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Annual Progress Report for 2000 Wind Energy and Atmospheric Physics Department

Søren E. Larsen and Birthe Skrumsager

Abstract

The report describes the work of the Wind Energy and Atmospheric Physics Department at Risø National Laboratory in 2000. The research of the department aims to develop new opportunities in the exploitation of wind energy and to map and alleviate atmospheric aspects of environmental problems. The expertise of the department is utilised in commercial activities such as wind turbine testing and certification, training programmes, courses and consultancy services to industry, authorities and Danish and international organisations on wind energy and atmospheric environmental impact.

A summary of the department's activities in 2000 is shown, including lists of publications, lectures, committees and staff members.

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Annual Progress Report for 2000 Resources and Results

Søren E. Larsen and Birthe Skrumsager

**Risø National Laboratory, Roskilde
January 2001**

1 Introduction

The departments research activities on wind energy and atmospheric processes have the overall objective to advance

- the competitiveness of the Danish wind power industry, setting the scene for implementation of the national energy policy in the area of wind energy and furthering the global application of wind power, and
- the atmospheric physics basis of assessment and forecast of wind effects, transport, conversion and exchange of atmospheric gases and particles in relation to climate studies, air pollution and accidents.

Hence the department aims to meet the need for new knowledge and consultancy assistance on wind turbine technology and the exploitation of wind energy, as well as to map atmospheric processes and alleviate airborne pollution. The research is carried out in co-operation with industry and other users of the research results and in close collaboration and in alliances with national and foreign universities and research organisations.

The activities of the department fall within the Risø program area *Wind Energy and Atmospheric Processes*. It has the objective to develop methods for design; test and siting of wind turbines, prediction of wind loads and wind resources as well as methods to determine the dispersion, transformation and effect of air pollution. The department is organised in programs and special tasks according to its main research and technical activities.

Research programmes:

- [*Aeroelastic Design*](#)
- [*Atmospheric Transport and Exchange*](#)
- [*Electrical Design and Control*](#)
- [*Wind Power Meteorology*](#)
- [*Wind Turbines*](#)
- [*Wind Turbine Diagnostics*](#)

Special tasks:

- [*Experimental Meteorology*](#)
- [*International Wind Power Consulting*](#)
- [*Wind Turbine Testing*](#)
- [*Wind Turbine Blade Testing Centre, Sparkær*](#)

The “Aeroelastic Design” programme involves the key issue development and use of aeroelastic codes, computational fluid dynamics (CFD) codes and design tools for wind turbine blades and airfoils as well as wind tunnel measurements of airfoil section flows. The codes are used for establishment of design load basis for wind turbines, further development of the three-bladed wind turbine concept and development of new wind turbine concepts.

In the "Atmospheric Transport & Exchange Programme" basic research into boundary-layer meteorology and atmospheric turbulence is carried out. In addition we study environmental problems related to transport of air-borne pollutants and turbulent exchange of matter in the interaction between the atmosphere and terrestrial or sea surfaces.

The programme “Electrical Design and Control” aims to lower the cost of wind energy by optimising the wind turbine as well as the grid interface and operation of the power system. The research involves topics such as control concepts for wind turbines; electrical components; grid connection and large-scale wind energy penetration; hybrid power supply systems and energy storage Combined with renewable energy sources.

The “Wind Power Meteorology” programme is aimed at assessments of wind resources for power production and wind loads on wind turbines and other constructions. The programme comprises development of models and software, field measurements and in-house as well as commissioned assessment studies.

The "Wind Turbine" program conducts strategic and applied research in load and safety, experimental verification, technical/economical analysis of wind energy's utilisation in grids and in hybrid energy systems. Our research within this program supports our consultancy activities for Danish and international authorities, organisations, banks and investors regarding wind energy projects. It also supports our participation in international standardisation.

The “Wind Turbine Diagnostics” program conducts strategic research to develop method for experimental determination of wind turbine characteristics, including test methods aimed for use by the wind turbine industry.

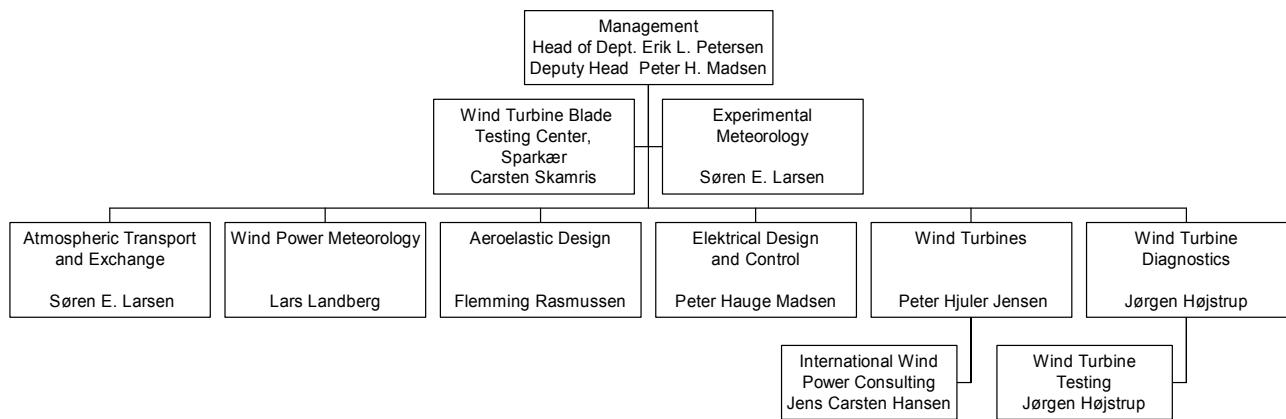
The special task “ Experimental Meteorology” serves as a departmental expert in organising and conducting field meteorological measurements, providing instruments, data systems, data management and organisation. It serves the research programs of the department and also external customers.

The special task “ International Wind Turbine Consulting” aims to utilise the knowledge and state of the art tools available at Risø to provide consulting and technical advice concerning international projects on the development and application of wind power technology.

The special task “Wind turbine Testing” offers its expertise in measuring techniques for wind turbine testing at Risø and from field measurements.

The special task “ Wind Turbine Blade Testing Centre, Sparkær” is accredited for static and dynamic fatigue test of wind turbine blades and it is offering this to Danish blade producers at the test centre in Sparkær. By the end of 2000 the Sparkær Centre is able to test blades with a length of up to 60m, both statically and dynamically.

In 2000 the department engaged 105 man-years, 7 of which involved PhD students and post-doctoral researchers. The departmental structure by the end of 2000 is illustrated in the block diagram below.



The key areas of scientific expertise in the department are boundary layer meteorology, atmospheric turbulence, aerodynamics, aero-acoustics, and machine and construction technology, and design of power systems and power system controls. The fields are Advanced exploiting full-scale field tests, laboratory tests and Advanced numerical simulation.

This annual report presents the department and the results in 1999, including the programmes and services, research highlights and other achievements. The report also presents lists of publications, lectures, committees and staff members.

Additional information on the department and its activities can be found on World Wide Web (WWW) on the address <http://www.risoe.dk/amv/>. The departments web pages are constantly updated.

2 The Department of Wind Energy and Atmospheric Physics 2000

The department's achievements in the wind-energy field were commented very favourably by IEA in their evaluation of the EFP program 1992 - 1997. The balance between *long-term fundamental research and good flexibility for solving urgent problems* and a *bottom-up R&D research* Based on industrial needs as well as a strong interaction with departmental user groups has been pointed out as an example. Together with the worldwide and especially the nation-wide growth of our wind-energy activities, this has led to an increased demand for the department's services also in 1999, ranging from research results to purely commercial tasks. The positive development of the department's results, economy and presentation of research results is still being continued.

All of our research programs have achieved significant technical-scientific results, and in 1999 we took decisive steps towards fulfilment of the demand for results in Risø's contract for 1999-2001 with the Ministry of Research and Information Technology. Thus the wind turbine industry displayed an interest in WASP Engineering (a wind-power meteorological prototype design tool) when introduced. Our "numerical wind tunnel" has now reached a development level where applicable results are in a current generation, e.g. in 1999 an answer to

the double-stall problem, a nuisance to industry for a long time. A set-up of dynamic profile data for technical aeroelastic calculations has been introduced. The European model system for decision support in case of large nuclear accidents has been finalised and delivered, and Risø is responsible for the central atmospheric dispersion module. Last not least, theoretical and experimental breakthroughs have been obtained in connection with our research activities within soil/vegetation exchange (SVAT).

Through aggressive recruitment and investment initiatives in 1999, the market-controlled business has been a success in several areas for the department, i.e. initiatives such as the blade testing activities in Sparkær and wind-turbine testing in Denmark as well as abroad. The market-controlled approval of wind turbines has been brought into more efficient and innovative continuity through an agreement on co-operation with Det Norske Veritas and a joint implementation of the activity. Also consultancy on wind energy is on the increase, and Based on a strategic analysis performed in 1999, we have decided to intensify and coordinate our achievement by establishing a new special task. Last not least, the marketing and sale of 214 copies of the latest version of the WAsP wind resource program have strengthened the department's leading international position in the wind-energy field.

This development has been a great challenge to the departmental management as well as the staff. This is illustrated by the employment of about 20 more persons in 1999 among whom three persons came from the IT Service Department. The latter have re-vitalised the development of Advanced measuring systems for research and testing in our department.

3 Status 2000 for the Department

The Department is responsible for Risø's program area "Wind Energy and Atmospheric Processes". This program area has the following objective: Development of methods for design, testing and siting of wind turbines, determination of wind loads and wind resources, as well as methods for determining the dispersion, conversion and effects of airborne pollution.

The department is responsible for a number of the performance requirements listed within the performance contract between the Ministry of Research and Information Technology and Risø National Laboratory. At mid-term, by the end of 1999, the fulfilment of the performance requirements of the department was as indicated in the table below.

3.1 Social and industrial relevance in Denmark and abroad

Danish wind power enjoys tremendous success. Expansion in Denmark has exceeded the objectives of Danish energy policy. Denmark is at the forefront of development and expertise; an industry has been established on a scale that provides 15,000 jobs in Denmark, supplying more than one-half of the world market. World-wide, as 1999 drew to a close, wind turbines having a capacity of 14,000 MW had been set up, producing 30 TWh, equivalent to Denmark's electricity production.

The Danish wind energy industry has more than 20 years' experience in research, development, production and use of wind energy, and wind power has become a distinctive and accepted part of the Danish electricity supply. The Danish wind turbine industry has seen growing volume of business and market share, with a volume of approx. DKK 14,000 million in 1999, equivalent to a 50–60% share of the world market. This trend in Denmark has been made possible through sustained political and public support and close interaction of government support of the market, research programmes, research and industry. Risø has played a crucial part in this development.

Denmark has had a wind energy research environment at Risø for more than 20 years and today Risø is the largest wind energy R&D centre in the world. In recent years, efforts have been boosted through expansion in terms of resources, while R&D activities have been developed in an increasingly specialised, dedicated and long-term direction. This is in order to contribute to the technological development while continuing to create new opportunities for the thriving and growing development departments of the wind turbine industry.

With atmospheric physics and knowledge of nuclear matters as a basis, Denmark has had a research environment in the area of nuclear safety since the establishment of Risø. Following the Chernobyl accident in 1986, this area of research attracted renewed attention and gave rise to the initial development of a European decision support system - *Real-time On-line DecisiOn Support (RODOS)* – intended as a decision support system for emergency management in Europe in the event of major nuclear accidents. Risø has been responsible for the central atmospheric physics dispersion module of the EU-funded project – a

joint venture of 40 institutions in 20 countries. The decision support system was delivered in 1999 and Risø is continuing its work of adapting the dispersion module to the Danish Emergency Management Organisation's decision support system *ARGOS-NT*.

Dissemination of research results and collaboration with Danish industry, including the participation of industry in advisory research committees

Table 3.1 Performance requirements of the contract between Risø and the Ministry of Research and Information Technology. Degree of fulfilment by end of 1999 in the contract period:

1	Wind power meteorological dimensioning tool, the Wind Atlas Analysis and Application Program (WAsP Engineering)	
	Development of an IT-Based complex of user-friendly, commercially available wind power meteorological dimensioning tools that enable global prediction and assessment of dimensioning wind conditions for wind turbines and other structures on land, on non-homogenous and complex terrain as well as in near-shore waters.	80%
2	Establishment of a "numerical wind tunnel"	
	Setting up a coherent collection of numerical tools to determine flows around wind turbines and to enable fundamental studies of the aerodynamic properties of blades/wind turbines, as well as to interpret field experiments and improve empirical methods.	75%
3	Basic design of a new concept for a three-bladed wind turbine	
	Development, in collaboration with industry, of the next generation of a flexible three-bladed wind turbine concept with extended design and optimisation possibilities in relation to the existing Danish concept, resulting in continued improvement of the yield/cost ratio.	80%
4	Establishment of a database for Advanced blade profiles	
	Development of a method for determining blade profile data and establishment of a database for blade profiles to describe the static and dynamic properties of the profiles in question before and after stalling; for use in aeroelastic calculations.	50%
5	Decision support system for nuclear emergencies (RODOS 2000)	
	In collaboration with European emergency management organisations, demonstration of a real time decision support system Based on models recognised at European level. It provides multi-scale dispersion descriptions of airborne pollution from point sources with on-line use of meteorological networks and terrain descriptions and allows greater certainty in identifying areas at risk and, thus, more targeted protective measures. The decision support system has been adopted by European emergency management organisations	100%
6	Model for soil-vegetation exchange (SVAT)	
	Development of a verified two-dimensional model for the purpose of calculating the exchange of water vapour, CO ₂ and other trace gases between the atmosphere and vegetated surfaces, having more extensive application in realistic heterogeneous situations, compared with current one-dimensional models	65%

The department is continuing and intensifying its long tradition of dialogue with the wind turbine industry. The most important interaction takes the form of joint financing of collaborative projects where the long-term R&D needs of industry are taken into account. In major projects, such as the aeroelasticity programme in the *Aeroelastic Design* research programme funded by the Danish Energy Research Programme, reference groups have been appointed with R&D managers and senior industrial engineers participating.

Since 1998, the department has completed a round of visits to the six largest enterprises in the wind turbine industry for the purpose of presenting a draft three-year plan and discussing ideas and requests for future research strategies and assignment with the executives and development managers of the enterprises. These visits have resulted in positive dialogue with the industry and both parties appear to be satisfied with this type of dialogue on the content and nature of collaboration.

The department has discussed appointing a formalised industrial contact committee with selected representatives from the wind turbine industry, but this suggestion was not received with much enthusiasm. In the experience of the department, for reasons of competition, representatives from the industry would be too reticent to allow for free dialogue. Points of view continue to be exchanged with the Danish Wind Turbine Manufacturers' Association.

The department endeavours to disseminate its research results effectively to the wind turbine industry, paving the way for subsequent and more detailed discussions with the individual enterprises. This is done through R&D info sheets, topical meetings, participation in the annual wind energy conference of the Danish Energy Agency and organising the annual departmental wind energy day. Market-managed activities play a significant role in disseminating research results from the department. Consultancy, testing of wind turbines, the operation of the Sparkær wind turbine blade testing facility, certification and approvals, patenting, sales of software, organisation of courses and other market-managed activities to a high degree contribute to substantiate the department's research and strategy. These activities have grown from DKK 5 million in 1997 to DKK 21 million in 1999.

As a result of its special competence in atmospheric physics, the department has expanded and intensified its collaboration with the agricultural sector. The Danish Bacon & Meat Council and the agricultural associations collaborate with the department on the matter of the airborne transmission of pathogens among pigs as well as on assessing and minimising malodour in pig production.

3.2 Collaboration with universities

The department is engaged in extensive collaboration with the Department of Energy Engineering at the Technical University of Denmark; this has been formalised in a framework agreement on strategic collaboration on numerical fluid mechanics. The agreement covers collaboration on research, joint development and exchange of software, collaboration on the Education of scientists and joint positions at the Technical University of Denmark and Risø.

In collaboration with the Department of Energy Technology at Aalborg University, the department has prepared a joint strategy for a strategic alliance on the development of the *Elektrisk Design og Styling* ("Electrical Design and Control") programme, collaborative research within the programme area, development and exchange of software, collaboration on education and joint positions at Aalborg University and Risø. Negotiations concerning the agreement have been concluded.

Through an adjunct professorship (an appointment made in 1999) the department undertakes teaching assignment in Denmark on boundary layer meteorology at the Department of Geophysics, Niels Bohr Institute, the University of

Copenhagen. Together with the Institute of Geography, the University of Copenhagen, the department works on the application of satellite data and other types of remote sensing in connection with meteorological and climatological problems.

3.3 Collaboration with other governmental research institutions

Collaboration between the department and the National Environmental Research Institute of Denmark mainly relates to the Department of Atmospheric Environment and the Department of Marine Ecology and Microbiology at the National Environmental Research Institute of Denmark. Underlying the work is a common strategy, but increased joint project work is equally important, with the expertise of the National Environmental Research Institute of Denmark and the department being mutually complementary in a number of problem areas. This applies particularly to the atmospheric exchange of pollutants with various ecosystems. Other governmental research institutions such as the Danish Institute of Agricultural Sciences and the Danish Forest and Landscape Research Institute are also involved in this work.

The department has been engaged in collaboration with the Danish Meteorological Institute (DMI) for many years. In recent years, this work has reached a deeper level and a larger degree of focus through a number of joint projects in which the collaboration has typically involved dedicated use of meteorological fields supplied by the Danish Meteorological Institute's weather forecasting model. Its applications are typically 36-hour forecasts of wind turbine parks' production or the dispersion of long-distance airborne pollution from major accidents.

The department has intensified collaboration with the Danish Hydraulic Institute (DHI), where there are plans to replace a collaborative project work, which has been going on for many years, on the effects of waves and wind on constructions. Actual centre collaboration focusing on marine-based wind turbine parks in Denmark and abroad will succeed the project.

The department is part of Solar Energy Centre Denmark, operated by the Danish Technological Institute, the Technical University of Denmark, the Danish Building Research Institute (SBI) and Risø.

4 Summary of the Performance, Research Programmes and Tasks

The following one-page tables summarise the objectives and performance of the department and its research programmes and operational tasks.

The objectives of each unit are specified in terms of basic objectives, mid-term goals spanning several years and milestones for the specific year of the report, here 1999. The milestones are divided into milestones referring to different research projects and milestones referring to initiatives aimed at industry. The end of 1998 specified these milestones; furthermore the tables include a follow-up column, indicating to what extent the 1999 milestones has actually been achieved during the year.

The lower parts of the tables summarise resource allocation for each unit and output statistics, both in terms of income, publications, Educational activities and co-operation with different sectors of society. For 1999 both planned and resulting figures by the end of the year are shown.

5 The Projects of the Department

The activities of the department is mostly organised in projects, that each are individual accounting units, each with its own account number, denoted “psp” at Risø. The following pages contain the project descriptions extracted from the central Risø accounting system. Each project description summarises the project objectives, and identifies partners, sponsors and the Risø contact person.

5.1 Aeroelastic Design (AED)

Title: Commercial Projects

Programme AED, psp 1110001-00, start date: continuous

Description: The activity represents different commercial projects in Aeroelastic Design, performed mainly for the wind turbine industry. In general these are smaller projects in line with the research activities. The objectives are three-fold: they represent a dedicated investigation, they act as an efficient way of transferring new knowledge, and give a direct and valuable feedback and inspiration for the research.

Partners: Risø together with industry

Sponsor: Danish industry.

Contact person: Flemming Rasmussen, flemming.rasmussen@risoe.dk
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Title: Investigation of the Aerodynamic Interaction between Wind Turbine Rotor Blades and the Tower and its Impact on Wind Turbine Design (ROTOW)

Programme and psp: AED, psp 1110017-00, start date: 1998.10.01

Description: The work concentrate on measurements and predictions of the aerodynamic forces and moments, the associated blade response and methods of characterising and reducing the unsteady loads, which result from the interaction. The methods used to investigate the interaction are as follows. 1) Wind tunnel tests of model scale blades; 2) field rotor blade pressure data analysis; 3) computational Fluid Dynamics (CFD) with a blade passing a tower; 4) Blade Element Theory (BEM) with investigation and tuning of dynamic stall models and 5) monitoring and analysis of operating machine data.

Partners: Imperial College (GB), Garrad Hassan & Partners Ltd (GB), T.G. Teknikgruppen AB (S), FFA (S), Bonus Energy A/S (DK), ECN (NL), National Technical University of Athens (GR), National Observatory of Athens (GR), Aristotle University of Thessaloniki (GR) and Risø National Laboratory (DK)

Sponsor: EC, Non-Nuclear Energy Programme: JOULE III.

Contact person: Christian Bak, christian.bak@risoe.dk +45 46775091

Title Viscous and Aeroelastic Effects on Wind Turbine Blades (VISCEL)

Programme and psp: AED, psp 1110018-00, start date: 01-07-1998

Description: The objectives of the VISCEL project are: 1) to employ systematic 3-D Navier-Stokes calculations for rotor blades of different shape in order to clarify the aerodynamic mechanisms associated to three-dimensional and rotational effects and their dependence on the geometrical and inflow parameters. 2) To revisit the dynamic stall problem from the aeroelastic point of view using simple modelling of dynamics and Advanced solvers for the aerodynamics. 3) To devise a comprehensive aerodynamic database including both the 3-D and

the aeroelastic results. This database will be valuable for tuning and assessing the performance of simpler, engineering-type, models. 4) To provide a detailed step by step account of the progress, significant achievements and breakthroughs which have been built up so far on the aerodynamic and aeroelastic codes through JOU2-CT93-0345, JOR3-CT95-0007 and the current project.

Partners: CRES, DLR, DTU, FFA , LM Glasfiber, NTUA, Risø

Sponsor: European Commission

Contact person: Niels N. Sørensen, nns@risoe.dk +45 46775053

Title: Verification of European Wind Turbine Design Codes.

Programme and psp: AED, psp 1110019-00

Description: Throughout the European wind turbine industry, wind turbine analysis codes are used for the calculation of dynamic loads and energy yield. The codes are Based on detailed aeroelastic and structural models. The methodology has been developed to a high level of complexity and the results of these codes are important for the design of wind turbine (components) and for certification purposes. In Europe different codes are used which are developed by several organisations. In the past some projects aimed at the determination of the accuracy and reliability of wind turbine codes. Nevertheless the level of confidence the industry and the certification institutes may have in the present codes is not known. The aim of the present project is to answer this question. The main objectives of the project are: to assess the accuracy and reliability of the most widely used European wind turbine design codes for improved support of wind turbine design and certification and to define recommendations for improvement of the present wind turbine design codes and the required supporting experiments.

Partners: Netherlands Energy Research Foundation, ECN, NL, Co-ordinator; Risø National Laboratory, Risø, DK, Partner; Centre for Renewable Energy Sources, CRES (GR), Partner; Garrad Hassan and Partners, GH, UK, Partner; Stork Product Engineering, SPE, NL Partner; Technical University of Denmark, DTU, DK, Partner; Teknikgruppen AB, TG, S Partner; National Technical University of Athens, NTUA, Partner; Lagerwey, The WindMaster B.V. NL, Partner

Sponsor: The European Commission and The Danish Ministry of Energy and Technology (Risø part).

Contact person: Kenneth Thomsen, kenneth.thomsen@risoe.dk +45 46775052

Title: NewGust

Programme and psp: AED, psp 1110020-00, Start date: 1998.07.01

Description: Up to now simple deterministic gusts have been used to determine extreme wind turbine response from aeroelastic calculations. However, amplitude and time period specified for these discrete events remain rather arbitrary and largely not validated. The main objective of NewGust is to develop a realistic and verified description of extreme gusts Based on the stochastic properties of the wind. The analysis comprises the following. 1) Development of a theoretical gust description; 2) experimental verification of the (mean) shape of extreme gusts; 3) development of an Advanced method to determine the dynamic response of a wind turbine on extreme gusts and 4) experimental verification of the loading and response of a wind turbine on extreme gusts.

Partners: Delft University, Risø and Vestas

Sponsor: EU

Contact person: Gunner Larsen, Gunner.Larsen@risoe.dk +45 46775056

Title: Site Specific Design of Wind Turbines Based on Numerical Optimisation, SITEOPT

Programme and psp: AED, psp 1110021-00, start date: 1998.08.01

Description: This project involves incorporation of site characteristics into the design process to enable site specific design of wind turbines. Two wind turbines of different concept are optimised at six different sites. Recommendable design guidelines are established for adoption of the existing wind turbines to specific sites and for new design of site-specific wind turbines. Existing design tools Based on numerical optimisation and aeroelastic calculations are improved with a detailed cost model and detailed wind climate input.

Partners: Risø, ECN, University of Sunderland, Bonus Energy A/S, Lagerwey B.W.

Sponsor: The European Commission, JOR3-CT98-0273, Danish Energy Agency, UVE 51171/98-0014

Contact person: Peter Fuglsang, peter.fuglsang@risoe.dk +45 46775071

Title: Design of a Rotor/Airfoil Family for Active Stall regulated Wind Turbines by Use of Multi-point Optimisation.

Programme and psp: AED, psp 1110023-00, start date: 1998.08.01

Description: This project involves design and experimental verification of a 600 kW rotor, which is optimised for active stall control. An optimisation study was carried out to determine optimum blade shape and optimum airfoil characteristics to obtain maximum possible energy and optimum active stall regulation. A blade was designed with the Risø-A1 airfoil family and the rotor was manufactured and installed on a 600 kW rotor. To evaluate the performance of the rotor, measurements are ongoing.

Partners: Risø, VEA Engineering, LM Glasfiber A/S, Nordvind

Sponsor: The Danish Energy Agency, UVE 51171/97-0051 51171/99-0028

Contact person: Peter Fuglsang, peter.fuglsang@risoe.dk +45 46775071

Title: Database on Wind Characteristics (<http://www.winddata.com>)

Programme and psp: AED, psp 1110024-00, start date: 1999.01.01

Description: The objective of this project is to provide wind energy planners, designers and researchers, as well as the international wind engineering community in general, with a source of reliable actual wind field time series observed in a wide range of different wind climates and terrain types. For convenience all available data are shown in a common format. The work with the database comprises the following activities. 1) To maintain the database in order to ensure that the data, as well as the hardware and software will be on-line and available. 2) To extend the database with meteorological data from countries outside Europe and from sites and wind climates that are not already well represented in the database. 3) To extend the database search and analysis facilities. 4) Disseminate the knowledge of the database and the possibilities for use of the data material.

Partners: U.S.A., Japan, Norway, Sweden, The Netherlands, Denmark

Sponsor: IEA Annex

Contact person: Gunner Larsen, gunner.larsen@risoe.dk +45 46775056

Title: Programme for Research in Aero-elasticity 2000-2001

Programme and psp: AED, psp 1110025-00, start date: 1999.07.01

Description: The project is a part of a five-year research programme on aeroelasticity and carried out in close collaboration with the Danish wind turbine industry. The research work has been centred within the following five areas. 1) Wind tunnel test of a NACA 63-415 airfoil with modified leading Edge. 2) Detailed verification of 3D CFD on the NREL rotor. 3) Development of a model

for airfoil roughness (CFD). 4) Aeroelastic modelling of a rotor with flexible blades. 5) Loads in combination with regulation – active stall – pitch regulation – variable speed. 6) Aero-acoustic modelling of propagation of airfoil noise from an airfoil.

Partners: DTU and Risø.

Sponsor: The Danish Ministry of Energy and Technology

Contact person: Helge Aagaard Madsen, helge.aagaard.madsen@risoe.dk
45 46775047

Title: Conversion of Danish Data for l "Database on Wind Characteristics"

Programme and psp: AED, psp 1110026-00, start date: 2000.01.01

Description: The objective of this project is to make already existing meteorological measurements available for researchers and engineers through "Database on Wind Characteristics". Special attention is paid to offshore measurements and to measurements originating from high wind sites in California, USA.

Partners: DTU, Elsamprojekt A/S, NEG Micon and Risø

Sponsor: The Danish Ministry of Energy

Contact person: Gunner Larsen, gunner.larsen@risoe.dk +45 46775056

Title: Determination of Damping for Blade and Tower Vibrations.

Programme AED, psp 1110027-00

Description: The aerodynamic damping of the different wind turbine mode shapes is very important for the load response. A method for measuring the damping at different wind speeds is developed. The method can support the identification of input parameters for aeroelastic load calculations and thus decrease the uncertainty of the resulting loads.

Partners: Bonus Energy A/S, LM Glasfiber, DTU and Risø.

Sponsor: The Danish Ministry of Energy and Technology.

Contact person: Kenneth Thomsen, kenneth.thomsen@risoe.dk +45 46775052

Title: Programme for Aero-elasticity Research 2000-2001

Programme and psp: AED, psp 1110028-00, start date: 2000.07.01

Description: The project is part of a five-year research programme on aeroelasticity and carried out in close collaboration with the Danish wind turbine industry. The research work has been centred within the following five areas.

1) Status on 2D and 3D CFD calculations. 2) Implementation of improved sub models on structural dynamics and aerodynamics in the two aeroelastic codes HawC and FLEX4. 3) Design of an airfoil series with high maximum lift for application on off shore wind turbines. 4) Investigation of the potential to determine dynamic stability. 5) Uncertainties in computing the fatigue life of a wind turbine. 6) Guidelines for optimised blade dynamics.

Partners: Danish Technical University and Risø.

Sponsor: The Danish Ministry of Energy and Technology.

Contact person: Helge Aagaard Madsen, helge.aagaard.madsen@risoe.dk
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5.2 Atmospheric Transport and Exchange

Title: Great Belt Climatology.

Programme and psp: ATU, psp 1100001-00, start date: 1977.01.01.

Description: Climatological wind monitoring with mean values and turbulence structure studies conducted in connection with the construction of the Great Belt Bridge and tunnel connection. After construction of the bridge, various consultancy projects are being conducted.

Partners: COWI Consult.

Sponsor: Sund & Bælt Inc.

Contact person: Niels Otto Jensen, Niels.otto.jensen@risoe.dk +45 46775007

Title: Aujeszky's Virus

Programme and psp: ATU, psp 1100006-00, start date: 1990.01.01.

Description:

On-line real-time Aujeszky pig disease airborne virus attack warning system Based on an on-line meteorology tower (Kegnæs, south-west Denmark)

Partners: Danish Bacon and Meat Council, veterinarian, Ph.D. Sten Mortensen Axelborg, Copenhagen

Sponsor: Danish Bacon and Meat Council

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk +45 46775009

Title: Ulborg

Programme and psp: ATU, psp 1100007-00, start date: 1990.09.01.

Description: A study of forest productivity correlated to water balance (i.e. precipitation and evapo-transpiration), nutrient balance, micrometeorology and air pollution. The Risø component of the project is the micrometeorological part, which supports the flux estimates of water vapour, CO₂, and other constituent fluxes (dry deposition). The project is part of the Pan-European Programme for the Intensive Monitoring of Forest Ecosystems. Two other forest sites (Linnet and Frederiksborg) are equipped with less intensive meteorological instrumentation.

Partners: Botanical Institute, Copenhagen University; DMU (Danish Environmental Research Institute), FSL (Danish Forest and Landscape Research Institute) and similar research institutes from 32 other European countries.

Sponsor: EC Directorate-General Agriculture (DG VI F.II.2) and The (Danish) National Forest and Nature Agency (SNS).

Contact person: Niels Otto Jensen, n.o.jensen@risoe.dk +45 46775007

Title: NATO/CCMS ITM conference

Programme and psp: ATU, psp 1100010, 1992

Description: The series of regular NATO/CCMS International Technical Meetings on Air Pollution Modelling and its Application (ITM) was started in 1974. Since 1992 Denmark has been pilot country with Risø acting as host organisation. The most recent, the 23rd ITM, was held near Varna, Bulgaria, September 28 - October 2, 1998. 120 participants representing 30 countries from North and South America, Europe, Asia and Australia attended the conference. Kluwer Academic-PLENUM Press publishes the conference proceedings (Air pollution modelling and its application #.).

Partners: National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences (latest conference).

Sponsor: NATO/CCMS

Contact person: Sven-Erik Gryning, sven-erik.gryning@risoe.dk

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Title: Air-sea Exchange

Programme and psp: ATU, 1100015-00, start date: 1999.02.01

Description: The overall goal is to develop and improve numerical models for the simulations of the marine environment and for assessment purposes. The Baltic is chosen as the case for this study. To study the behaviour, variability and response of the Baltic ecosystem to the atmospheric input at the sea-surface a marine model and an atmospheric model are constructed and linked. Furthermore a database containing chemical and meteorological parameters will be established and used for model validation.

Partners: Finnish Inst. of Marine Research, Finnish Met. Institute; Uppsala Univ. and National Environ. Res. Institute

Sponsor: Nordic Council of Ministers, The air- and sea group.

Contact person: Lise Lotte Sørensen, lotte.geern@risoe.dk +45 46775015

Title: BNFL Peer Review

Programme and psp: ATU, psp 1100 017-61, start date: 1996-08-01

Description: Peer review of the environmental dose assessment models to be used by Westlake Research Institute (WRI) on behalf of BNFL for the assessment of radiation doses to individuals in Ireland from releases from Sellafield (in connection with Short and Others v BNFL and Others). Risø has followed the WRI implementation and testing of the selected sub-models on a test-sample basis.

Partners: Department of Nuclear Safety Research

Sponsors: British Nuclear Fuels

Contact person: Søren Thykier-Nielsen, soeren.thykier@risoe.dk

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Title: EUROFLUX

Programme and psp: ATU, psp 1100018-00, start date: 1996.01.01.

Description: The main task of the project is to carry out long term (Eddy-correlation) measurements of CO₂ and water vapour fluxes over European forests. Main objectives are as follows. 1) To provide useful parameters for global and regional scale modellers and to analyse the variables that determine energy partitioning by forests in different climatic zones. 2) To determine the sink strength of European forests for carbon and the factors that governs the gains and losses including differing vegetation composition in different climate regions. A specific Risø interest is to develop an improved Soil Vegetation Atmosphere Transfer (SVAT) model.

Partners: Dept. of Forest Science and Environment, University of Tuscia, Viterbo, Italy (project leader) and ten other research institutes from EU countries.

Sponsor: EC Directorate-General Science, Research and Development (DG XII)

Contact person: Niels Otto Jensen, n.o.jensen@risoe.dk +45 46775007

Title: RS-Model

Programme and psp: ATU, psp 1100030-00, start date: 1997.01.01.

Description: The long title of the project is "Remote Sensing Based Crop Simulation and Soil-Vegetation-Atmosphere-Transport Modelling" and the primary objective is the integration of remotely sensed information and vegetation (crop) modelling at landscape scales. The main emphasis is on the hydro-

logical aspects. Risø contributed with one experimental station measuring fluxes on the field scale (observation height about 2m. Other groups participated with five similar stations situated in various crops in order to contribute with one experimental station measuring fluxes on the landscape scale (observation height 48 metres). Finally the measured fluxes on field and landscape scale were compared with simulated fluxes by means of an aggregation model Based on remotely sensed surface parameters, that is being developed.

Partners: Danish Institute of Plant and Soil Science, Research Centre Foulum (project leader); Danish Hydraulic Institute; Department of Agricultural Sciences, the Royal Veterinary and Agricultural University; Institute of Geography, University of Copenhagen.

Sponsor: The Research Programme on Earth Observation under the Danish Research Councils.

Contact person: Niels Otto Jensen, n.o.jensen@risoe.dk +45 46775007

Title: Research & Development.

Programme and psp: ATU, psp 1100032-00, start date:

Description: Research and development activities within the ATU programme that are not directly related to the research and development activities of any individual project.

Partners: -

Sponsor: Internal

Contact person: Søren E. Larsen, soeren.larsen@risoe.dk +45 46775012

Title: Atmospheric Measurements at Mars.

Programme and psp: ATU, psp 1100035-00, start date: 1997.04.01.

Description: Participation in Mars missions involving surface landers. Participation in atmospheric science teams for the NASA Pathfinder Lander, and in the multinational NetLander project aiming to place 4 surface stations simultaneously on the surface of Mars. Work with the planing, instrument development, surface atmospheric measurements and data interpretation

Partners: ATMIS team in Pathfinder and Netlander. Primary: JPL, Pasadena; FMI, Helsinki; CNES, Paris; UW, Seattle.

Sponsor: Danish Research Agency, Grant No. 9602457 & 9802921.

Contact person: Søren E. Larsen, soeren.larsen@risoe.dk +45 46775012

Title: OMEXII-2.

Programme and psp: ATU, psp 1100040-00, start date: 1998.08.01.

Description: The objective of the OMEXII-2 project is to determine the carbon balance at the ocean shelf outside North Western Portugal to evaluate whether the margin is a sink or source of atmospheric Carbon. OMEXII-2 descends from a number of earlier OMEX projects all focused on the carbon cycle of the marginal seas west of Europe. The project involves 29 partners. Risø's participation focuses on estimation of air sea exchange of CO₂.

Partners: Université Libre, Brussels; Université Liege; GEOMAR, Kiel; University of Tromsø; PML, Plymouth; POL, Merseyside, UK.

Sponsor: EC RTD ENVIRONMENT & CLIMATE Programme MAS3-CT97-0076.

Contact person: Søren E. Larsen, soeren.larsen@risoe.dk +45 46775012

Title: RTMOD

Programme and psp: ATU, psp 1100041-00, start date: 1998.01.01.

Description: RTMOD is an automated statistical evaluation package for the inter-comparison of the predictions of mathematical models simulating the dispersion of air pollutants. The background of RTMOD is the ETEX project that

involved about 50 models run in several Institutes around the world to simulate two real tracer releases involving a large part of the European territory. The project continues with ENSEMBLE, starting on Oct 1, 2000.

Partners: German Weather Service, Royal Netherlands Meteorological Institute, National Inst. of Public Health and Environmental Protection, Royal Meteorological Institute Belgium, Meteo-France, The British Met. Office, Finnish Meteorological Institute, Swedish Meteorological and Hydrological Institute, Danish Meteorological Institute, Austrian Meteorological and Geophysical Office, ENVIROWARE-SRL, Polish Atomic Energy Institute, Norwegian Meteorological Office, Greece National Research Centre "Demokritos", JRC-Ispra - Environment Institute - European Commission, University of Manchester, Savannah River National Laboratory, Danish Emergency Management Agency.

Sponsor: EU Community Research - Nuclear sciences and technologies

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk +45 46775009

Title: COFIN

Programme and psp: ATU, psp 1100042-00, start date: March 1, 1998

Description: Random concentration fluctuations caused by atmospheric turbulence tend to intensify the hazards of toxic and flammable gas releases. Practical risk analysis of industrial hazards often involves dispersion modelling of the gas field. This does usually not include concentration fluctuations, since existing theory is considered difficult in application or to rely on too idealised situations. The aim of the COFIN project is to develop a model framework applicable also for practical risk assessment. The approach is semi-empirical; i.e. we examine the statistical properties of experimental data and include stochastic information in the models.

Partners: Sheffield University.

Sponsor: EU-ENVIRONMENT Programme, contract no. ENV4-CT97-0629

Contact person: Morten Nielsen, n.m.nielsen@risoe.dk +45 46775022

Title: SMP-2, C and N Exchange

Programme and psp: ATU, psp 1100043-00, start date: 1997.07.01.

Description: The objectives of this subproject (9.1.1 Atmosphere/canopy exchange of C and N compounds) is to quantify through experimental field measurements the fluxes of gaseous C and N compounds over forest and over a nearby agricultural field and to compare the fluxes over these two different ecosystems. The set-up relies to a fairly large degree on the infrastructure established in connection with the EUROFLUX project.

Partners: Partners in Centre for Sustainable Land Use and Management of Contaminants, Carbon and Nitrogen, and University of Kiel, Chalmers University of Technology, Göteborg

Sponsor: The Danish Environmental Research Programme.

Contact person: Niels Otto Jensen, n.o.jensen@risoe.dk +45 46775007

Title: PEP (Pilot study on Evaporation and Precipitation in the Baltic sea)

Programme and psp: ATU, psp 1100044, start date: 1 Nov. 1997

Description: The main objective of PEP is to estimate precipitation (P) and evaporation (E) over the Baltic Sea. Risø has performed continuous measurements of evaporation with an Eddy correlation technique at Christiansø during the 18-month period (May 1998 to December 1999). During a two week concentrated field effort in October /November 1998, Risø performed extensive radio soundings at Christiansø. Based on the radio soundings the height of the boundary layer was determined, having typical values in the range of 500 metres, and successfully simulated.

Partners: Uppsala Univ. and SMHI (Sweden); Max-Planck-Inst. Hamburg, and Univ. of Kiel (Germany) and FMI (Finland).

Sponsor: EC RTD ENVIRONMENT AND CLIMATE Programme (ENV4-CT97-0484)

Contact person: Sven-Erik Gryning, sven-erik.gryning@risoe.dk
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Title: SNF-Atlantic CO₂ and Particulates.

Programme and psp: ATU, 1100045-00, start date: 1997.12.01

Description: The objective of the project is to study the origin, variability and air/sea fluxes of CO₂ and atmospheric particulates over the North East Atlantic Region (NEAR). The study is carried out by measuring the CO₂-concentration in water and air, and the amount of particulate matter in the near surface air; deriving local area average surface fluxes of CO₂ and particulates at selected locations within NEAR.

Partners: Copenhagen University, National Environmental Research Institute, and Danish Meteorological Institute.

Sponsor: The Danish National Science Research Council,

Contact person: Lise Lotte Sørensen, lotte.geern@risoe.dk +4546775015

Title: SFINCS.

Programme and psp: ATU, psp 1100046-00, start date: 1997.04.01.

Description: The SFINCS project aims to improve the parameterisation of the atmospheric boundary layer in climate and weather forecasts models. The project is especially focused on strong stable and strong unstable conditions and on aggregation. The work includes theoretical analysis, comparison with measurements and implementation in numerical models.

Partners: Uni. Uppsala, SMHI, Sweden, Max Planck Institute, Hamburg, NOAA, Athens, Inst. Atmos. Phys., Moscow

Sponsor: EC RTD ENVIRONMENT & CLIMATE ENV4-CT97-0573

Contact person: Søren E. Larsen, soeren.larsen@risoe.dk +45 46775012

Title: URAHFREP.

Programme and psp: ATU 1100049-1 start: 1998.01.01.

Description: The aim of the HF project is to test whether an instantaneous accidental release of HF acts as a passive trace gas cloud or a buoyant cloud with a lift-off. If HF acts as a buoyant cloud, safety distances around factories using or producing HF can be reduced. Experimental campaigns have been designed where Risø's mini lidar system will be used to measure a passive cloud and a HF cloud respectively, to test the theory. At Risø the project involves both experimental and modelling work and is made in co-operation with the System Analysis Department, Risø National Laboratory. The System Analysis Department is project co-ordinator at Risø, and the main task for Risø is to conduct the experimental campaign, interpret the measurements, and to develop a new HF thermodynamic module to be included in the Risø heavy gas model developed in the System Analysis Department.

Partners: HSE, England, CEA France, SUAS/FOA Sweden, BRE England, AEA Technology

Sponsor: European Commission

Contact person: Hans E. Jørgensen, hans.e.joergensen@risoe.dk

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Title: AutoFlux.

Programme and psp: ATU, psp 1100051-1, start date: 1998.08.01.

Description: The AutoFlux project aims to develop and test an autonomous flux measuring station for atmospheric fluxes of momentum, latent and sensible heat, and CO₂. The stations are planned for unattended operation from remote stations or from Voluntary Observing Ships (VOS) from commercial sea transport. The project involves both instrument and system development and construction. The fluxes are mainly from turbulence measurements by the dissipation method.

Partners: Uppsala Univ., Southampton Ocean. Centre, Gill Instruments, Royal Dutch Met, Inst. CETP/CNRS France.

Sponsor: EC RTD ENVIRONMENT & CLIMATE Programme MAS3-CT97-0108.

Contact person: Morten Nielsen, n.m.nielsen@risoe.dk +45 46775022

Title: Understanding the Role of Vehicle Emissions in the Formation of Secondary Organic Aerosols (DMI Wind Climate)

Programme and psp: ATU, psp 1100-053-1, start date: 1999.01.01.

Description: This grant (held together with Sara Pryor) is to foster research innovation in collaboration with Ford Research Centre in Aachen. The main focus of the project is to develop explicit chemistry modules to describe the production of condensable molecules through atmospheric oxidation of volatile organic compounds. These modules are being evaluated against two parameter absorption approaches currently used in atmospheric chemistry modules.

Partners:

Sponsor: Ford Research Centre, Aachen

Contact person: Rebecca Barthelmie, r.barthelmie@risoe.dk +45 46775020

Title: SAT-MAP-CLIMATE

Programme and psp: ATU, psp 1100054-1, start date: 1999.04.01.

Description: Satellite Based maps of land surface roughness, albedo and vegetation state will be area-averaged and input to the HIRLAM model. Validation of wind and temperature data at synoptic weather stations. Validation of surface flux data from land and ocean meteorological masts in Denmark. The possibility of surface flux climatology mapping will be evaluated. Further will a one-year climate prediction be carried out with the seasonal land surface effects included in the input conditions. This work is basic to improvements in global climate change predictions.

Partners: Danish Meteorological Institute, University of Copenhagen

Sponsor: Danish Research Agency, ESA/ Danish Natural Science Research Council, case no 9802916

Contact person: Charlotte Bay Hasager, charlotte.hasager@risoe.dk +45 46775014.

Title: LSMC 2000

Programme and psp: ATU, psp 1100 055-1/2/3, start date: 1999-10-01

Description: Enhancement of the ARGOS version Local Scale Model Chain (LSMC) such that it can be applied to "Danish national scale" (horizontal: 400 km x 400 km, vertical: 2 km). The work includes several model enhancements: Trifurcating, vertical shear rise, improved treatment of inversion layer effects, new resistance method for dry deposition, a new plume rise module and coupling to the GSF food chain module and restructuring of Rimpuff.

Partners: Danish Emergency Management Agency, Prolog Development Centre, Danish Meteorological Institute, GSF (German National Research Centre for Environment and Health)

Sponsors: Danish Emergency Management Agency
Contact person: Søren Thykier-Nielsen, soeren.thykier@risoe.dk
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Title: Pigs in Space

Programme and psp: ATU, psp 1100059-1, start date: 1999.01.01.

Description:

In today's large-scale pig farming units, malodour in the near by environment is a concern, and in some cases a problem for the nearby neighbours. Mitigation in form of odour reduction is costly and requires decision support based on a scientific basis. Together with the Danish environmental Institute (NERI), full scale odour concentration dispersion tests on second time scale are being conducted from a 1600 pig fattening unit farm house in Rogers- Jutland. Combined smoke tracer (LIDAR) and gas tracer (SF₆) experiments are conducted to determine the best strategy for venting and mitigating the effects of malodour.

Partners: National Environmental Research Institute (NERI) + Danish Bacon and Meat Council - Axelborg (Peter Kai)

Sponsor: Danish Agricultural structure fond + Danish Bacon and Meat Council - Axelborg

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk +45 46775009

Title: SNF-EU-Climate

Programme and psp: ATU, psp 1100061-1, start date: 2000.01.01.

Description: National funding to write EC RTD Energy, Environment and Sustainable Development proposal on the topic: Study of bio-geophysical parameters from satellites for regional weather forecasting and regional climate models in Europe.

Partners: DMI, Univ. Copenhagen, Meteorological Office Spain, Meteorological Office Finland, Lund University, Valencia University, Valladolid University

Sponsor: Danish Research Agency, Danish Natural Science Research Council (SNF), case no 9903231

Contact person: Charlotte Bay Hasager, charlotte.hasager@risoe.dk
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Title: EU-MEAD

Programme and psp: ATU, psp 1100062-1, start date: 2000.02.01

Description: The overall objective is to describe the effects of atmospheric nitrogen deposition on coastal water biogeochemistry. To achieve this goal a high-resolution atmospheric model describing the complex meteorology and atmospheric nitrogen chemistry of the coastal zone and a coupled hydrodynamic biogeochemical model of the Kattegat to assess the impact of atmospheric deposition events is being developed. To parameterise the models sampling of fluxes in field experiments are conducted. Furthermore a retrospective analysis of existing atmospheric deposition, phytoplankton abundance and satellite imagery data takes place to investigate any links between atmospheric nitrogen deposition and bloom development.

Partners: National Environmental Research Institute, East Anglia University, Stockholm University and Göteborg University.

Sponsors: EC RTD Environment and Sustainable Development Programme EVK3-CT-1999-00014.

Contact person: Lise Lotte Sørensen, lotte.geern@risoe.dk +45 46775015

Title: Coastal Lincom

Programme and psp: ATU, psp 1100063-1, start date: 2000.03.01.

Description: A new sea-breeze wind model is being developed based on the LINCOM linearised flow model equations for conservation of momentum, mass and heat. The model will be used for coastal dispersion assessment and for coastal wind resource estimation.

Partners: DERA- Porton Down- U.K.

Sponsor: DERA - UK

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk +45 46775009

Title: CEPROS airborne disease spread

Programme and psp: ATU, psp 1100064-1, start date: 1999.06.16.

Description: 1) Establishment of a simple design tool based on Rimpuff for optimal piglet farmhouse layout in order to minimise airborne disease transmission between units. 2) Maintain real-time on site meteorological measurements from a small Met tower during field tests with disease spread between containers with piglets.

Partners: Danish Veterinary Serum Institute

Sponsor: CEPROS - Danish Ministry of Agriculture

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk
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Title: WATERMED

Programme and psp: ATU, psp 1100066-1, start date: 2000.02.01.

Description: Water use efficiency in natural vegetation and agricultural areas by remote sensing in the Mediterranean basin. The microscale aggregation model will be run for heterogeneous land surfaces to estimate areal heat and water vapour flux based on high-resolution satellite remote sensing data and compare to field data and low-resolution satellite data results in Mediterranean climates.

Partners: Valencia University, Spain, INRA France, Centre Royal de Télédétection Spatial in Morocco, Nat. Authority for Remote Sensing and Space Sciences in Egypt

Sponsor: EC INCO-MED Shared Cost Contract No. ICA3-CT-1999-00015

Contact person: Charlotte Bay Hasager, charlotte.hasager@risoe.dk
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Title: SNF-EU-Network

Programme and psp: ATU, psp 1100067-1, start date: 2000.12.15.

Description: National funding to write EC Human Potential – Research Training Networks proposal on the topic: Surface-atmosphere exchange process in climate, meteorological and hydrological models. The goal is to establish an international research network for exchange of PhDs and Post Docs.

Partners: Finnish Met. Office, Bulgarian Academy of Science, Athens Univ., Wageningen Univ., Bayreuth Univ., Inst. of Atmospheric Physics (IFA) Italy

Sponsor: Danish Research Agency, Danish Natural Science Research Council (SNF), case no. 0001295

Contact person: Charlotte Bay Hasager, charlotte.hasager@risoe.dk
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Title: ENSEMBLE

Programme and psp: ATU, psp 1100069-1, start date: 2000.10.01.

Description: ENSEMBLE addresses the problem of achieving a common coherent strategy across European national emergency management when national Long-range dispersion forecasts differ from one another during an accidental

atmospheric release of radioactive material. ENSEMBLE produces new Web-based software tools for real-time reconciliation and harmonisation of dispersion forecasts from meteorological and emergency centres across Europe during an accident. ENSEMBLE software tools will be set available to participating national emergency and meteorological forecasting centres, which may choose to integrate them directly into operational emergency information systems, or possibly use them as a basis for future system development.

Partners: German Weather Service, Royal Netherlands Meteorological Institute; National Inst. of Public Health and Environ. Protection; Royal Meteorological Institute, Belgium; Meteo-France, The British Met. Office; Finnish Meteorological Institute; Swedish Meteorological and Hydrological Institute; Danish Meteorological Institute; Austrian Meteorological and Geophysical Office; ENVIROWARE-SRL; Polish Atomic Energy Institute; Norwegian Meteorological Office; Greece National Research Centre "Demokritos"; JRC-Ispra - Environment Institute; European Commission; University of Manchester; Savannah River National Laboratory; Danish Emergency Management Agency.

Sponsor: EU Community Research - Nuclear sciences and technologies.

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk +45 46775009

Title: DAONEM

Programme and psp: ATU, psp 1100070-1, start date: 2000.10.01.

Description: The objective of DAONEM is to improve the predictive capabilities of the RODOS system by developing and implementing data assimilation tools. In the development of a data assimilation capability for the early phase, a Gaussian-puff meso-scale RIMPUFF atmospheric dispersion model will be used. This model provides a realistic description of the different processes associated with the atmospheric dispersion of radioactive material, without requiring too much computing time. The complexity of the model will not prove advantageous, since in even more complex models, e.g., a particle model, the implementation of the Kalman filter would be at least an order of magnitude more difficult. Since the original dispersion model was not tailored for data assimilation purposes, it will be necessary to modify its architecture to satisfy the requirements imposed by the data assimilation approach. Almost all work by Risø will be undertaken within the first project year 1 October 2000 through 30 September 2001.

Partners: MOL/ Belgium, University of Warwick, UK

Sponsor: EU Community Research - Nuclear sciences and technologies.

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk +45 46775009

Title: Dispersion of fertiliser

Programme and psp: ATU, psp 1100071-1, start date: 2000-08-01

Description: water jets emitting droplets, which will settle on the ground may spread fertiliser, by gravity settling. As material in the droplets is a potential health risk, a work has started in co-operation with the Danish Zoonosis centre to estimate the spread of such fertiliser droplets. Rimpuff is used for the calculations. The results are intended as the basis for estimation of the possible health risks in connection with this type of fertiliser application.

Partners: Danish Zoonosis centre

Sponsors: Danish Zoonosis centre

Contact person: Søren Thykier-Nielsen, soeren.thykier@risoe.dk
+45 46775026

Title: DSSNET

Programme and psp: ATU, psp 1100072-1, start date: 2000.10.01.

Description: DSSNET will establishing an effective and accepted framework for better communication and understanding between the operational community and the many and diverse disciplines involved in R&D for making well informed and consistent judgements with respect to practical improvements of emergency response in Europe. DSSNET will establish a close interaction between the users of decision support systems, in particular of RODOS, and the R&D community to understand each other needs and to feed back the experience with the practical application of the systems

Partners: FZK/ Karlsruhe

Sponsor: EU Community Research - Nuclear sciences and technologies.

Contact person: Torben Mikkelsen, torben.mikkelsen@risoe.dk
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Title: ANICE

Programme and psp: ATU, 1100303-00, start date: 1998.02.01

Description: The overall goal of the ANICE project is to develop a coupled Lagrangian-Eulerian model of atmospheric nitrogen deposition, which includes extended performance of air-sea flux parameterisations and inclusion of heterogeneous processes. There are three tasks in the project: transport and chemistry modelling, instrument development, and field experiments, where fluxes and parameters for model validation are measured.

Partners: National Environmental Res. Inst., TNO Physics and Electronics Lab., Hamburg Uni., East Anglia Uni.

Sponsor: EC RTD ENVIRONMENT AND CLIMATE Programme ENV4-CT97-0594.

Contact person: Lise Lotte Sørensen, lotte.geern@risoe.dk +45 46775015

5.3 Electrical Design and Control (EDS)

Title: Solar Energy Centre Denmark, Hybrid Systems part

Programme and psp: EDS, 1115003-00, 1998.01.01

Description: Participation in the work of the Solar Energy Centre Denmark who performs the main part of the research in the field of solar energy in Denmark. The particular responsibility of Risø in this Centre is in the field of stand-alone pv-systems and hybrid system (pv-wind-diesel-battery). The work involves development of technology, controls and tools for system analysis.

Partners: Technological Institute (TI), Danish Technical University (DTU), Danish Building Research Institute (SBI)

Sponsor: Danish Energy Agency

Contact person: Henrik Bindner, henrik.bindner@risoe.dk +45 46 775050

Title: Design and Development of a Gear-less Wind Turbine with a Multi-pole Generator.

Programme and psp: EDS, psp 1115009-00, start date: 1996.01.01; end date: 2000.02.01

Description: Main goal of the project was to design and develop a gear-less stall regulated wind turbine with a multi-pole generator, power electronics and variable speed operation due to the t main features as follows. a) Reduced requirements to grid strength; b) improved power quality; c) controllable power output; d) increased yearly power production; e) smaller loads and reduced acoustic noise. During the project, it turned out that the multi-pole generator

solution would become too expensive. Therefore, the main goal was changed to design and implementation of 1) a control strategy for variable speed and 2) a blade pitch system.

Partners: NEG Micon (Nordtank Energy Group), Siemens and Elkraft.

Sponsors: Danish Energy Agency, case no 1363/96-0003 (EFP).

Contact person: Lars Henrik Hansen, lars.henrik.hansen@risoe.dk
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Title: Donegal Wind Farm, Thermie

Programme and psp: EDS, 1115011, 1996.09.01

Description: The objective of the project was to develop, implement and test a control scheme for a complete wind farm that ensures that the voltage level at the point of common connection never exceeds the level prescribed by the utility. A voltage controller was installed at a 6*600kW wind farm that based on the actual voltage level controlled the active power output of the wind farm.

Partners: Vestas A/S, Gineadoiri Gaoithe Tearanta, EuroScan

Sponsor: EU Thermie

Contact person: Henrik Bindner, henrik.bindner@risoe.dk +45 467 5050

Title: Power Quality and Integration of Wind Farms in Weak Grids

Programme and PSP: EDS, psp 1115015-00, start date 1998.04.01

Description: The objective of this project has been to study wind farms connected to weak grids and to provide recommendations for the grid connection. The conditions in India have been studied as an example of very large wind farm regions connected to very weak grids in rural areas. Both the influence of the grid on the wind turbines and the influence of the wind farms on the power quality have been assessed.

Partners: DEFU (Danish Utilities Research Institute) and ER&DCI(T) (Electronic Research and Development Institute of India)

Sponsor: Danish Energy Agency 1363/98-0024 and the Indian Ministry of Non-Conventional Energy Sources (MNES) ref.: 52/164/97/WE/PG dated 7/10/98

Contact person: Poul Sørensen, poul.e.soerensen@risoe.dk +45 46775075

Title: Monitoring of Wind Turbines

Programme and psp: EDS, 1115016, 1999.01.01

Description: Advanced condition monitoring of wind turbines primarily of the gearbox, the main bearings and parts of the wind turbine structure in order to be able to perform preventive maintenance and avoid operation in situations with extremely high loads.

Partners: Dan-Service, CC Electronics, Leif Hansen Rådg. Ing., Flender, WEA Engineering, Ingemannsson Technology

Sponsor: EU CRAFT

Contact person: Henrik Bindner, henrik.bindner@risoe.dk +45 4677 5050

Title: IRENE2010

Programme and psp: EDS, 1115017, 1999.05.01

Description: The focus is on the implications of the targets of the EU white paper on renewable energy of the European power system. Through an analysis of the state-of-the-art of current practices in the fields of production and transmission capacity planning, stability analysis, security assessment and scheduling and dispatch practices points have been identified that needs change when large amounts of renewable energy are being included in the power production.

Partners: Tractebel, EDF, PPC, Iberdrola, Elsamprojekt, Eurec Agency

Sponsor: EU ALTERNER

Contact person: Henrik Bindner, henrik.bindner@risoe.dk, +45 4677 5050

Title: Simulation of Wind Power Plants

Programme and psp: EDS, psp 1115018-00, start date 2000.04.01

Description: The objective of this project is to develop a model for the 6x2 MW wind farm in Hagesholm and its interaction with the power systems. The 2000 models are developed in the commercial tool for power system simulation DIgSILENT. The available models for power system components in DIgSILENT are used, whereas the wind turbine models are built from standard dynamic blocks.

Partners: Aalborg University, Dancontrol Engineering A/S

Sponsor: Danish Energy Agency 1363/00-0003

Contact person: Poul Sørensen, poul.e.soerensen@risoe.dk +45 46775075

Title: Windplus

Programme and psp: EDS, 11150020, 2000.07.01

Description: The project aims at improving the performance of wind diesel systems by including battery storage in the system layout. The focus of the project is on systems control (scheduling, dispatch, demand side management and storage control) in order to maximise the fuel saving and battery lifetime.

Partners: Vergnet, ECN, Scottish Power, Alstom, CINAR

Sponsor: EU FW5

Contact person: Henrik Bindner, henrik.bindner@risoe.dk +45 46775050

Title: Conceptual Survey of Generators and Power Electronics for Wind Turbines.

Programme and psp: EDS, psp 1115021-01, start date: 2000.05.16.

Description: The objective of the project is to gather, promote and disseminate *state of the art* knowledge on generators and power electronics for wind turbines. The survey focuses on the electric development of wind turbines. It presents an overview of the state-of-the-art of generators and power electronics, future concepts and technologies within generators and power electronics, market needs in the shape of requirements to the grid connection, and consistent system solutions, plus an evaluation of these seen in the prospect of market needs.

Partners: Aalborg University.

Sponsors: None.

Contact person: Lars Henrik Hansen, lars.henrik.hansen@risoe.dk
+45 46775076

Title: IEA Wind R&D

Programme and psp: EDS, psp 1115083, start date: 2000.01.01.

Description: The Danish Energy Agency has asked Risø to represent Denmark as the permanent national member of the Executive Committee of the IEA implementing agreement for co-operation in the research and development of wind turbine systems. The task comprises participation in the meetings and ExCo tasks, preparation and presentation of national reports as well as co-ordination on the Danish level.

Partners: Members of the IEA implementing agreement

Sponsor: The Danish Energy Agency

Contact person: Peter Hauge Madsen, peter.hauge@risoe.dk +45 46775011

5.4 Wind Power Meteorology (VKM)

Title: European Wind Atlas

Programme and psp: VKM, psp 1105 001-00, start date: 01/01/1989

Description: Distribution of the European Wind Atlas published in 1989.

Partners: None

Sponsor: Various

Contact person: Niels G. Mortensen, niels.g.mortensen@risoe.dk
+45 46775027

Title: Wind Atlas Analysis and Application Programme (WAsP)

Programme and psp: VKM, psp 1105 002-01/02, start date: 01/07/1987

Description: Development, implementation and verification of software tools intended for wind data analysis, map Editing and digitisation, wind atlas generation, wind climate estimation, wind power production prediction, micro-siting of wind turbines, wind farm production calculations, wind farm efficiency evaluation as well as wind climate and wind resource mapping. Furthermore the project includes software support, courses and training.

Partners: None

Sponsor: Various

Contact person: Niels G. Mortensen, niels.g.mortensen@risoe.dk
+45 46775027

Title: Wind Atlas for the Gulf of Suez

Programme and psp: VKM, psp 1105 005-00, start date: 01/01/1995

Description: Distribution of the Wind Atlas for the Gulf of Suez 1991-95 and the associated database.

Partners: None

Sponsor: Various

Contact person: Niels G. Mortensen, niels.g.mortensen@risoe.dk
+45 6775027

Title: Wind Atlas for Russia

Programme and psp: VKM, psp 1105007-00, start date: 1997.

Description: The project aims at developing a wind atlas for Russia. The methodology used is that of the European Wind Atlas (the Risø Wind Atlas Methodology). The project will analyse data from more than 300 stations distributed all over the Russian territory. Each station will be analysed with respect to meteorological data (wind speed and direction), terrain (orography and roughness) and obstacles.

Partners: RDIEE, Istra, Moscow Region, Russia

Sponsor: Danish Energy Agency, contract: 2136/97075-0018

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: Instrumentation of Offshore Masts

Programme and psp: VKM, psp 1105011-00, start date: 1997.08.01.

Description: This project involves instrumentation of a number of offshore masts (Gedser)

Partners: Land, Gedser Rev, Rødsand and Omø Stålgrunde) and running of the necessary meteorological instrumentation to provide a database for wind resource assessment.

Sponsor: SEAS/ELKRAFT

Contact person: Rebecca Barthelmie, r.barthelmie@risoe.dk +45 46775020

Title: WASP Engineering Version 1.0 DK Wind Conditions for Wind Turbine Design

Programme and psp: VKM, psp 1105021, start date: 1997.01.01.

Description: WASP Engineering is a series of experimental and theoretical activities concerning properties of the winds in moderately complex terrain with relevance to loads on wind turbines and other large structures. These properties include extreme winds, wind shear and turbulence. Most of the models have been integrated in a windows programme prototype, also called WASP Engineering.

Partners: Svend Ole Hansen ApS.

Sponsor: The Danish Energy Agency, Contract ENS-1363/97-0004.

Contact person: Jakob Mann, jakob.mann@risoe.dk +45 46775019

Title: Instrumentation of Mast at Middelgrunden

Programme and psp: VKM, psp 1105024-00, start date: 1997.08.01.

Description: This project involves instrumentation of the offshore mast at Middelgrunden and running of the necessary meteorological instrumentation to provide a database for wind resource assessment.

Partners:

Sponsor: SEAS/ELKRAFT

Contact person: Rebecca Barthelmie, r.barthelmie@risoe.dk +45 46775020

Title: WASP Consulting

Programme and psp: VKM, psp 1105026-01, start date: N/A continuous.

Description: This project covers all consulting done in connection with wind resource estimation. This includes second opinion studies, due diligence, offshore wind farm production estimation, measuring programs and so on.

Partners: various commercial and international institutions

Sponsor: various

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: Wind Energy Feasibility Studies in Estonia

VKM, psp1105026-04, start date: 1999.04.01

Description: To clarify legal and institutional aspects of wind energy in Estonia; (2) select possible wind turbine sites near Tallinn; (3) estimate wind potential; (4) evaluate wind energy economy for these sites and (5) evaluate also the need for and activities at a wind energy know-how centre near Tallinn. VEA/Risø has contributed especially to (3) and (5).

Partners: SEAS Wind Energy Centre (project leader), Elkraft Consult, Tripod Wind Energy ApS (all DK)

Sponsor: Danish Environment Related Energy Sector Programme (Danish Energy Agency)

Contact person: Ole Rathmann, ole.rathmann@risoe.dk+45 46775003

Title: The Numerical Wind Atlas - the KAMM/WASP method

Programme and psp: VKM, 1105028-00, start date: 01/04/1998

Description: Deriving wind atlases from numerical simulations with the Karlsruhe Atmospheric Mesoscale Model KAMM using climatologies of the large-scale geostrophic wind from the NCEP/NCAR reanalysis. Simulations are performed for different regions in Europe and compared with wind atlas data derived from observations in these regions. The effect of different grid resolution on the results is investigated. Also, the size of maps to clean the observations is varied to investigate its effect on the observed wind atlas data.

Partners: None
Sponsor: Danish Energy Agency, EFP 1998
Contact person: Helmut P. Frank, helmut.frank@risoe.dk +45 46775013

Title: Short-term prediction DE
Programme and psp: VKM, psp 1105029-00, start date: 1998.06.01.
Description: The project aims at implementing a version of Risø's Prediktor Programme for a number of sites in Germany alongside a new prediction model developed by University of Oldenburg. Furthermore the effects of wind farms distributed over a large area will be investigated.
Partners: University of Oldenburg, Germany; Fachhochschule Magdeburg, Germany.
Sponsor: European Commission, JOULE contract no JOR3-CT98-0272.
Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: Analysis of the Wind Resource at Middelgrunden
Programme and psp: VKM, psp 1105-031-1, start date: 1998.01.01.
Description: The focus of the project was to analyse existing measurements from the mast at Middelgrunden together with long-term data sets in order to provide an estimate of the long-term wind resource for Middelgrunden wind farm. Additional analysis was undertaken to provide details regarding the turbulence and stability characteristics of the site.
Partners: SEAS/ELKRAFT
Sponsor: EFP
Contact person: Rebecca Barthelmie, r.barthelmie@risoe.dk +45 46775020

Title: MOWIE
Programme and psp: VKM, psp 1105033-1, start date: 1998.06.01
Description: Improving tools for Predicting wind energy production in mountainous regions.
Partners: FMI, COORD (FR), CRES (GR), UU (SE), DEWI (DE), Bonus (DK), + three associated contractors
Sponsor: EU, DG XII, Contract No JOR3-CT98-0254 (DG 12 - WSMN)
Contact person: Erik Lundtang Petersen, erik.lundtang@risoe.dk +45 46775001

Title: EU-Measure Correlate Predict
Programme and psp: VKM, psp 1105034-1, start date: 1998.05.01.
Description: The project aims at developing new measure-correlate-predict methods. A neural network will be developed alongside a mathematical/statistical model developed by Risø and one by Ecotecnica. The three developed methods will be compared.
Partners: Renewable Energy Systems, UK; Ecotecnica, Spain.
Sponsor: European Commission, JOULE contract: JOR-CT98-0295
Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: EU-Offshore Wind/Wave
Program and psp: VKM, psp 1105035-1, start date: 1998.
Description: This project is linked to the Marie Curie research grant to Bernhard Lange's PhD thesis.
Partners: University of Oldenburg, Germany
Sponsor: European Commission
Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: Predicting Offshore Wind Energy Resources (POWER)

Programme and psp: VKM, psp 1105036-1, start date: 1998.08.01.

Description: POWER is funded by the European Commission JOULE program. To date the focus of the project is the mapping of thirteen years of near-surface offshore wind speeds based on pressure gradients (geostrophic wind) for the whole sea area of the European Union. Two approaches are being compared: the WASP model and a newly developed Coastal Discontinuity Model (CDM) which accounts for stability variations in coastal regions using temperature differences. The main results indicate that stability is a very important factor in predicting wind profiles up to 20 km from the coast. Initial comparisons with SODAR data (collected by ECOFYS at the Measurement Platform Noordvik) also indicate substantial variations from the classic 'log-profile' even during the winter period.

Partners: CLRC (Rutherford Appleton Laboratory), (UK), Ecofys (NL), KEMA Sustainable The Netherlands (NL), University of East Anglia (UK)

Sponsor: European Commission

Contact person: Rebecca Barthelmie, r.barthelmie@risoe.dk +45 46775020

Title: IRESMED

Programme and psp: VKM, psp 1105037-1, start date 1998.11.01.

Description: Integration of renewable energies in the Southern Mediterranean region.

Partners: OME, COORD (FR) + 13 EU + eight South. MED. countries

Sponsor: EU, DGXII, Contract No JOR3-CT98-0209 (DG 12 - WSMN)

Contact person: Erik Lundtang Petersen, erik.lundtang@risoe.dk 4546775001

Title: EFP99 - Zephyr

Programme and psp: VKM, psp 1105039-1, start date: 1999.04.01.

Description: The project aims at developing a new system for short-term prediction of the output from wind farms, Zephyr. Zephyr combines the physical approach of Risø with the statistical approach of IMM at the Danish Technical University. The model is to be developed and installed at all the Danish utilities with wind energy. The HIRLAM model of the Danish Meteorological Institute drives the predictions.

Partners: IMM, DMI, SEAS, Elkraft, Elsam, Eltra, Denmark

Sponsor: Danish Energy Agency, EFP99 contract: 1363/99-0017

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: UVE99 - Site Assessment

Programme and psp: VKM, psp 1105040-1, start date: 1999.

Description: The project aims at assessing a number of sites in different climatological and orographic settings. The assessment will be done with respect to the wind resource and wind engineering aspects. After visits to the sites, a report generalising the findings of the individual studies will be written. This report can be used as a guideline for assessing a site.

Partners: Bonus, NEG Micon, Vestas, Denmark

Sponsor: Danish Energy Agency, UVE99 contract: 51171/98-0035

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: Wind Resources at Rødsand and Omø Stålgrunde

Programme and psp: VKM, psp 1105041-1, start date: 1999.05.01.

Description: The focus of the project was to analyse existing measurements from the Rødsand and Omø Stålgrunde masts together with long-term data sets in order to provide an estimate of the long-term wind resource at these prospective wind farm sites. Additional analysis was undertaken to provide details re-

garding the turbulence and stability characteristics of the sites. Wind speed profiles and distributions at Rødsand are impacted by stability even after fetches over more than 20 km. Statistical analysis of the data sets indicates that wind speeds offshore are not more highly correlated than those at land sites. Wind speeds above turbine cut-in speeds however are more persistent while those below cut-in wind speeds are less persistent.

Partners:

Sponsor: SEAS/ELKRAFT

Contact person: Rebecca Barthelmie, r.barthelmie@risoe.dk +45 46775020

Title: Transfer of wind-resource know-how to the Czech Republic.

Programme and psp: VKM, psp1105042-1, start date: 1999.11.01

Description: The project aims at increasing the Czech capacity to estimate domestic wind resources. A training workshop for about 10 target persons is established; The project performs in general terms a survey of the wind resources in the C.R., clarifying and possibly seeking to propose a solution for an existing less successful wind farm project.

Partners: None.

Sponsor: DANCEE, case no 124/043-0056

Contact person: Ole Rathmann, ole.rathmann@risoe.dk +45 46775003

Title: EPRI-Prediktor Texas

Programme and psp: VKM, psp 1105043-1, start date: 2000.10.01.

Description: Confidential

Partners: Confidential

Sponsor: EPRI/DOE.

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: Efficient Development of Offshore Wind Farms (ENDOW)

Programme and psp: VKM, psp 1105044-1, start date: 2000.03.01.

Description: ENDOW is a new research project being co-ordinated at Risø and is funded under the European Commission Fifth Framework. The objectives of the proposal are to evaluate the performance of a variety of wake models in the offshore environment; to enhance these models and link them to improved boundary layer models. This is in order to provide tools to enable offshore wake effects to be compared with other factors impacting design and economics of offshore wind farms.

Partners: University of Uppsala (SE), Garrad Hassan and Partners (UK), Robert Gordon University (UK), University of Oldenburg (D), SEAS (DK), ELSAM (DK), NEG MICON (DK), ECN (NL), ECOFYS (Sub-contractor to ECN) (NL)

Sponsor: European Commission Fifth Framework

Contact person: Rebecca Barthelmie, r.barthelmie@risoe.dk +45 46775020

Title: Baltic Wind Atlas

Programme and psp: VKM, psp1105045-1, start date: 2000.01.01

Description: The project aims at establishing a wind atlas for relevant areas in the Baltic countries by reviewing and analysing existing wind measurements and by establishing new measurements in specially prospective (coastal) areas. The Risø contribution is mainly consultancy on selecting new measurement sites and on purchase and installation of measuring equipment.

Partners: UNDP Global facility (project leader); Lars Mach (free-lance wind energy consultant), Germany

Sponsor: UNDP / UNOPS, RER /99/G41

Contact person: Ole Rathmann, ole.rathmann@risoe.dk +45 46775003

Title: CIEMAT-Prediktor Ciemat

Programme and psp: VKM, psp 1105046-1, start date: 2000.10.01.

Description: To implement the Risø Prediktor short-term prediction system for a number of wind farm sites in Spain. The project is carried out in co-operation with CIEMAT

Partners: CIEMAT, Spain

Sponsor: CIEMAT, Spain.

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: EPRI-Prediktor California

Programme and psp: VKM, psp 1105047-1, start date: 2000.10.01.

Description: Confidential

Partners: Confidential

Sponsor: EPRI/Californian Energy Commission, USA

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: UNEP-SWERA Global Wind Atlas

Programme and psp: VKM, psp 1105048-1, start date: 1999.

Description: This is a project which is developing a full-scale UNEP/GEF funded project with the purpose of creating a solar and wind atlas for 10-15 countries around the globe. The project will output a proposal to UNEP for this full-scale project

Partners: NREL, USA; TERI, India;

Sponsor: UNEP/GEF and Risø/VKM own funds.

Contact person: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: WASP Engineering 2000

Programme and psp: VKM, psp 1105049-1, start date: 2000.03.01.

Description: The purpose of the project is to verify, refine and develop micro-meteorological tools for the estimation of load-critical wind conditions in landscapes in Denmark and Europe, where wind turbines are likely to be situated. These conditions include turbulence, both natural and turbine wake generated, shear and extreme winds. Among the goals of this project are to establish connections between measured storms in Denmark and a global meteorological database; computer implementations of turbine wake models; construction of an extreme value analysis module of meteorological records, and to investigate the limits of the applicability of the models.

Partners: Svend Ole Hansen ApS., Vestas Wind Systems A/S

Sponsor: The Danish Energy Agency, Contract ENS-1363/00-0015.

Contact person: Jakob Mann, jakob.mann@risoe.dk +45 46775019

Title: CDMED

Programme and psp: VKM, psp1105050-1, start date: 2000.03.01

Description: Scenarios and strategies for the implementation of the Clean Development Mechanism of the Kyoto Protocol in the Mediterranean region.

Partners: OME (Observatoire Mediterranéen de L'énergie)(France, COORD.), IPTS (JCR), ENEL(It), NREA (Egypt).

Sponsor: EU Research DG. Project no: NNE5-1999-00351

Contact person: Erik Lundtang Petersen, erik.lundtang@risoe.dk
+45 46775001

Title: CleverFarm.

Programme and psp: VKM, psp 1105051-1, start date: 2000.04.01.

Description: The goal of the project is to construct an "intelligent" computer system, which integrates a large variety of different monitoring approaches. The system includes short-term prediction of the wind farm electricity production, video camera surveillance of the wind farm, information on the current running conditions and wind turbine fault prediction. This combination enables the wind farm owner to effectively plan the maintenance of the wind farm. Furthermore the short-term predictions add extra value to the wind farm produced electricity.

Partners: Gram & Juhl/Århus, DMI, ISET/Kassel, RES/London, SEAS/Haslev, EHF/University of Oldenburg

Sponsor: EC EESD Programme ERK6-CT-1999-00006.

Contact person: Gregor Giebel, Gregor.Giebel@Risoe.dk +45 46775095

Title: WEMSAR

Programme and psp: VKM, psp 1105052-1, start date: 2000.03.01.

Description: Wind energy mapping using Synthetic Aperture Radar. To develop, validate and demonstrate the potential use of satellite-based Synthetic Aperture Radar, scatterometer and altimeter data combined with meteorological observations for the mapping of wind resources in offshore and near-coastal regions for sites located in Norway, Denmark and Italy. For regional scale calculations the Karlsruhe Atmospheric Mesoscale Model (KAMM) will be used and for the local scale calculations WASP.

Partners: Nansen Environmental and Remote Sensing Centre Norway, NEG Micon, Terra Orbit AS Norway, ENEA Italy

Sponsor: EC RTD Energy, Environment and Sustainable Development ERK6-CT1999-00017

Contact person: Charlotte Bay Hasager, charlotte.hasager@risoe.dk +45 46775014

Title: Improved Description of the Wind Climate in Denmark Regarding Determination of the Wind Resource

Programme and psp: VKM, 1105053-1, start date: 01/04/2000

Description: The Danish Meteorological Institute is further developing HIRLAM (High Resolution Limited Area Model) to improve the prediction of wind and weather in general. One goal is to investigate the possibility of using the electricity production of wind turbines as a measure of wind speed, i.e. to use the wind turbines similar to huge anemometers. Risø derives the wind speed information from the power generation using the wind farm model in WASP. Eltra provides power data.

Partners: Danish Meteorological Institute (DMI), Eltra

Sponsor: Danish Energy Agency (EFP 2000)

Contact person: Helmut P. Frank, helmut.frank@risoe.dk +45 46775013

Title: UVE-2000, Calculation of Energy Production

Programme and psp: VKM, psp 1105054-1, start date: 01/01/2000

Description: Establishment of a database of case studies containing data and information required to evaluate the accuracy and reliability of wind power production estimations using different approaches and computer models. Case studies are established for different wind climatologies and topographical settings. Comparison of predictions and actual power productions from wind turbines and wind farms serve to evaluate and map the uncertainties involved and, possibly, improve the prediction skill.

Partners: Energi- og Miljødata, Elsamprojekt, WEA Engineering, Bonus, NEG Micon A/S, Nordex, Vestas, Wincon
Sponsor: The Danish Energy Agency (UVE), WEA Engineering, Bonus, NEG Micon A/S, Nordex, Vestas, Wincon
Contact person: Niels G. Mortensen, niels.g.mortensen@risoe.dk
+45 467750 27

Title: SNF-WINDENG

Program and psp: VKM, psp 1105055-1, start date: 2000.

Description: This is a small project for writing a proposal to the European Commission for a research network in wind power meteorologically related subjects.

Partners:

Sponsor: National Research Council (SNF), Denmark

Contact: Lars Landberg, lars.landberg@risoe.dk +45 46775024

Title: Wind Atlas for South Africa

Programme and psp: VKM, 1105056-1, start date: 06/06/2000

Description: Risoe give advice to ESKOM in the task to produce a wind atlas for South Africa. The work includes a WASP course in South Africa, assistance in the analysis and quality control of the wind atlas.

Partners: None

Sponsor: ESKOM.

Contact person: Helmut P. Frank, helmut.frank@risoe.dk +45 46775013

Title: Validity of the Assumption of Gaussian Turbulence

Programme and PSP: VKM, PSP 1105300-00, start date: 1/1 1998

Description: Wind turbines are designed to withstand the impact of turbulent winds, which fluctuations usually are assumed of Gaussian probability distribution. Based on a large number of measurements from many sites, this seems a reasonable assumption in flat homogeneous terrain whereas it may fail in complex terrain. At these sites the wind speed often has a skew distribution with more frequent lulls than gusts. In order to simulate aerodynamic loads, a numerical turbulence simulation method was developed and implemented. This method may simulate multiple time series of variable not necessarily Gaussian distribution without distortion of the spectral distribution or spatial coherence. The simulated time series were used as input to the dynamic-response simulation Programme Vestas Turbine Simulator (VTS). In this way we simulated the dynamic response of systems exposed to turbulence of either Gaussian or extreme, yet realistic, non-Gaussian probability distribution.

Partners: Vestas Wind Systems, The Technical University of Denmark

Sponsor: The Danish Energy Agency

Contact person: Morten Nielsen, n.m.nielsen@risoe.dk +45 46775022

5.5 Wind Turbines (VIM)

Title: Consulting

Programme and psp: VIM, psp 1120006

Description: Consulting services are carried out for the private sector when required: Assistance to NEG Micon A/S in assessing wind farm production data. The result of measurements is used to decide whether or not production warranties have been met. Design calculations for the offshore wind farm, Rødsand, for SEAS. For the computations, the aero-elastic computer code HAWC has been amended to include hydraulic loads.

Partners: None

Sponsor: Private sector

Contact person: Sten Frandsen, sten.frandsen@risoe.dk +45 46775072

Title: Response Calculations for the Rødsand Offshore Wind Farm.

Programme and psp: VIM & AED, psp 1120006-00, start date: 01.08.2000.

Description: A number of load cases was analysed in order to determine how the loading from winds, waves and sea-ice act on a offshore wind turbine foundation.

Partners: Seas, Carl Bro A/S

Sponsor: Commercial, Seas

Contact person: Morten Lybech Thøgersen, morten.thoegersen@risoe.dk +45 46775968

Title: Response Calculations for Middelgrunden Offshore Wind Farm.

Programme and psp: VIM & AED, psp 1120006-04, start date: 01.02.2000.

Description: A limited number of load cases was analysed in order to determine how the loading from winds and waves act on offshore wind turbine foundation. The aeroelastic code HawC was used.

Partners: Seas, Carl Bro A/S

Sponsor: Commercial, Seas

Contact person: Morten Thøgersen, morten.thoegersen@risoe.dk +45 46775968

Title: Education Programme for staffs at The Energy & Environment Offices

Programme and psp: VIM, psp 1120051-05, start date: 01.01.2000.

Description: A series of courses in renewable energy technologies is designed. It has been prepared and by the project partners for the staffs at the Energy & Environment Offices in Denmark as well as at The National Danish Energy Information Centre - both having public information in energy and environmental subjects as their main activities. The overall objective is to develop the quality of the services provided by the centres by strengthening the staff capabilities in their role as renewable energy advisors to the public. The immediate objective of the courses is to strengthen the staff's knowledge in renewable energy technologies, including bio fuel, solar heating, wind power and heat pumps. The following courses are provided both in 2000 and in 2001. Bio fuels, basic (two days); Bio fuels, extended (one day); Wind power, basic (two days); Wind power, extended (one day); Solar Energy, basic (two days); Solar Energy, extended (one day); Heat pumps, basic (two days) and Heat pumps, extended (one day). The aim is to develop (a structure for and) input to valuable handbooks in the selected renewable energy technologies, course material are developed, collected and organised in binders, one for each of the participants. The courses are provided in Danish only.

Partners: DTI (The Danish Technological Institute) (project co-ordinator),

SEK (Association of Energy Offices), DV (Danmarks Vindmølleforening).

Sponsor: The Danish Energy Agency; The Association of Energy Offices.

Contact person: Per Nørgaard, per.norgaard@risoe.dk +45 46775068

Title: Isolated Systems with Wind Power

Programme and psp: VIM, psp 1120-084, start date 1998.02.01

Description: The main objective of the project is to establish an operational set of engineering methods for design and evaluation of isolated electric power supply systems with a large proportion of wind power. The methodology will be developed based on practical experience using existing analysis and simulation models. The project includes a literature review as well as measurements and examples from isolated systems in Egypt, and it will result in a set of guidelines and an outline of an implementation strategy.

Partners: NREA - National renewable Energy Agency, Egypt

Sponsor: Danish Energy Agency, Energy Research Programme EFP-97, case no 1363/97-0007

Contact person: Per Lundsager, per.lundsager@risoe.dk, +45 46775045

Title: Calibration of Partial Safety Factors for Design of Wind Turbine Rotor Blades Against Fatigue Failure.

Programme and psp: VIM, psp 1120092, start date: 01.01.1998.

Description: The project has performed a calibration of partial safety factors for wind turbine rotor blades subjected to fatigue loading in flapwise and Edge-wise bending. While earlier models - developed by the authors - dealt with such calibrations for site-specific individual turbines only, the calibration model applied herein covers an integrated analysis with different turbines on different sites and with different blade materials. The result is an optimised set of partial safety factors, i.e. a set of safety factors that lead to minimum deviation from the target reliability of the achieved reliabilities over the selected scope of turbines, sites and materials. The turbines included in the study cover rated powers of 450-600 kW.

Partners: Det Norske Veritas (DNV)

Sponsor: Danish Energy Agency 'Development programme for renewable energy', case no. 51171/96-0038

Contact person: Morten Lybech Thøgersen, morten.thoegersen@risoe.dk +45 46775968

Title: Pre-Project: Development of New Blade Test Methods.

Programme and psp: VIM, psp 1120098-00

Description: This project includes investigations in better determination of blade properties using modal analysis, investigations in use of thermographic techniques especially in fatigue testing and investigation of the number of cycles required to test a wind turbine blade in fatigue.

Partners: LM Glasfiber A/S.

Sponsor: Danish Energy Agency 511+71/97-0043.

Contact person: Erik R. Jørgensen, erik.r.jorgensen@risoe.dk + 45 46775064

Title: European Wind Turbine Certification

Programme and psp: VIM, psp 1120099, start date: 01.05.99

Description: Comparison of wind turbine certification carried out by 4 different certifying bodies. The objective is to establish a basis for harmonisation of certification procedures for wind turbines in EU.

Partners: Cres, Greece; DNV, Denmark; ECN, The Netherlands; GL, Germany

Sponsor: EC, contract JOR3CT980265

Contact person: Peter Hjuler Jensen, peter.hjuler@risoe.dk +45 46775037

Title: Probability Distribution of Fatigue Strength of Rotor Blades (PROFAR).

Programme and psp: VIM, psp 1120100-00

Description: The PROFAR project aims to give a deeper understanding of the blade to blade variation of the fatigue strength of rotor blades and determination of the statistical distribution function by which this variation can be described. The statistical parameters for this distribution function are calculated. The project includes fatigue test of 40 small blades and test of the materials used in the project.

Partners: TU-Delft, ECN, CRES.

Sponsor: EC JOR3-CT95-0266, Danish Energy Agency 51171/98-0021.

Contact person: Erik R. Jørgensen, erik.r.jorgensen@risoe.dk +45 46775064

Title: Laser Anemometry for Control and Performance Measurements on Wind Turbines

Program and psp: VIM, 1120102

Description: The current project is focused on designing a cost effective laser anemometer to provide information about the wind speed approaching the wind turbine and to implement this information into the turbine control system for regulating the blade pitch and the speed of the rotor. The anemometer is planned to be mounted on the nacelle of the turbine and focus a laser beam a distance in front of the turbine. The wind speed is determined from the Doppler shift induced on the light scattered off the airborne aerosols in the focus region of the laser beam. Theoretical investigations on the correlation between the wind speed measured in the small volume of the focus region and the total wind as seen by the whole rotor are in progress. Also, strategies for controlling the turbine using this new information are discussed and implemented. The main benefits from implementing the laser anemometer together with the control system are foreseen to be reduced mechanical stresses due to wind gusts in strong winds and an increased energy yield at low wind speeds.

Partners: Risoe, NEG Micon A/S Howden Laser Division, Wind Engineering Aps

Sponsor: EU

Contact person: Sten Frandsen, sten.frandsen@risoe.dk +45 46775072

Title: Operation and Maintenance Economics of Wind Turbines

Programme and psp: VIM, psp 1120105-00, start date: 1998.01.01.

Description: The purpose of the project is as follows. An update of data and statistics on establishment, operation and maintenance costs with specific weight on the 500-750 kW generation; to highlight questions regarding technically and economically lifetime of wind turbines using the data on operation and maintenance costs; to disseminate the results in Denmark and also Internationally.

Partners: Wind turbine industry, Elsam, Elkraft, and Danmarks Vindmølleforening.

Sponsors: Danish Energy Agency, case no 51171/96-0039 (UVE).

Contact person: Lars Henrik Hansen, lars.henrik.hansen@risoe.dk +45 46775076

Title: Guidelines for Design of Wind Turbines.

Programme and psp: VIM, psp 1120110, start date: 01.01.1999.

Description: The knowledge in wind turbine design gained within the last decades is immense and often only available in the form of scattered publications and various notes. The project 'Guidelines for the Design of Wind Turbines' was initiated in order to collect and compile this knowledge and present it in a clear and easily accessible publication. The publication is produced through a co-

operation between Risø National Laboratory and Det Norske Veritas; parties that are both involved in wind turbine certification. Thus, an important part of the guidelines is to outline current design requirements, which a new turbine must satisfy in order to achieve a type approval.

Partners: Det Norske Veritas (DNV)

Sponsor: Danish Energy Agency 'Development programme for renewable energy', case no 51151/98-0036.

Contact person: Jesper H. Schaarup, jesper.schaarup@risoe.dk +45 46775065

Title: Type approval of domestic wind turbines 2000.

Programme and psp: VIM, psp 1120112, start date: 00.01.01

Description: Commercial type approval (HC- and HB-Approval) according to "Teknisk grundlag for godkendelse af vindmøller med rotordiameter mellem 2 meter og 13 meter". 1) HB-Type approval of Calorius Type 37 ver 3.

Partners: -

Sponsor: -

Contact person: Poul Højholdt, poul.hoejholdt@risoe.dk +45 46775063

Title: Design Basis for Offshore Wind Turbines

Programme and psp: VIM, psp 1120115, start date:

Description: For the immediate future, 700 MW of offshore wind farms are planned for the relatively shallow waters around Denmark. In preparation of the first demonstration projects of each approx. 100 units it was proposed to conduct an investigation of the needs as to revision of the design basis for wind turbines and subsequently prepare such revision.

Partners: SEAS, Elsamprojekt, Rambøll, Niras, DNV

Sponsor: Danish Energy Agency

Contact person: Sten Frandsen, sten.frandsen@risoe.dk +45 46775072

Title: Availability for Offshore Wind Farms.

Programme and psp: VIM, psp 1120117, start date: 01.03.1999.

Description: The purpose of the project is to analyse the availability of offshore wind farms considering the difficulties in order to maintain the farm. The availability is analysed accounting for the influence of the environmental conditions (winds, waves, temperatures etc). The project seeks to include the preventive and the corrective maintenance as well as the accessibility for the personnel.

Partners: Risø National Laboratory (SYS and VEA) and Seas Wind Energy Centre.

Sponsor: Danish Energy Agency 'Development programme for renewable energy', case no 51171/98-0033.

Contact person: Morten Lybech Thøgersen, morten.thoegersen@risoe.dk +45 46775968

Title: Certification of Wind Turbines.

Program and psp: VIM, psp 1120120-00

Description: Certification of Wind Turbines is made by "Det Norske Veritas, Denmark" (DNV) in a technical co-operation with RISØ. This Co-operation will through its foundation in the DNV and RISØ organisations and on basis of their experienced and highly qualified staffs cover all technological areas necessary for design verification of wind turbines.

Partners: Det Norske Veritas, Denmark (DNV).

Sponsor: Private firm

Contact person: Erik R. Jørgensen, erik.r.jorgensen@risoe.dk +45 46775064

Title: Consultancy to the Danish Energy Agency

Programme and psp: VIM 1120122, start date January 2000

Description: Assistance to DEA in formulating the strategy and action plan for research and development in the period 2000 to 2004. Evaluation of individual applications for R&D funding under the wind energy research programmes EFP and UVE.

Partners: DEA.

Sponsor: The Danish Energy Agency

Contact person: Egon T.D. Bjerregaard, egon.bjerregaard@risoe.dk
+45 4677586

Title: Fatigue strength and life of wind turbine components

Programme and psp: VIM/AFM, 1120124-00, start date: May 1, 2000

Description: The aim of the project is to develop probabilistic tools that are useful in assessing the fatigue strength and service lifetime of large wind turbine components. Applying these tools it is possible to evaluate the uncertainties related to the computations of service life times which are necessary when judging the economical risks associated with establishing new offshore wind turbine sites.

Partners: Elsamprojekt, Risø: VIM and AFM, and some factories

Sponsor: ELTRA

Contact person: C.P. Debel (AFM), c.p.debel@risoe.dk +45 46775061 or
Niels Jakob Tarp-Johansen (VIM), niels.jacob.tarp-johansen@risoe.dk
+45 46775078

Title: Contract Concerning Services to DEA

Program and psp: VIM, psp 1120300, start date: January 2000

Description: The general purpose of the programme is to support and maintain the departments status as the national knowledge centre in the field of wind energy, and to assist the Danish Energy Agency (DEA) in managing the Danish Approval Scheme for Wind Turbines. The programme consists of three main categories subdivided into a total of 15 defined activities with individual goals for the actual one-year period. The main categories are 1) knowledge centre for wind energy; 2) Approval Scheme for Wind Turbines, 3) Test methods for type approval of wind turbines. The contract is based on obligations described in an ongoing agreement with DEA.

Partners: A number of companies and institutions are involved in the program

Sponsor: Danish Energy Agency

Contact person: Egon T.D. Bjerregaard, egon.bjerregaard@risoe.dk
+45 46775086

Title: Wind Turbine Round Robin Test program, IEA Annex 16

Programme and psp: VIM, psp 1120300-3-2, start date: 1999.01.01.

Description:

An extensive field measuring campaign has been conducted for the performance and load assessment of a round robin wind turbine at different test stations within the Annex XVI "Wind Turbine Round Robin Test Programme" to the IEA Wind Energy R&D Implementing Agreement. The objective of the work is to compare, to identify and to quantify the differences in the actual performance of and loads on the wind turbine, and to stipulate error sources in the total uncertainty budget of the measurements.

Partners: NREL , AWTS, CRES

Sponsor: ENS.

Contact person: Uwe S. Paulsen, uwe.schmidt.paulsen@risoe.dk
+45 46775055

Title: Mechanical Power Measurements on Wind Turbine Rotor Shaft
Programme and psp: VIM, psp 1120300-3-2, start date: 1999.01.01.

Description:

To improve and verify a new measurements concept for measuring mechanical power on a wind turbine. Analysis of the performance, accuracy and application possibilities are made.

Partners: FKS, Bergen Norway **Sponsor:** ENS.

Contact person: Uwe S. Paulsen, uwe.schmidt.paulsen@risoe.dk
+45 46775055

Title: Variable Speed/Poor Grid Power Transducer

Programme and psp: VIM, psp 1120301-8, start date: 2000.11.01.

Description: To test and document a power transducer suitable for wind turbine systems with variable speed or poor grid systems with large frequency fluctuations.

Partners:

Sponsor: ENS

Contact person: Uwe S. Paulsen, uwe.schmidt.paulsen@risoe.dk
+45 46775055

Title: Preliminary Technical Concept for Offshore Wind Farm near Helgoland

Programme and psp: VIM/INR, psp 1170 001-00, Start date: 30 June 2000

Description: In co-operation with Elsamprojekt, Risø assists Windland Energieerzeugung GmbH in preparing a concept for offshore wind farm near Helgoland. Windland develops a project for an offshore wind farm in two phases: 1) 100-120 MW, and 2) 750 MW. The Services are aimed at technical aspects and a sketch design level concept mainly re: Physical environment and sites, Technical concept of OWECs, foundations and installation, Wind farm electrical design, operation, noise calculation and visualisation.

Partners: Elsamprojekt A/S

Sponsor: Windland Energieerzeugung GmbH

Contact person: Jens Carsten Hansen, carsten.hansen@risoe.dk +45 46775074

Title: Project Completion Report with Perspective Analysis on the project Demonstration and Development of Technology and Planning in the Wind Energy Sector in Egypt

Programme and psp: VIM/INR, psp 1170 020-00, Start date: 05 November 1999

Description: The objectives of the assignment are as follows. 1) To document the status of development at the termination of the Danida support to Demonstration and Development of Technology and Planning in the Wind Energy Sector in Egypt. 2) To provide an assessment of possible future role in a wider context of the project outputs notably the Hurghada Wind Energy Technology Centre and the Wind Energy Master Plan for Egypt.

Partners: -

Sponsor: DANIDA

Contact person: Jens Carsten Hansen, carsten.hansen@risoe.dk +45 46775074

Title: Site Calibration, 60-MW Wind Farm at Zafarana, Egypt

Programme and psp: VIM/INR, psp 1170 076-02, Start date: September 1996

Description: The project provides a calibration of terrain descriptions of the 60-MW wind farm site at Zafarana, Egypt, for wind flow modelling using an adaptation of the IEC site calibration methodology. It will transfer of knowledge and experience about the methodology and the on-site wind conditions for accurate

wind turbine micro-siting and information about wind conditions before and after wind farm installation, including turbulence characteristics.

Partners: -

Sponsor: DANIDA

Contact person: Jens Carsten Hansen, carsten.hansen@risoe.dk +45 46775074

Title: Capacity Building on Technological and Economic Integration of Wind Energy and other Relevant Renewable Energy Technologies into the Electricity Systems of Pacific Island Countries (PICs)

Programme and psp: VIM/INR, psp 1170 089-00, Start date: 1 February 2000

Description: To contribute South Pacific regional programmes regarding human resource development “To build and strengthen the manpower and institutional capabilities ... in government departments and the private sector ...”, and energy “To strengthen the capacities of member countries to plan and manage their energy sectors by: ... policy development and energy planning ... promotion of renewable energy technologies ...”. Primary output is to assist development of a post-graduate course at University of South Pacific.

Partners: UNEP Collaborating Centre on Energy and Environment (UCCEE) located at Risø National Laboratory, Denmark

Sponsor: United Nations Environment Programme (UNEP) with the Energy and Ozone unit as responsible programme.

Contact person: Per Nørgård, per.norgaard@risoe.dk +45 46775068

Title: Wind Atlas for Egypt

Programme and psp: VIM/INR, psp 1170104-00, start date: 19/12/1997

Description: The objective is to improve the conditions for large-scale wind power development in Egypt through the following. 1) To establish a wind atlas for Egypt with emphasis on those parts where the wind regimes are attractive. 2) To establish an extended and updated wind atlas for the Gulf of Suez. 3) Provision of a decision tool for environmental impacts (especially on bird migration). 4) Provision of recommendations for a common framework for wind farm planning in the Gulf of Suez. 5) Transfer of knowledge and experience about the methodology applied in establishing a wind atlas.

Partners: Ornis Consult, DMU

Sponsor: DANIDA

Contact person: Jens Carsten Hansen, carsten.hansen@risoe.dk +45 46775074

Title: Project Design and Advisory Services to be Provided for the Implementation of Nrea/Danida 60-mw wind farm project at Zafarana

Programme and psp: VIM/INR, psp 1170106-00, Start date: January 1998

Description: As Sub-Consultant to COWI A/S to provide consulting services re: 1) *Pre-Award Phase:* to define scenarios for siting of wind turbines, calculate energy outputs, recommend an optimum use of land, review of power performance estimates submitted by the Tenders. 2) *Design Phase:* to prepare a detailed layout of the Wind Farm including optimisation of annual energy output. 3) *Construction Phase:* to define and review the power curve verification performed by an independent third party.

Partners: COWI A/S

Sponsor: DANIDA

Contact person: Jens Carsten Hansen, carsten.hansen@risoe.dk +45 46775074

Title: National Wind Turbine Test Station, India

Programme and PSP: VIM/INR, psp 1170111, start date 1999.01.01 (VIM psp 1120-111 in 1999)

Description: The main objective of the project is to promote and accelerate wind utilisation in India by establishing national facilities for testing and certification of wind turbines, for the preparation of standards and certification rules and for monitoring of the technical performance of wind turbines in India. During phase 1 of the project, covered by the existing contract for 1999 and 2000, a core professional organisation and facilities for stationary and field power performance measurements have been established and a preliminary type approval system has been developed. Major components in the project include institutional development, training in the form of workshops as well as on-the-job training during testing and certification, and technical assistance with equipment and facilities.

Partners: Det Norske Veritas, India; PEM Consult, Denmark; NIRAS A/S, Denmark.

Sponsor: Danida - Danish International Development Agency, Contract number 1363/503, File number 104.Indien.179

Contact person: Per Lundsager, per.lundsager@risoe.dk +45 46775045

Title: Demonstration Wind Farm Project Design, South Africa

Programme and psp: VIM/INR, psp 1170113-00, Start date: 22 January 1999

Description: The objective of the assignment is: as Core-Consultant to produce an agreed project document (Design Stage) in the standard DANCED format. It fully describes possible DANCED support to bulk wind energy generation in South Africa through support to the establishment of the Slangkop demonstration wind farm in Darling, Western Cape, generated through the participatory project development methodology outlined in the DANCED Project Management Manual, project.

Partners: Rambøll and Adventures in Sustainable NRG (NL)

Sponsor: DANCED

Contact person: Jens Carsten Hansen, carsten.hansen@risoe.dk +45 46775074

Title: Energy Management in Lesotho – Wind Energy Advisor

Programme and psp: VIM/INR, psp 1170116-00, Start date: February 1999

Description: Objectives are as follows. 1) Assistance in selecting areas with potential wind energy resources in Lesotho. 2) To make wind resource assessment for selected areas of Lesotho and to present results in a wind atlas format. 3) To apply wind resource assessment results in selected wind-power project feasibility study. 4) To recommend inputs to a wind energy programme as part of the Lesotho Energy Master Plan. The project supplies and installs 3 sets of measurement equipment, and it measures at selected sites for 1 year after which data analyses and feasibility study are performed.

Partners: Rambøll

Sponsor: DANCED

Contact person: Jens Carsten Hansen, carsten.hansen@risoe.dk +45 46775074

Title: Wind Measurements and Wind Power Feasibility at Selected Sites in Tanzania

Programme and psp: VIM/INR, psp 1170118-00, start date: 01 January 2000

Description: The objectives of the assignment are as follows. a) To provide tools and build the capacity in Tanzania to enable wind resource assessment at selected locations, adequate for determining the feasibility of wind power utilisation. b) To determine the feasibility of establishing a pilot wind farm connected to the public power supply system in one of four pre-selected localities.

The project supplies and installs four sets of measurement equipment, and it measures at the pre-selected sites for one year after which data analyses and feasibility study are performed.

Partners: -

Sponsor: DANIDA

Contact person: Per Nørgård, per.norgaard@risoe.dk +45 46775068

5.6 Measurement and Data Technique (MDT)

Title: Management and Administration.

Programme and psp: MDT, psp 1160000-1, start date:

Description: The project includes the MDT activities that are associated with management, administration, internal meetings and other activities not related to any specific projects or to the general research and development project.

Partners: None

Sponsor: Internal..

Contact person: Søren E. Larsen, soeren.larsen@risoe.dk +45 46775012

Title: Small Measuring Stations.

Programme and psp: MDT, psp 1160001-00, start date: -

Description: Establishment, service and data management for a number of small meteorological measuring stations, typically managed for specific projects or as part of the long term strategic measurements of the department.

Partners: -

Sponsor: Internal, and many different external sponsors.

Contact person: Søren E. Larsen, soeren.larsen@risoe.dk +45 46775012

Title: General Technological Development and Maintenance

Programme and psp: MDT, psp 1160003-00, start date: -

Description: The project includes the technological development and maintenance of the technical facilities and activities charged to EME.

Partners: None

Sponsor: Internal.

Contact person: Søren E. Larsen, soeren.larsen@risoe.dk +45 46775012

Title: Risø Mast.

Programme and psp: MDT, psp 1160 003-01, start date: 06/06/1957

Description: Monitoring of meteorological conditions at Risø (nuclear facility) and establishment of a climatological reference data set for Denmark. Profiles of wind speed, direction, air temperature. Also included are measurements of direction variance, relative humidity, barometric pressure, precipitation, duration of sunshine, and solar insulation. Occasional testing of other meteorological sensors.

Partners: None

Sponsor: None

Contact person: Niels G. Mortensen, niels.g.mortensen@risoe.dk +45 46775027

Title: Offshore Data Logging.

Programme and PSP: MDT, PSP 1160004, start date: 1999-01-01.

Description: The project focuses on installing, servicing and storing data from a number of off-shore measuring stations in the inner Danish Waters for SEAS Wind Energy Centre.

Partners: None.

Sponsor: SEAS Wind Energy Centre.

Contact person: Ole Frost Hansen, ole.frost@risoe.dk +45 46775525

Title: Small Contracts.

Programme and psp: MDT, psp 1160007-1, start date: 2000-01-01.

Description: The project comprises smaller commissioned work and supply of measurement equipment. The customers are mainly companies or institutions working with wind energy, meteorology or environmental protection. Examples are technical support for the Environmental Authorities of Copenhagen and operation of offshore meteorology masts for SEAS Wind Energy Centre.

Partners: None.

Sponsor: København Kommunes Miljøkontrol, SEAS Wind Energy Centre, Faroe Island Harbour Authorities, etc.

Contact person: Ole Frost Hansen, ole.frost@risoe.dk +45 46775525

Title: Lesotho Met. Stations.

Programme and psp: MDT, psp 1160008-1, start date: 1999-12-01.

Description: The project comprises the supply of three state of the art automatic battery-powered wind-measuring stations for 30 m masts recording wind speed statistics, wind direction, air pressure and temperature. The stations include sensors, signal conditioning units, data logger, data storage and data reading equipment. The stations are supplied to psp 1170116-00, Energy Management in Lesotho, which in turn supplies the stations to Danced.

Partners: None.

Sponsor: Danced.

Contact person: Ole Frost Hansen, ole.frost@risoe.dk +45 46775525

Title: Tanzania Meteorological Stations.

Programme and psp: MDT, psp 1160009-1, start date: 2000-02-01.

Description: The project comprises the supply of four state of the art automatic battery-powered wind-measuring stations for 30 m masts recording wind speed statistics, wind direction, air pressure, solar radiation and temperature. The stations include sensors, signal conditioning units, data logger, data storage and data reading equipment. The stations are supplied to psp 1170118-00, Tanzania wind measurements, which in turn supplies the stations to Danida.

Partners: None.

Sponsor: Danida.

Contact person: Ole Frost Hansen, ole.frost@risoe.dk +45 46775525

Title: Equipment for NWTTS, India.

Programme and psp: MDT, psp 1160010-1, start date: 1999-12-01.

Description: The project comprises the supply of two complete sets of sensors and data acquisition equipment for testing of two wind turbines at the National Wind Turbine Test Station at Kayathat in India. Each set constitutes a self-contained measurement system capable of performing power curve measurement according to IEC TC88 1400-12, as well as type testing according to the Indian provisional type test system.

Partners: None.
Sponsor: Danida.
Contact person: Ole Frost Hansen, ole.frost@risoe.dk +45 4677 5525

Title: DMU-LMP Measuring Stations.
Programme and psp: MDT, psp 1160011-1, start date: 1999-12-01.
Description: The project comprises the supply of one meteorological station for the LMP national environmental programme. The station is based on a newly developed data acquisition unit, which digitises analogue and pulse frequency modulated inputs locally, and transfers data serially to a central computer. In addition three existing stations are updated to the level of the new station.
Partners: None.
Sponsor: National Environmental Research Institute of Denmark, NERI.
Contact person: Ole Frost Hansen, ole.frost@risoe.dk +45 46775525

5.7 Wind Turbine and Blade Testing (VMD)

Title: Management of Wind Turbines and Workshop (at The Test Station)
Programme and psp: VMD, psp 1125002
Description: The project is used to check the income and expenditure in connection with operation of the wind turbines erected at Risø and some parts of expenditures at the workshop.
Partners: None
Sponsor: NESA
Contact person: Per Harvøe, per.harvoe@risoe.dk +45 46775038

Title: Experimental Investigation of Ultimate Loads
Programme and psp: VMD, psp 1125086-00, start date: 01-01-97
Description: The purpose is measure both wind field and structural response on wind turbines at extreme conditions (high wind and large wind gusts) and to describe extreme events in order to support and improve codes and standards.
Partners: NEG Micon
Sponsor:
Contact person: Søren M Petersen, soeren.m.petersen@risoe.dk +45 46775043

Title: Identification of Variables for Site Calibration and Power Curve Assessment in Complex Terrain (Sitepariden)
Programme and psp: VMD, psp 1125101-00, start date 1998.08.01
Description: The Sitepariden project aims to contribute to a better understanding of the parameters which affect the power curves in complex terrain as compared to the parameters in flat terrain. The project consists of two major components: 1. Site calibration and power curve assessment in flat and complex terrain on geometrically identical turbines and 2. Inter-comparison of the response of some of the partner-used cup anemometers in natural conditions both in flat and complex terrain. Most of the tasks are completed and data analysis is commenced.
Partners: Risø, CRES, DEWI, Windtest, ECN, NEG Micon A/S, Bonus
Sponsor: EU
Contact person: Ioannis Antoniou, ioannis.antoniou@risoe.dk +45 46775082

Title: CLASSCUP

Programme and psp: VMD, psp 1125103-00, start date: 1998.09.01.

Description: The primary objective is to produce a cup anemometer design has a combined inherent uncertainty of less than 0.5 % or 0.05 m/s, related to a developed classification system. A secondary objective is to prepare a classification system, which will allow users of anemometry in the wind energy field to select anemometers suited to specific required applications. For known ranges of environmental operational conditions, for wind turbines and cup anemometers, the user of the system shall be able to assess the accuracy of cup anemometers, and to compare different designs.

Partners: FFA Sweden, DEWI, Germany.

Sponsor: EU RTD Non Nuclear Energy Programme JOULE III JOR3-CT98-0263.

Contact person: Troels Friis Pedersen, troels.friis.pedersen@risoe.dk
+45 46775042

Title: ADAPTURP

Programme and psp: VMD, psp 1125108-00, start date: 01-12-98

Description: The purpose is to examine the total design envelope criteria of selected Wind Turbines for complex terrain operation. And to quantify and verify the performance of the adapted stall, pitch and variable speed Wind turbines through detailed wind, load, power and machine condition measurement programs.

Partners: CRES, CIEMAT, RISO, TG, Gamesa, ECN

Sponsor:

Contact person: Søren M Petersen, e-mail: soeren.m.petersen@risoe.dk
+45 46775043

Title: Performance and Load Measurements on Land and Offshore Installed Wind Turbines without a Meteorological Mast (SODAR)

Programme and psp: VMD, psp 1125114-00, start date 1999

Description: The SODAR project aims to study the possibility of the Sonic Detection And Ranging Devices to measure the wind velocity by means of remote sensing. The reason for this is that wind turbines still grow larger and the so do the costs associated with the installation of meteorological masts for the measurement of the wind characteristics. In this phase of the project a SODAR was situated close to the Risø 123m meteorological mast. The goal of the project was to study the instrument itself and to compare the results to cup anemometer measurements. Encouraging results have been obtained.

Partners: Risø

Sponsor: Danish Energy Agency

Contact person: Ioannis Antoniou, ioannis.antoniou@risoe.dk +45 46775082

Title: NEG Micon.

Programme and psp: VMD/PRV, psp 1155008-07, start date: 01-02-97

Description: Power curve and rotor load measurements on two turbines erected in a wind farm in Jutland.

Partners: NEG Micon

Sponsor: NEG Micon

Contact person: Søren M Petersen, soeren.m.petersen@risoe.dk +45 46775043

Title: NEG Micon A/S
Programme and psp: VMD/PRV, psp 1155008-08, start date:
Description: Measurement of rotor loads
Partners: NEG Micon
Sponsor: NEG Micon
Contact person: Søren M Petersen, e-mail: soeren.m.petersen@risoe.dk

Title: NEG Micon A/S
Programme and psp: VMD/PRV, psp 1155016-01, start date 1999
Description: Power curve and structural loads measurements
Partners: Risø
Sponsor: NEG Micon
Contact person: Ioannis Antoniou, ioannis.antoniou@risoe.dk +45 46775082

Title: NEG Micon A/S
Programme and psp: VMD/PRV, psp 1155016-02, start date:
Description: Load and power curve measurement.
Partners: NEG Micon
Sponsor: NEG Micon
Contact person: Allan Vesth, e-mail: allan.vesth@risoe.dk +45 46775049
Søren M Petersen, soeren.m.petersen@risoe.dk +45 46775043

Title: NEG Micon USA
Programme and psp: VMD/PRV, psp 1155016-03, start date 1999
Description: Power curve and structural loads measurements
Partners: NEG Micon
Sponsor: NEG Micon
Contact person: Ioannis Antoniou, ioannis.antoniou@risoe.dk +45 46775082

Title: Load Measurements on NEG Micon
Programme and psp: VMD/PRV, psp 1155016-04, start date: 1999.06.01.
Description: To provide load documentation
Partners: **Sponsor:** NEG Micon, Randers Denmark
Contact person: Uwe S. Paulsen, uwe.schmidt,paulsen@risoe.dk
+45 46775055

Title: NEG Micon, USA
Programme and psp: VMD/PRV, psp 1155016-06
Description: Confidential
Partners: NEG Micon A/S.
Sponsor: NEG Micon A/S.
Contact person: Troels Nielsen, troels.eske.nielsen@risoe.dk +45 46775081

Title: Oak Creek Measurements
Programme and psp: VMD/PRV, psp 1155016-07, start date: 01-05-00
Description: Confidential
Partners:
Sponsor:
Contact person: Søren M Petersen, e-mail: soeren.m.petersen@risoe.dk
+45 46775043

Title: NEG Micon
Programme and psp: VMD/PRV, psp 1155016-08, start date October 2000
Description: Power curve and structural loads measurements
Partners: NEG Micon
Sponsor: NEG Micon
Contact person: Ioannis Antoniou, ioannis.antoniou@risoe.dk +45 46775082

Title: NEG Micon DK.
Programme and psp: VMD/PRV, psp 1155016-09
Description: Measurement of power performance.
Partners: NEG Micon
Sponsor: NEG Micon
Contact person: Troels Nielsen, troels.eske.nielsen@risoe.dk +45 46775081

Title: Vestas Spain. **Confidential**
Programme and psp: VMD/PRV, psp 1155017-01, start date: 01-03-99
Description: Measurement project.
Partners: Vestas
Sponsor: Vestas
Contact person: Søren M. Petersen, soeren.m.petersen@risoe.dk
+45 46775043

Title: Wincon. **Confidential**
Programme and psp: VMD/PRV, psp 1155018-01, start date:
Description: Measurement system
Partners: Wincon
Sponsor: Wincon
Contact person: Søren M Petersen, soeren.m.petersen@risoe.dk
+45 46775043

Title: Mechanical Rotor Shaft Measurements on Wind Turbine with new soft brake option
Programme and psp: VMD/PRV, psp 1155019-01, start date: 1999.01.01.
Description: To improve and verify a new soft braking concept for stopping a wind turbine. Analysis of the performance and safety are made.
Partners: Svendborg Brakes
Sponsor: Svendborg Brakes
Contact person: Uwe S. Paulsen, uwe.schmidt.paulsen@risoe.dk 45 46775055

5.8 Type Approval and Certification (SPK)

Title: Blade Testing, LM Glasfiber A/S
Programme and psp: SPK, psp 1165001
Description: Sparkær Centre is an accredited testing laboratory for wind turbine blades. The strength of the blade static as well as fatigue is tested. Furthermore is the dynamic behaviour, such as natural frequencies and damping measured. The tests are carried out on the facilities in Sparkær and as field measurements.
Partners: LM Glasfiber A/S
Sponsor: LM
Contact person: Carsten Skamris, c.skamris@risoe.dk +45 46775066

Title: Blade Testing, Vestas Wind Systems A/S

Programme and psp: SPK, psp 1165002

Description: Sparkær Centre is an accredited testing laboratory for wind turbine blades. The strength of the blade static as well as fatigue is tested. Furthermore the dynamic behaviour, such as natural frequencies and damping, is measured. The tests are carried out on the facilities in Sparkær.

Partners: Vestas Wind Systems A/S

Sponsor: Vestas

Contact person: Carsten Skamris, c.skamris@risoe.dk +45 46775066

6 Committee and Expert Group Memberships

Aagaard Madsen, H. Science Panel, NREL-NASA Ames Unsteady Aerodynamics 10m HAWT Wind Tunnel Test

Aarhus, K. Danish Energy Agency, Advisory Board. Working Group: Certification and Testing of Blades for Wind Turbines

Barthelmie, R. Technical Committee for the Offshore Wind Energy in Mediterranean and Other European Seas (OWEMES) 2000

Barthelmie, R. American Association of Aerosol Research, Atmospheric Aerosols Working Group

Barthelmie, R. Air and Waste Management Association, Visibility Working Group

Barthelmie, R.J. European Aerosol Society Modelling, Working Group

Bjerregaard, E. Danish Energy Agency, Task Group for Wind Energy R&D

Bjerregaard, E. *Secretary*, Danish Energy Agency, Approval Scheme for Wind Turbines

Christensen, C.J. *Chairman*, International Electrotechnical Committee, Technical Committee 88, Wind Turbine Systems

Christensen, C.J. Dansk Elektroteknisk Komite, DEK. Teknisk Udvalg 88 (S-588) Sikkerhed af Elproducerende Vindmøller (Danish Electrotechnical Committee, Technical Committee S-588, Safety on Wind Turbine Generator Systems)

Christensen, C.J. *Chairman*, European Standards for Wind Turbines, CENELEC BTTF 83-2

Frandsen, S. International Electrotechnical Committee (IEC), Technical Committee TC88, Working Group 6, Test procedures for Wind Turbine Testing

Frandsen, S. Dansk Elektroteknisk Komite, DEK. Teknisk Udvalg 88 (TU88), Sikkerhed af Elproducerende Vindmøller (Danish Electrotechnical Committee, Technical Committee TU88, Safety on Wind Turbine Generator Systems)

Frandsen, S. International Electrotechnical Committee, Technical Committee 88 (TC 88), Safety of Wind Turbine Generator Systems, Working Group 3, Offshore Issues

Friis Pedersen, T. Technical Committee on Certification and Type Approval, Danish Energy Agency

Friis Pedersen, T. *Convenor*, International Electrotechnical Committee (IEC), Technical Committee 88, Maintenance Task MT12, Power Performance Measurement Procedures

Friis Pedersen, T. Dansk Standard (DS). Teknisk Udvalg (S588), Sikkerhed Elproducerende Vindmøller (Danish Standard, Technical Committee S588, Safety on Wind Turbine Generator Systems)

Gryning, S.E. *Honourable Secretary*, European Association for the Science of Air Pollution (EURASAP)

Gryning, S.E. *Chairman*, Executive Committee, NOPEX

Gryning, S.E. International Scientific Committee on the International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes

Gryning, S.E. *Chairman*, Scientific Steering Committee on NATO/CCMS International Technical Meetings on Air Pollution Modelling and Its Application, Conference Series

Gryning, S.E. Science Panel on Atmospheric Chemistry Research (DG XII, EU)

Gryning, S.E. *Guest Editor*, Theoretical and applied Climatology. Special issue on “Land-surface/atmosphere exchange in high-latitude landscapes”

Gryning, S.E. *Editorial Advisory Board*, Bulgarian Geophysical Journal

Hasager, C.B. Corps of External Examiners, University of Copenhagen

Hasager, C.B. Corps of External Examiners, Roskilde University Centre (RUC)

Hasager, C.B. *Convenor*, European Geophysical Society, Symposium on Land Surface Parameterisation in Global Hydrological and Atmospheric Models

Hasager, C.B. *Convenor*, European Geophysical Society, Symposium on Inter-annual Variability in Biosphere-atmosphere Exchange

Hasager, C.B. *Convenor*, European Geophysical Society, Symposium on Surface Fluxes - Local Scale Over Land

Hasager, C.B. *National EC-representative*, DG VI, Working Group on Remote Sensing Applications on Forest Health Assessment

Hasager, C.B. Steering Committee, MEAD, EU RTD project

Hasager, C.B. *Treasurer*, Erdas Imagine, Danish User Group

Hasager, C.B. *Associate Scientist*, European Space Proposal: surface processes and ecosystems changes through response analysis (SPECTRA). A land surface satellite space mission proposal for the years 2005-

Hauge Madsen, P. *Chairman*, Dansk Standard (DS). Teknisk Udvalg S588, Sikkerhed af Elproducerende Vindmøller (Danish Standard, Technical Committee S588, Safety of Wind Turbine Generator Systems)

Hauge Madsen, P. *Chairman*, International Electrotechnical Committee, Technical Committee 88 (TC 88), Safety of Wind Turbine Generator Systems, Working Group 7, Revision of Part 1: Safety Requirements

Hauge Madsen, P. *Chairman*, International Electrotechnical Committee (IEC). Technical Committee 88 (TC88), Safety of Wind Turbine Generator Systems, Working Group 9: Certification Procedures of Wind Turbines

Hauge Madsen, P. International Electrotechnical Committee (IEC). Technical Committee 88 (TC88)

Hauge Madsen, P. European Standards for Wind Turbines, CENELEC BTTF 83-2

Hauge Madsen, P. *Board Member*, Fuel and Combustion Technology Association, Danish Society of Chemical, Civil, Electrical and Mechanical Engineering (IDA)

Hauge Madsen, P. *Editorial Board*, “Wind Energy”, Wiley & Sons

Hauge Madsen, P. Wind Energy Advisory Committee, Danish Energy Agency

Hauge Madsen, P. Danish Energy Agency, Committee on Implementation of IEC-standards in the Danish Type Approval Scheme

Hauge Madsen, P. *National Member*, IEA R&D Wind Executive Committee

Hjuler Jensen, P. Det Norske Veritas (DNV), Expert Committee for Wind Turbines

Hjuler Jensen, P. Germanischer Lloyd, Expert Committee for Wind Turbines,

Hjuler Jensen, P, Risø National Laboratory, Steering Committee, Approval Secretariat

Hjuler Jensen, P. International Electrotechnical Committee (IEC). Technical Committee 88 (TU88), Safety of Wind Turbine Generator Systems

Hjuler Jensen, P. Dansk Elektroteknisk Komite, DEK. Teknisk Udvalg 88 (TU 88) Sikkerhed af Elproducerende Vindmøler (Danish Electrotechnical Committee, Technical Committee TU 88 Safety on Wind Turbine Generator Systems)

Hjuler Jensen, P. Committee on Criteria for Design and Certification of Wind Turbines, Danish Energy Agency

Hjuler Jensen, P. International Electrotechnical Committee (IEC), Technical Committee 88 (TC 88) Safety on Wind Turbine Generator Systems, MT-14

Hjuler Jensen, P. *Vice President*, European Wind Energy Association (EWEA)

Hjuler Jensen, P. European Standards for Wind Turbines, CENELEC BTTF 83-2

Hummelshøj, P. *Secretary*, Nordic Society for Aerosol Research (NOSA)

Hummelshøj, P. International Advisory Organisation Committee, The Aerosol Society

Højholdt, P. Technical Committee for Domestic Wind Turbines

Jensen, N.O. European Geophysical Society. *President of Meteorology*, Oceans and Atmosphere (OA)

Jensen, N.O. *Secretary*, Steering Committee, Danish Society for Atmospheric Research (DSAR)

Jensen, N.O. National Committee of IUTAM (International Union of Theoretical and Applied Mechanics)

Jensen, N.O. National Committee for the International Geosphere-Biosphere Programme (IGBP)

Jensen, N.O. *Editorial Board*, Boundary-Layer Meteorology

Jensen, N.O. *President*, International Commission of Dynamic Meteorology (ICDM) under IAMAS, International Association of Meteorology and Atmospheric Physics

Jensen, N.O. *Associate Editor*, Quarterly Journal of Royal Meteorological Society

Jensen, N.O. Expert Group Geoscience, Swedish Natural Science Research Council

Jensen, N.O. Scientific Advisory Group, Pan European Programme for the Intensive Monitoring of Forest Ecosystems

Jørgensen, E.R. Steering Committee DNV Wind Turbine Certification

Jørgensen, H.E. *Vice President*, Danish Meteorological Society

Kristensen, L. *Associate Editor*, Quarterly Journal of Royal Meteorological Society

Krogsgaard, J. *Editorial Committee*, European Small Hydro Power Association (ESHA), Atlas of European Small-Scale Hydropower Potential

Krogsgaard, J. *Editorial Committee*, European Small Hydro Power Association (ESHA), Layman's Guidebook on how to develop a small hydro site

Krogsgaard, J. *Governing Board*, European Small Hydropower Association (ESHA)

Krogsgaard, J. *Editorial Committee*, EU Alternner II Program Energy for a Free Europe

Landberg, L. Steering Committee of Off-shore Wind Energy Network, UK

Landberg, L. Supervisory Committee of the EFP project "Effective siting of wind farms"

Landberg, L. *Editorial Board*, Wind Engineering

Landberg, L. Steering Committee, DSAR (Danish Society of Atmospheric Research), Meteorology and Wind Energy

Larsen, S.E. National Committee for the International Geosphere-Biosphere Programme (IGBP)

Larsen, S.E. Committee on the Marine Aerosol and Gas Exchange (MAGE) Subproject of the International Global Atmospheric Chemistry Programme IGBP

Larsen, S.E. National Committee for Climate Research. Danish Committee of the World Climate Programme (WCRP)

Larsen, S.E. Scientific Committee of EUROTRAC2

Larsen, S.E. Steering Committee, EUROTRAC2-CAPP Project

Larsen, S.E. Steering Committee DSAR (Danish Society of Atmospheric Research)

Mann, J. Scientific Committee on Boundary Layers and Turbulence, American Meteorological Society

Mikkelsen, T. *Board Member*, Board of Governors, Risø National Laboratory (elected by Risø's academic personnel)

Mikkelsen, T. *Board Member*, Risø Strategic Advisory Panel for Nuclear Safety

Mikkelsen, T., *Board Member*, RODOS Management Group RMG, Radiation Protection Research Programme EU, DG-XI/XII

Mikkelsen, T. *Work Group Leader* for Atmospheric Dispersion within the RODOS real-time Decision Support System, Community Research

Mikkelsen, T., *Project Co-ordinator*, Fifth Framework Program on Nuclear Science and Technology "ENSEMBLE", European Commission

Mikkelsen, T., *Convenor*, European Geophysical Society (EGS) - Mesoscale Transport and Diffusion

Mikkelsen, T. *Guest Editor*, Journal of Physics and Chemistry of the Earth, 1996 ff.

Mortensen, N.G. Nordic TeX Committee

Mortensen, N.G. Quality Control Committee on Exhibition on Energy Production and Environment

Mortensen, N.G. Corps of External Examiners, University of Copenhagen

Mortensen, N.G. Corps of External Examiners, Cairo University

Nørgård, P. Science and Technology Committee, The Society of Danish Engineers

Nørgård, P. *Chairman*, Society for Technology Assessment, The Society of Danish Engineers

Nørgård, P. Corps of External Examiners, Aalborg University, Denmark

Petersen, E.L. EUREC-Agency EEIG

Petersen, E.L. *Editorial Board*, International Journal of Solar Energy

Petersen, E.L. *Editor*, "Wind Energy", Wiley & Sons

Rasmussen, F. *Editorial Board*, "Wind Energy", Wiley & Sons

Rasmussen, F. Science Panel, NREL-NASA Ames Unsteady Aerodynamics 10m HAWT Wind Tunnel Test

Skamris, C. International Electrotechnical Committee (IEC), Technical Committee TC88, Working Group 9: Certification Procedures of Wind Turbines

Skamris, C. Danish Energy Agency, Technical Committee (IEC), Technical Committee on Certification and Type Approval

Skamris, C. Danish Energy Agency, Advisory Committee for Wind Turbine Blades

Skamris, C. Danish Energy Agency, Advisory Board. Working Group: Certification and Testing of Blades for Wind Turbines

Sørensen, L.L. Scientific Committee of the Nordic Network for Research and Education Project "Integrated approaches to drainage basin nutrient inputs and coastal eutrophication"

Sørensen, P. International Electrotechnical Committee (IEC), Technical Committee TC88, Working Group 10

Thykier-Nielsen, S. Ad Hoc Group on the NEA/CEC Intercomparison Exercise on PCA Codes
 Vignati, E. Association for Aerosol Research (GaeF)
 Winther-Jensen, M. Advisory Committee on Insurance, The Danish Wind Power Utilities
 Winther-Jensen, M. International Electrotechnical Committee (IEC). Technical Committee 88 (TC88), Working Group 8, Testing of Rotor Blades
 Winther-Jensen, M. European Standards for Wind Turbines, CENELEC BTTF 83-2, Technical Committee on Labour Safety

7 Publications

7.1 International publications

- Andersen, K.K.; Madsen, H.; Hansen, L.H. (2000) Modelling the heat dynamics of a building using stochastic differential equations. *Energy and Buildings*, **31**, 13-24
- Anfossi, D.; Degrazia, G.; Ferrero, E.; Gryning, S.E.; Morselli, M.G.; Trini Castelli, S. (2000) Estimation of the Lagrangian structure function constant C_0 from surface-layer wind data. *Boundary-Layer Meteorology*, **95**, 249-270
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- G.; Ricci, L.; Nielsen, M.; Allan, B.J.; Coe, H.; McFiggans, G.; Plane, J.M.C.; Collett, J.L.; Moore, K.F.; Sherman, D.E. (2000) ACE-2 HILL-CLOUD. An overview of the ACE-2 ground-based cloud experiment. *Tellus B*, **52**, 750-778
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- Dannemand Andersen, P.; Hjuler Jensen, P. (2000) Wind energy today and in the 21st century. *Int. J. Global Energy Iss.*, **13**, 145-158
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- Geernaert, G.L.; de Leeuw, G.; Despiou, S.; Larsen, S.E. Noone, K. (eds) (2000) CAPMAN. Coastal Air Pollution Meteorology and Air-sea Nutrient exchange. Subproject description. EUROTRAC-2. GSF-Forschungszentrum für Umwelt und Gesundheit GmbH. International Scientific Secretariat, Munich, 58 pp.
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- Gryning, S.E.; Hansen, F. (1999) Heat, momentum and vapour fluxes and profiles of wind at the agricultural site Tisby (data set on appended CD-ROM). *Agric. Forest Meteorol.*, **98/99**
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- Frandsen, S. (2000) Rapporteur at Université de La Rochelle (FR) PHD degree: Constantin Condaxakis, "Controle passif des pales d'eoliennes et simulation de leur comportement"
- Fuglsang, P. (2000) Optimum design of wind turbine rotors. Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August
- Fuglsang, P. (2000) MDO design methods for wind turbines. Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August
- Fuglsang, P., 2000, Optimum design of airfoils for wind turbines Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August
- Fuglsang, P. (2000) MDO design examples. Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August
- Gryning, S. E. (2000) Evaluation and selection of applications - criteria and practice. Lecture, FIRST seminar, Danish Research Agency, information on resources and employment, "How to obtain EU funding". Parkens Conference Center, Hall of Carlsberg, Copenhagen, 29 November 2000
- Hansen, L.H. (2000) Committee member of PhD project on "Dynamic modeling of energy systems", IMM, Danish Technical University, 1 January 1998
31 December 2000
- Hansen, M.H. (2000) Modal analysis of wind turbine blades. Lecture at course, Institut for Faststofmekanik, Danish Technical University, January
- Hasager, C.B.(2000)Nature and technique. Herlev Skole, 28 November

- Jensen, N.O. (2000) Evaluation of exogenic processes, Swedish Natural Science Research Council, Stockholm (SE), 14-19 January
- Johansen, J. (2000) Energy technique as basis for a career (in Danish). Briefing session for students, Institut for Energiteknik, Danish Technical University, Lyngby (DK), 6 April 2000
- Landberg, L. (2000) WAsP course, Danish Technical University, Institut for Energiteknik, Lyngby (DK), 10 and 13 April 2000
- Landberg, L., N.G. Mortensen, O. Rathmann and B. Lange (2000). Three-day course in WAsP: the Wind Atlas Analysis and Application Programme. Nihon Daigaku Kaikan, Idgaya, Tokyo, Japan, 20-22 June
- Larsen, S.E. Lectures in micro-scale meteorology, Niels Bohr Institute for Astronomy, Physics and Geophysics, University of Copenhagen, spring term
- Mann, J. (2000) Stochastic loading of structures, DCAMM PhD School for Experimental Fluid Mechanics and Data Interpretation, Danish Technical University, 13-21 June
- Mikkelsen (2000) Atmospheric local-scale dispersion modelling. ARGOS course. Danish Meteorological Institute, 27 January
- Mortensen, N.G. (2000). Three-day course in WAsP: the Wind Atlas Analysis and Application Program. Elektrowni "Rybnik" S.A. w Stodolach, Rybnik, Poland, 6-8 November
- Mortensen, N.G. (2000). Two-day training course in siting of wind-monitoring systems. Elektrowni "Rybnik" S.A. w Stodolach, Rybnik, Poland, 9-10 November
- Mortensen, N.G. (2000). Two-day training course in meteorological measurements and data analyses. Elektrowni "Rybnik" S.A. w Stodolach, Rybnik, Poland, 11-12 November
- Mortensen, N.G., O. Rathmann L. Landberg, and J. Badger (2000). Three-day course in WAsP: the Wind Atlas Analysis and Application Program. Risø National Laboratory, Roskilde, Denmark, 5-7 December
- Mortensen, N.G.; Rathmann, O. Lange, B.; Landberg, L. (2000) WAsP course, Tokyo (JP), 20-22 June 2000
- Nørgaard, P. (2000) Educational programme for the staff at the Energy & Environment Offices in Denmark. Risø National Laboratory, 28-29 August
- Nørgaard, P. (2000) Educational programme for the staff at the Energy & Environment Offices in Denmark. NEG Micon A/S, Randers (DK), 12 September
- Rathman, O.; Nørgaard, P. (2000) Wind resource training workshop, part 1, Most, The Czech Republic, 5-7 September
- Rathman, O.; Nørgaard, P. (2000) Wind resource training workshop, part 2, Foundation for Assistance to Local Democracy, Prague, 10-12 October
- Sørensen, L.L. (2000) Atmospheric nitrogen load to Kattegat. Aalborg University, May
- Sørensen, L.L. (2000) Lecture for students from the Faro Islands, Risø National Laboratory, October
- Sørensen, N.N. (2000) CFD in wind energy. Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August
- Sørensen, N.N. (2000) Mesh generation. Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August
- Sørensen, N.N. (2000) 2-D airfoil computations. Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August
- Sørensen, N.N. (2000) 3-D rotor computations. Course on Advanced topics in wind turbine aerodynamics, Lyngby (DK), 16-25 August.
- Thyker-Nielsen, S. (2000) The RIMPUFF atmospheric local- and meso-scale dispersion model. ARGOS course, Danish Meteorological Institute (DK), 27 Jan 2000. Unpublished

7.9 Seminars held in the department

Badger, J. "Potential vorticity unshielding - a mechanism for rapid mid-latitude synoptic development and singular vector growth" (November)

Bergmann, J. "The atmospheric angular momentum balance - revisited - implications on frictional boundary layers" (May)

Bergmann, J. "Implications of the stability caused vertical decrease of density on constant flux layers and idealised stable ABL" (June)

Borgas, M.S. "Peak-to-mean fluctuations of chemical concentrations in plumes in turbulent flows" (October)

Falge, E. "The natural ecosystem global carbon and energy flux network" (August)

Pecséli, H, "Fish swimming - is it worthwhile?" (October)

Takle, E.S. "Pilot study of influences of atmospheric pressure fluctuations on fluxes of trace gases from soils" (May)

7.10 Assignments and awards

Søren E. Larsen, Group Achievement Award for the Mars Pathfinder Atmospheric Structure and Meteorology Instrument Operations Team presented by The National Aeronautics and Space Administration in recognition of exceptional performance in the planning, operation, and data analysis of the atmospheric structure and meteorology instrument

Søren E. Larsen, Group Achievement Award for the Mars Pathfinder Participating Scientists Experiment Operations Team presented by The National Aeronautics and Space Administration in recognition of exceptional performance in the support of the science analysis interpretation, and display of the Mars Pathfinder data

8 Staff and Guests

Administration

Clausen, Gitte, *Project Administrator* (maternity leave from 14 December)

Hyllested, Karen, *Administrative officer* (from 1 October)

Harvøe, Per, *Administrative Officer*

Madsen, Peter Hauge, *Deputy Department Head*

Petersen, Erik Lundtang, *Department Head*

Secretaries

Andreasen, Mette F. (Trainee, 1 October 2000 - 1 April 2001)

Christiansen, Ulla Riis

Sørensen, Else Holst, (Temporary Assistant, from 15 March)

Programme: Aeroelastic Design

Scientific staff

Bak, Christian

Bertagnolio, Franck

Fuglsang, Peter

Hansen, Morten, Hartvig

Johansen, Jeppe

Larsen, Gunner

Larsen, Torben Juul

Madsen, Helge Aagaard

Nim, Erik (1 September 2000 - 31 August 2002)

Petersen, Jørgen Thirstrup

Flemming Rasmussen, *Programme Head*

Sørensen, Niels Nørmark

Thomsen, Kenneth

Vølund, Per (till 30 September)

PhD students, graduates and post doctoral researchers

Baumgart, Andreas (till 31 March)

Secretary

Madsen, Tina Precht (from 1 March)

Programme: Atmospheric Transport and Exchange

Scientific staff

Astrup, Poul

Gryning, Sven Erik

Hasager, Charlotte Bay

Hummelshøj, Poul (on leave till 1 April 2001)

Jensen, Niels Otto

Jørgensen, Hans

Mikkelsen, Torben

Larsen, Søren, *Programme Head*

Nielsen, Morten

Sørensen, Lise Lotte

Thykier-Nielsen, Søren

PhD students, graduates and post doctoral researchers

Dellwik, Ebba

Dunkerley, Fay (from 1 April)

Frohn Lise (in a collaboration with NERI)

Secretary

Skrumsager, Birthe

Programme: Electric Design and Control**Scientific staff:**

Bindner, Henrik W.

Hansen, Lars Henrik

Hauge Madsen, Peter, *Programme Head*

Sørensen, Poul

PhD students, graduates and post doctoral researchers

de Barros, Eliza Medeiros

Rosas, Pedro André

Hansen, Anca Daniela (till 14 January 2001)

Pereira, Alexandre (till 29 February)

Rasmussen, Mikkel Hjortshøj (1 September - 31 December)

Secretary

Madsen, Jytte

Programme: Wind Power Meteorology**Scientific staff**

Badger, Jake (from 1. November)

Barthelmie, Rebecca (from 1 June)

Frank, Helmut

Kristensen, Leif

Landberg, Lars, *Programme Head*

Mann, Jakob

Mortensen, Niels Gylling

Rathmann, Ole

Sempreviva, Anna Maria

PhD students, graduates and post doctoral researchers

Giebel, Gregor (1 July 2000 - 30 June 2001)

Joensen, Alfred (till 31 May)

Lange, Bernhard (till 30 June)

PhD theses

Giebel, Gregor

Sales Co-ordinator

Nielsen, Rikke (from 15 November)

Secretary

Werner, Anette (from 15 November)

Programme: Wind Turbines**Scientific staff**

Bjerregaard, Egon

Christensen, Carl Jørgen (retired on 31 March)

Clausen, Niels-Erik (from 1 October)

Debel, Christian (from 26 January)

Engelund, Svend (1 February - 12 May)

Frandsen, Sten Tronæs

Hansen, Jens Carsten

Højholdt, Poul

Jensen, Peter Hjuler, *Programme Head*

Jørgensen, Erik Rosenfeldt

Krogh, Thomas

Lundsager, Per

Noe Poulsen, Peter (from 1 October)

Nørgaard, Per

Poulsen, Peter Noe (from 1 October)

Preem, Mikkel (from 1 October)

Schaarup, Jesper
Tarp-Johansen, Niels (from 1 May)
Thøgersen, Morten Lybech (from 1 December)
Winther-Jensen, Martin (till 30 June)
PhD students, graduates and post doctoral researchers

None

Technical staff

Hagensen, Flemming
Lange, Rolf

Secretaries

Henriksen, Mette Porsdal (maternity leave from 1 May)
Kiler, Diana (from 1 May)
Westermann, Kirsten

Programme: Wind Turbine Diagnostic

Scientific staff

Antoniou, Ioannis
Højstrup, Jørgen, *Programme Head* (from 1 August)
Krogsgaard, Jørgen
Nielsen, Troels Eske
Paulsen, Uwe Schmidt
Pedersen, Troels Friis, *Research Expert*
Petersen, Søren Markkilde
Vesth, Allan (from 1 October)

Technical staff

Borchsenius, Jens
Christensen, Kurt
Clemmensen, Kaspar
Hansen, Per
Høst, Oluf
Larsen, Gert
Nielsen, Finn Linke
Rasmussen, Michael

Secretary

Hansen, Anne-Marie

Special Task: Experimental Meteorology

Scientific staff

Courtney, Mike (on leave till 1 March 2001)
Enevoldsen, Karen (from 1 April)
Hansen, Ole Frost
Larsen, Søren, *Head*
Møller, René
Sanderhoff, Peter

Technical staff

Andersen, Anker Bruun
Christensen, Lars (on leave till 1 April 2001)
Hansen, Arent
Hansen, Finn
Hansen, John (on leave till 1 April 2001)
Jensen, Gunnar
Lund, Søren
Nielsen, Jan

Secretary

Skrumsager, Birthe

Sparkær Centre (Wind Turbine Blade Testing)

Scientific staff

Eisenberg, Yoram (from 3 January)

Grove-Nielsen, Erik (till 30 June)

Hornbech, Jan (from 1 October)

Kristensen, Ole Dahl (from 15 August)

Kristiansen, Kristian Quist (till 30 September)

Pedersen, Henrik Broen (from 3 January)

Skamris, Carsten, *Head* (from 1 January)

Thomsen, Christian Leegaard (from 1 October)

Aarhus, Karl

Technical staff

Bruun, Peter (till 31 March)

Ersgaard, Gunnar

Lind, Peter (from 1 September)

Pedersen, Jimmy

Petersen, Johnny Mandrup (1 April - 30 September)

Thinggaard, Jesper

Secretary

Kristensen, Bente Hangaard

8.1 Guest scientists

Akmal Abd El-Ghelli, M.	26.11 - 10.12	Cairo, Egypt
Barthelmie, Rebecca	03.01 - 11.01	Indiana University, USA
	23.05 - 31.05	
Batchvarova, Ekaterina	18.01 - 03.02	Sofia, Bulgaria
	04.05 - 01.06	
	08.08 - 25.08	
	14.11 - 28.11	
Monroe, Rich	18.06 - 28.06	Great Britain
Pryor, Sara	23.05 - 31.08	Indiana University, Bloomington, IN
	18.12 - 22.12	
Tillman, Jim	18.11 - 25.11	Seattle, USA.
Watson, Rich	21.02-27.02	University College, Dublin, Ireland

Title and authors

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Wind Energy Department

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Abstract (max. 2000 characters)

The report describes the work of the Wind Energy and Atmospheric Physics Department at Risø National Laboratory in 2000. The research of the department aims to develop new opportunities in the exploitation of wind energy and to map and alleviate atmospheric aspects of environmental problems. The expertise of the department is utilised in commercial activities such as wind turbine testing and certification, training programmes, courses and consultancy services to industry, authorities and Danish and international organisations on wind energy and atmospheric environmental impact. A summary of the department's activities in 2000 is shown, including lists of publications, lectures, committees and staff members.

Descriptors INIS/EDB

AIR-POLLUTION; METEOROLOGY; PROGRESS REPORT; RISØ
NATIONAL LABORATORY; RESEARCH PROGRAMMES; WIND
TURBINES

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