Smart Rotor

Gijs A.M. van Kuik, Lars O. Bernhammer, Aubryn Cooperman
Flow Theme 4 meeting 14.5.2014
# Overview

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Objectives

- Whole project: Study the impact of a much more detailed control of blade loads by applying flaps distributed along the blade, with respect to loads, safety and reliability of the offshore wind turbine
- The main target: make the step from Smart rotor analysis to a conceptual design of a Smart Turbine
- Development of analysis/design tools
Work packages

- **WP1 Code development** ✓
- **WP2 Model test in OJF** (✓ first tests completed)
- **WP3 Study of alternative flap configurations** ✓
- **WP4 Code validation by Sandia experiments** ✓
- **WP5, Conceptual design of full turbine** *(real scale turbine section under development, connected to WP2)*
- **WP 6, Cost of Energy analysis** *(t.b.d.)*
- **WP 7 Synthesis and Writing of thesis**
Planning and Milestones – Part I
Analysis

- The analytical part is composed out of the creation of an analysis tool and its usage to determine the cost of energy.
- The associated milestones are the validation and verification of the code by summer 2012.
- Detailed quantification of extreme and fatigue loads for all turbine components completed.
- The next following milestone on the theoretical side is the cost analysis. This is needs input by ECN later in the project.
Planning and Milestones – Part II Implementation

- **Code validation**: Sandia experiments, completed by 2012
- A novel flap concept has been tested in the Open Jet Facility in a non-rotating reference frame.
- Sub-systems have been tested (Trailing edge tab control & Energy Harvesting)
- System integration currently under development
Planning and Milestones – Aubryn Cooperman

- Reviewed available sensor technologies for load monitoring on wind turbines
- Small turbine system obtained for testing of sensors in Open Jet Facility and rooftop field tests
- Developing shape analysis algorithms for two sensor systems:
  - Inertial sensing using micro-electromechanical systems (MEMS)
  - Fibre optic shape sensing using Rayleigh backscattering
- Milestone will be implementation of sensor systems on test turbine
Risks and Acceleration

- No simulation risks. Code is complete, verified and validated
- Load reduction results obtained, only open end is the translation into costs ➔ Technical risk very low
- Design: Subsystem level complete
- Risk system integration ➔ Risk present but controllable
- Prevention: Re-using of already existing test set-up
- Mitigation: Two test campaigns in autumn with time to correct errors

- Acceleration: Technology demonstration provides system that is ready to be integrated in turbine (plug-and-play concept)
Contribution to FLOW targets

- Demonstration of load reduction in blade, nacelle and tower
- This can be translated into a more cost efficient design
- Flow cost model not applicable for this project
- Physical demonstration on real scale section as driver for implementation
Thank you

Questions?