Copenhagen Offshore Wind Conference 2005

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Siemens Wind Power

SWP's Offshore Experience and lessons brought forward to **BURBO Offshore Wind Farm**

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Siemens' Offshore experience

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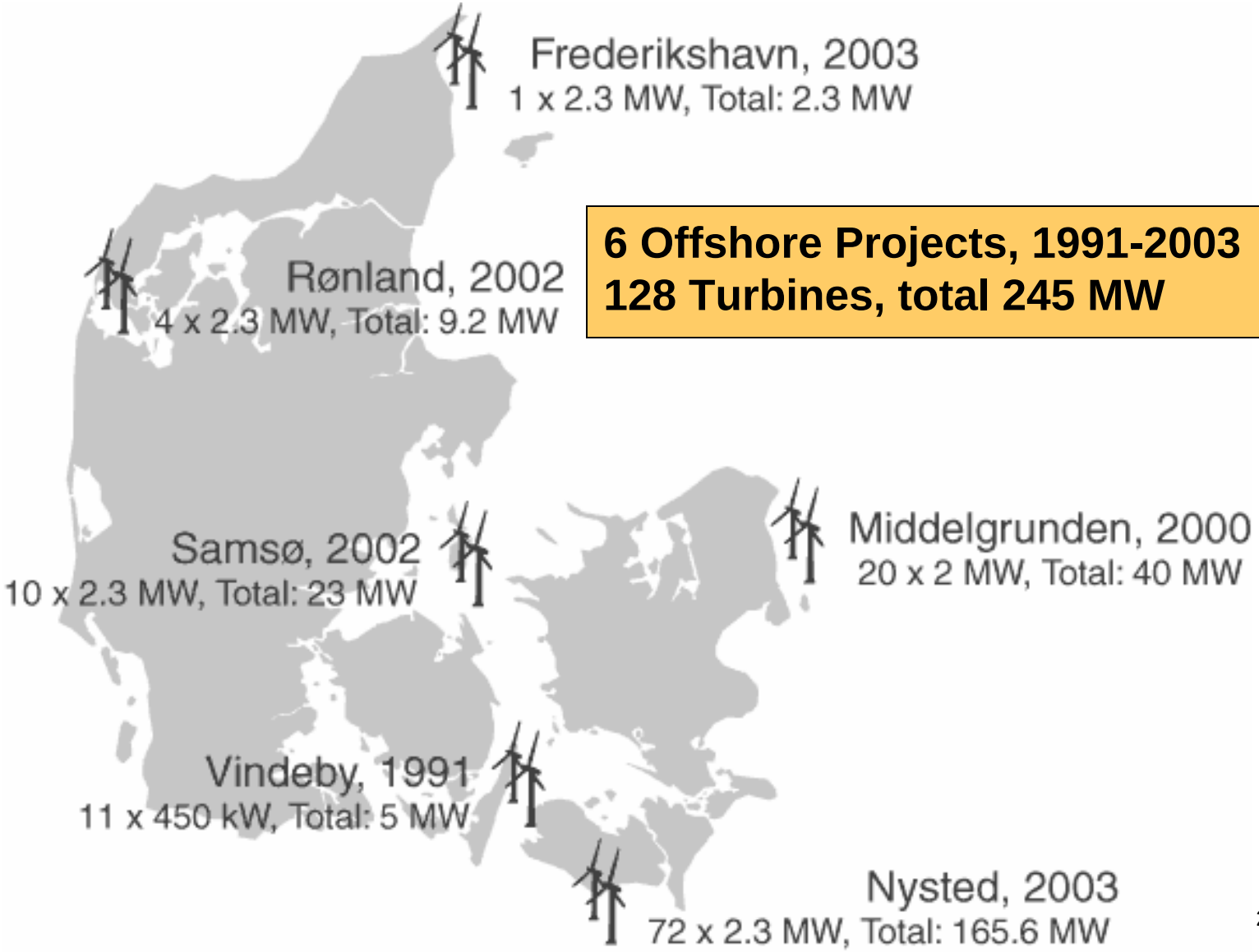

6 Offshore Projects, 1991-2003
128 Turbines, total 245 MW

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Long-Term Strategy

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The long-term strategy behind offshore activities:

- Get one of the first, moderate-size demonstration projects to acquire longest possible experience
- Base offshore projects on proven turbine technology to avoid combining new technology risks with offshore risks
- Accept early offshore projects only in shallow and/or less exposed waters and refuse projects in deep and/or exposed waters until complete offshore technology (turbine modifications, installation, service, access) has been proven

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Vindeby

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Vindeby, Main Project Data

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World's first offshore wind farm:

- 11 x 450 kW, 1991
- Built by SEAS for demonstration of potential in offshore wind power
- Bonus scope of supply: Turbines, SCADA, installation, 2 years WOM

Essentially an onshore wind farm moved offshore:

- Water depths 2-5 m
- Moderate fetch (10-15 km) in prevailing wind direction
- Turbines in two rows, 8.5 D spacing in rows, 8.5 D spacing between rows

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Vindeby, Turbine Details

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Offshore modifications implemented at Vindeby:

- Built-in nacelle crane for service works, can install larger crane for main component replacement
- Totally enclosed nacelle and tower
- Cooling with heat exchanges for gearbox and generator
- Climate control with dehumidifiers in nacelle and tower
- Transformer in bottom of tower

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Vindeby, Installation

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Installation by onshore methods moved offshore:

- Foundations and electrical infrastructure installed separately by others
- Turbines installed with normal onshore mobile crane placed on standard offshore barge
- Turbines shipped two at a time, completely assembled with rotors
- 11 turbines installed in 12 days

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Vindeby, Experience

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14 years of operation with no major problems:

- High turbine availability
- Climate control very efficient - turbines as new inside
- Higher incidence of lightning strikes than onshore
- Moveable crane for main components not used
- Conical foundations cause access problems due to standing waves
- Useful weather windows sometimes significantly shorter than predicted by statistics

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Middelgrunden

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Samsø

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Nysted

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Nysted, Main Project Data

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World's largest offshore wind farm:

- 72 x 2.3 MW, 2003
- Built by E2, owned jointly by E2, DONG and Sydkraft
- Bonus scope of supply: Turbines, SCADA, installation, 5 years WOM

A true offshore wind power plant:

- Water depths 5-10 m
- Substantial fetch (80-100 km) in prevailing wind direction
- Turbines in grid pattern, 5.8 D spacing in rows, 10.3 D spacing between rows

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Nysted, Turbine Details

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Updated offshore modifications based on Vindeby:

- Built-in nacelle crane for service works, can install two versions of larger cranes
- Totally enclosed nacelle and tower
- Cooling with heat exchanges for gearbox and generator, temperature control in narrow range
- Climate control with dehumidifiers in nacelle and tower
- Transformer in bottom of tower
- Automatic lubrication systems with 12+ months capacity
- Permanent on-line machine condition monitoring
- Dynamic power factor correction system and fault-ride-through capability

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Challenges of Nysted

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Identified critical issues for installation:

- Offshore installation scheduled for 80 days
- Logistics
- Flow of components at base harbour
- Pre-assembly at base harbour
- Test at base harbour

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Port of Nyborg – Logistic centre

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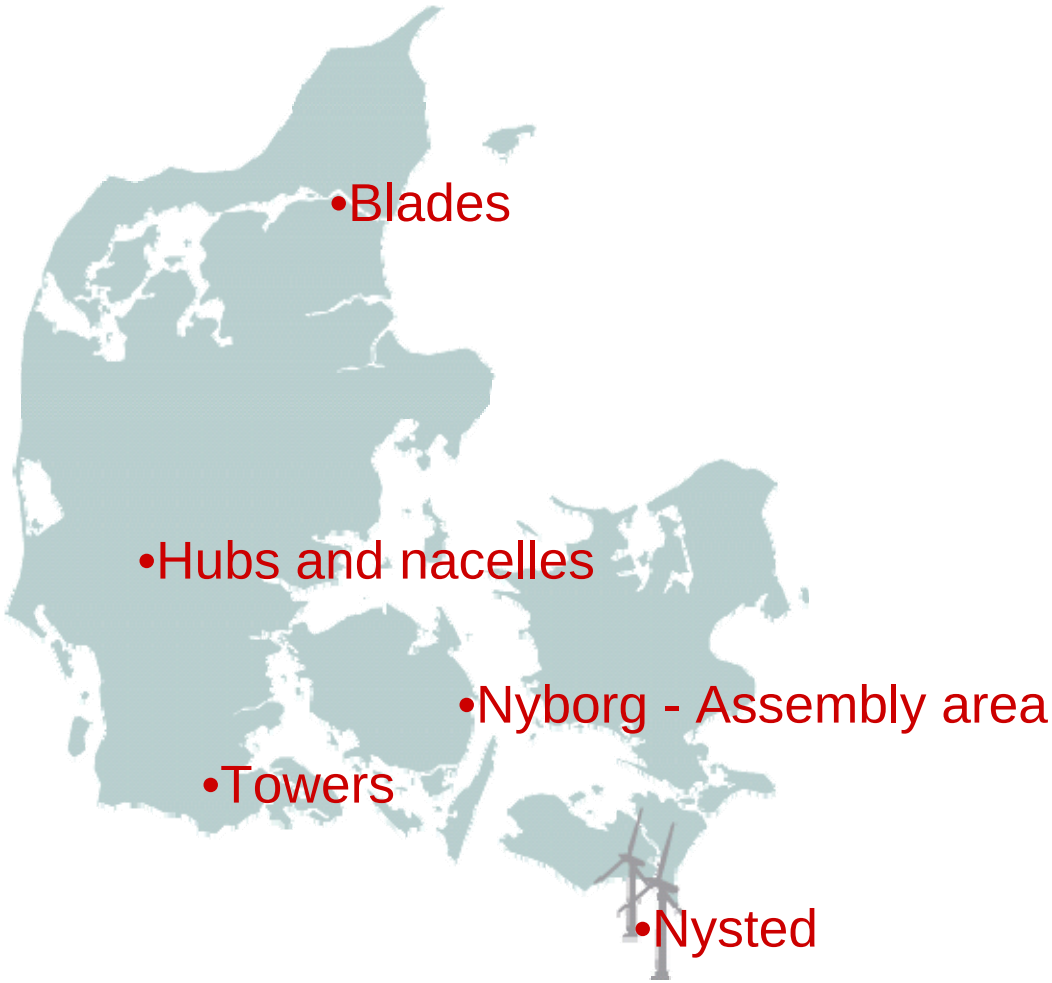
- Was chosen due to lack of useable harbours close to the site
- Location approx. 10 hours sailing from the site



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Port of Nyborg – base harbour

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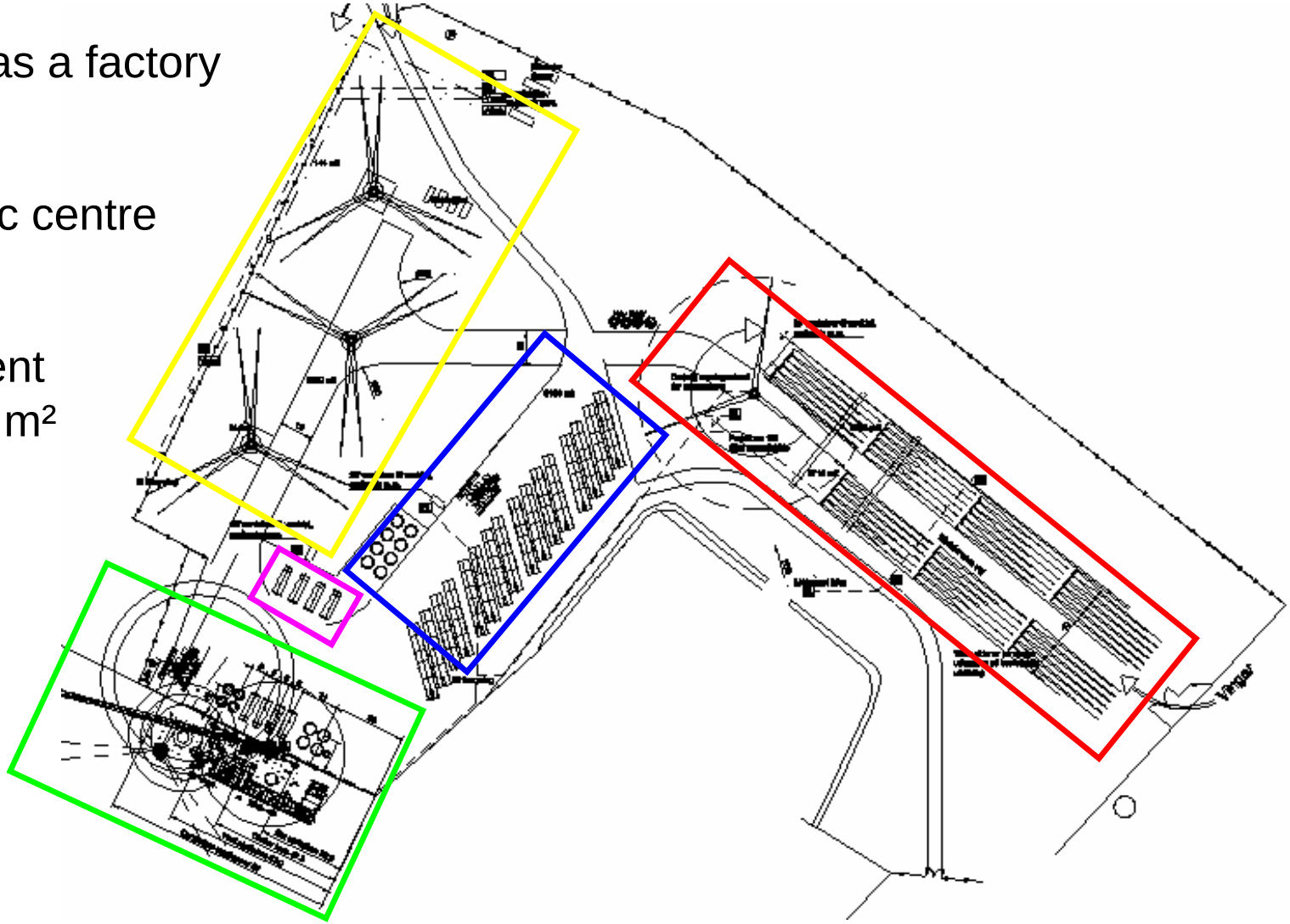
- Designed as a factory
- Purpose
  - Logistic centre
  - Buffer
- Arrangement
  - 60000 m²



Port of Nyborg – base harbour

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- Main tasks at harbour
  - Pre-assembly
  - Test
  - Quality control
  - Vessel loading

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Nysted, Installation

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Offshore installation strategy:

- Extended preparation work using mock-ups etc.
- Turbines installed with (proven) A2SEA vessel
- Turbines shipped four at a time, loaded on vessel as towers in two sections, nacelles, and completely assembled rotors. (Significant engineering effort was invested in getting an optimal loading plan including mock-ups and scale models)
- 72 turbines installed in 79 days

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Conclusion from implementation of previous projects

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Successes

- Few last minute changes due to early testing and use of mock-ups
- Use of pre-assembling at base harbour
- Use of pre-tests at base harbour
- Use of extensive QA control before load-out
- Load arrangement of installation vessel (tested in detail using scale models)
- Installation within time schedule
- Take-over generally on or ahead of schedule

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Conclusion from implementation of previous projects

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Lessons learned

- Do your *homework* with testing and use mock-ups. The offshore environment is **NOT** the place for testing interfaces and quality procedures
- Importance of efficient quality control at base harbour is crucial for the commissioning and later operation of the wind farm.
- Importance of pre-assembling and tests at base harbour in order to minimize offshore work
- Focus on commissioning works - good planning and minimizing the needed time for commissioning is vital for a successful implementation of an offshore project

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Operational Experiences from previous projects

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Status after 2-14 years of operation:

- Installation and commissioning of all projects according to schedule or better
- Take-over generally achieved on or ahead of schedule
- Only minor troubles so far
- Availability generally high on all projects

*All SWP's offshore projects are regarded as **successful** projects both regarding installation and operation*

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Next Project – Burbo Offshore Wind Farm

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…so much for the past and the present

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What about the future?

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Next Project – Burbo Offshore Wind Farm

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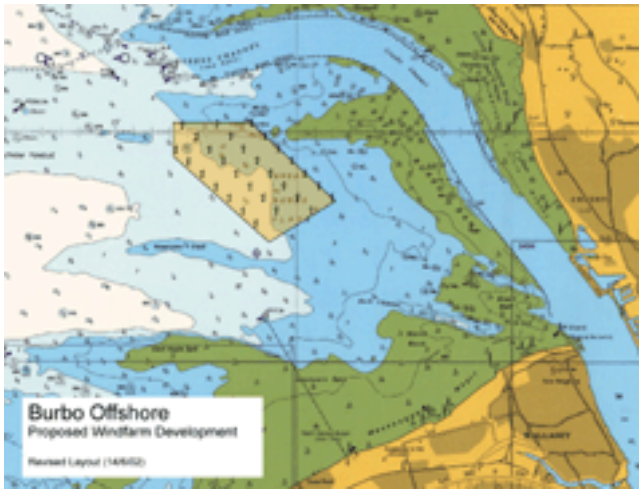
Burbo Offshore Wind Farm



- Location: UK west coast, Liverpool Bay
- Owner: ELSAM and EDF Energie Nouvelles
- Construction Period: Foundations 2006 and turbines early 2007
- WTG: Siemens 3.6MW offshore
- Size of project: 25 units equalling 90MW installed capacity
- Scope of supply: Design, Manufacture and installation of towers and turbines and 5 years S&M

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Challenges for BOWF

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How do we make Burbo another success?

Design:

- Finalise all project specific design in due time to be able to do mock-ups and pre-assemblies in cooperation with the engineer and owner of the project in order to minimize the risk of errors in interfaces and components which are not “ready to go offshore”.

- Use proven turbine technology – at the time of installation the prototype have been in operation for more than 2.5 years.

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Challenges for BOWF

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How do we make Burbo another success?

Installation:

- Development of efficient load out/installation method/setup that allows pre-assembling and tests to the highest possible degree. (Difficult in UK ports due to locks and limited space)

- Make sure that all processes during the installation are well prepared in all aspects such as
  - Time consumption (minimize bolting in seafastening etc.)
  - H&S issues are incorporated in the design and all risks are minimized/dealt with in advance

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Challenges for BOWF

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How do we make Burbo another success?

Commissioning:

- Preparing of the commissioning works in order to obtain an efficient start-up of the wind farm
  - Make sure the grid is available immediately after the individual turbines are erected.
  - Minimize the works and testing to be done offshore
  - Commissioning works are planned for the good weather season

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Challenges for BOWF

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How do we make Burbo another success?

Operation:

- Offshore modifications are primarily based on the experiences from Nysted with only small changes

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Conclusion

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How do we make successful offshore projects?

- Do your homework – be ready in all aspects of the works and do not leave anything “to be tested when we have mobilized”.
- Work pro-active with your client and agree well in advance on interfaces and technical solutions
- Do not compromise the time needed to prepare properly for the job. *Time and money invested in testing, planning and preparation of offshore projects will be the best investment you will ever make!*

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