*Offshore Wind Energy Research in Germany - **RAVE** – **R**esearch at **A**lpha **VE**ntus*

Jens Tambke[1], Bernhard Lange[1], Kurt Rohrig[1],

P. Quell*, M. Knops*, M. Heinicke*, A. Rettenmeier*, M. Kühn*, W. Rücker*, M. Baeßler*, R. Rolfes*, G. Haake*, B.Hahn[1], M.Benesch*, H.v.Radecke*, K. Finger*, T. Neumann*, K.Herklotz*

[1] ISET - Institut für Solare Energieversorgungstechnik e.V.
Koenigstor 59, 34119 Kassel
Phone: +49-561-7294-214; Email: jtambke@iset.uni-kassel.de

*see text for affiliations and contact information

Abstract:
To start the large-scale deployment of offshore wind in German waters, the German Federal Ministry for the Environment (BMU) supports the offshore test site "alpha ventus" in the North Sea with a research budget of about 50 million Euro in the next years. The overall objective of the research is to reduce the costs of offshore wind energy deployment in deep water. In order to provide all participating research projects with detailed data, the test site will be equipped with extensive measurement instrumentation.
This research initiative was named ***RAVE*** – ***R***esearch at ***A***lpha ***VE***ntus – and consists of a variety of projects in connection with the installation and operation of alpha ventus. As part of the ***RAVE*** initiative, so far the participating institutes and companies have prepared projects on the following topics:

- Realization of the joint measurements and data management
- Analysis of loads, modelling and further development of the different components of offshore wind turbines
- Loads at offshore foundations and structures
- Further development of LIDAR wind measuring techniques
- Grid integration of offshore wind energy
- Monitoring of the offshore wind energy deployment in Germany – "Offshore WMEP"
- Measurement of the operating noises and modelling of the sound propagation between tower and water
- Ecologic research

1. Introduction

The objective of the German federal government's offshore strategy is to set up offshore wind farms with a total installed capacity of 20 to 25 GW by the year 2030. As the first German offshore wind farm, the offshore test site “alpha ventus” (www.alpha-ventus.de) will be the starting point of this development. The area is located 45 km north of the island Borkum next to the research platform "FINO 1". It will comprise twelve offshore wind turbines with a total capacity of 60 MW. Six Multibrid M5000 turbines will be installed in summer 2008, six REpower 5M turbines will follow in 2009. The BMU supports alpha ventus with a major research funding. This paper describes the first projects of this research initiative called ***RAVE*** (www.rave-offshore.de).

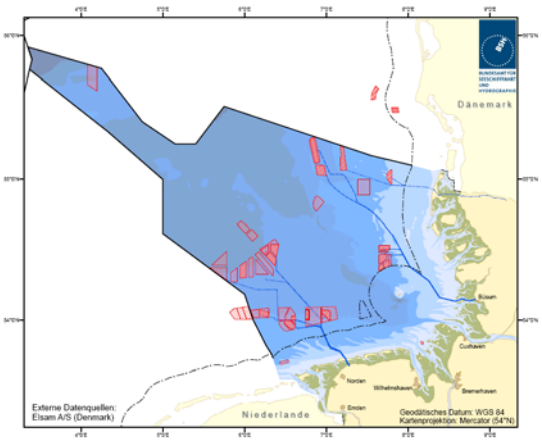

Fig. 1: German sites for offshore wind farms in the North Sea (source: www.bsh.de).

2. REpower: Development of an innovative, performance-optimized and cost-efficient rotor blade for offshore wind turbines

Project leader: REpower Systems AG, Hollesenstraße 15, 24768 Rendsburg (www.repower.de)
Project partners: Leibniz University Hannover, RWTH Aachen University

Main research questions:

- How can higher aerodynamic efficiency be achieved?
- Can the planned innovations increase the economical efficiency?
- Will an advanced production technology contribute to such improved results?

On the German side of the North and Baltic see offshore wind parks with a total installed capacity of more than 5.000 megawatt are already permitted. A large part of the planned farms is based on the 5 megawatt turbine REpower 5M. REpower will deliver six wind turbines for the first offshore wind farm in Germany's North Sea territories. Higher electricity yields from wind energy and significantly lower costs for electricity generation over the lifetime of a wind turbine make projects at sea more attractive and bring forward the offshore wind energy as a whole. The planned technical innovations of the turbine component rotor blade aim to contribute to this.

The project deals with the development of an innovative, yield-optimized and cost-efficient rotor blade for offshore wind turbines. It is designed to improve the REpower 5M wind turbine with its installed capacity of 5 megawatt with respect to costs, durability and convenient maintenance. Based on expertise gathered from prototype turbines the further development shall respect the specific challenges of offshore sites. Even though the experiences made are overall positive there is a need for a targeted technological development of the rotor blade towards the necessary operating efficiency. With the expertise and support from research institutions and companies the project will analyse technical innovations in aerodynamics, structural form, manufacturing technology and structure monitoring. The implementation of the advancements shall as far as possible be implemented in the offshore test site “alpha ventus”.

The project has two major themes, (1) the improvement of aerodynamics and (2) cost reduction. Through the interconnection between the R&D activities executed by industry and science a broad practice-oriented scientific progress is made in the explored areas.

Contact: Peter Quell, REpower Systems AG, 24768 Rendsburg, Tel.: + 49-4331-13 13 9140
Martin Knops, REpower Systems AG, 24768 Rendsburg, Tel.: +49-4331-1313-9121

3. REpower: Further development of offshore wind turbine components with respect to costs, longevity and servicing convenience

Project leader: REpower Systems AG, Hollesenstraße 15, 24768 Rendsburg, Germany

Project partners: RWTH Aachen University, University of Duisburg

Main research questions:

- Can modern offshore turbines fulfil future grid requirements, which are comparable to conventional power plants?
- Can new control methods reduce mechanical loads of the turbine resulting in lower material input without cutting down the energy yield?
- Reaching a high level of transparency for offshore wind power plants by means of a new generation of SCADA system

The project aims at the optimization of the wind energy converter (WEC) REpower 5M regarding costs, longevity and simplicity of servicing. The advancements base on experiences gained with first prototype versions of this type installed. The innovative approaches used are seen as logical step in the further development, taking into account particularly the

requirements of an offshore environment. Especially in view of the current developments and perspectives in this area, the efforts shall make sure that important steps towards a further development of the WEC technology are taken in good time.

The mechanical and electrical individual systems work across the system „wind energy plant“ always jointly, so that backlashes occur in all directions. Due to the variety of interactions the system always has to be looked at and optimized as a whole. This holistic approach is followed also on the organizational level as the involvement of universities, non-university research institutes und industry players is a central implementation method.

The project is composed of several work packages that relate to the different WEC components and contribute to the overall outcome. They include (1) gearbox, (2) grid, (3) advanced controls, (4) SCADA, and (5) logistics. The selection of measures to deploy is driven by the pool of experience from operating the REpower 5M as well as by the perspective of excellent opportunities that the offshore test field offers.

The results that REpower expects from the project efforts are mainly contributions to cost reduction earnings increase and an improved availability rate of the offshore wind turbine.

Contact: Peter Quell, REpower Systems AG, D-24768 Rendsburg, Tel.: + 49-4331-13 13 9140
Matthias Heinicke, REpower Systems AG, D-22297 Hamburg, Tel.: +49-40-5555 090 3009

4. Multibrid: Development, construction and testing of the M5000 wind turbine under offshore conditions in the German offshore test field alpha ventus

Project leader: Multibrid GmbH, Am Lunedeich 156, 27572 Bremerhaven, info@multibrid.com

The offshore test field alpha ventus is a show case of the German wind industry and the reliability of the technology installed. The research in the test field enables the manufacturers to enhance new technology and answers open research questions.

For the first time six machines of the type Multibrid M5000 will be installed in the North Sea in the German offshore test field alpha ventus in 2008. The M5000 is a 5 MW windturbine, which was designed especially for the hard offshore conditions.

The windturbines are based on so called tripod foundations. Up to now there were two Multibrid M5000 turbines erected onshore in Bremerhaven. Two more will follow in the first quarter of 2008 in Bremerhaven as well. The two up to now installed Multibrid M5000 showed brilliant results. The availability as well as the performance exceeded all expectations.

To verify the offshore capability of the Multibrid M5000 under real conditions and to enhance the turbine, a research project with several topics is carried out within the framework of test field research.

This research project relates to (1) blade connection, (2) appliances for installation of the turbine, (3) converter and transformers, (4) cooling system, (5) several concepts of erection and start of operation (implementing), maintenance, (6) data exchange interface and (7) strong wind cut-off. In the framework of the test field project there are new developments for the above mentioned topics tested under offshore conditions.

5. *RAVE* – OWEA: Verification of offshore wind turbine designs

Project Coordinator: SWE - Endowed Chair of Wind Energy at the Universität Stuttgart

Main research questions:

- What is the effect of specific atmospheric conditions in offshore environments on the power curve of wind turbines and can power curves be measured offshore with sufficient accuracy using LIDAR technology?
- How does operation in the wake of other turbines effect a wind turbine’s loading in an environment with very low ambient turbulence?

- Are state of the art simulation models and tools appropriate to predict wind turbine behaviour and loading for offshore applications and how much can the results be improved by an integrated analysis if complex foundations are involved?
- How should an efficient, robust and durable load monitoring system for offshore wind turbines look like and how can it help to improve wind turbine performance?

As experience with large offshore turbines in Germany is limited today, this joint project aims at the verification of several key aspects of offshore wind turbine technology. The project comprises the following four work packages:

The objective of the work package *Power curves offshore*, led by the German Wind Energy Institute DEWI, is the risk mitigation for the estimation of energy yield by evaluating the effects of specific atmospheric conditions of the offshore environment on power curves of wind turbines. Furthermore, the measurement of power curves offshore by means of LIDAR technology will be tested and improved.

The *Flow conditions inside wind farms and the loading of wind turbines operating in wake* of other turbines will be examined in a second work package, headed by ForWind, the Centre for Wind Energy Research at the Carl von Ossietzky Universität Oldenburg.

The joint project is also concerned with the *Verification of wind turbine dynamics and loads*, with a special focus on the verification of state of the art simulation models and tools. Further development of integrated analysis methods of wind turbines with complex offshore foundations is also part of this work, which will be led by the SWE. The last package, also headed by the SWE, will deal with efficient and robust methods for *Online load monitoring.* Besides research on direct measurement practices on main components of wind turbines, also load estimation methods based on SCADA signals will be examined.

Partners and Contact:

- Prof. Dr. Martin Kühn (kuehn@ifb.uni-stuttgart.de)
  SWE - Endowed Chair of Wind Energy (www.uni-stuttgart.de/windenergie)
- Institute of Aerodynamics and Gasdynamics (www.iag.uni-stuttgart.de/IAG)
- DEWI GmbH – German Wind Energy Institute (www.dewi.de)
- ForWind - Centre for Wind Energy Research in Oldenburg (www.forwind.de)
  ForWind - Centre for Wind Energy Research in Hannover (www.forwind.de)
- REpower Systems AG (www.repower.de)
- Multibrid GmbH (www.multibrid.com)
- DEWI-OCC Offshore and Certification Centre GmbH (www.dewi-occ.de)
- Federation of German Windpower (www.wind-fgw.de)
- Germanischer Lloyd Wind Energy (www.gl-group.com)
- ISET e.V. (www.iset.uni-kassel.de)

6. *RAVE* – LIDAR:

Further development of LIDAR wind measuring techniques for offshore application

Project leaders: SWE - Endowed Chair of Wind Energy at Universität Stuttgart and ForWind, the Center for Wind Energy Research of the Universities Oldenburg and Hannover.

Main research questions:

- What are the capabilities of a standard LIDAR system for application in the offshore wind energy industry?
- How does power curve assessment with LIDAR systems compare to standard procedures with cup anemometers?
- What is the dynamic loading of affected wind turbines operating in offshore wind farms and how can it be simulated?
- Which improvements in wind turbine operation can be achieved by sensing the short term inflow wind field?

The scope of this joint project is the development of LIDAR technologies to support other research at the offshore test site “alpha ventus”. This remote sensing technique with high spatial and temporal resolution presents a great advantage for offshore development. The measurement techniques to be developed will have direct applications to the measurement of power curve and nacelle-based inflow/wake wind fields. Moreover, research-oriented work is done in regards to wake loading simulation and loading control strategies based on inflow measurements. The mentioned nacelle-based wind field measurements are used to verify the findings in these two applications.

Experience with standardized measurements is brought by the project partner DEWI while the partner DLR brings its experience with LIDAR systems. Measurement campaigns onshore will be performed on a 5MW wind turbine owned by Multibrid GmbH, while offshore met mast and LIDAR comparisons are performed at the FINO 1 offshore platform. Dissemination to the German industry and support in the definition of guidelines for power curve measurements with LIDAR are performed by an expert committee of the Federation of German Windpower (FGW).

The work is organized in four work packages. The work package *LIDAR technology* deals with the specification, acquisition and calibration of a commercial LIDAR system for the measurement campaigns. *Power curve measurement* is dedicated to power curve assessment with ground-based LIDAR using standard statistical methods. Additionally, it deals with the development of new methods for the measurement of non-steady short-term power curves. W*ind field research* aims at the development of wake loading simulation methods of wind turbines and the exploration of loading control strategies and nacelle-based wind field measurement techniques. Finally, dissemination of results to the industry takes place in work package *Technology transfer*.

Partners and Contact:

- Andreas Rettenmeier (rettenmeier@ifb.uni-stuttgart.de)
  SWE - Endowed Chair of Wind Energy (www.uni-stuttgart.de/windenergie)
- ForWind - Center for Wind Energy Research (www.forwind.de)
- DEWI GmbH (Deutsches Windenergie Institut) (www.dewi.de)
- DLR Oberpfaffenhofen (www.dlr.de/ipa)
- FGW - Federation of German Windpower (www.wind-fgw.de)
- Multibrid GmbH (www.multibrid.com)

7. *RAVE* – Foundations: A practical design and monitoring procedure for foundations of offshore wind turbines under cyclic loads

Project leader: BAM - Federal Institute for Materials Research and Testing - Division VII.2, Buildings and Structures, Unter den Eichen 87, D-12205 Berlin, www.bam.de

Main research questions:

- Can we predict the long-term behaviour of the turbine’s foundation?
- What’s the influence of the pore water pressure on the pile’s resistance?
- What is the effect of the combined lateral and axial load on the pile’s resistance?

Up to now, there are many open questions concerning the construction of offshore wind turbines with a reliable grounding on the seabed. The foundation plays a key role on the safety of the whole turbine, since for instance excessive deformations of the bedding or progressive changes in the soil’s stiffness can make the turbine unfit for service or even lead to the collapse of the whole construction.

For the given pile dimensions of the different foundation types and soil characteristics in the North and Baltic Seas, the effect of the cyclic dynamical loads from wind, waves and service on the behaviour of the foundation is still unclear.

This project shall produce analysis criteria for the selection of appropriate foundation systems (monopile, tripod, jacket, etc…) for the offshore wind turbines. The intended investigations aim to develop calculation methods and models for the design of the different

foundation alternatives. The design procedure shall contemplate the safety level and limits for both the load-bearing capacity (failure of the foundation) and the service ability (excessive deformations or inclination of the tower).

A set of reduced-scale (1:32) and small-scale (1:100) model tests will provide information about the evolution of significant parameters of the embedment (soil stiffness, pore water pressure, axial load transfer, etc) during the cyclic load. Additionally, a numerical model including a high quality constitutive model calibrated with laboratory tests shall be developed to investigate the influence of the pore water pressure in the system's behaviour. The results from the model tests, the numerical model and the present state of the art shall lead to practical design proposals for the engineer.

The validation of the models and procedures will be done with measurements from a real tripod foundation in the offshore test site alpha ventus. Strain gauges and accelerometers will inform indirectly about the lateral bedding and axial load transfer (skin friction and tip resistance) of the quasi-static and dynamic systems under the effects of the permanent service loads and the occasional extreme events. The stress condition of the surrounding soil will be registered through measurements of the pore water pressure and total stress near the pile.

The results from this project will improve the safety and availability of offshore wind turbines while reducing at the same time the financial costs for inspection and maintenance tasks.

Contacts: werner.ruecker@bam.de, matthias.baessler@bam.de, pablo.cuellar@bam.de

8. GIGAWIND *alpha ventus*: Holistic design concept for offshore wind turbine support structures on the base of measurements at alpha ventus

Project leaders: Leibniz University Hannover and Fraunhofer-Gesellschaft

Main research questions:

- How can offshore turbine support structures be improved in order to become an economic mass product?
- What are the real and individual loadings of an offshore turbine and how can they be measured and observed?
- How can the life time of offshore structures be extended?
- Which changes in the sea bed are expected by driven piles?

When planning an offshore wind turbine, one of the biggest cost factors compared with onshore turbines is the support structure. In particular this aspect becomes more important since thousands of turbines are planned in the North and Baltic Sea.

Priority objective of this project is the reduction of the cost for offshore turbine support structures, which means towers, different types of substructures and foundations. This can be divided in designing lighter support structures on the one hand (material cost) and in optimising the design process on the other hand (personnel cost). Because of the interdisciplinary orientation of the project the coverage of all civil engineering problems is intended.

This is reflected in several work packages of the project: (1) Load modelling for wind and waves and its correlation effects, (2) Influence of manufacturing aspects on service life analysis, (3) Corrosion protection for offshore steel structures, (4) Reliable monitoring of loadings at global and local parts of the structure, (5) Development of new scour protection systems and local scour monitoring, (6) Modelling of the load-carrying behaviour for driven offshore piles and (7) Automated validation of general structural models.

Algorithms, new methods and software-tools will be developed and validated by measurement data from the test field. With a more efficient design process and by utilisation of design reserves the support structures can be provided more economically.

With the integration of separate computational tools into an easy operable simulation und design package with common interfaces the effort of the design process will be minimised. The holistic design concept for offshore WT support structures is build up in a modular way, so further extensions can easily be implemented.

Project Homepage: www.gigawind.de

Partners and Contact:

- Prof. Raimund Rolfes (+49-511-7623867), Institute for Structural Analysis, Leibniz University Hannover, Appelstr. 9A, D-30167 Hannover
- Fraunhofer Center for Wind Energy and Maritime Engineering, 27572 Bremerhaven
- REpower Systems AG (Cooperation partner)
- Multibrid GmbH (Cooperation partner)

9. *RAVE* - Grid Integration: grid integration of offshore wind farms

Project Coordinator: ISET - Institut fuer Solare Energieversorgungstechnik e.V., 34119 Kassel

Main research questions:

- How can the fluctuating nature of the wind power output from large offshore wind farms be characterised with regard to its integration into the electricity supply system?
- How can an optimal wind power forecast for offshore wind farms be achieved?
- How can a large number of offshore wind farms be controlled to ensure an optimal integration of the power output into the grid?

The development of strategies and tools to integrate offshore wind power into the electricity supply system is a crucial prerequisite for the future expansion of offshore wind energy in Germany. The research project "Grid integration of offshore wind farms" will develop strategies and demonstrate tools for the integration of offshore wind farms into the German electricity supply system. The project focuses on reducing the need for balancing energy and reserve power with an advanced wind power forecasting system and on ensuring the safety and reliability of the supply system by improving the operational control of offshore wind farms with the Wind Farm Cluster Management System. Power output measurements of the wind farm alpha ventus will be analysed together with meteorological data and measurements at the grid connection point. The project is structured in three work packages:

1.) In a first step large power fluctuations, which are caused by the concentration of generation on a large wind farms, will be analysed and a model will be developed which allows the description of the fluctuating nature of offshore wind power generation. The power fluctuations for a future expansion of offshore wind power in Germany will be assessed using this model.

2.) A second aim is to reduce the balancing and reserve power needed to integrate offshore wind power in the German electricity supply system. Based on the first step an offshore specific wind power forecasting model will be developed.

3.) The fluctuating offshore wind power generation has to be integrated into the electrical supply system. The third part of the project focuses on the development of strategies and improvement of tools for the operational control of wind power. The aggregation of several offshore wind farms as well as of distributed wind farms on land to clusters in the gigawatt range allows the operational control of wind power in a similar way as conventional power plants. The test and verification of these strategies will be performed in the framework of the ***RAVE*** initiative.

Partners and Contact:

- Bernhard Lange (blange@iset.uni-kassel.de)
  ISET - Institut fuer Solare Energieversorgungstechnik e.V. (www.iset.uni-kassel.de)
- University of Kassel (www.uni-kassel.de)
- Otto-von-Guericke University Magdeburg (www.uni-magdeburg.de)
- Carl von Ossietzky University Oldenburg (www.uni-oldenburg.de)
- REpower Systems AG (www.repower.de)

- Multibrid Entwicklungsgesellschaft mbH (www.multibrid.com)
- Deutscher Wetterdienst (www.dwd.de)
- WEPROG - Wetter und Wind Energie Prognose (www.weprog.com)
- Hochschule Magdeburg-Stendal (www.hs-magdeburg.de)

10. Offshore-WMEP: Monitoring of the offshore wind energy deployment in Germany

Project leader: ISET - Institut fuer Solare Energieversorgungstechnik e.V., 34119 Kassel

Main research questions:

- What is the influence of the special offshore-conditions on the operating performance of the wind turbines; what are the main differences to onshore-systems?
- Which energy yield can be achieved and how strong are the fluctuations caused by the variation of wind speeds?
- Are there any special prosperities and/or embarrassments for different system concepts, different concepts of installation, maintenance strategies and different grid-connection-concepts?

During the last 15 years, the operational characteristic of German onshore wind power was monitored and analysed within the framework of the 'Scientific Evaluation and Measurement Programme' (WMEP). The results of this project showed the technological progress and the cost-effectiveness of the wind energy in Germany since the beginning of the German support scheme for wind energy. Through that information onshore wind power became a recognised energy generation technology. Nowadays, the question how strong offshore wind power can contribute to the energy system of the future. Therefore the follow-up project 'Offshore-WMEP' was launched to evaluate financial, technological and operational aspects of this new application.

The 'Offshore-WMEP' will be carried out in close cooperation with manufacturers, operators and other relevant market participants. Its aim is to analyse economics, availability and the impact of offshore wind farms on security of supply by a comprehensive acquisition of all necessary operating data. This data will provide the base for a systematic analysis of offshore wind power, resulting in an independent evaluation of this technology.

For this purpose, the project is grouped in four work packages: (1) Project coordination
(2) Conception of the implementation of the Offshore-WMEP
(3) Development of a data management system
(4) Implementation of the Offshore-WMEP at alpha ventus and further wind farms.

The results of the project shall minimize the risks for the installation, operation and grid integration of large offshore wind farms and thereby promote further development of the offshore technology. The conclusions of this project will provide a valuable source of information for decision-makers with regard to the future development of offshore wind energy.

Project Homepage: http://www.windmonitor.de
Partners and Contact:

- Berthold Hahn (bhahn@iset.uni-kassel.de), ISET e.V.
- Fördergesellschaft Windenergie e.V. (FGW)
- Ingenieurgesellschaft für Zuverlässigkeit und Prozessanalyse (IZP) Dresden

11. *RAVE* – Noise: Measurement of the operational underwater noise immission of wind turbines of the alpha ventus offshore wind farm

Project Leader: FH Flensburg - University of Applied Sciences, Flensburg

Main research questions:

- How loud are single 5 MW offshore wind energy converters in the water?
- What amount of underwater noise does the alpha ventus wind farm produce?
- How do weather and tide conditions influence underwater noise production and propagation?
- What is the shape of the transfer-function between tower vibration and underwater noise?

Goal of this research project is the measurement of the operational underwater sound immission of different types of 5 MW offshore wind energy converters (OWEC) under varying boundary conditions. Background of the project is the question of the exposure of marine animals to noise, especially marine mammals, in the vicinity of offshore wind farms.

The noise production of OWEC and the underwater sound propagation are influenced more or less by many parameters (boundary conditions), such as wind velocity, wind direction, sea state, water height, water flow profiles, water temperature, water temperature profiles, salinity, etc. The following problems will be investigated:

- Measurement of the underwater noise production of different types of OWEC under various boundary conditions
- Determination of the transfer function between tower vibration (structure-borne sound) and emitted underwater noise for different types of OWEC
- Influence of different boundary conditions on sound propagation
- Measurement of the total underwater noise immission of the alpha ventus wind farm at all possible boundary conditions.

To this end a total of 5 hydrophones will be positioned about 3 meters above the sea bed near 2 OWEC and near the research platform FINO1, which is located at a distance of 400 m from the wind farm. In addition acceleration sensors will be mounted at the underwater and over-water sections of the OWEC towers. Measuring computers that are installed in both OWEC and on FINO1 will digitize the signals of the acceleration sensors and hydrophones and will transmit the data to a file server onshore. The measuring system can be remote controlled from onshore so that measurements can be performed in all weather conditions.

Contacts: michael.benesch@fh-flensburg.de, hermann.vanradecke@fh-flensburg.de

12. *RAVE* – Ecology: Coordination of ecological research and evaluation of the BSH standard "Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment" (StUK 3)

Project Coordinator: BSH – Federal Maritime and Hydrographic Agency, Hamburg

Main research questions:

- What are the effects on the marine environment, e. g. marine mammals, passage migrants and migratory birds, fish, and benthos caused by a wind farm at different spatial scales?
- Will there be a habitat loss for marine mammals and passage migrants?
- What is the effect of construction and operational noise on marine mammals and fish?
- Will there be a change in community structure for fish and benthos caused by the introduced artificial reef?
- Will there be any avoidance of the wind farm for migratory birds?

Ecological monitoring and accompanying research play an important role in the realisation of alpha ventus. The Federal Maritime and Hydrographic Agency (BSH) as the authorising agency has developed a standard for environmental research at offshore wind farms (StUK 3). Compliance with the standard during construction and operation of the wind farm is obligatory for approval holders. The features of conservation interest to be studied are marine mammals, passage migrants and migratory birds, fish, and benthos.

The BSH has been commissioned to develop a concept for ecological accompanying research for the first 12 wind turbines. Its results will be used to evaluate the BSH's StUK 3 standard. The concept will not cover only the first application of the BSH's StUK 3 standard but will include additional research projects funded by the Federal Ministry for Environment (BMU). This coordinated approach will allow synergy effects in respect of methods and funding. Ecological research at the offshore wind farm is aimed primarily at gaining better knowledge of the impacts of offshore windfarms on the marine environment during the construction and operation phases. The results will be used to examine whether the StUK 3 standard is efficient and adequate and to evaluate it for other wind farm projects.

Contact: Kristin Finger (kristin.finger@bsh.de)
BSH – Federal Maritime and Hydrographic Agency, Hamburg (www.bsh.de)

13. *RAVE* – Coordination: Organizing the research cooperation at alpha ventus

Project leader: ISET - Institut fuer Solare Energieversorgungstechnik e.V., 34119 Kassel

The coordination project is the instrument to coordinate the whole RAVE initiative, to network all the single ***RAVE*** projects and to represent them. The overall objective is to provide the structure of a strong joint programme for the associated projects. In order to use synergies and improve the quality of the results, a balanced concept was developed for the cooperation between the different projects in the test field. The coordination project consists of four work packages:

(1) The organisational coordination is achieved by the ***RAVE*** steering committee, including the coordinators of all single RAVE projects, by internal RAVE services as well as mediation within the RAVE initiative and representation of interests to the outside.

(2) The partner DEWI GmbH is in charge of the coordination of the joint measuring operations, including the continuing development of the general measurement concept and catalogue, the definition of the different measurement systems, a concept for the supervision of the measurements and of the data management.

(3) The scientific coordination work package provides the frame for the organization of scientific conferences and special topic workshops related to ***RAVE*** projects. Another task is the information of the national and international scientific community on ***RAVE*** results.

Moreover, the international cooperation is supported through ***RAVE*** delegates in the Technology Platform Wind Energy (TP Wind) at the European Commission and through cooperation within the IEA Wind Implementing Agreement - Annexes XXIII and XXV.

(4) Last but not least, the ***RAVE*** coordination project informs the public, politicians, administrations and companies about the research taking place at the offshore test site alpha ventus, e.g. on the ***RAVE*** homepage and with summarising reports and publications.

Contacts:

Coordination:	Jens Tambke (jtambke@iset.uni-kassel.de), ISET e.V.
	Bernhard Lange (blange@iset.uni-kassel.de), ISET e.V.
Measurement concept:	Thomas Neumann (t.neumann@dewi.de), DEWI GmbH - German Wind Energy Institute
RAVE Measurement project:	Kai Herklotz (kai.herklotz@bsh.de), BSH - Federal Maritime and Hydrographic Agency

http://www.rave-offshore.de