

UpWind



MCE Brussels, Rue de l'Aqueduc 118, 1050 Brussels
9 October 2008 (14:00 – 17:30)

Coordinator of UpWind
Peter Hjuler Jensen
Risø DTU



SIXTH FRAMEWORK PROGRAMME

UpWind 

Program for Mid Term UpWind Work shop

Introduction	
14:00 - 14:10	Opening and introductory remarks <i>Peter Hjuler Jensen, Risø/DTU (UpWind co-coordinator)</i>
14:10 - 14:30	Main conclusions from the last Periodic Activity Report <i>Jos Beurskens, ECN (UpWind co-manager)</i>
Mid term results of selected UpWind Work Packages	
14:30 - 14:50	Up scaling, Integrated design, Standards <i>Sten Frandsen, Risø/DTU (WP 1A1 Leader)</i> <i>Bernard Bulder, ECN (WP 1B4 Leader)</i>
14:50 - 15:10	Smart rotor blades <i>Gijs van Kuik, Delft University of Technology (WP 1B.3 Leader)</i>
15:10 - 15:30	Aerodynamics and aero-elastics <i>Flemming Rasmussen, Risø/DTU (WP2 Leader)</i>
15:30 - 15:50 Coffee/Tea Break	
15:50 - 16:10	Rotor structure and materials <i>Bert Janssen, ECN (WP3 Leader)</i>
16:10 - 16:30	Transmission and conversion <i>Jan Hemmelmann, GE Global Research (WP 1B.2 Leader)</i>
16:30 - 16:50	Design of Large Sectional Blades <i>Angel González Palacios, Gamesa Innovation & Technology (WP 1B1Leader)</i>
16:50 - 17:10	Flow in wind farms <i>Rebecca Barthelmie, University of Edinburgh (WP 8 Leader)</i>
17:10 - 17:30	Training and education <i>Evangelos Politis, CRES (WP 1A.3 Leader)</i>
17:30 - 17:35	Closing remarks



UpWind

Project title: Integrated Wind Turbine Design

- ✧ FP6 Integrated project
- ✧ Start date: 1 March 2006
- ✧ Duration: 60 months
- ✧ 40 partners (39 to 43)
- ✧ Costs: 22,340,000 EUR (+)
- ✧ EC funding: 14,288,000 EUR (+)

Annual General Meeting:

Report for the year and plan for next 18 month



UpWind Work package structure





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WP descriptions available

Challenge

Research activities

Results and expectations

Contact data

Participants of WG



THE RESEARCH ACTIVITIES

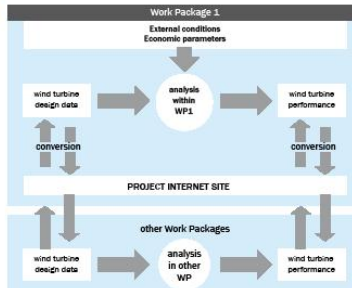
The main research activities for the integral design approach and standards' work package include:

- Defining and updating a reference wind turbine and a reference technical-economic cost model for benchmarking to be used for communication of the design parameters and design developments and the main economic and dynamic performance parameters for all UpWind project activities;
- Development, application and evaluation of an integral design approach methodology in offshore wind turbine design;
- Development of standards in general and for the application of the integral design approach, including definitions of interfaces between models, including data needs, specifications and protocols;
- Definitions and specifications of experimental data to be condensed into input design parameters for the design models or to verify critical design and performance issues.

In practical terms, the above research activities are sub-divided into 4 tasks.

SUBTASK A: REFERENCE WIND TURBINE AND COST MODEL

The subtask is dedicated at facilitating the integration of the different activities in all the horizontal (and vertical) work packages throughout the project. For this, a reference wind turbine will be defined to provide a basis for communication and comparisons. The design parameters and the main characteristics, including results of parameter sensitivity studies, will be defined and kept up to date. Input data will be provided from the other work packages. The data will be made easily accessible to all partners in the project.



SUBTASK B: INTEGRAL DESIGN APPROACH METHODOLOGY

Other technology sectors, such as air-transport, have experienced a development similar to wind energy with respect to increasing complexity and focus on specialists. For some of these technologies "Knowledge Based Engineering" (KBE) is investigated as a means to increase productivity of the design teams and to reduce the boundaries between disciplines. KBE tries to model not only properties of a product, but also the knowledge about the product that captures the engineering intent behind the design. KBE can be used in Design and Engineering Engines (DEE), to automate the multi-disciplinary processes. This automation is not intended to replace the design team, but rather to replace routine activities and to improve efficiency and consistency of information exchange. As a result, design teams will have more time for their creative contributions and thus can increase their productivity. Core element of the

DEE is a (multi-) model generator in which the parametrical description of the product resides. It gets input from a concept generator and (re)generates the input for the analysis tools: the discipline silos. Typically, the discipline silos are commercial off-the-shelf analysis tools. The Knowledge Based Engineering tools reside in the concept generator.

Thus, the objective of this activity is to assess the feasibility of this approach for wind turbine design and to develop the knowledge needed to generate a DEE for this purpose. It is noted that the analysis tools in the discipline silos are external tools and are not part of the development undertaken in this activity. However, this activity will contribute to and make use of the common formats developed in this task, as these represent the interfaces between the model generator and the analysis tools. The reference turbine will be used as a case study.

Integration and Scientific work packages

WP Number	Work Package	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10
1	Aerodynamics & aero-acoustics	100	100	100	100	100	100	100	100	100	100
2	Rotor structure and materials	100	100	100	100	100	100	100	100	100	100
3	Foundations & support structures	100	100	100	100	100	100	100	100	100	100
4	Control systems	100	100	100	100	100	100	100	100	100	100
5	Remote sensing	100	100	100	100	100	100	100	100	100	100
6	Condition monitoring	100	100	100	100	100	100	100	100	100	100
7	Flow	100	100	100	100	100	100	100	100	100	100
8	Electrical grid	100	100	100	100	100	100	100	100	100	100
9	Management	100	100	100	100	100	100	100	100	100	100
10	Management	100	100	100	100	100	100	100	100	100	100

Homologously the scientific work packages are developed and verified the integration work packages.

SUBTASK C: DEVELOPMENT OF (PRE) STANDARDS FOR THE APPLICATION OF THE INTEGRAL DESIGN APPROACH

This subtask is dedicated to the development and formulation of standards in a broad sense, and for the application of the integral design approach of subtask B. Hence the subtask C aims at integrating the design models, experimental methods and concepts arising from the horizontal work packages.

SUBTASK D: INTEGRATION, REVIEW AND PLANNING WORKSHOPS

This subtask focuses on coordination and cross-cutting activities.

RESULTS AND EXPECTATIONS

So far cost functions for the components of the wind turbine, for which the input from parallel project activities is needed have been developed.

This WP works in close cooperation with the WP Upscaling (1B5).

The final results of the work package include:

- Guidelines for the integral design approach, including guidelines for design models, experimental methods and concepts arising from the scientific WPs;
- Recommendations and pre-standards to be submitted for IEC/ISO and CEN/ CENELEC for the revision or development of international standards for design and tests of wind energy systems.



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Central Project Site (CPS)

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Subject	Replies	Posted By
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Events

< April 2007

Sun	Mon	Tue	Wed	Thur
1	2	3	4	5
8	9	10	11 Annual General Assembly. Please look at ...	12
15	16	17	18	19



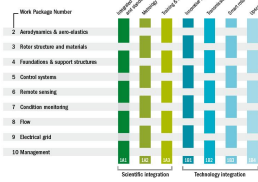
Wind Energy Technology from a Historical Perspective

Wind turbines for electricity generation appeared for the first time at the end of the 19th century. Since then, there have been at least three distinct periods of technology development. Both the first and second period failed to create a large-scale market for wind energy - even when new and more competitive concepts were developed, the abundance of cheap fossil fuels blocked wind's market development. However, the oil crisis of 1973 radically altered external conditions. Previous achievements in wind energy were translated, through rapid technical advances, into new and improved concepts. This shift development formed the basis for a market that has evolved spectacularly since the early 1990s.

As wind energy penetration overtakes certain thresholds in the electricity supply system, new technical challenges are emerging. Wind turbines have become the largest rotating machines mankind has ever seen. To make these systems reliable and cost effective, the designs have to be reconsidered. Meteorological, aerodynamic, and elastic phenomena, which were irrelevant in the past, now need to be understood, analysed and incorporated into fully integrated design tools. The objective of the European UpWind project is to address these challenges. The project explores the design boundaries of the very large wind turbines of the future.

2015

UpWind
Structure of the UpWind project.
Scientific and Integrating Work Packages.



2005

- 2015 - ...**
- Wind energy continues to increase its share of total worldwide energy generation.
 - Continuous improvements in wind turbine technology due to the introduction of new materials, very advanced aerodynamic control, compact directly driven generator concepts based on super conductors and strongly strengthened gear.
 - Offshore is a mature technology and represents a significant part of total capacity, deep offshore developments of industrial scale.

- 2005 - 2015**
- Outstanding growth of wind related fields: China, South America.
 - Current use of limited number of wind turbine types on the market.
 - High degree of standardisation.
 - Minimum size for wind based machines grows up to 7 MW and 130 metre rotor diameter.
 - EU still European industrial leader.
 - Appearance of 'blatant' technologies in offshore wind turbine concepts.
 - First testing of 10 MW, 100 metre prototypes in the near future.

- 1995 - 2005**
- Third development period characterised by increasing of wind turbine and increasing capacity of wind farms.
 - Commercial market takes off in Europe and USA.
 - Establishes mass production of wind turbines and industrial components, such as blades and electrical conversion systems.
 - Numerous regions of mass offshore wind turbine manufacturing.
 - Large energy companies enter the market.
 - Specialisation of the industry into different segments: farm, housing and on-grid design and development to specialised component manufacturing, installation and maintenance.
 - Take-off of offshore market.

- 1985 - 1995**
- Small and medium size wind turbines used extensively.
 - Development and testing of very large scale prototype wind turbines.
 - 0-1 MW, featuring changing concepts (rotors high tip speed ratio and two blades rotors), variable speed generator systems (low mechanical transmission), converter, directly drive generator systems (no mechanical transmission).
 - First medium size wind farms in land.
 - First wind turbines and small wind farms offshore.
 - Commercial exploitation by private individuals, companies and utilities.
 - Beginning of spectacular market growth in Europe and USA.

1950

1920

1973

1995

1985

- 1880 - 1920**
- First electricity generating wind turbines.
 - Generators: 10 - 20 kW.
 - Blades: 10 - 18 metres.
 - Flat and curved blade profiles.
 - Electric generators directly connected to grid and DC generators for battery charging.
 - Small turbines.
 - Single machines.

- 1920 - 1950**
- First record of use of wind turbines for rural electrification and battery charging.
 - Increased rotor diameters.
 - Development of direct drive from complete products.
 - Generators: 0 - 100 kW.
 - Blades: 6 - 5.5 metres.
 - Increased system efficiency.
 - Single (prototype) machines.

- 1950 - 1973**
- Continued development at low level during period of abundant oil and cheap oil and natural gas supply.
 - First first important classic designs, development of some extreme design features such as high tip speed ratio, unconventional transmission and towers.
 - Generators: 100 kW.
 - Blades: 24 metres.
 - Only prototype tested.

- 1973 - 1985**
- Second record of wind turbine technology.
 - Classic design further improved by adopting modern materials and turbine materials, modify three mechanical parts.
 - Design and testing of small scale machines with breakthrough technologies (high tip speed ratio, variable speed conversion systems, downwind rotors, direct drive conversion systems, self-exciting converters).
 - Generators: up to 3000 kW.
 - Blades: up to 300 metres.

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