Collegiate Wind Competition Turbine Design

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University of Wyoming
College of Engineering and Physical Sciences

Collegiate Wind Competition
U.S. Department of Energy

Project Description

Design, fabricate, and test a model floating wind turbine. Performance is evaluated based on scoring across three tasks:

(1) Power Curve Performance: the turbine to generate power from 5 – 11 m/s wind speed
(2) Safety: limit rotation speed when prompted or above 11 m/s, and restarts when safe
(3) Float and Mooring Success: resists tipping past 15° up to 13 m/s wind speed

Design Requirements

- Produce power from 5-11 m/s wind speed
- Slow rotational speed to less than 10% of maximum achieved on command
- Tower resists tipping more than 15° at wind speeds up to 13 m/s
- Rotor and nacelle fit inside 45 cm cube
- Ferrous metal tower with height of 55-75 cm and outer diameter of 1.5 in
- Starts producing power at 5 m/s wind speed
- Floats in a 114 x 96 x 91 cm water tank
- Foundation avoids collision with test tank during turbine operation
- Can turn into the prevailing wind direction
- Mooring lines and weights adjustable without hands touching water

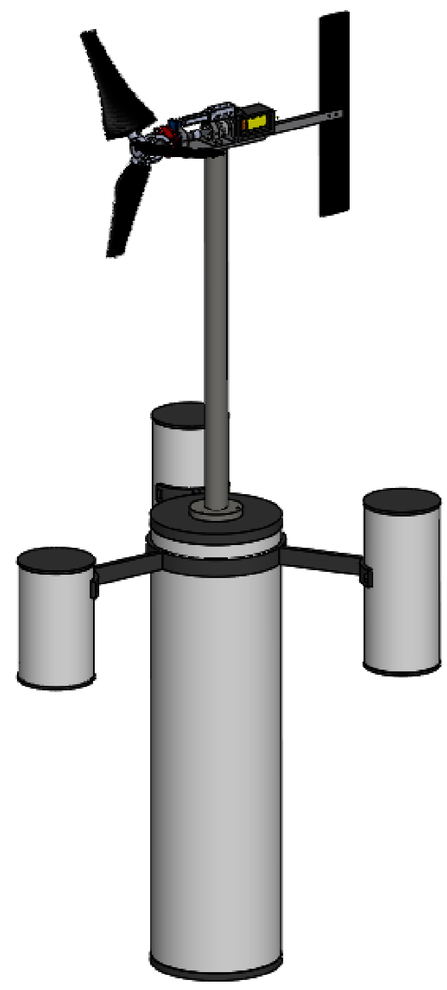

Figure 1: Turbine Model

Figure 2: Rotor

Figure 3: Foundation

Fabrication Progress

Nacelle and Rotor

- Mix of 3D printed parts, machined parts, and sourced parts
- Components press fit or fastened with M3 and M4 bolts
- Nacelle requires generator mount modification and wind vane fabrication before final assembly
- Rotor successfully fabricated and assembled

Foundation

- Mix of sourced parts and 3D printed parts
- All components completed and awaiting assembly
- Waterproof with caulk and secure caps with PVC glue
- Buoys secured to frame with hose clamps and shims
- 50 lb ballast constructed from 1 lb lead ingots
- Tower secured to central buoy with three M8 bolts
- Mooring lines adjustable via in-line tensioner

Testing

Power Curve and Safety Testing

- Conducted in the Mezzanine Wind Tunnel Lab L27
- Electronics measure electric power output at wind speeds from 5 – 11 m/s
- Plot power curve and compare to simulated results
- Verify microcontroller initiates safety stop procedure by feathering blades when requested
- Tipping moment apparatus measures moment at 15° tilt and 13 m/s wind speed

Foundation Testing

- Foundation tested in 1000 L tank located in lab L35
- Mooring and weight system secures foundation
- Apply moment until tower tips 15° and compare to measurement from wind tunnel testing
- Tip angle measured with digital inclinometer
- Mooring weight location and mooring line tension will be adjusted to achieve desired tipping resistance

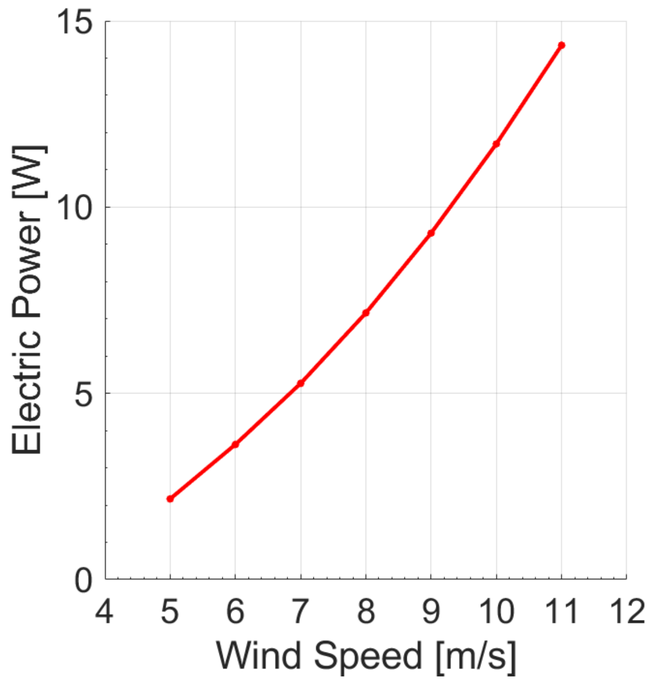

Figure 4: Simulated Power Curve

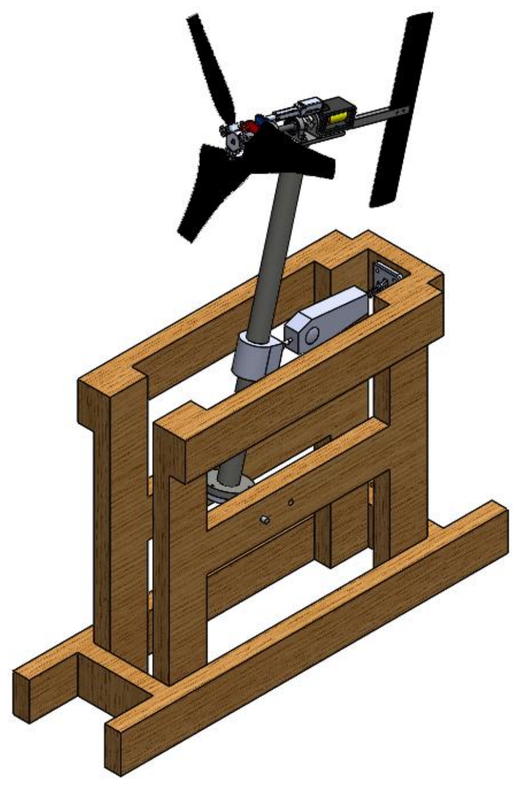

Figure 5: Moment Apparatus