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Technological Implementation Plan - eTIP

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Project_id: 1291
Contract number: ENK6-CT-2001-00552

Overview of the project

EC program:	EESD
Title of project:	Reliable optimal use of materials for wind turbine rotor blades
Acronym:	OPTIMAT BLADES
Programme type:	5th FWP (Fifth Framework Programme)
Contract Number:	ENK6-CT-2001-00552
Website:	www.ecn.nl/optimat
Start date:	01 Jan 2002
End date:	30 Apr 2006

Coordinator Details

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CENTRE FOR RENEWABLE ENERGY SOURCES, GAVRIILIDES Pavlos (Mr)
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Knowledge Centre Wind turbine Materials and Constructions, Don van Delft

Commission Officer Name: Thierryd'Estaintot

Original research objectives

Various factors will determine the development of wind energy. Economy plays a dominant role, but also rational use of resources. Economy dictates minimisation of investment and operational costs of wind turbines that have reliable and structurally optimised blades over their designed lifetime. Rational use of materials supports this as well as the policy to minimise such use for reasons of minimal use of earth resources and for environmental reasons. The economy of large wind farms calls for reliable and non-stop operation and for dedicated methods for monitoring and repair, in particular for offshore wind farms owing to poor accessibility. To these ends, design data and tools need to be accurate and trustworthy. However, before this project such data and tools are quite often far from being consistent, reliable, sufficient and satisfactory. The project aims at providing the necessary underlying knowledge for strongly improving the situation. The outcome is a consistent set of accurate and reliable design recommendations. More in particular, the project OPTIMAT BLADES addresses the problem of strain, stress and fatigue in wind turbine

blades for various materials. Such blades are subject to severe fatigue loadings, e.g. variable amplitude loadings with often more than one billion fatigue cycles and to a variety of external conditions, sometimes of a severe nature. Moreover, the blades consist of thick laminates that are in a state of complex stresses. Therefore, the scientific and technical objectives of the project are: * to obtain improved and profound knowledge of blade material behaviour under variable amplitude loading, under complex stress states and under extreme external conditions, * to obtain improved and profound knowledge of the stress state and behaviour of thick laminates, * to obtain improved knowledge of the interaction of the conditions mentioned above, * to develop methodologies for repair, * to develop methodologies for condition assessment, residual strength and lifetime prediction, and * to implement the obtained knowledge into a consistent set of accurate and reliable design recommendations. The acquired knowledge and tools will result in reliable blades, reduced use of material and less waste, reduced environmental impact, extended lifetime for blades, larger availability of wind turbines and extension of the possible size of wind turbines. To meet the ambitious objectives and to ensure wide acceptance of the design recommendations, a large consortium of 10 research institutes, 6 manufacturers and 2 certification bodies from 8 EU countries is formed.

Expected Deliverables

The chief deliverable of OPTIMAT BLADES is a consistent set of accurate and reliable design recommendations for wind turbine blades. In order to generate this set, improved and detailed models on blade material behaviour will be developed and pertinent data will be collected. The models and data relate to the behaviour under variable amplitude loading, under complex stress states and under extreme external conditions, both per item as collectively. Furthermore, improved and detailed models as well as data will be generated for the stress state and behaviour of thick laminates. At the same time, methodologies for repair will be developed as well as methodologies for condition assessment, residual strength and life prediction. In more detail and structured along the main lines of the project the following items will be delivered: 1. test report describing material, laminates and fatigue tests 2. report about fatigue results including damage accumulation factor 3. report describing of New Wisper standard load spectrum 4. validation report of New Wisper 5. report on interaction tests and New Wisper testing on alternative materials 6. report on validated composite mechanics and FEM formultion guidelines for blade design 7. report on validated multi-axial static and fatigue failure criteria 8. database of mechanical properties for reference materials 9. report on assessment of failure probability under uni- and multi-axial static and fatigue load 10. report on quantification of complex stress state effect on blade design 11. report about variations in multi-axial predictions due to material choice 12. proposal for eventual modifications of partial safety factors 13. report on microstructural model and identification of degradation parameters 14. report on definition of extreme conditions and procedures for testing under extreme conditions 15. phenomenological micromechanics models for sensitivity analyses 16. report on effects of extreme conditions on reference material properties 17. report on effect of environmental ageing on reference material 18. report on variations in extreme conditions predictions due to material choice 19. database on degradation behaviour of tested material combinations 20. report on definition of typical thick laminates 21. evaluation report comparing analytical methods with data 22. report on selected repair techniques for small specimens 23. evaluation report on repair techniques for small specimens 24. report on design and tes of thick, curved components 25. production of large components with and without repaired flaws 26. review report on existing predictive models for residual strength 27. experimental database from residual strength tests 28. validated engineering model for residual strength prediction 29. validated engineering model for residual lifetime evaluation and strategy for condition assessment 30. experimental database from residual strength tests on alternative materials 31. validated engineering models for residual strength and life prediction using condition assessment 32. summary report phase 1 33. draft design recommendations for reference material 34. summary report phase 2 35. design recommendations for the next generation of rotor blades for wind turbines 36. production of small specimens of reference material 37. production of small specimens of alternative materials

Project's actual outcome

(to be inserted)

Broad dissemination and use intentions for the expected outputs

The outputs of OPTIMAT BLADES will be made available primarily to parties working in or related to the wind energy area in Europe. The parties range from industries (design and manufacturing of wind turbine blades in particular), engineering consultancies, certification bodies, research institutes, governmental bodies to energy providers. (This broad range is witnessed by the participants in the project.) Elements of the outputs will also be useful to other parties, e.g. industries and research institutes that apply composite materials. A report containing recommendations for design and manufacturing of wind turbine blades is the key output indispensable for any party working in the field. Besides that, underlying non-confidential information will be presented in reports and on conferences. Design tools, especially computer codes, and instructive recommendations for repair and maintenance of blades will be available, mainly commercially. Another output is in the form of databases that are open as far as they are non-confidential.

Quantified Data on the dissemination and use of the project results

	Curently achieved quantity	Estimated future quantity
Product innovations		
Process innovations		
New services (commercial)		
New services (public)		
New methods		
Scientific breakthrought		
Technical standards to which this project has contributed		
EU regulations/directives to which this project has contributed		

International regulations to which this project has contributed

PhDs generated by the project

Grantees/trainees including transnational exchange of personnel

Comment on European Interest

European dimension of the problem (The extent to which the project has contributed to solve problems at European level)

Policies for a substantial development of wind energy have been set out by many countries and by the EU. At present, many parties feel it is hindered by non-optimal design recommendations for wind turbines and wind parks. In the project knowledge and methodologies will be developed and eventually come together in new, consistent, accurate and reliable design recommendations. Such new knowledge and design recommendations for wind turbines and wind parks will be beneficial to industries, energy suppliers and the energy consumer. The implementation of wind energy as an energy source in Europe will be fostered. The ambitions are realised not only by the contents of the project but also by the broad range and the recognised excellence of the participants.

Contribution to developing S&T co-operation at international level. European added value (Development of critical mass in human and financial terms; combination of complementary expertise and resources available Europe-wide)

The project brings together many outstanding parties. The cooperation will not end with the project. The project has laid the foundations for new alliances and strengthened existing ones. The added value for Europe is summarised in the following points: (1) through the gathered knowledge and the developed design recommendations Europe has established a prominent position for wind energy world-wide for a considerable time, (2) industries, including energy providers, have strengthened their competitive position inside and outside Europe with many export opportunities, (3) S&T institutions have shown to be able to build up and maintain networks to the benefit of science and technological development, (4) Europe is now better equipped to proceed with the speedy development of wind energy, (5) wind energy S&T and also materials S&T greatly benefit from the results of the project, (6) the economics and rational use of resources in the area of wind energy have improved considerably.

Contribution to policy design or implementation (Contribution to one or more EU policies; RTD connected with standardisation and regulation at Community and/or national levels)

Since the project significantly contributes to the economics and rational use of material in the area of wind energy, new plans can be drawn for the development and implementation of wind energy. Policy makers, publically as well as industrially, have more accurate, reliable and consistent data at hand to develop such new plans for wind energy. Implementation will gain momentum as the design recommendations will be widely accepted. Rational use of earth's resources is another policy issue that is served by the results of the project.

Improving the quality of life in the Community

It is evident that the project supports sustainable development. The improved opportunities for wind energy as well as the use of resources enhance the preservation of the environment. In that way it contributes to the quality of life in the EU.

Provision of appropriate incentives for monitoring and creating jobs in the Community (including use and development of skills)

The gathered knowledge and new design recommendations strengthen European industries and S&T institutions in wind energy. Their competitive positions have certainly gained from the project. Jobs will well increase in number and have a higher quality content.

Supporting sustainable development, preserving and/or enhancing the environment (including use/conservation of resources)

The project supports sustainable development. The improved opportunities for wind energy as well as the use of resources enhance the preservation of the environment.

Result(s) for this project

----- Number of result: 25575 -----

Title of the result	1. Recommendations on testing and characterisation of materials
Category	A: results usable outside the consortium
Partner owning the result	Bert Janssen Don van Delft ANTIKAINEN Petteri (Mr) HALLING Kaj (Engineer) GAVRIILIDES Pavlos (Mr) DUTTON Geoff (Dr) JANSSEN Bert (Ir) KORSGAARD John (Dr) BONETA Javier (Mr) ERIKSSON Christer (Dr) STEPHAN Arndt (Dr) VAN HEMELRIJCK Danny (Professor) NATH Christian (Dr) VAYENAS Constantinos (Professor) BRONDSTED Povl (Dr)

KOCHENDORFER Richard (Professor)
MOLLY Jens Peter (Engineer)

Contact person for the result

Name	
Position	
Organisation	
Address	
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e_mail	
URL	
specific url	

Summary

During the project much experience has been gained towards testing and material characterisation methods. Unexpected results were found regarading - the sensitivity to fatigue testing frequencies - the influence of the choice of the stress-strain curve used for the determination of stiffness moduli. Both aspects are adequately covered in any test recommendation to date known to the consortium. TC? << Further details on participants and their position need adjustment >>

Subject descriptors

Documents

Documentation type :	Reports
Details	OB xxx
Status:	Confidential

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

	Actual current quantity	Estimated future quantity
Time to application / market (in months from the end of the research project)		
Number of (public or private) entities potentially involved in the implementation of the result :		
of which : number of SMEs :		
of which : number of entities in third countries (outside EU) :		
Targeted user audience: # of reachable people		

# of S&T publications (referenced publications only)	
# of publications addressing general public (e.g. CD-ROMs, WEB sites)	
# of publications addressing decision takers / public authorities / etc.	
Visibility for the general public	YES

Further collaboration, dissemination and use of the result

(please tick the boxes corresponding to what form of contact you are seeking and what future steps you envisage in order to use your research results.)

LIC	License agreement
MKT	Marketing agreement
MAN	Manufacturing agreement
JV	Establish a joint enterprise or partnership
PPP	Private-public partnership
FIN	Development financing
VC	Venture capital/spin-off funding
CONS	Available for consultancy
INFO	Information exchange/Training
R&D	Further research or development
Other	(please specify below)

Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25576 -----

Title of the result	2. Geometry of standard Optimat Blades test specimen
Category	A: results usable outside the consortium
Partner owning the result	Bert Janssen ANTIKAINEN Petteri (Mr) Don van Delft HALLING Kaj (Engineer) GAVRIILIDES Pavlos (Mr) DUTTON Geoff (Dr) JANSSEN Bert (Ir) KORSGAARD John (Dr) BONETA Javier (Mr) ERIKSSON Christer (Dr) STEPHAN Arndt (Dr) VAN HEMELRIJCK Danny (Professor) NATH Christian (Dr) VAYENAS Constantinos (Professor) BRONDSTED Povl (Dr) KOCHENDORFER Richard (Professor) MOLLY Jens Peter (Engineer)

Contact person for the result

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Position	
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Summary

For the Optimat Blades project, a test specimen geometry has been determined which is suitable for both static tension, compression and fatigue tests. To date, separate geometries are typically recommended, for instance by ISO/ASTM standards. Although the specialised geometries can often achieve better results for most basic tests, such as static tensile or compressive tests, the addition of a more generally usable test geometry is recommended for especially residual strength tests. TC? << Further details on participants and their positions need adjustment >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

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Number of (public or private) entities potentially involved in the implementation of the result :		
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# of publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25578 -----

Title of the result	3. Geometry of cruciform test specimen
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

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Organisation	
Address	
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Summary

For testing bi-axial material properties, a cruciform test geometry was developed by the consortium and tested at VUB. The development of a test geometry by FE analyses and tests and the development of the test set-upo allows for adequate bi-axial testing (tensile forces only), which could find general use in bi-axial tests of fiber reinforced materals, also outside the rotor blades. VUB? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

	Actual current quantity	Estimated future quantity
Time to application / market (in months from the end of the research project)		
Number of (public or private) entities potentially involved in the implementation of the result :		
of which : number of SMEs :		
of which : number of entities in third countries (outside EU) :		
Targeted user audience: # of reachable people		
# of S&T publications (referenced publications only)		
# of publications addressing general public (e.g. CD-ROMs, WEB sites)		
# of publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25579 -----

Title of the result	4. Geometry for tubular test specimen
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

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Summary

Another option for bi-axial testing is the use of tubular specimens on a tension-torsion test machine. Although not especially developed for Optimat Blades, the added insight gained in manufacturing of the tubular specimens might prove useful for future research projects. DLR? LM? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

	Actual current quantity	Estimated future quantity
Time to application / market (in months from the end of the research project)		
Number of (public or private) entities potentially involved in the implementation of the result :		
of which : number of SMEs :		
of which : number of entities in third countries (outside EU) :		
Targeted user audience: # of reachable people		
# of S&T publications (referenced publications only)		
# of publications addressing general public (e.g. CD-ROMs, WEB sites)		
# of publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25614 -----

Title of the result	5. Validated composite mechanics and FEM guidelines and recommendations
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

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Summary

The knowledge gained from the extensive number of tests will be used to check and adapt commonly used composite mechanics rules as well as serve as a base for the formulation of FEM guidelines which accurately incorporate the composite behaviour. UP? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate	Pre-existing know-how Tick a box and give the corresponding details (reference number,

	Current				Foreseen	etc) if appropriate	
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

	Actual current quantity	Estimated future quantity
Time to application / market (in months from the end of the research project)		
Number of (public or private) entities potentially involved in the implementation of the result :		
of which : number of SMEs :		
of which : number of entities in third countries (outside EU) :		
Targeted user audience: # of reachable people		
# of S&T publications (referenced publications only)		
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# of publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25618 -----

Title of the result	6. Suitable repair techniques for FRP rotor blades
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

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Organisation	
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Telephone	
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URL	
specific url	

Summary

A number of repair techniques has been tested and compared. It seems that for a simple scarf a slope of 1:50 is sufficient, steeper slopes seem to lead to a rapid degradation in strength. Even so, a 20% loss in static strength is to be expected. After the conclusion of the fatigue tests some recommendations on the fatigue behaviour of repaired specimens will be added. CRES? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

	Actual current	Estimated future

	quantity	quantity
Time to application / market (in months from the end of the research project)		
Number of (public or private) entities potentially involved in the implementation of the result :		
of which : number of SMEs :		
of which : number of entities in third countries (outside EU) :		
Targeted user audience: # of reachable people		
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# of publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

(please tick the boxes corresponding to what form of contact you are seeking and what future steps you envisage in order to use your research results.)

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R&D	Further research or development
Other	(please specify below)

Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25619 -----

Title of the result	7. Validated micro mechanics models
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

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Position	
Organisation	
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Telephone	
Fax	
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URL	

specific url

Summary

The continuum damage mechanics is used to describe the constitutive behaviour of UD laminate with damage. The progressive fiber fracture, as it is affected by interface strength, debonding growth and matrix cracking, is considered as a main damage mechanism causing the stiffness reduction. The internal state variable that accounts for fiber fracture is formulated within the used theory. The methodology is proposed to measure the values of the internal state experimentally. The FEM analysis and Monte Carlo simulations are used in order to predict the internal state variable according to the outlined theoretical formulation. The predicted values of internal state variables are compared with experimental results. RISO? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

	Actual current quantity	Estimated future quantity
Time to application / market (in months from the end of the research project)		
Number of (public or private) entities potentially involved in the implementation of the result :		
of which : number of SMEs :		
of which : number of entities in third countries (outside EU) :		
Targeted user audience: # of reachable people		
# of S&T publications (referenced publications only)		
# of publications addressing general public (e.g. CD-ROMs, WEB sites)		
# of publications addressing decision takers / public authorities / etc.		
Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

(please tick the boxes corresponding to what form of contact you are seeking and what future steps you envisage in order to use your research results.)

LIC	License agreement
MKT	Marketing agreement
MAN	Manufacturing agreement

JV	Establish a joint enterprise or partnership
PPP	Private-public partnership
FIN	Development financing
VC	Venture capital/spin-off funding
CONS	Available for consultancy
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R&D	Further research or development
Other	(please specify below)

Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25620 -----

Title of the result	8. New Wisper standard load spectrum
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

Name

Position

Organisation

Address

Telephone

Fax

e_mail

URL

specific url

Summary

A NEW WISPER standard load sequence that reflects today's state-of-the-art in wind energy conversion technology has been established. The idea is that material characteristics like fatigue life limits can be provided with better confidence for use in modern wind turbine rotor blade design when a test sequence reflecting today's turbine technology is used to establish such characteristics. ECN? DEWI? DLR? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen	Tick	Details
	Tick	NoP	NoI	Details	Tick		
Patent applied for							

Patent granted

Patent search carried out

Registered design

Trademark applications

Copyrights

Secret know-how

Other - specify:

Application sectors

Current stage of development

Quantified data about the result

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Visibility for the general public	YES	

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25621 -----

Title of the result	9. Validated engineering model for residual strength prediction
Category	A: results usable outside the consortium

Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

Name	
Position	
Organisation	
Address	
Telephone	
Fax	
e_mail	
URL	
specific url	

Summary

The laminate's strength after fatigue is measured for the laminates. Apart from providing useful insights in the material strength behaviour, this enables accurate strength degradation modelling, which can be beneficially used in lifetime prediction methods. Using strength degradation models, lifetime prediction can be improved relative to the "classical" Miner damage rule, by taking into account the effect of loading sequence. WUC? UP? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

	Actual current quantity	Estimated future quantity

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Visibility for the general public	YES

Further collaboration, dissemination and use of the result

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25681 -----

Title of the result	10. Validated engineering model for the residual life evaluation
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

Name	
Position	
Organisation	
Address	
Telephone	
Fax	
e_mail	
URL	

specific url

Summary

No text yet .

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen	Tick	Details
	Tick	NoP	NoI	Details	Tick		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
Trademark applications							
Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

Quantified data about the result

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Visibility for the general public	YES	

Further collaboration, dissemination and use of the result

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25682 -----

Title of the result	11. Optidat data base including analysis software
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr) BONETA Javier (Mr) KORSGAARD John (Dr) JANSSEN Bert (Ir) DUTTON Geoff (Dr) GAVRIILIDES Pavlos (Mr) HALLING Kaj (Engineer) ANTIKAINEN Petteri (Mr) Bert Janssen Don van Delft

Contact person for the result

Name	
Position	
Organisation	
Address	
Telephone	
Fax	
e_mail	
URL	
specific url	

Summary

All test results of the project have been collected in a major Excel spreadsheet so as to allow for easy selection and assessment of the more than 2400 tests carried out to date on criteria specified by the user, making available the vast amount of data gathered within the project to researchers worldwide. A specialised plot tool allows for the direct derivation of S-N lines based on fatigue tests. During the project, progress of the project is tracked using the spreadsheet as well. WMC? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

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	Current				Foreseen		
	Tick	NoP	NoI	Details	Tick	Tick	Details
Patent applied for							
Patent granted							
Patent search carried out							

Registered design

Trademark applications

Copyrights

Secret know-how

Other - specify:

Application sectors

Current stage of development

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Details: Please describe in more detail what you are looking for - your intension, and/or your offer to others.

Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

----- Number of result: 25683 -----

Title of the result	12. Design recommendations for next generation of rotor blades
Category	A: results usable outside the consortium
Partner owning the result	MOLLY Jens Peter (Engineer) KOCHENDORFER Richard (Professor) BRONDSTED Povl (Dr) VAYENAS Constantinos (Professor) NATH Christian (Dr) VAN HEMELRIJCK Danny (Professor) STEPHAN Arndt (Dr) ERIKSSON Christer (Dr)

BONETA Javier (Mr)
KORSGAARD John (Dr)
JANSSEN Bert (Ir)
DUTTON Geoff (Dr)
GAVRIILIDES Pavlos (Mr)
HALLING Kaj (Engineer)
ANTIKAINEN Petteri (Mr)
Bert Janssen
Don van Delft

Contact person for the result

Name	
Position	
Organisation	
Address	
Telephone	
Fax	
e_mail	
URL	
specific url	

Summary

For the first time a large coherent research programme on materials is carried out. The major aspects covered by the project will be translated into updated design recommendations for wind turbine blades. WMC? << Awaiting adjustment of pertinent details >>

Subject descriptors

Documents

Intellectual Property Rights

Type of IPR	Knowledge: tick a box and give the corresponding details (reference numbers, etc) if appropriate					Pre-existing know-how Tick a box and give the corresponding details (reference number, etc) if appropriate	
	Current				Foreseen	Tick	Details
	Tick	NoP	NoI	Details	Tick		
Patent applied for							
Patent granted							
Patent search carried out							
Registered design							
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Copyrights							
Secret know-how							
Other - specify:							

Application sectors

Current stage of development

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Visibility for the general public	YES

Further collaboration, dissemination and use of the result

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Potential offered for further dissemination and use

Profile of additional partner(s) for further dissemination and use

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(Project Coordinator) **Name**: Bert Janssen **Organisation**: ECN **Address**: Westerduinweg 3 1755 LE Petten The Netherlands

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