Performance and reliability benchmarking using the cross-company initiative WInD-Pool

October 14th, 2015 | RAVE Offshore Wind R&D Conference 2015, Bremerhaven

Stefan Faulstich, Sebastian Pfaffel, Berthold Hahn, Johanna Hirsch
Performance and reliability benchmarking using the cross-company initiative WInD-Pool

Contents

- Motivation
- The WInD-Pool approach
- Exemplary Results
- Conclusion and Outlook
Motivation

Challenges of an Operator

How to improve?
Best Practices

Maintenance optimization?
Reliability characteristics

Strengths and Weaknesses?
Benchmarking
WInD-Pool
Wind Energy Information Data-Pool

- Cross company initiative of leading operators and Fraunhofer IWES
- Converts operational experience into knowledge
- Performance Benchmarks
- Reliability Characteristics
- Funded by the Federal Ministry for Economic Affairs and Energy (BMWi)

EVW I + II
(Onshore WT)

Offshore~WMEP
(Offshore WT)
WInD-Pool
Working Principle

Operator

Data acquisition

Core data
Operating data
Event data

Operator

Performance Benchmark

Benchmarks

Reliability characteristics

Operator

Operator

Confidentiality

Non-Confidential
Public analyses
Third parties

Group analyses

Participant specific analyses

Anonymised Benchmarks
for the public
Customer specific analyses
(e.g. component suppliers)

Benchmarks dependent on requirements
(e.g. turbine concepts)

Reliability Characteristics
(Reliability Parameter Library)

Operator

Analyses of single wind farms

Reliability analyses
Exemplary Results
Underlying Data

### Available Data

**Offshore**
- Operating Data of 298 WT (2009 – 2015)
- Event Data of 55 WT (2,675 months)

**Onshore**
- Operating Data of 200 WT (2004 – 2014)
- Event Data of 574 WT (42,800 months)

### Analyzed Data

**Offshore**
- Operating Data of 158 WT
- Years 2011 - 2014
- Good data 95 %

**Onshore**
- Operating Data of 200 WT
- Years 2013 – 2014
- Good data 95.2%

Presented results are highly aggregated and solely based on operating data (SCADA)

Presented analyses were carried out specifically for this publication and do not represent the extent of “normal” reporting
Exemplary Results
Key Performance Indicators

- Wind conditions at hub height (nacelle anemometers)
  - Onshore: 5.6 m/s, 187 W/m²
  - Offshore: 7.9 m/s, 566 W/m²

- Capacity Factor
  - Onshore: 18.4%, 1610 hours of full load
  - Offshore: 39%, 3422 hours of full load

- Time based and production based availability (data gaps considered as downtime)
  - Onshore: 94.1% and 92%
  - Offshore: 92.2% and 88.1%
Exemplary Results

Operating States

- **Onshore**
  - Low wind conditions
  - Idling 10% of time due to low wind
- **Offshore**
  - Frequent data gaps
  - High share of rated operation

**Onshore**
- Low wind conditions: 45%
- Idling 10% of time due to low wind: 32%

**Offshore**
- Frequent data gaps: 22%
- High share of rated operation: 15%
Exemplary Results
Events: Frequency and Duration
Exemplary Results
Further Results at a Glance

- Increasing event rate at higher wind speed
  - Mainly resets and short downtime

- Long Downtimes account for ~70% of total downtime
  - Only about 6% of all events

- 18% (onshore) respectively 27% (offshore) of all technical events are wind farm wide events
  - Wind farm wide data gaps account for 22% (onshore) respectively 74% (offshore) of all data gaps
Conclusion and Outlook
A Benefit for the whole Industry

- WInD-Pool is an ongoing initiative of Operators and Fraunhofer IWES turning operational experience into knowledge
- WInD-Pool provides significant benefits for participating Operators
- Further Operators are welcome to join the initiative
- Detailed maintenance data are the next “BIG STEP”
- Application of standards is very important for comparability
- Fundamental questions can be answered as part of research work
- Results on onshore and offshore WT show significant differences