RAVE
RESEARCH AT ALPHA VENTUS

Press Release

alpha ventus: research and industry present common achievements

8. May 2012
Bremerhaven/Kassel

Operators, developers and researchers of the research initiative RAVE will present in an international conference from 8 to 10 May 2012 in Bremerhaven the operational experience and test results of the first German Offshore Wind Farm "alpha ventus". They will discuss experiences and results for the expansion of offshore wind energy utilisation. Mit 300 Teilnehmern aus Wissenschaft und Industrie ist die Konferenz ausgebucht. With 300 representatives from science and industry the conference is fully booked. Over a third of the participants are from Belgium, Denmark, France, Norway, Spain and UK. Two thirds are from Germany.

The research initiative RAVE accompanies the construction and operation of the alpha ventus test site, to attain a broad basis of experience and expertise for future offshore wind farms. The experiences show that the research funding of the German government is necessary to set up a reliable and environmentally friendly future energy supply system. The challenges are: What effects do factors such as wind, weather and waves have on nacelles, towers and rotor blades? Where do we need additional research that the wind power plants will produce power reliable for many years? What influence does the construction and operation of the plants have on the sensitive ecosystems of the sea? Over 150 researchers are working on the RAVE project to resolutely develop wind energy further to make it a pillar of Germany's future energy system.

Offshore wind energy is important for the renewable energy mix

Germany is working hard to convert its energy system so that supplies can be met for the most part using renewable energy sources. Wind energy plays a decisive role in this. Last year, 8 % of German electricity demand was met by wind energy. This considerable sum is mainly due to the agreeably high amount of new wind parks being erected and also to repowering measures inland. In order to realize the goals of the energy transition however, offshore wind power has to be given a boost.

The first step has already been taken. The first German offshore wind park, alpha ventus, funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), has produced almost 270 GWh in the first complete year of operation and thus made a much higher contribution than had been expected. The Renewable Energy Law provides a further excellent legal framework for both onshore and offshore wind power plants. Considerably increased research funding of the German ministry of environment is of valuable assistance for engineers both in companies and in science in gaining the know-how necessary for achieving reliable offshore power generation at clearly reduced costs.

„Offshore wind energy is an essential element for a balanced mix for the future renewable energy supply", explains Professor Jürgen Schmid, Director of the Fraunhofer Institute for Wind Energy and Energy System Technology IWES in Kassel. "In a 100 % renewable energy concept, the electricity will mostly be generated by wind and photovoltaics. In addition combined heat and power plants (CHP) can produce climate-friendly energy fired by biogas, by methane or hydrogen produced with renewable power. The experience curve of the onshore wind energy generation is widely advanced. So this form of cheap renewable energy has to be expanded. Together with offshore utilisation, the share of wind energy will increase to cover 60 percent of the future power supply. The fluctuations of these plants can be compensated by photovoltaic and bio energy plants. But also offshore wind energy plants have a balancing effect because of the different meteorological conditions", explains Jürgen Schmid.

Coordinator:

Fraunhofer IWES

Project supervisor:

ptj Projektträger Jülich Forschungszentrum Jülich

Funding body:

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

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alpha ventus 2011: over 4400 full load hours and up to 97 percent availability

The alpha ventus consortium DOTI, formed by the companies of EWE, E.ON and Vattenfall, can look back with satisfaction on a successful 2011: the twelve wind power turbines of Germany's first offshore wind farm have fed over 267 gigawatt hours of electricity into the German power grid over the entire year. That is a calculative equivalent of 4450 full load hours of the twelve 5 megawatt turbines. This puts the amount of power generated by alpha ventus at around 15 percent over the projected total for the year of more than 3900 full load hours. "These results exceed our expec-tations", says a pleased Dr. Claus Burkhardt of EWE in his capacity as DOTI Managing Director and General Project Manager. "The exceptionally high power yields achieved by alpha ventus in 2011 are due primarily to the nearly constant and excellent wind conditions at the wind farm together with a high turbine availability of up to 97 per-cent (the average was 95 % over the year). And the positive earnings continuing also in the first quarter 2012 with a plus of 10 percent compared to the energy yield pro-jection." Burkhardt adds that the alpha ventus offshore test field proves that offshore wind farms can be economically and commercially viable in Germany in the long term despite challenging conditions, such as long distances from coastlines and great water depths.

Research initiative RAVE accompanies alpha ventus

„The wind farm alpha ventus is not only a milestone for the wind energy utilisation at sea, it is also a subject of intensive research activities. The research initiative RAVE accompanies the construction and operation of the „alpha ventus" test site, to optimise the utilisation of offshore wind energy. 33 projects with a total budget of 51.7 Mio Euros form a research network coordinated by Fraunhofer IWES. The consortium consists of 45 institutes and companies," says Dr. Joachim Kutscher from PtJ Jülich who is the RAVE supervisor on behalf of the German environmental ministry.

"To develop offshore wind energy successfully, a broad cooperation in a multiple of research themes is required. The main focus will be on cost reduction, increase in yields, high availabilities, technologies for the grid integration and ecological investigations", explains project leader Dr. Bernhard Lange from Fraunhofer IWES, which is coordinating the RAVE research initiative.

"The first steps which have been taken to utilize wind energy at sea are very promising and have good prospects. Nevertheless it is important to link the expertise gained through this practical implementation to research and development, since this technology has to be developed further. Only by pooling our creativity to improve this comparatively new technology can we achieve the high goals which have been set concerning revenue, reliability and costs for electricity from the sea." adds Prof. Schmid who is a member of the German Advisory Council on Global Change which advises the German Government.

"Not only did we improve the reliability and cost effectiveness of our REpower 5M with the results of our research projects, but we also established a basis for the subsequent turbine generation." Dr. Jan Kruse, Manager R&D projects at REpower Systems SE.

RAVE includes different research approaches focused on the interdependency of environmental and technological impacts of offshore wind energy generation. The results of RAVEs research projects serves not only the industry and authorities as valuable base for the right technical orientation and offshore rules and regulations but offers as well a wide public acceptance approach of a still young offshore industry. All responsible authorities in Germany and beyond in Europe are aware of the fact that the ambitious targets of environment protection cannot be reached without offshore wind energy. Therefore the scientific results have to be applied to environmental aspects, offshore industry and shipping. The consequent continuation of research and development projects within RAVE is mandatory for a sparing utilization of resources (environment, off-shore wind energy, shipping and last but not least consumer) of offshore wind energy," announced Jean Huby, CEO AREVA Wind representative for the involved project manager.

More information
on offshore wind energy:
www.bmu.de
www.erneuerbare-energien.de
www.alpha-ventus.de
www.offshore-stiftung.de

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Future technologies

For offshore wind energy, Professor Andreas Reuter, Director of the Fraunhofer Institute for Wind Energy and Energy System Technology IWES in Bremerhaven sees the necessity of carrying out more work on improving reliability and reducing costs. Due to long time-to-market processes for the implementation of new technologies, we have to start working on the concepts for the 2020ies right now. In the short run, the industrialization of the process chain for wind power generating plants is the challenge we have to meet. Especially the automization of production steps, for example in rotor blade manufacturing, can improve the quality and lead to cost reductions.

Ecology

The aim of the accompanying RAVE ecological research is to gain more insight into constructional and operational effects on the marine environment such as benthos, fish, resting birds, migratory birds, and marine mammals. "The results are different due to their very nature; in some areas natural development has taken place as predicted at the outset. The base constructions were quickly colonized; no negative or unbalanced developments were observed with benthos or fish. Observations of resting birds delivered no surprises; displacement effects were hardly noticeable. To date, no concrete results have been derived from the migratory bird research work. It had been hoped that study results would show exactly which species crossed over the wind park in which directions and at which time. Further research must be carried out on this." summarises Christian Dahlke, Head of the Division "Management of the Oceans" at the Federal Maritime Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie, BSH).

Acceptance of offshore wind energy

"Overall, coastal residents as well as tourists evaluate offshore wind energy rather positively – visible parks which are close to the shore are less accepted, however. To keep the acceptance in the long term, maritime safety is most important, followed by bird and sea mammal protection. Coastal residents experience the sea as their unique region. To incorporate their experience and expertise fosters acceptance. They demand to be integrated into the planning process seriously and transparently. Further, they need to be informed continuously", observes Dr. Gundula Hübner, from the Martin-Luther-Universität Halle-Wittenberg.

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More detailed results of RAVE research projects

For the intensive measuring campaign at the offshore and onshore installations of the alpha ventus wind farm a sub set of wind turbines and their support structures are fully equipped with strain gauge sensors, acceleration sensors, leveling sensors, acoustic sensors and sensors to study the hydrographical environment and the marine boundary layer in the wind farm. Electrical measurements are carried out on the high and the low voltage part of the offshore transformer platform and supplemented by measurements on the onshore transformer station.

A firm foundation

Within the offshore test field alpha ventus, two newly developed steel foundation types are introduced. On the one hand the so called tripod, a main column that splits into three legs, and on the other, Jacket foundations, a lattice framework on which as many similar parts as possible are used. Both types are anchored to the ground by three or four steel piles, respectively. “Through new sensor technology the behaviour of the grouted connection between pile and foundation could be monitored. Moreover, by running several experiments, a better understanding of breaking-wave loads could be achieved, here a reduced load coefficient was estimated, and the scour development underneath the structures was investigated. Furthermore, a monitoring system was tested. It includes the dynamics of the foundation and enables conclusions to be drawn about the fatigue life status of certain parts.”, so the project leader of RAVE – GIGAWIND alpha ventus Prof. Dr. Raimund Rolfes from Leibniz University Hanover.

In addition the project RAVE Foundations investigates the effects of wind, waves and operations on the foundations. The RAVE Geology project investigates the ocean floor and particularly its suitability for offshore construction.

Developing and optimising new technologies

Before the construction of offshore wind parks begins on a larger scale, it is imperative to incorporate the experience and knowledge gained from the planning, construction and operation of the „alpha ventus“ test site into further developing and optimising the technology.

Within the research project RAVE-LIDAR, the remote sensing technology Lidar was used to develop different wind energy applications for onshore and offshore purposes. “We performed measurements from the FINO I platform as well as from the nacelle of wind turbines. Using a self-developed Lidar scanner it is possible to steer the laser beam in any direction and to obtain information about the wind fields both in front and behind the turbine. New predictive control strategies can detect gusts in advance and the rotor blades can be pitched accordingly. The aim is to reduce loads and to design lighter turbines and substructures. Furthermore, the nacelle-based measurements can replace expensive met masts needed for the certification process of wind turbines onshore and offshore, including floating turbines”, explains project leader Andreas Rettenmeier from Stuttgart University.

More information
on offshore wind energy:
www.bmu.de
www.erneuerbare-energien.de
www.alpha-ventus.de
www.offshore-stiftung.de

Finally, the monitoring project RAVE - Offshore WMEP gathers essential operational data in order to investigate topics like the influence of meteorological conditions, energy output and full-load hours, downtime, electricity production costs, availability, maintenance and grid integration. “The systematic collection of standardized information from different wind farms allows basic questions to be answered concerning offshore wind energy use and provides the participants with an opportunity to identify weak-points and thus to optimize operation and maintenance”, explains project leader Paul Kühn from Fraunhofer IWES the project objectives. “The interested public is informed on the status and the development of wind energy utilization through the information portal www.windmonitor.de and the annually published Wind Energy Report Germany.”

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Bringing the electricity safely to and through the land

The energy from offshore wind parks must first be brought to land using subsea cables. The high-performance connections on land are used to transport the generated electricity to load centers where much electricity is needed. In the RAVE Grid Integration project, strategies for the integration of offshore wind energy into the power grid are being developed and implemented. The aim is to reduce balance energy

and the provisions for reserve power with the help of newly developed offshore wind power prediction systems while at the same time ensuring the high availability and the safety of the grid. "New methods enable the use of many weather forecasts simultaneously. With this, they not only provide an improved power forecast, but also assess the accuracy of their own forecast. This is an important advantage for grid security issues and the calculation of reserve power." explains project leader Dr. Bernhard Lange of Fraunhofer IWES.

Keeping nature in mind
The goal of the complementary ecological research in the RAVE Ecology project is to gain extensive knowledge of the impacts of construction and operation conditions on the marine environment, for example, on benthos, fish, resting birds, migratory birds and marine mammals. The main focus of the RAVE Geology project is to pursue the acquisition and evaluation of the sediment dynamical processes (scour) and overall sand movement in order to obtain reliable information for the design basis of the offshore constructions and the liquefaction behaviour of the upper seabed. In the RAVE Operational Noise project the underwater operational acoustic noise of the wind turbines, various boundary conditions as well as the overall noise stress for sea life and particularly sea mammals are being determined.

The project RAVE - hydro sound mitigation investigates the reduction of construction noise during the installation of an offshore wind turbine by use of a layered air bubble curtain (prototype) close to the foundation. "The results show that the bubble curtain's mitigation effect is strongly dependent upon the tide and the related flow speed and direction. The reason is, that a bubble curtain at the same time close to the pile and subjected to current and waves, isn't able to wrap the pile entirely. This results in an anisotropic and time-dependent mitigation effect in the environment. At turn of tide the good reduction effect was available in every direction. In this situation the evaluated reduction could be quantified by 13 db for the SEL (sound exposure level) at distance 750 m.", explains project leader Dr. Tanja Grießmann from Leibniz University Hanover.

The safety of wind parks will be enhanced in the RAVE Sonar project through the technical integration of sonar transponders in the overall design.