Simulation of wake effects between two wind farms

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Simulation of wake effects between two wind farms

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Support by
Outline

- Introduction EERA-DTOC;
- Layout of the offshore wind farm cluster;
- Participants & models;
- Identification of a flow case;
- Results from SCADA data analysis;
- Results from the cluster models;
- Comparison of park efficiency;
- Conclusion & acknowledgement;
Introduction to EERA-DTOC

**EERA:** European Energy Research Alliance

The **DTOC** project combines expertise to develop a multidisciplinary integrated software tool for an: optimised design of offshore wind farms and clusters of wind farms.

The wake models results are compared to the measurements of wake effects:
1) between wind turbines and;
2) between wind farms;
Offshore wind farm cluster

**Rødsand II wind farm**
- Owner: E•ON
- SWP: 2.3-92.6m, VS & VP
- Spacing: variable 5 – 6 – 7 - 10D
- Operational status: good
- 1 month data 5-10 m/s representing East & West

**Problems**
- Lack of inflow reference & time stamps

**Nysted wind farm**
- Owner: DONG Energy A/S
- Bonus 2.3-82.4 m, 2-speed, active stall
- Principal spacing: 10.1 & 5.6 D
- Annual eq. full load hours≈3300

**Problems**
- Different owner
- Lack of synchronization

Cluster wake
Cluster layout

by courtesy of E•ON
Wind farm clustering

Offshore wind farm cluster: Rødsand II & Nysted

Reference diameter: D=92.6m

Rødsand II:
90 x SWT-2.3-92.6m

Nysted:
72 x Bonus-2.3-82.4m

Model inflow
77-117°
8 m/s

SCADA reference
Visualisation of SCADA analysis

Rødsand II: WDIR=72° ±5°; U=8±1 m/s
## Participants & models

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<th>Models</th>
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<tr>
<td>SCADA(BA)</td>
<td>DTU Wind Energy/K.S.Hansen</td>
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<td>FUGA/SO (1)</td>
<td>DTU Wind Energy/S. Ott</td>
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<td>NOJ(GU) (2)</td>
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<td>Meso/PV (5)</td>
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<td>AD/RANS (6)</td>
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<td>FarmFlow (9)</td>
<td>ECN Wind Energy/J.G Scheepers</td>
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<td>RANS/f_pC (10)</td>
<td>DTU Wind Energy/P.vd Laan</td>
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Model results for Rødsand II, U=8 m/s; WD=97

Offshore wind farm cluster: Rødsand II & Nysted

Reference diameter: D=92.6m

Model inflow
$U_{hub}=8 \text{ m/s}$
WDIR=97°
Model results for Rødsand II, U=8 m/s; WD=97°
Cluster modeling results, $U=8 \text{ m/s; WD}=97^\circ$
Park efficiency comparison

Rødsand II: Measured and simulated sectorwise park efficiency; $U=8$ m/s & $\Delta=5^\circ$
Conclusion

• The benchmark have demonstrated that both size and location of the distinct deficit zones - caused by the Nysted wind farm have been predicted well by the models.

• The benchmark concludes that several park models are able to handle the clustering of wind farms and ready to be integrated in the software, developed as part of “Design Tool for Offshore Wind Farm Cluster” (EERA-DTOC).

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