Offshore Wind Risks - Issues and Mitigations

Baltexpo 2011 - Offshore Wind presented by DNV

Ian Chester / Jan Talaśka
2011-09-05
DNV – An Independent Foundation

300 offices

100 countries

9,000 employees, of which 76% have a university degree
Services to the Wind Industry

Advisory Services

- Wind Resource Assessment
- Project Development Support
- Due Diligence
- Marine Advisory Services
- Asset Risk Management
- Wind Turbine Technology
- Health, Safety and Environmental Risk Management
- Training and Educational Programs

Accredited Services

- Project Certification
- Type Certification
- Testing Services
  - Power Performance Testing
  - Loads Testing
Major Risks in Offshore Wind Farms

- Wind energy uncertainty
- Construction
- Turbine technology
- Turbine foundations
- Subsea cables
- Grid connection
- Offshore access
- Marine conditions
- Regulatory regime
Offshore Wind - Combining DNV competences

25 years of hands-on experience with wind turbines + 40+ years of offshore oil & gas experience = Global leader in project risk and certification of offshore wind projects
Wind Energy Uncertainty

- **Issue**
  - Reliability of kWh generated estimates
  - Real on-site data are scarce
  - Wind resource estimates have large uncertainty
  - Loss factors are not well understood (e.g. wakes and turbulence)
  - Potential large variation in wind resource across a R3 site

- **Mitigation**
  - Offshore measurement (fixed tower, novel solutions) over sufficient period of time (> 2 years)
  - Layout optimisation and understanding the trade-offs
  - Transparency of energy estimates
Site Conditions – Marine Environment

- **Issue**
  - The weather and sea conditions
  - Varying water depths and sea bed conditions across a site
  - Weather window for offshore work is small

- **Mitigation**
  - Solid, site-specific information
    - Measurement campaigns
    - Data mining
    - Geotechnical investigation
    - Safety factors in design
  - Relevant learning from oil and gas
  - Development / use of equipment / methods suitable in adverse conditions
Wind Turbine Technology

- **Issue**
  - Large MW turbines required 10 MW?
  - Component failures difficult to rectify offshore

- **Mitigation**
  - Turbine selection
  - Strong warranty agreements
  - Condition monitoring
  - Data monitoring, analysis and response
  - Proactive maintenance
  - Further research into design loadings
  - Turbine type certification
  - Engineered for reliability
Wind Turbine Foundations

- **Issue**
  - Costly foundation designs due to:
    - Harsher marine conditions
    - Deeper water
    - Larger turbines
  - Shallow-water solutions may not work

- **Mitigation**
  - Standardisation
  - Quality control during manufacture
  - Research programs (e.g. Carbon Trust OWA)
  - Information sharing between WTG manufacturer and foundation designers for benefit
Subsea Cables and Power Transmission

**Issue**
- Many problems during cable installation, e.g. improper cable handling
- Human introduced hazards (e.g. anchoring)
- Natural hazards (seabed mobility)
- Unplanned downtime not considered in energy estimates

**Mitigation**
- Cabling
  - Understand site-specific conditions
  - Chose appropriate cabling design (e.g. armour, burial depth, scour protection)
  - Work with experienced partners
  - Plan with contingencies
- Substation
  - Realistic expectations for annual maintenance time
  - Include unplanned outages
  - Diligent inspections and maintenance
Grid Connection

- **Issue**
  - Load centres are far away from offshore wind farms
  - Congestion in certain areas of the grid
  - Long distance / high power will require (less proven) offshore HVDC solutions
  - Uncertainty about ownership / operation of assets

- **Mitigation**
  - Early dialogue between developer and grid operator
  - Careful evaluation of various options
Construction

- Issue
  - Major project
  - Contract strategy selection
  - Managing the interfaces
  - Supply chain and facilities
  - Unexpected technical issues

- Mitigation
  - Previous project experience
  - Project lifecycle engineering supervision
  - Installation concept studies
  - Develop your own team
  - Plan A, B and C
  - Project Certification
Construction Vessels

- **Issue**
  - Vessels are scarce and expensive (e.g. +100 k£/day + mob/demob)
  - Capabilities (crane, deck space, propulsion) limited
  - Vessel reliability

- **Mitigation**
  - Developers building own vessels
  - Long-term contracts (but uncertainties about project schedules)
Offshore Access

- **Issue**
  - Current access solution (boat fendering) limited by sea state (e.g. < 1.5 m significant wave height)
  - Access to turbines more frequent than expected
  - Health and safety issues – reputational risk

- **Mitigation**
  - Improvement of current solutions (e.g. to 3 m significant wave height)
  - New access solutions (e.g. heave-compensated gangway)
  - Additional access by helicopter-hoisting
  - Research programs (e.g. UK Carbon Trust OWA)
Operations & Maintenance

- **Issue**
  - Determining the optimum O&M approach
  - Lack of deep offshore wind O&M experience in the market
  - Limited experienced personnel
  - Personnel health and safety issues

- **Mitigation**
  - Minimise need to access the turbines
  - Turbines designed for easy O&M
  - O&M considered at the windfarm design concept stage
  - Specialist vessels required
Regulatory Regime

- **Issue**
  - Investors looking for long-term certainty
  - UK ROC scheme reasonably successful, but also discussion about feed-in tariffs
  - Carbon tax

- **Mitigation**
  - Firm statement and action from Government
  - Long-term agreements
  - Know the market
An Opportunity

- The wind industry is moving further offshore
- Need to quantify offshore risk and become comfortable with it
- Lever oil & gas experience
- Prime movers will have an advantage
- Reliable project outturns – cost, schedule and quality
Safeguarding life, property and the environment