



Dedicated to innovation in aerospace

'We share the sky'

Match Making Event Borssele Wind Farm Site V, Richard Bakker, 24 November 2016

Wind Energy and Aerospace Technology

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Supporting the technological and environmental challenges of wind energy production

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"INNOVATIVE SOLUTIONS FROM THE AEROSPACE DOMAIN OFFER OPPORTUNITIES FOR WIND ENERGY PRODUCTION"

NLR - Dedicated to innovation in aerospace

www.nlr.nl

"WE SHARE THE SKY"

NLR offers specialised knowledge and consultancy in the following areas:

Wind Turbine Technology

- Blade profile design
- Blade aero-elastic, loads and fatigue analyses
- New composite materials and light construction techniques
- Blade erosion, icing and lightning protection systems
- Test facilities, loads and fatigue assessments
- Generator technology

Control & Maintenance

- Wind turbine blades and system components loads and fatigue monitoring and analysis
- Analysis of the application of helicopters for installation and operation of wind turbines
- Performance of helicopters and drones for aerial servicing of wind turbine

Environment & Safety

- Assessment of acoustic signatures and the perception of wind turbine sound
- Noise source localisation, field testing, noise reduction studies and the development of practical and efficient noise reduction solutions
- Safety Assessments for the development of wind turbines near an airport
- Aeronautical Studies to reduce the environmental impact of aircraft warning lights
- Definition of the operational limitations for helicopter aerial servicing operations on wind turbine parks
- Application of RPAS (Remotely Piloted Aerial Systems or 'Drones') including legislation
- Aircraft operations in a wind turbine wake

Environment

Noise, lighting and the visual appearance of wind turbines have caused public distress. NLR's Virtual Community Noise Simulator offers a virtual environment for visual and auditive demonstrations, which can be used in support of societal acceptance. NLR disposes of tools to objectively analyse the acoustic and visual characteristics of a wind turbine. The acoustic wind tunnel together with noise localisation methods can pinpoint the noise sources and aid in the development of the appropriate noise suppression. In the past this technique has initiated and encouraged the development of the blade trailing edge, saw-tooth noise reduction device.

Technology

One of the suggested ways to improve the efficiency of a wind turbine rotor is to increase its overall dimensions and rpm. This causes the blade tip to reach transonic tip speeds. NLR has knowledge of the aerodynamic phenomena in this speed regime. NLR can assist in the design of an effective blade profile and address the appropriate blade erosion, icing and lightning protection measures. It has extensive knowledge of low-cost fabrication and application of composite materials and can perform specialised structural and aero-elastic analyses.

Safety

Wind turbines may pose a safety hazard to aircraft operations, especially near airports. This concerns the obvious collision risk but also includes the disturbance of radar, navigation aids and communication systems and the turbulence induced by a wind turbine. Regulations to control these risks can seriously limit the siting options for a developer of wind farms. However, deviations of these regulations may be allowed based on a dedicated Safety Assessment. Over the years NLR has performed numerous Safety Assessments for various (international) customers.

Please contact us for more information

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Aero-Acoustics Research

Noise localisation
Acoustic wind tunnel testing



Quiet and efficient
wind turbines



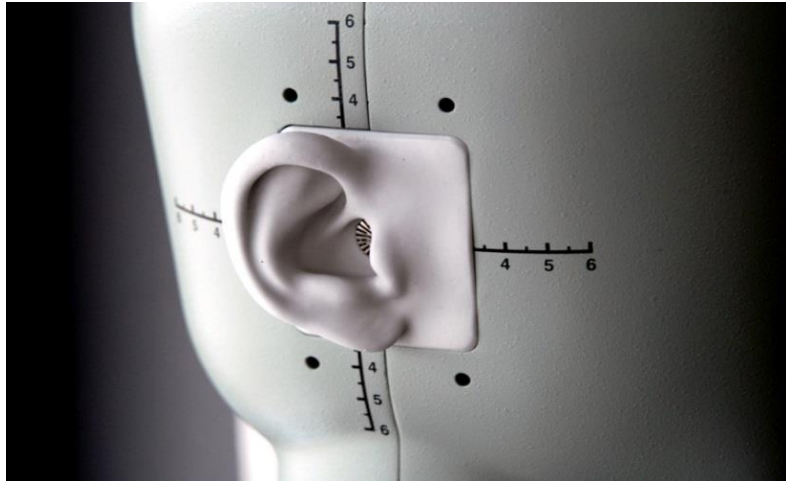
Reliable tools to predict, measure
and reduce wind turbine noise

- Provide design guidelines for noise reduction concepts
- Acoustic and aerodynamic wind tunnel testing of prototypes
- Full-scale testing

Full scale testing
Noise reduction devices

Virtual Community Noise Simulator

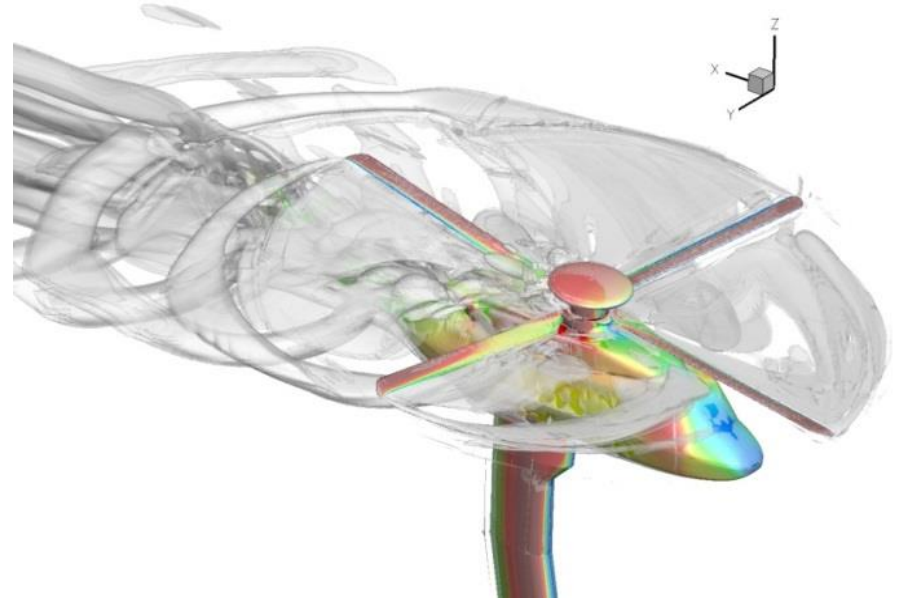
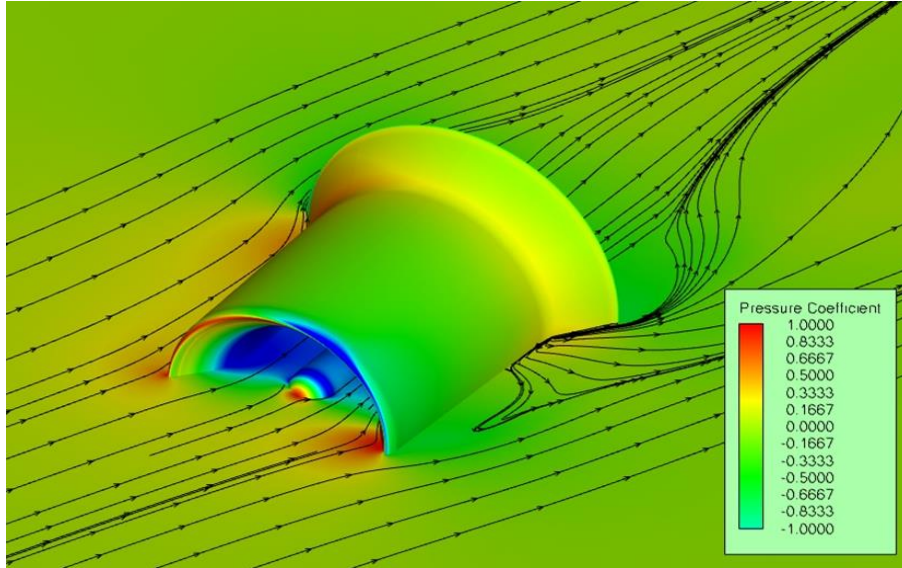
Stakeholder management



Annoyance and perception

Computational Fluid Dynamics

Optimised duct for small urban wind turbine



Flow analysis of helicopter configuration in wind tunnel

Structures testing & evaluation

Mechanical testing and load monitoring

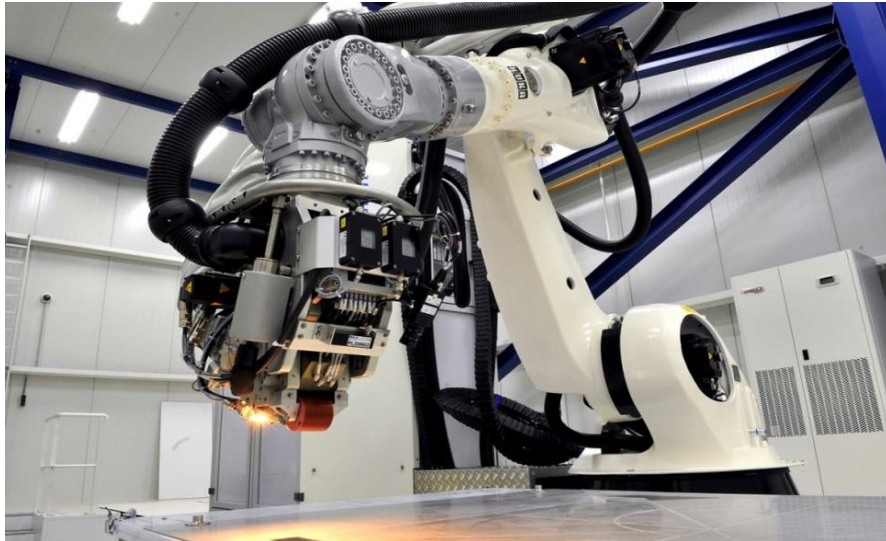


Environmental testing



Composites

Composite materials



***Automated Composite
Manufacturing Plant***

Environmental Protection

Blade Erosion and Icing



Lightning

Offshore Wind Energy, Maintenance & Operations

Aerial Servicing



Remotely Piloted Aerial Systems

Wind Turbine (park) and Flight Safety

Obstacle Assessment



Windfarm Obstacle Lights



Dedicated to innovation in aerospace

Fully engaged

Netherlands Aerospace Centre

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