Distributed Wind Aeroelastic Modeling (dWAM)

Introduction

Aeroelastic modeling is the primary method for the structural and performance assessment of any wind turbine. These tools provide an understanding of the impact of design parameters on turbine loading and power performance before operating in the field. Despite these advantages, the use of aeroelastic modeling in the distributed wind energy industry is limited.

Objective

This project aims to improve the aeroelastic modeling tools for distributed wind turbines (DWTs) to enable the design and certification of optimized turbine technology with a competitive cost of energy.

Components of the Project

Advanced Reference Turbines for Distributed HAWT Archetypes (ARETHA) including:

- Focus on modern, horizontal axis archetypes
- OpenFAST code improvements
- Validation using research turbines at NREL's Flatirons Campus
- Code-to-code verification activities
- Develop guidance documents and improved user manuals

Vertical Axis Wind Turbine (VAWT) Modeling

- Includes modeling code and user-experience improvements in collaboration with Sandia National Laboratories
- Coupling of Sandia's OWENS code and NREL's OpenFAST/AeroDyn tools

Automated Campbell Diagram Capabilities (ACDC)

- Develop a streamlined, documented, and automated procedure to generate a Campbell diagram
- Aids in meeting requirement for certification to International Electrotechnical Commission (IEC) 61400-2

Design Load Basis Guidance

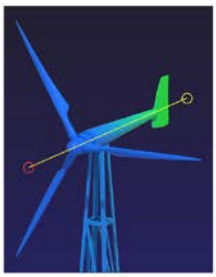
- Develop guidance on selecting critical vs. non-design-driving load cases and creating a design load basis for distributed wind turbine modeling
- Industry workshop to better understand real-world field failures of distributed wind turbines

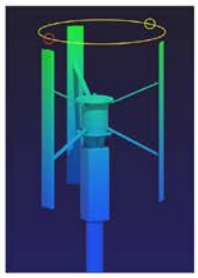
Future Outcomes

Advancements in aeroelastic modeling of DWTs will result in impactful deployment acceleration and cost reduction of optimized, certified turbine designs. Designers will have access to guidance documents, validated model templates and load reports, and automated analysis tools, allowing increased industry adoption of aeroelastic modeling tools. This will result in a more efficient design and certification process of optimized and more reliable DWTs.

Partners

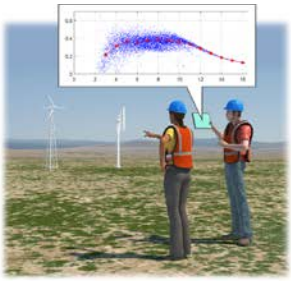
- Sandia National Laboratories
- Technical University of Denmark
- RRD Engineering
- Windward Engineering
- Advanced Renewable Technology
- Bergey Windpower
- QED Wind Power
- Eocycle Americas
- XFlow Energy
- University of Calgary
- University of Massachusetts Amherst





Model Improvements

- Improved Physics for Distributed Archetypes
- Vertical-Axis Wind Turbine (VAWT) Modeling
- Automated Campbell Diagram Capabilities (ACDC)



Validated Reference Turbines

- Advanced Reference Turbines for Distributed HAWT Archetypes (ARETHA)
- Research Turbine Data for Model Validation
- Code Comparison for Verification

Improved User Experience

- Design Load Basis Guidance With Real-World Failure Mode Research
- Improved OpenFAST Documentation
- VAWT-Specific Scripts and Guidance
- ACDC Tools

Impacts Realized

- Optimized, Certified Designs
- Improved Reliability
- Lower Cost of Wind Energy

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