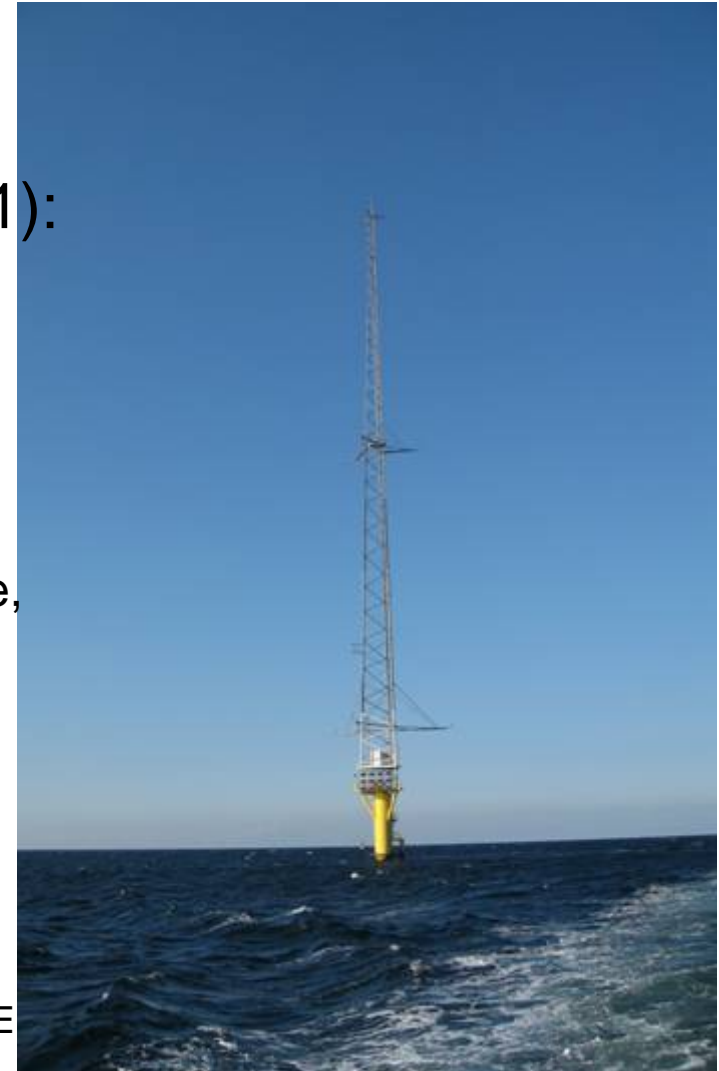
- What is the character of wind off shore: average wind speed, turbulence intensity, wind shear
- Describe the wake effects due to the wind turbines
- What is the character of the sea state (swell, wave height) in relation to the wind
- Generate both detailed information and average values





Wind and wave characteristics (1):

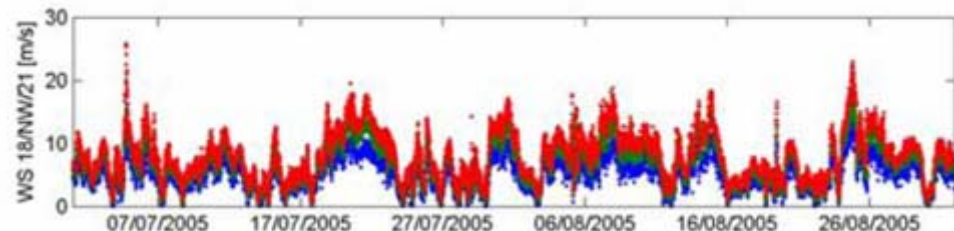
- Wind measurements with met mast
 - At 22, 70 and 116 meters height
 - Cup and ultra sonic measurements
 - Wind direction at all three heights
 - Data in 10 minute average values
 - Related parameters like air temperature, rain fall, sea water temperature and metmast acceleration
 - Wave data from ADCP





Wind and wave characteristics (2):

- Extra features
 - Higher measurement frequency during special campaigns
- Wake effects
 - Output measurement on individual wind turbines
 - Position of met mast enables single and multi wake effect measurement





Research topics on design, safety and construction logistics:

- How is structural safety achieved
- What are influences of weather and sea state on construction activities
- What risks are relevant and how are they managed





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Design, safety and construction logistics:

- Reporting of
 - Overall design of the wind farm
 - Construction method
 - Project management structure
 - Planning
 - Relation to the permits
 - Risk management
 - Quality assurance
 - Basic financial figures





Research topics on dynamics of the wind turbines:

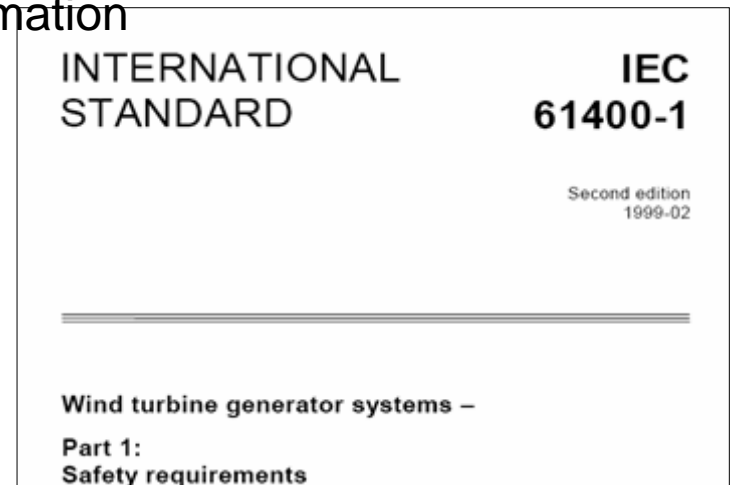
- How will the dynamic behaviour of the wind turbines be?
- What loads will occur in the drive train?
- What blade movements will occur?





Dynamics of the wind turbines:

- Measurement of dynamic behaviour of two wind turbines
 - Eigen frequency
 - Occurring loads in the drive train
 - Combined with SCADA status information
 - Special measurement campaigns





Research topics on performance of the wind turbines:

- What influence will off shore conditions have on:
 - PV curve
 - Availability
 - Maintenance and repair
 - Operations





Performance of the wind turbines:

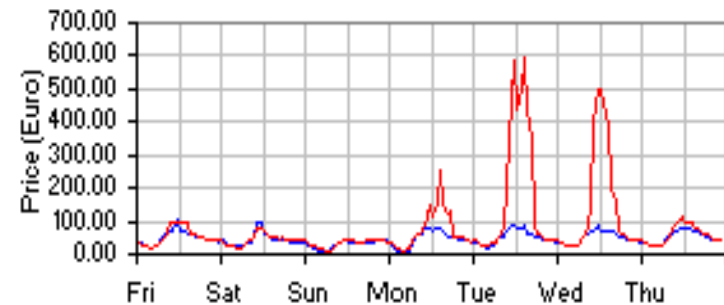
- PV curve
 - Measurement according to IEC 61400-12 where possible
- Availability
 - On wind turbine and wind farm level
 - Causes of down time
- Maintenance
 - Reports on corrective maintenance
 - Reports on condition monitoring
 - Application of LCCM model
- Operations
 - Logbook on operations
 - Weather forecast and influence on work at site





Research topics on power quality, grid connection and power predictability:

- Quality of power delivered
- Grid connection design
- Power predictability and economic value of power prediction





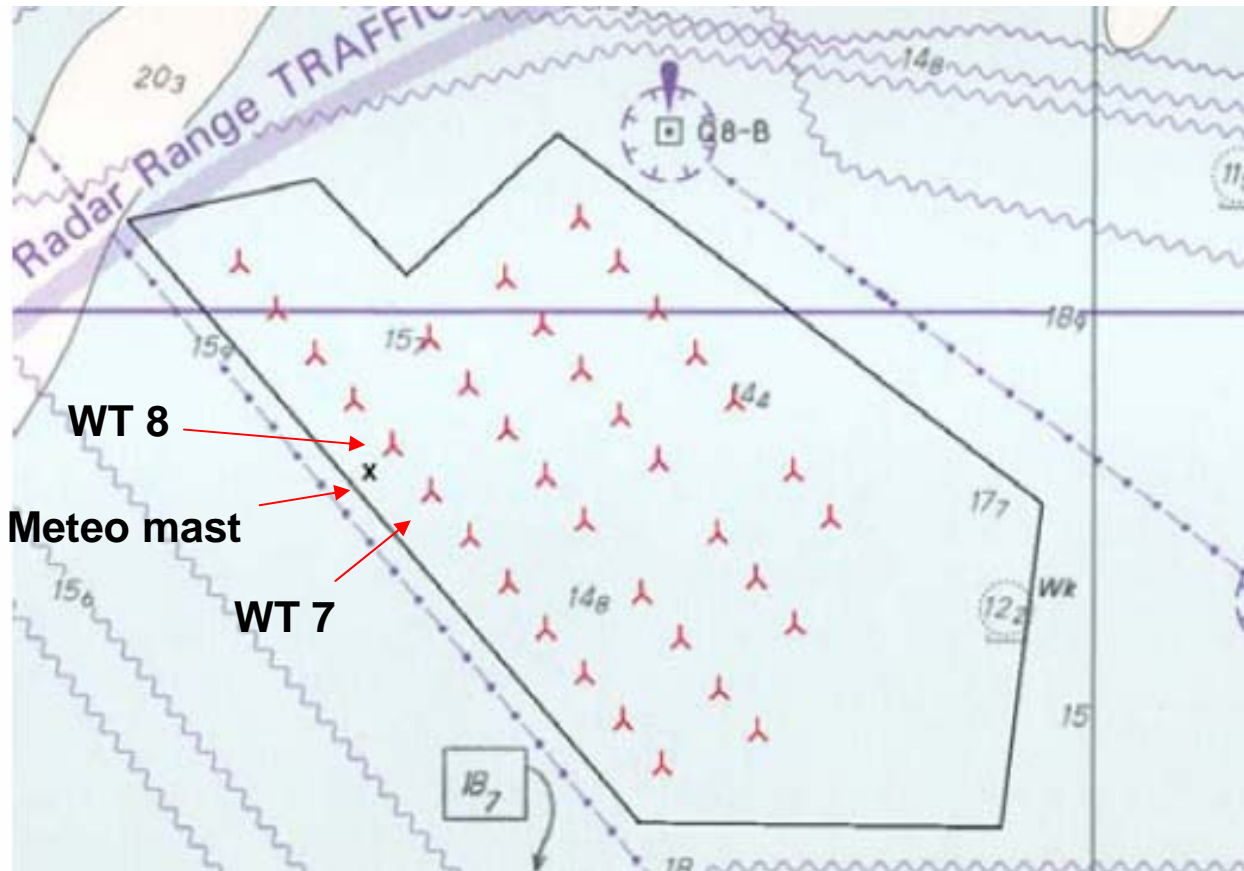
Power quality, grid connection and power predictability:

- Quality
 - Measurements of all relevant parameters like voltage, current, power factor
 - SCADA status data w.r.t. occurring events
 - According to IEC 61400-21
 - Measurements of SCC cable temperature
- Grid connection
 - Report on grid connection design
- Power predictability
 - Comparison of predicted (AVDE) data with real time data
 - Economic evaluation of added value of the prediction tool



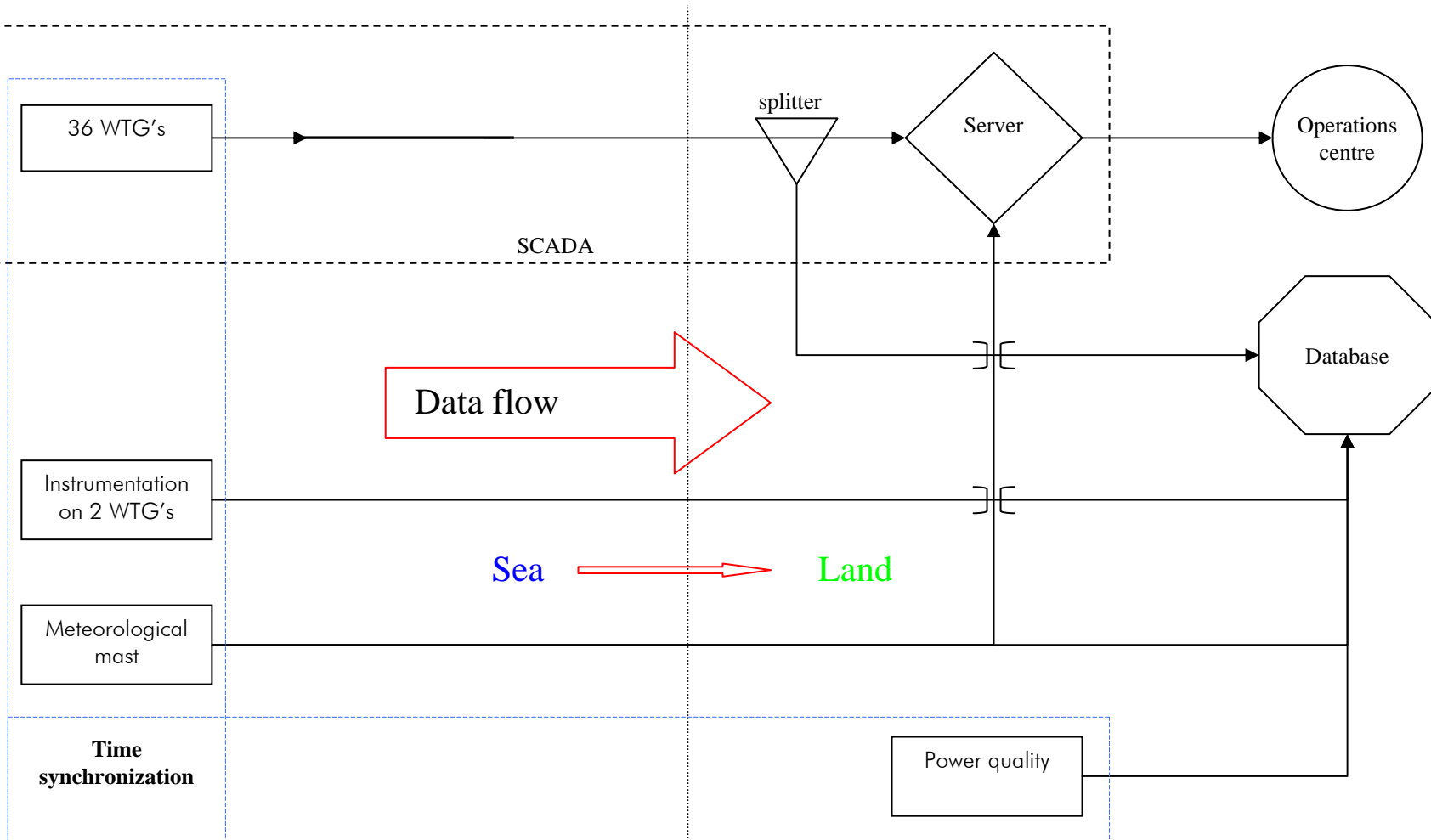


Wind turbines with extra NSW-MEP instrumentation and meteo mast





General lay out instrumentation NSW-MEP Technology





Indicative planning public reports:

- Wind resource: monthly data files, half yearly wind resource reports until end 2009
- Bio fouling: yearly, Q2 2008, Q2 2009 and Q2 2010
- Lightning: yearly, Q2 2008, Q2 2009 and Q2 2010
- Operational issues: Q2 2008, Q2 2009 and Q2 2010
- Short term output prediction: half yearly, Q2 2008, Q4 2008 and Q2 2009
- Wake effects: once, Q2 2008
- Morphology: yearly, Q4 2008, Q4 2009 and Q4 2010



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Data confidentiality:

- Public data
 - Available on the internet: www.noordzeewind.nl and www.windoffshore.nl
- Confidential data
 - Content and availability on request at and subject to approval of NoordzeeWind
 - Restrictions will apply