

Renewable Energy Engineering

Extended exercise 2.4

Wind turbine performance using BLADED

Use models of 2 wind turbines: 1.3 MW (stall regulated, 55m diameter) and 2 MW (pitch regulated, 80m diameter). Open each model in BLADED, run the appropriate calculation and plot the following:

- a. Run a Steady Power Curve calculation.
 - View the turbine power curve, by plotting electrical power v. hub wind speed. Mark on the power curves the cut-in, rated and cut-out wind speeds. Compare performance of a stall and pitch wind turbine.
 - Plot pitch angle v. hub wind speed. Show the rated wind speed.
 - Plot power coefficient v. hub wind speed
 - Plot thrust coefficient v. hub wind speed
- b. Run a Performance Coefficients calculation.
 - Plot power coefficient v tip speed ratio
- c. Run a Steady Operational Loads calculation.
 - Plot Tower Fx load at any tower height v. Hub wind speed. This is the force acting on the tower in the direction of the turbine axis. This force is also referred to as the 'Thrust' force. At what wind speed is this force a maximum? Can you explain why this is?
 - Plot Hub Mx load v. hub wind speed. This is the useful torque load generated by the rotor blades that acts to turn the turbine drive shaft. What do you notice about the variation of this load above rated wind speed? Why do we see this?
- d. Run a Steady Power curve calculation.

Plot Rotor speed (rad/s) v. hub wind speed.

A plot of generator torque (or generator power) against generator speed can be obtained by running a Steady Power Curve calculation and then selecting both of the variables individually in separate channels. The x-axis can then be set as generator speed.

Data and Resources to support the exercise

1. Introduction to BLADED
2. To obtain an Educational copy of BLADED contact DNVGL through:
Email: bladed@dnvgl.com
Website: <https://www.dnvgl.com/services/bladed-3775>
3. BLADED models of 80m diameter and 55m diameter wind turbines