RAVE
RESEARCH AT ALPHA VENTUS
Eine Forschungsinitiative des Bundesumweltministeriums

RAVE 2012 Conference – a First Summary

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Gefördert auf Grund eines Beschlusses des Deutschen Bundestages

Projektträger

Koordination

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

ptJ Projektträger Jülich Forschungszentrum Jülich

Fraunhofer IWES

RAVE – at a Glance

- 1200 sensor applications at rotor, nacelle, tower and foundations in the offshore wind farm alpha ventus,
- Mainly concentrated on two research turbines next to FINO 1,
- FINO 1 wind measurements as reference,
- Lidar wind field investigation,
- Electrical power measurements onshore and (offshore),
- 33 R+D-projects working partly in research compounds/ networks,
- Research founded by BMU with 51 Mio. Euro,
- **Aim:** To gain data and experiences from the operation of 5 MW turbines far offshore for the design, planning and operation of future offshore wind deployment.
- By: Development and validation of tools, design principles and gaining knowledge on the behaviour of large turbines at sea.

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RAVE – Main Topics of Research

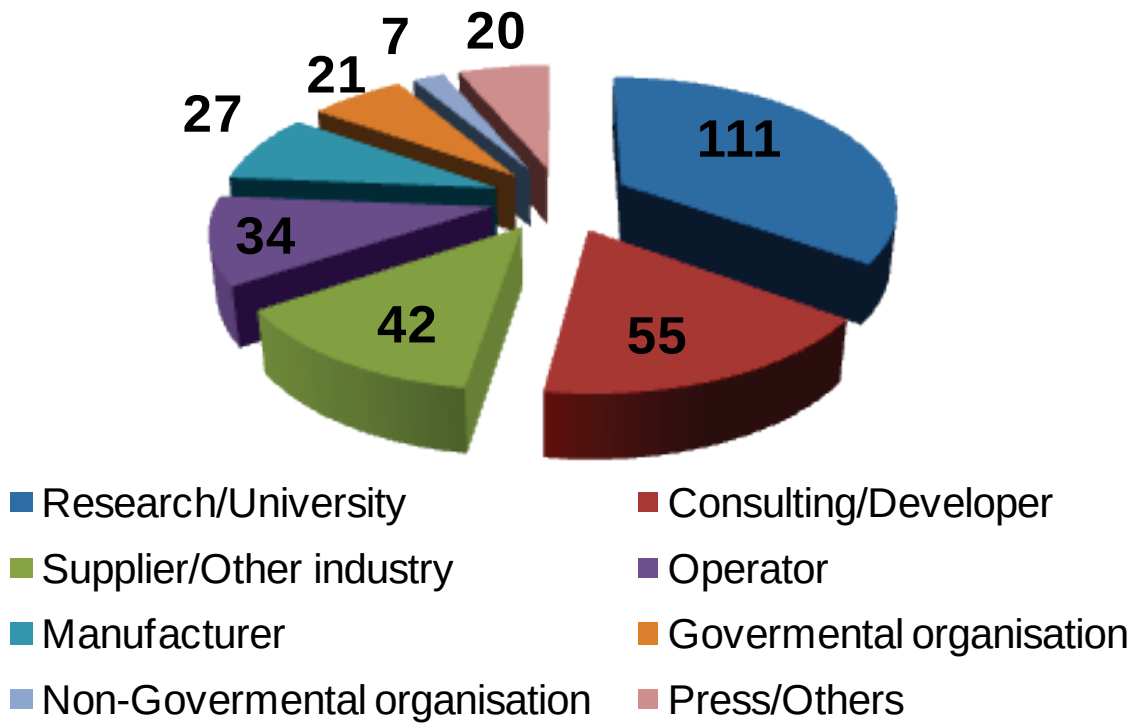
- Pile – soil interaction,
- Foundations (loads, scour, tools for the calculation of all relevant processes),
- Test and further development of turbines and components,
- Load dynamics of the hole turbine, considering all main components and the wind field in front and behind the turbine,
- Further development of Lidar technology and it's application towards turbine and wind farm controlling,
- Wind statistics, turbulence and atmospheric boundary layer,
- Operation and failure statistics of offshore wind farms,
- Environmental influence on materials,
- Ecological accompanying research, social acceptance
- Grid interaction of the wind farm.

RAVE - Conference

Total: 317

Industry: 158

Participation - institutions



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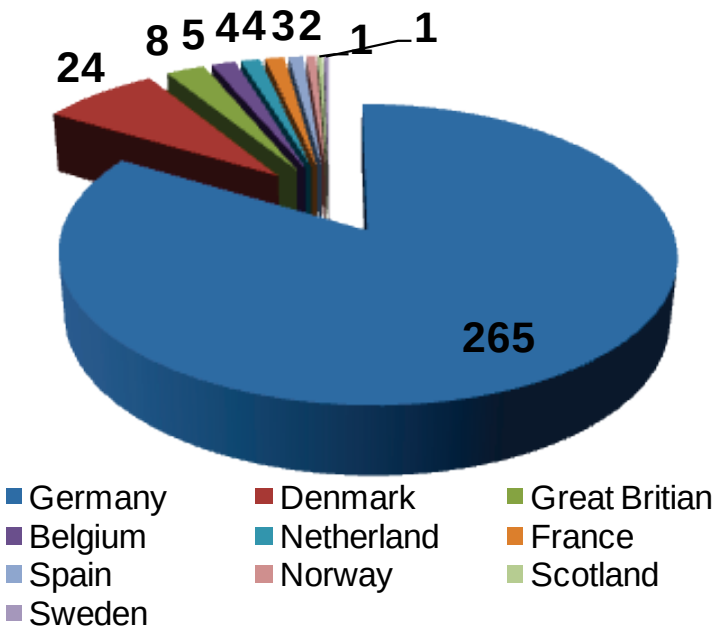
RAVE - Conference

Total: 317

International: 52



- Content (**examples**), conclusions and proposals of the sessions will be shortly highlighted at the following pages – making no claim to be complete and without embracing the speakers opinion in every case.

Opening Session / Welcome Massages

Highlights

- Offshore Wind muss weiterentwickelt werden – d.h., der Erkenntnisprozess insgesamt muss fortgesetzt werden.
- Offshore Ausbau ist wichtige Komponente des Energiekonzeptes der Bundesregierung...
- Windenergie bildet den Schwerpunkt unter den Erneuerbaren.
- .....alpha ventus (av) gehört zu einer einmaligen Forschungsinfrastruktur, mit der wir heute ausgestattet sind.
- Lesons learned werden von den beteiligten Energieunternehmen in Windparks der nächsten Größe umgesetzt (Riffgat/2012, Amrumbank/2013, Dan Tysk/2013).
- Präfektur Fukushima erkundigt sich nach den Erfahrungen aus av.

Opening Session / Panel Debate I

Highlights

- Lessons learned: AREVA end of line Teststand zur Qualitätssicherung realisiert.
- REpower: “Wir hören nicht auf, in alpha ventus zu lernen.”
- Windparkklasse: „alpha ventus stile“,
- BSH: Wir müssen heute größerskalige Effekte betrachten.
- RAVE hat deutsche Windenergieforschung zusammengeführt...,
- Weltweit (quasi)-beste Offshore Wind Bedingungen in der Nordsee.
- Durch Zusammenarbeit von Wissenschaft und Industrie kann man der internationalen Konkurrenz widerstehen.
- Unternehmensübergreifende Zusammenarbeit der Industrie ist zunehmend erforderl. (gemeinsame Plattformen, Standardisierung).

Opening Session / Panel Debate II

- Es gibt bei Offshore keine Technik von der Stange. D.h., es werden Testmöglichkeiten benötigt.
- Deutschland ist ein klassisches Maschinenbauland, kein klassisches Offshore-Land. Diese Erfahrungen müssen wir erst gewinnen. Forschungskooperationen mit NOR, UK, NL, DK können Synergien bringen.

Offshore Measurements & Data, H&S

Highlights / Results

- Data Warehouse: 10 Tbyte, 85 accredidated users.
- Download activities have grown significant and to an unexpected extend.
- Measures / proposals for the optimization of the download process are under development.
- New measuring technologies have been installed first time (Water pressure mantel, relative displacement box, sensors at the pile).
- Lidar scanner: Wakes have been made visible and quantifiable.
- Two Lidar scanners shall be placed at one turbine to observe inflow and outflow. Work on a robust nacelle Lidar is in progress.
- Sonar warning transponder for submarines was developed.
- Proposals for remote-medical H&S technology under development.

Environmental Monitoring I

Highlights / Results

- Migrating birds recognize turbines and can drop aside (under normal visual conditions).
- Harbour porpoises have been registered (came back) after construction.
- Diversity of Benthos increased.
- Attracting effects for sea-gulls (flying below 60 m).
- Belgium: No significant ecol. impact – except of pile driving sound.
- Social acceptance increased 2011 compared to 2009.
- Operational sound is of lower ecological relevance.

Conclusions / Proposals

- Development of robust bird observation methods for bad weather conditions is needed.

Environmental Monitoring II

Highlights / Results

- Bubble curtains can reduce ramming sound emission effectively – especially with high density of small bubbles.
- Porpoise Monitoring: Passive detection in the wind farm (PODs) is more effective than ship based monitoring. (When / how many porpoises return to the area?)

Conclusions / Proposals

- Optimization of sound reduction systems is further of relevance -
- as well as sound minimized foundation technologies.

Wind Turbine Design and Loads

Highlights / Results

- REpower: RAVE results have been used for the development of 6M turbine,
- REpower: Without cooperation with researchers the application of Lidar on the turbine would not have been possible,
- AREVA. Learned from the experiences in alpha ventus; new cooling system developed and tested, “AREVA will stay a reliable industrial partner in RAVE”
- An operation and failure statistics data base is of high relevance – progress is underway in cooperation with national and international offshore players.

Wind Turbine Control and Wind Farm Flow

Highlights / Results

- Lidar based control can improve the energetic output of a turbine by 1 - 2 %,
- Progress in turbulence and wake simulation and in understanding turbulence interaction between offshore wind farms.
- Progress in simulation of wake effects on turbine loads.

Future tasks/ proposals

- Investigation of long term cumulative loads are of highly relevance for the understanding of the turbine live time circle.
- Planned Lidar measuring campaigns at av will give data for further model improvement.

Support Structures

Highlights / Results

- Challenges are resulting from the necessity of serial production.
- Development and test of non invasive methods to monitor imperfections.
- Loads from breaking and non breaking waves and scour detection.
- Development of a monitoring device/tool for grouted joints,

Conclusions / Proposals

- Wave load models improved (breaking wave will be included).
- Wave and tide induced scours can be simulated today – further improvement needed.
- Suction Bucket and gravity based foundation are of highly interest.

Final Remarks

- Offshore wind technology is not yet “business as usual” – it needs more research and tests.
- RAVE improved the practical understanding of complex aspects of offshore wind, tremendous increase of in offshore situ data, next steps in model validation and –improvement have been made,
- Many practical results have been achieved but further and closer cooperation of industry and research is important.
- Practical results should be transported more intensively to the public.
- A concept of “virtual test sites” is under discussion between IWES, Offshore Foundation and BMU. This means “many” small test sites, for different purposes/ topics . It should be a coordinated activity using the RAVE experiences and integrating RAVE data (and ongoing measurements) as well.

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