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OFFSHORE WIND RESEARCH AND DEVELOPMENT CAPABILITIES

O&M AND RELIABILITY:

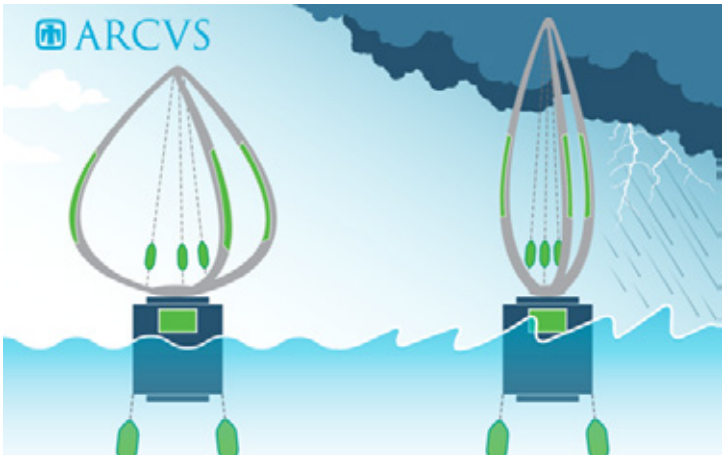
- Autonomous non-destructive inspection technologies that can characterize structural defects from manufacturing and subsequent blade operation
- Rotor sensing technologies to monitor blade loading and damage for normal and extreme operations of modern wind turbines
- Blade O&M optimization tool for erosion prediction and crack growth
- Developed novel additively manufactured 3-D printed tip that can be swapped out if damaged by lightning or leading edge erosion
- Knowledge of environmental aspects of automated drone inspection
- Large composite specimen collection with engineered flaws and damage

ANCHORING, MOORING AND STATIONKEEPING:

- Sandia Lake Facility– 15-24 m deep basin for testing scaled platforms, anchoring and mooring configurations, and novel rotor concepts. Pre-permitted, enabling quicker time to testing
- Active-hybrid truncated mooring test capability with hardware-in-the-loop system that actuates mooring forces at truncation point to account for effects that cannot be modeled physically
- Intermediate scale testing of floating offshore platforms up to 1:10 scale and turbine Reynolds numbers between 1-3 million
- Physical and numerical analysis for sediment stability for optimal cable routing and ideal cable burial depth

PLATFORM DESIGN AND OPTIMIZATION:

- Recent experience in floating system design and analysis through industry partnership for a floating VAWT system
- Development of topology-optimized structures for hydrodynamic performance and reduced material volume
- Metocean environmental analysis to identify/project extreme sea states and resulting device loads
- High-fidelity computational fluid dynamics simulations of floating bodies with multi-physics coupling, including mooring system representations
- Modular barge testing at the Sandia Lake Facility to mimic low roll/pitch angular deflections of a tension-leg platform or higher deflections representative of a semi-submersible platform



U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration

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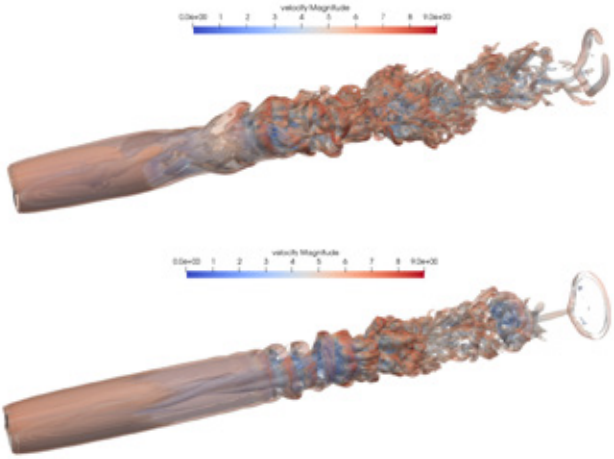
HIGH FIDELITY MODELING:

- Sandia has developed state-of-the-art models for wind turbine simulations, including turbulence models for blade-resolved simulations, fluid-structure interactions, fluid-controls interactions, complex terrain, ocean waves and advanced actuator lines
- Nalu-Wind/AMR-Wind – an open-source computational hybrid solver applied to two-phase flow for wind-water environments, scalable to petascale computing platforms
- Active wake control strategies developed from high fidelity models to improve wind farm power gains
- A Verification and Validation framework to systematically assess and improve the predictive capability of the computational code
- DAKOTA code for optimization and uncertainty quantification

INNOVATIVE ROTOR DESIGN:

- Composite materials and structural optimization to active and passive aerodynamic load control designs
- Recent experience in scaled design with the National Rotor Testbed design project– a highly instrumented blade design to validate design models
- Numerical Manufacturing and Design (NuMAD) blade structural optimization tool and design tool to assess aeroelastic performance
- Offshore Wind Energy Simulator (OWENS) software toolset for the analysis, design, and certification of offshore vertical axis wind turbines
- Extensive experience in composite materials research, including reliability and damage detection, and material optimization for rotor designs
- Assessment of aerodynamic improvements and degradation (e.g., erosion)



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