**Competition Summary**

The Department of Energy Collegiate Wind Competition (CWC) is hosted by the National Renewable Energy Laboratory (NREL) at the 2022 CLEANPOWER conference. Each team creates an offshore wind turbine prototype that is tested in a wind tunnel to determine best design and performance. The purpose of the CWC is to prepare students for the growing wind energy industry with real-world experiences.

**Electrical**

- **Pitching Servo**
  - Controls angle of attack of blades
  - Activated during E-stop to reduce rotation speed
  - Used for curtailment at high wind speeds

- **SEPIC**
  - Converts varying output voltage from generator into a steady 5 volts
  - Used to power microcontroller, E-stop, pitching servo

- **Microcontroller**
  - Controls pitching servo, monitors and executes E-stop, reads power output, controls mode switch

- **Mode Switch**
  - Controls source power from the load during startup and sink power during normal operation

- **Variable Resistance**
  - Byte representation of resistors makes it possible to have 256 different resistance values (parallel combinations)
  - Resistor values chosen as power of 2

- **Software**
  - Resistance is calculated to sink max power without exceeding generated power (which produces counter torque)

**Mechanical**

- **Nacelle**
  - Holds the 3 phase generator, coupling, servo, linkage, and rotating shaft

- **Blades**
  - NACA 4412 aerofoil, 3 blade designs for different RPMs (1200, 1500, 1800)

- **Tower**
  - Fiberglass tower to provide structural stability

- **Transition Piece (Stub)**
  - Reproduction of component provided at competition for testing purposes

- **Blades**
  - NACA 4412 aerofoil, 3 blade designs for different RPMs (1200, 1500, 1800)

- **Yaw Mechanism**
  - Turns the nacelle into the direction of the wind, locked by a set screw

**Competition Requirements**

- The turbine prototype must be designed to withstand continuous winds up to 50 mph at sea level
- The turbine prototype must stay within the constraints outlined in figures 1, 2, and 3

**Foundation**

- **Requirement:** Foundation must fit within an imaginary ~6in x ~6in x ~4in box (WxLxH)
- **Solution:** Upside-down bucket with a ~6in diameter

**Testing**

- **Emergency Stop Test Results**
  - Turbine rotational speed dropped below the required 10% of nominal operating speed (shown by the dashed red line) in under 10 seconds

- **Foundation Test Results**
  - Displacement under ½ inch (6 mm) requirement for all applied forces in water

- **Wind Speed Test Results**
  - Max pitch angle resulted in the highest cut-in speed → ideal for the emergency stop condition
  - Min and Medium pitch angles work optimally in 6-25 mph (3-11 m/s) wind speeds → ideal for power output test