Network Title: Wind energy assessment and wind engineering

Network Short Title: WINDENG

Contract Number	HPRN-CT-2002-00215

Commencement date of contract **01/09/2002** Duration of contract **40 months**

Period covered by the report: 01/09/2004 – 31/08/2005

The Principal Contractor

Co-ordinator Anna Maria Sempreviva

Risoe National Laboratory [RISOE]
Department of Wind Energy
Frederiksborgvej 399, DK-4000 Roskilde
+45 46775025
+45 46775975
anna.sempreviva@risoe.dk

Part A - Research Results

A.1 Scientific Highlights

Describe *(in no more than two pages)* the scientific highlights of the network during the reporting period. Indicate, referring to Annex I of the contract, to which Objective(s) and/or Task(s) and/or Milestone(s) these highlights relate to. Indicate also the network teams contributing to these highlights and, referring to A.2 also, add any relevant publication references.

The original work plan was divided into the following 5 interrelated tasks and a participant coordinates each task.

1. Study and modelling of turbulence in the Planetary Boundary Layer (PBL),
2. Wind energy assessment in complex terrain (SITING),
3. Wind modelling in complex terrain (MODELING),
4. Offshore wind engineering (OFFSHORE), and
5. Power forecast (POWER).

As in stated in the 2nd annual report, the scientific activity that appointed scientists are carrying on, concerns tasks 1, 2, 3, and 4. Task 5 is considered as an application of task 3. A large group of young scientists (YS) has been organised within the modelling activity and they have been producing a number of publications, conference proceedings, contributions to conferences. Workshops have been organised by and organisation of workshops.
Also the other YS involved in the other tasks have produced a number of high quality papers, thought for some of them collaboration has not been as good as amongst the modellers, thought their results were important for the activity of others.

A.1 Tasks 1 and 4.

The objective of these two tasks is to define reliable values for turbulence descriptors to be used in modelling the turbulent wind fields over all environments. To study, model and measure the turbulence in the atmospheric PBL is of vital importance for wind energy assessment and wind engineering in complex terrain and offshore; therefore, some basic studies have been carried out under this task.

A.1.1. Task 1. Modelling atmospheric turbulence in complex terrain and during stable atmospheric conditions. (FMI) by Ivan Mammarella.

The Monin- Obukhov theory is the paradigm most used to interpret observations and to model atmospheric surface layer processes. Limits of applications of the theory in inhomogeneous turbulent flows in the framework of surface layer similarity theory, has been investigated using turbulence data measured in a typical area for the subarctic Northern Finland. This work has been carried out using data collected in a typical area for the subartic Northern Finland at three levels on a tower located at the FMI Sodankyla Meteorological Observatory.

Part of this work was also finalized to support the modeling work of the other YS employed at FMI. The goal has been to simulate periods characterized by stable conditions, to evaluate the limit of the turbulent parameterization included in a flow model (section A.2.)

Ivan Mammarella has been appointed at FMI. After his appointment ended, it was agreed between FMI and Risoe to support him further and funding, for 5 month salary, was moved from Risoe to FMI to allow development of a cooperation on turbulence over the forest and on basic studies of turbulence offshore. (see agreement in Appendix). Ivan will end his activity in the Network at Risoe, during the last two months of the Network.

A.1.5. Task 1, 4. Atmospheric turbulence offshore. Influence of Temperature and humidity dissimilarity over the offshore fluxes. Ivan Mammarella (FMI-Risoe).

A.1.2. Task 1. Extreme wind atlas (Risoe)

A global extreme wind atlas has been constructed based on NCEP/NCAR reanalysis data. The geostrophic wind at sea level is calculated from pressure as well as geo-potential height. The geostrophic wind is further extrapolated to 10 m over a flat area with roughness length of 5 cm before the 50-year wind is obtained. The comparison with measurements from Europe and the Gulf of Suez suggests that the reanalysis can capture an outline of a storm as well as the 50-year wind, both omni-directional and sector wise, but there is a general underestimation of the reanalysis due to crude temporal and spatial resolution.

This task has not been in collaboration with other Partners, however, it has been of great interest for all of them and especially for the Industrial Partner. The papers produced here are of very good quality.

A.1.3. Task 1. Evaluation of a new optical fibre-based mono-static continuous wave Doppler wind LIDAR for atmospheric boundary layer applications. (NEG-Micon/VESTAS, Risoe and in cooperation with QineticQ (Laser Developper))

Remote sensing of wind speeds in the atmosphere is attractive because it replaces the expensive use of tall met masts, but remote sensing techniques often suffer from lack of precision, in particular in connection with wind energy applications. However a recent development in optical remote sensing (LIDAR) based on telecom technology and improved computational signal treatment has been shown to overcome these problems in recent boundary layer measurements. A newly designed portable fibre-based wind Lidar system "ZephIR" has been tested for accuracy with remote wind measurement applications in the atmospheric boundary layer. ZephIR is a focused CW fibre based ($1.55\ \mu m$) Doppler LIDAR operating in the range 10 – 200 meters with processed wind speed sampling rates up to 25 Hz. Two experiments with the wind LIDAR were performed; in the first set up the LIDAR was used in staring mode and measured the wind along the direction of the mean wind with the purpose of testing the optimal set up and compared the data with the cup anemometer. The second set up was to determine wind profile, with a scanning for different kind of altitude (from 44 to 123m). First, the wind LIDAR was evaluated in "staring mode" by intercomparison of wind measurements obtained by the LIDAR at 60-meter range with a calibrated cup anemometer. Although the two instruments have different spatial and temporal averaging volumes, a correlations better than 0.99 between the ten-minute averaged wind speeds from the cup anemometer and the wind LIDAR could be obtained. Secondly, by changing focus and scanning through a rotating prism, horizontally averaged wind speeds above ground (i.e. the LIDAR was run in "virtual met tower" mode) were obtained. Mean wind speeds obtained by the ZephIR system We were compared with the corresponding values from several meteorological towers equipped with calibrated cup anemometer devices and sonic anemometers in the range 44 meters to 123 meters height. Because the remote sensed wind measurements shows excellent agreement with classical instruments the new remote-sensing device has potential for exploration, research and understanding wind and turbulence phenomena in the upper surface layer (i.e. between 50 and 200meters above ground)

Regis Danielian has ended his contract within WindEng in May 2005, after a 12 months contact and an extension of 6 months. (sect B5.4)

A.1.4. Tasks 1, 4 . Stability effects on predicted wind profiles and power output offshore. By Maurizio Motta (Risoe-ENERGI E2)

A thorough knowledge of the variation of wind speed with height is essential to assess accurately wind power output at a certain site. A crucial role in affecting the wind speed profiles is played by atmospheric stability, which leads the simple, standard logarithmic approach to fail under non-neutral conditions. The typical shortage of information available offshore makes these tasks even more challenging at such sites. Two main topics have been addressed, using data from existing or potential offshore wind farm sites in Denmark: assessing the climatology of atmospheric stability, and subsequently estimating the wind profiles. The occurrence of different stability conditions was studied at a few measurement sites, both offshore and coastal, relative to various time scales (hour, season and year) and to a number of parameters, such as wind speed and direction, in order to isolate the general features, and disentangle possible synoptic footprints from local effects. The influence of different approaches in extrapolating the profiles from the available data has been investigated. The work has been carried out in close collaboration between Risoe and SEAS/ENERGI E2, which owned the offshore sites, and kindly provides data.

After Risoe Maurizio Motta has worked at ENERGI E2 applying the knowledge acquired at Risoe in commercial tasks. The tasks in E2 have been: analysis of wind climate at the offshore site of Omø Stålgrunde (DK), and subsequent design of the layout of a potential 40 x 5 MW wind farm on site, using a number of tools such as WAsP and WindPRO. Use of NCAR/NCEP reanalysis data as reference time series for correlation with measured data sets through MCP techniques at the offshore sites of Scarweather Sands (UK) and Cabo de Trafalgar (E). Maurizio was also involved in study of the availability and variability of the wind resource in different regions of Europe and neighbouring countries, aimed at potential distributed investments; and the analysis of the fluctuations of the wind index in Denmark.
Maurizio Motta ended his contract in February 2004 and is returned to Italy. However, he has applied and got a position in Denmark at EMD (developer of the WindPRO software package for project design and planning of both individual wind turbines and wind farm projects, starting form January 2006. He produced two papers and is co-author of a paper and of conference proceedings.

A.2. Task 2, 3 and 5. Use of meso-scale models for wind energy applications and siting (Uni-Old, FMI, DEWI, ISAC-CNR, CRES)

The objective of this task is to "To improve existing methods used for modelling wind flow and wind climate within Europe" both onshore and offshore.

With the ISAC-CNR young scientist who started their activity later, there has been a group of seven YS working in this task. Although the ISAC fellows started later than the others, they have integrated well into the group and all have reached a good level of autonomy and a first-class international network. Meetings and contacts have been rather frequent and a number of common papers, conference proceedings and conference contributions was produced.

Wind energy applications traditionally require long-term series of wind observations to properly plan the position of a given wind turbine or park and to forecast the energy yield. For wind energy projects, short-term (1-2 years) wind measurements are normally used to describe wind speed and direction on the site of interest. If long-term observations (10 years or more) are available for a location not so far from the site, short-term observations can be correlated with long-term data to reduce the influence of inter-annual variations.

Numerical modelling represent is the solution to obtain information on wind flow over complex terrain or where the availability of long-term observation is poor, such as offshore regions. With computational resources presently available, numerical models might also be used to simulate long-term time series of wind. These models can be applied on a resolution (1-3 km) relevant for wind resource assessment and power forecast.

The network partners have decided to adopt the MM5 3.4 version: a numerical weather prediction model developed by the Pennsylvania State University and National Centre for Atmospheric Research (**http://www.mmm.ucar.edu/mm5/mm5-home.html**). One of the most interesting features of MM5 modelling system is the possibility for the user to select different physical parameterisation schemes and the presence of a set of pre-processing and post-processing programs that make it easier, as an example, to spatially interpolate terrestrial and meteorological datasets to the model grid or to assimilate meteorological observations into the simulation. MM5 is able to run on a wide range of computer platforms or with parallelisation on distributed or shared memory machines. The use of MM5 for wind energy assessment has been undertaken, as an example, for calculations involving the Brazilian Wind Atlas; similar applications are presently under discussion in Ireland. This framework motivated Uni-Old, DEWI, FMI, ISAC, and CRES to investigate the potential of the model for applications concerning high-resolution wind prediction.

A second workshop on MM5 and the new model WRF has been organised by the WindEng modelling team and was held in Rome in December 2004 by the young scientists employed at ISAC-CNR. A link to the workshop is on the www.windeng.net home page. Beside the WindEng fellows, a number of other scientists from other institutions participated to it. FMI provided datasets for case studies from northern Finland. Risoe provided offshore data sets. During the workshop, several simulations for different PBL-schemes using different initial data and different horizontal resolution were performed and comparisons with meteorological mast data were achieved. A common paper has been produced by Silke Dierer (ISAC).
At the end of his contract in Rome Tim de Paus has got a position in Oldenburg, to continue his work there within WindEng. Sielke Dierer contract at ISAC has been prolonged for 6 months until October 2005.. Lorenzo Claveri moved from Oldenburg to FMI in July 2005.

A.2 Joint Publications and Patents

Maurizio Motta (E2/Risoe)

The influence of non-logarithmic wind speed profiles on potential power output at Danish offshore sites. Motta, M., Barthelmie, R.J. and Vølund, P. (Wind Energy, 8, 2005)

Barthelmie, R.J., Frost Hansen, O., Enevoldsen, K., Højstrup, J., Frandsen, S., Pryor, S., Larsen, S., Motta, M., and Sanderhoff, P. Ten years of meteorological measurements for offshore wind farms. (Journal of Solar Energy Engineering, 127, nr. 2, 2005)

Ten years of measurements of offshore wind farms – what have we learnt and where are the uncertainties? Barthelmie, R.J., Frost Hansen, O., Enevoldsen, K., Motta, M., Pryor, S., Højstrup, J., Frandsen, S., Larsen, S., and Sanderhoff, P. (The Science of making Torque from Wind, EWEA Special Topic Conference, 2004)

Climate of coastal and offshore stability conditions in Denmark: effects on potential power production. Motta, M., Barthelmie, R.J. and Vølund, P. (EGU Conference, Nice (F), 2004)

Regis Danielian (Neg-Micon/VESTAS/Risoe ext cooperation with QnetiQ Ltd.)

Lidar - A Revolutionary Method of Wind Field Measurement for the Wind Power Industry David Smith, Dr. Michael Harris and Adrian Coffey, QinetiQ Ltd., Hans Jorgensen, Torben Mikkelsen and Jakob Mann, Risoe; Regis Danielian, Vestas, POWERGEN Conference, 2004, Orlando

Wind lidar evaluation at the Danish wind test site Hovsore: Smith, D., Harris, M., Coffey, A., Mikkelsen, T., Joergensen, H.E., Mann, J., Danielian, R. Extended abstract in Proceedings of European Wind Energy conference (EWEC) 2004, London

Surface-Layer Wind and Turbulence profiling from LIDAR: theory and measurements. Régis Danielian (Vestas Wind System),Hans Ejsing Jørgensen (Wind Energy Department, Risø), Torben Mikkelsen (Wind Energy Department, Risø), Jacob Mann (Wind Energy Department, Risø) and Mike Harris (Qinetiq)

Ivan Mammarella (FMI-ISAC-Risoe)

Longitudinal spectra of wind velocity in the atmospheric surface layer perturbed by a small topographic ridge. Tampieri F., I. Mammarella, and A. Maurizi (2004), Il Nuovo Cimento C, 27 (2), 167-178

The perturbation of turbulence structure due to the interaction of a katabatic flow with a steep ridge. Mammarella I., F. Tampieri, M. Nardino and M. Tagliazucca (2005). Environmental Fluid Mechanics, 5 (3), 227-246

Turbulence statistics measurements above a heterogeneous forest. Submitted to Boundary Layer Meteorology. Mammarella I., B. Tammelin, R. Hyvonen and E. Gregow.

Mammarella I. and R. Hyvonen (2004). The structure of the ABL at Sodankyla. FMI Report for the Project "Sound propagation in the ABL"

Mammarella I. and B. Tammelin (2005): Analysis of turbulence statistics above a Scots pine forest in a sub-arctic norther region. In Proceedings of The Fourth European - African Conference on Wind Engineering. Prague, 11-15 july, 2005

*I. Mammarella and N.O. Jensen(**Risoe**)(2006):*Turbulent Statistics and Spectra Over Forest with Non-Uniform Fetch Conditions: Submitted to the Conference Specialist Workshop in

Flux Measurements in difficult conditions to be due on 26-28 January 2006 in Boulder, Colorado.

Erik Gregow (FMI) (See also Dierer, Mammarella and Beran)
Wind Field Prediction in Coastal Zone: Operational Mesoscale Model Evaluation and Simulations with Increased Horizontal Resolution, Erik Gregow (submitted)

Jiri Beran (Oldenburg-FMI)

Offshore wind Modelling and forecast: Beran, Jiri, Claveri, L., Lange, B., von Bremen, L. Extended abstract for MM5 Training Workshop, June 2005, Boulder

Marine Boundary Layer Modelling for the Offshore Wind Power Generation: Beran, Jiri, Abstract for German EAWE Meeting, April 2005, ISET Kassel, Germany

Offshore wind modelling and forecast: Jiri Beran, Erik Gregow, Lorenzo Claveri, Francesco. Submitted Abstract for European Wind Energy conference (EWEC) 2006, Athens

Lorenzo Claveri (Oldenburg-FMI)

Offshore wind resource assessment with a mesoscale Model: Claveri, Lorenzo, Beran, J., Durante, F., Lange, B., von Bremen, L., Lange, M.

Abstract for

- German EAWE Meeting, April 2005, ISET Kassel, Germany
- European Geosciences Union (EGU) General Assembly 2005, Vienna
- 5th Annual Meeting of the European Meteorological Society (EMS), Utrecht, 2005

Quality of two different wind speed forecasts for the North and Baltic Sea – Verification with synoptic offshore measurements between 10m and 100m height: Tambke, J., Poppinga, C. Claveri, L., von Bremen, L., Graewe, U. Abstract for Abstract for 5th Annual Meeting of the European Meteorological Society (EMS), Utrecht, 2005

Wind speeds and momentum fluxes in the marine boundary layer of the North Sea – Predictions and 1 year measurements up to 100m height: Tambke, J., Bye, J.A.T., Claveri, L., von Bremen, L., Lange, B., Wolff, J.-O. Abstract for 5th Annual Meeting of the European Meteorological Society (EMS), Utrecht, 2005

Forecasting 25 GW Wind Power above North and Baltic Sea: Tambke, J., Poppinga, C., von Bremen, L., Claveri, L., Lange, M., Focken, U., Bye, J.A.T., Wolff, J.-O. Extended abstract in Proceedings of Copenhagen Offshore Wind Conference 2005, Copenhagen

Marine Meteorology for Multi Mega Watt Turbines: Tambke, J., Claveri, L., Bye, J.A.T., Poppinga, C., Lange, B., von Bremen, L., Wolff, J.-O. Extended abstract in Proceedings of Copenhagen Offshore Wind Conference 2005, Copenhagen

Advanced Forecast Models for the Grid Integration of 25 GW Offshore Wind Power in Germany: Tambke, J., Poppinga, C., von Bremen, L., Claveri, L., Lange, M., Focken, U., Bye, J.A.T., Wolff, J.-O. Extended abstract in Proceedings of European Wind Energy conference (EWEC) 2006, Athens (in review)

Offshore Meteorology for Multi Mega Watt Turbines: Tambke, J., Claveri, L., Bye, J.A.T., Poppinga, C., Lange, B., von Bremen, L., Wolff, J.-O. Extended abstract in Proceedings of European Wind Energy conference (EWEC) 2006, Athens (submitted)

Francesco Durante

A sensitivity study of mesoscale wind profile simulations to PBL parameterization: Durante, Francesco, de Paus, T, Beran, J., Lange, B., Strack, M. Abstract for European Geosciences Union (EGU) General Assembly 2005, Vienna

Validation of MM5 With Measured Profiles at Cabauw, The Netherlands and Wilhelmshaven, Germany: Durante, F., de Paus, T., Focken, U., Strack, M. Extended abstract in Proceedings of 7th German Wind Energy Conference (DEWEK), Wilhelmshaven, 2004

Validation of Mesoscale Simulations for Offshore Sites: Durante, F., Strack, M. Extended abstract in Proceedings of 7th German Wind Energy Conference (DEWEK), Wilhelmshaven, 2004

A sensitivity study of mesoscale wind profile simulations to planetary boundary layer parameterization: Durante, Francesco, de Paus, T, Beran, J., Lange, B., Strack, M. Abstract for 5th Annual Meeting of the European Meteorological Society (EMS), Utrecht, 2005

Barbara Jimenez (CRES-Uni.Old-Risoe)

Offshore wind resource assessment: Comparative study between MM5 and WASP: Jimenez, Barbara, Durante, F., Lange, B., Kreutzer, T., Claveri, L. Extended Abstract in Proceedings of Copenhagen Offshore Wind Conference October 2005, Copenhagen, Denmark.

Tidal Influence on Offshore and Coastal Wind Resource Predictions at North Sea: Barbara Jimenez, Bernhard Lange and Detlev Heinemann. Abstract for European Wind Energy conference (EWEC) 2006, Athens, Grece. (Submitted)

Offshore wind energy potential in the Mediterranean basin, comparison of the wind climatology from three models: Birgitte Furevik, A.M., Sempreviva, Rebecca J., Barthelmie and Barbara Jimenez. Poster at 31st International Symposium on Remote Sensing of Environment *June 20 - 24, 2005, St. Petersburg, Russian Federation.* (Risoe- isac-CRES)

Silke Dierer (ISAC)

Application of the model MM5 for wind energy purposes – progress report of the WINDENG Project: Dierer, S., de Paus, T., Durante, F., Gregow, E., Lange, B., Lavagnini, A., Strack, M., Tammelin, B. Wind Engineering (submitted to Wind Engineering, 2005)

Creating a wind climatology for Sardinia: Dierer, S. Progress report 2004-2005, Wind Energy Assessment Studies and Wind Engineering (HPRN-CT-2002-000215), pp.13.Part B - Comparison with the Joint Programme of Work (Annex I of the contract)

Xiaoli Guo Larsén

Effects of disjunct stride and averaging time on maximum wind speeds. Xiaoli Guo Larsén and Jakob Mann, submitted to *Journal of Wind Engineering and Industrial Aerodynamics* (2005-03-11).

Extreme winds and the connection to reanalysis data. Xiaoli Guo Larsén and Jakob Mann, to submitted to *Journal of applied meteorology* (2005-11-06).

Extreme winds and the connection to reanalysis data. Xiaoli Guo Larsén, Jakob Mann and Hans Jørgensen, Conference proceedings in *The one day conference on extreme winds and developments in modelling wind storms*, Cranfield University, (16) 2004.

Regional extreme wind climates and local winds, Jakob Mann, Xiaoli Guo Larsén and Hans Jørgensen, Conference proceedings in *The one day conference on extreme winds and developments in modelling wind storms*, Cranfield University, (17) 2004.

Impact from climate change on extreme winds and icing conditions in the Baltic Sea region. Niels-Erik Clausen, Sven Erik Gryning, Xiaoli Guo Larsén, Niels Jacob Tarp-Johansen, Hamele Hotttinen, Rebecca Barthelmie, Sara Pryor and Per Lundsager, Extended Abstract in proceedings of *Copenhagen Offshore Wind Conference, October* 2005, Copenhagen, Denmark.

B.1 Research Objectives

State whether the research objectives, as set down in Annex I of the contract, are still relevant and achievable. If not, explain why.

Briefly, research objectives where:

- To define reliable values for turbulence descriptors to be used in modeling the turbulent wind fields,
- To improve existing methods used for modeling wind climates under the different conditions existing within Europe

This research objective have been very relevant and have been reached.

B.2 Research Method

Has the research method changed from that described in the contract? If so, how?

The general methodological approach described in the contract involve three strictly connected activities:

- Exploitation of existing databases,
- Improvement and application of models and tools and
- Comparison between data and models.

This approach has been adopted.

B.3 Work Plan

Provide an update of, and explain any significant differences in, the current work plan in comparison to the original plan in the contract (Annex I of contract), in terms of:

- **Breakdown of tasks**

During the1st kick-off meeting the status of national and international projects, databases and models were considered and Table 1 summarises the new allocation of tasks in the proposed network, and the co-ordinating institution.

Task	1				2			3		4				5		
Responsibility for tasks	Risø.VEA				FMI			DEWI		Risø.VEA				UNI-OL		
PARTICIPANT	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	5.1	5.2	5.3
1.Risø.VEA	X	X	X	X	X	X		X	X	X	X	X	X	X		
2.UNI-OL							X		X			X		X	X	X
3.DEWI				X		X	X		X	X						
4.VESTS	X	X			X	X										
5.CRES	X	X	X		X	X								X		
6.ENERGI E2										X	X	X	X	X		
7.ISAC-CNR		X	X		X	X			X							
8.FMI		X	X		X	X			X	X				X		

All Partners have appointed at least a Scientist and YS have been moving between Institutions.

Schedule and Milestones

With regard to Milestones, comment specifically on the status of those expected, from Annex I, to be achieved in the Reporting Period, giving any relevant publication or other references.

Milestones have been all fulfilled. Two annual meetings and a workshop have been organised. Also an Informal meeting has been arranged.

Research effort of the participants (Use a table similar to Annex I of the contract, section 3)

Professional research effort on the network project			
Participant	*Young researchers financed by the contract* (man-months) (a)	Researchers to be financed by other sources (man-months) (b)	Researchers likely to contribute to the project (number of individuals) (c)
1.RISØ.VEA	34	6	4
2.UNI-OL	31	20	3
3.DEWI	26	4	1
4.VESTAS	36	12	2
5.CRES	12	6	2
6.ENERGI E2	12	6	1
7.ISAC-CNR	26	10	2
8.FMI	24+7	10	2
Total	18	18	5

B.4 Organisation and Management

B.4.1 Describe, how the network is being organised and managed with reference to the relevant section in Annex I of the contract. Explain any changes, which have occurred. Describe the network's communication strategy, dissemination of information, e.g. presentation at international conferences, including those outside EU Member and Associated States for which prior approval has been obtained. Give the networks' website address and, if relevant, add copies of any Newsletters produced in the Reporting Period.

In this 3rd year period, the activity of the network has been going on after plan under the constant monitoring of the coordinator, whose activity has been mainly to advise the partner institutions on measures to be undertaken for different issues i.e. moving funding among institutions to support mobility of YS, or organization of meetings, dissemination of information and participation to events outside EU.

Networks events were published on the network home page.

Part of this 3rd year period was used to plan a new network within the 6th Framework Marie Curie Training Network call FP6-2004-Mobility1 where 6 of the 8 partners are involved. Due to the success of WindEng, the other partners were well motivated to be included in the new project. The new Network called ModObs is an Interdisciplinary and Multi sectorial Network and will address improvements of climate models using downscaling techniques and new measurements techniques and it is a natural spin-off of WindEng. The partnership was open to other European Institutions working on atmospheric modeling from General Circulation models to Micro-scale models and remote sensing and to a regional Utility. The choice of the new partners has been mostly based on both they research quality and their record of good cooperation with the WindEng Partners.
Young Scientists have been actively participating to a large amount of General Topics Conferences as the Annual Assembly of the European Geophysical Union and Specialised Conferences as the European Wind Energy Conferences, where they have established an international network. Other young scientists outside the network have shown interest in the YS activity and participated to the workshops organised by the modeller's group.

Output of the workshops have been published on the network home page, www.WindEng.net and access to presentations have been allowed on request.
Two more YS have been authorised by the Commission to participate to the main international event concerning the MM5 model i.e. *2005 Joint WRF/MM5 User's Workshop*, Boulder, Colorado, in June 2005. There, they presented the MM5 experience within the activity in WindEng.

B.4.2 List all major network meetings, network workshops etc. which have taken place within the reporting period. If an External Expert has been invited, provide more details, i.e. who, from which institute, network event attended and role undertaken.

Part of the leading group meet at the German Wind Energy Conference DEWEK in Wilhelmshaven, 19-21.10.04. (see minute) where it was decided to organize a second workshop on the MM5 model, including the new version WRF, in parallel to the 2nd yearly network meeting. This second workshop was organised by the WindEng modelling team and was held in Rome in December 2004, hosted by the young scientists employed at ISAC-CNR.
A link to the workshop is on the www.windeng.net home page. Beside the WindEng fellows, a number of other scientists from other institutions participated to it. An activity paper has been written by Silke Dierer and submitted to the Wind Engineering Journal (see joint publications).

Since the mid-term review took place in June 2004, the 2nd yearly meeting was hold in Rome in December 2004. This was mainly to decide how to end the network and to resume financial issues. (see included meeting time schedule and minute).

The 3rd and final Network meeting was held in Oldenburg 29-31 August 2004. (time schedule included). During this meeting, all YSs, included them who had ended the contract, were invited to attend and present their work. Their presentations, in Power Point, have been collected into a CD and will be published on the Network Home and in the E-windeng Journal.

B.4.3 Describe the networking which has taken place during the reporting period, including, for example, secondments/ visits (who, where, when, how long and for what purpose, preferably in tabular form), bilateral meetings, e-discussions, videoconferencing. It is preferable to also represent secondments/visits between participants and/or collaborations in either graphical and/or tabular form using, for example, with information entered in each box to indicate the type of activity undertaken. Alternatively this information can be represented graphically as a network diagram showing the links, visits, collaborations, etc. between each participant.

From/ To	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7	Team 8
1.RISØ						YS frequent visits	YS paper in collaboration	
2.UNI-OL			YS bilateral meetings					YS Secondment
3.DEWI		YS bilateral meetings						YS e-discussions
4.VESTAS	Young scientist for experimental issues							
5.CRES		YS secondment and e-discussions					YS paper in collaboration	
6.SEAS	YS Frequent visits							
7.ISAC	YS visit and e-discussions And YS secondment	YS e-discussions	YS e-discussions					YS e-discussions
8.FMI	YS visits and common work	YS e-discussions						

The fellow at Risoe/E2 has been in constant contact with SEAS that owns the stations and data used for the analyses.
There have been frequent exchange of knowledge and experience between the all partners. , this resulted in different common papers. DEWI and the Uni-Old have been the core group in this cooperation. The young scientists there are visiting each other weekly.

B.5 Training

B.5.1 Describe the measures taken to publicise vacant positions.

The last available position at Oldenburg has been advertised via e-mailing lists and a scientist from the associated countries has been chosen.

B.5.2 Using the following table compare the progress in recruitment of young researchers (Pre-Doc and Post-Doc) with the plan in the contract. Explain any changes in the breakdown of pre- and post-docs from the contract. (Note that columns a and b in the second table must be identical to the figures laid down in Annex I of the contract). Comment on the progress of recruitment to date and the projection for the next year(s), particularly if the recruitment has fallen behind schedule at any of the participants.

The following agreement about moving funding amongst partners were officially arranged between Partners (see agreement in Appendix):

Oldenburg to FMI. Since Erik Gregow from FMI had started before the other YS, it was decided to support him for further 5 month to allow him to share his longer experience with the other fellows.

CRES to Oldenburg. CRES had faced a problem during the second year: a pre-doc scientist who was hired within the network decided to go back to work on his PhD in England. After one year at CRES, Barbara Jimenez asked then whether it was possible to use part of the remaining funding at

CRES to finance her stay at the University of Oldenburg on an offshore project where German data were available and to work in close cooperation with the other YSs.

Risoe to FMI. The contract of Ivan Mammarella expired at the end of December 04. Ivan had applied for a Post-Doc Position in Finland but the results will be given not before the second half of 2005; Since Ivan's work interested Risoe, he was also supported to study turbulence offshore finalised to large wind parks installation in coastal areas at FMI. He will end WindEng in Denmark at Risoe for the last two months of the network.

Uni-Old – FMI: Lorenzo Claveri had shown interest to work in the Finnish Meteorological Institute; therefore exchange of funding was agreed between Oldenburg and FMI.

Participant	Contract deliverable of Young Researchers to be financed by the contract (person- months)			Young Researchers financed by the contract so far (person-months)		
	Pre-doc (a)	Post-doc (b)	Total (a+b)	Pre-doc (c)	Post-doc (d)	Total (c+d)
1.RISØ	12	24	36	12	23	35
2.UNI-OL	12 (36)	18 (0)	30 (36)	25	+6	31
3.DEWI	15 (32)	9 (0)	24 (32)	26	0	26
4.VESTAS	12 (30)	12 (0)	24 (30)	36	0	36
5.CRES	12	12	24	3	12	15
6.SEAS	0	12	12	0	12	12
7.IFA	12	12 (18)	24 (30)	12	18	30
8.FMI	12	12	24	12+5+7	12+2	38
Total	87 (146)	111 (78)	198 (224)	137	85	223

The sign (+) indicates funding exchanged among partners

B.5.3 Describe how the young researchers have been integrated into the research programme.

All appointed researchers have started to work on factual projects in cooperation with or of interest for other partners and were introduced to the necessary tools. There were no problems of integration in this 3rd period.

B.5.4 Describe the special measures being undertaken to train the young researchers, in particular training through visits and secondments, at network meetings, Young Researcher meetings, tutoring by External Experts, training on specialised instruments, presentations at conferences etc. Explain any differences in comparison to the contract.

The DEWI - Uni-Old and FMI YS have been trained on MM5 methodology, structure, software programs and problems. At present there is a frequent exchange of knowledge and experience between the two teams.
Intensive email contact was established concerning starting-up problems and experiences gained so far.
Francesco Durante (DEWI), Lorenzo Claveri and Jiri Beran (Uni-Old) attended MM5 and WRF tutorial class of 5 days to NCAR, Boulder, USA. At NCAR all modules of MM5 were explained, also Unix shell programming was educated in an advanced level and there was a hands-on session to learn how to use MM5 and its individual modules. These meetings, were organised also as workshops where all participants presented their work and discussed problems or new methodologies.
Maurizio Motta, Xiaoli Larsen have benefited from courses and seminars held at Risø. Amongst them, a *WAsP* (*Wind Atlas Analysis and Application Program*) Course and *WasP Engineering* . The Risoe WAsP and WAsP engineering teams have been tutoring them in the application of WAsP in real cases.
Sielke Dierer has visited Risoe and maintained e-mail contact with Jake Badger at Risoe to exchange experience in use of meso-scale models for the production of wind climate atlases.
Regis Danielian, was trained and was give the possibility to be responsible for an experimental campaign in Australia, funded by VESTAS in order to test the new Lidar instrument. He also spent two periods of one week each in England to be trained on the Lidar technology and operational issues.

Helene Muri (VESTAS) has attended a WasP Course in Spain.
All YS have participate to a number of Conferences such as General i.e. the European Geophysical Union annual meetings or more specialised i.e. European Wind Energy Conferences where research Institutions and Private Sector Companies meet.

Describe also any training being provided in complementary skills, such as, for example, language courses, supervision, tutoring, teaching, presentation and other communication skills, project management.

Sielke Dierer and Tim de Paus attended Italian classes, Jiri Beran, Lorenzo Claveri and Francesco Durante attended German classes.

B.5.5 Describe the special measures, if any, which have been taken to promote equal opportunities.

In WindEng, we have appointed twelve young scientists, among them, four were women. This 33% of female researchers in a field usually dominated by man is a good result.

B.5.6 If relevant, describe the measures being taken to exploit multi disciplinarity in the training programme.

Not Relevant

B.5.7 If relevant, describe how connections to industrial and commercial enterprises have been exploited in the training programme.

Maurizio Motta has worked within cooperation between Risoe and SEAS/ ENERGY2, (regional utilities), on research and commercial tasks applied to the installation of offshore wind parks in Denmark. At Risoe, he was trained in working with the WAsP model (that is one of the standard tools for the purpose).
Regis Danielian has also worked within cooperation between Risoe, Neg-Micon/VESTAS and QinetiQ on the development of a Lidar System for Wind Energy applications. This item is of great interest for VESTAS that is the world leading Wind Turbine manufacturer. VESTA has also funded an experimental campaign of a month in Australia.
Helene Muri has also worked at Neg-Micon/VESTAS in commercial tasks. However, due to the confidentiality of those tasks, she was not able to cooperate with the other YSs, thought she did participate to all the other young scientists common meetings. She is going to start a PhD in England.

B.6 Difficulties

Briefly explain any difficulties, which have been encountered in the implementation of the contract. Describe action being taken/proposed to tackle these difficulties.

No other difficulties encountered beside the Confidentiality of Commercial tasks in the Industry Partner.