CWC Test Team A
Kory Joe
Devon Hardy
Aaron Deluca
Evan Heiland
Qian Zhao
Soud Alsahli
ME476C, Section 001

To: Dr. Sarah Kay Oman and graders

From: CWC Test Team A: Kory Joe, Devon Hardy, Aaron Deluca, Evan Heiland, Qian Zhao, Soud Alsahli

Date: October 13, 2017

Re: Analytical Analyses 1 Team Memo

Devon Hardy – Blades

Analytical analysis for the wind turbine blades will be worked on in MatLab. Calculations will pertain to the coefficient of performance vs tip speed ratio. Furthermore, ideal characteristics for the airfoils such as cord length and pitch angle will be analyzed. This information can be used as a starting point to increase the performance of the turbine. It also shows how the performance of the turbine will vary as the turbine will seldom act at the tip speed ratio that is designed for. This will also allow the analysis of the turbine within QBlade to begin.

Soud Alsahli – Drive Train Shaft

Analytical analysis for the drive train shaft fatigue factors of safety will be carried out in MatLab. An excel spreadsheet may also be used to calculate the factors of safety. Relevant analysis methods will be cited to the "Shigley's Mechanical Engineering Design" textbook used in NAU machine design classes. In addition, diameter, moment, and torque applied to the shaft need to be determined for the factors of safety. This can either be carried out by hand or within MatLab or excel. That will be determined when the analysis is carried out.

Aaron Deluca – Generator

For the generator analytical assignment, a dynamometer will be used to test several motors and generate power curves for them which show power output as a function of RPM. The power curves will then be used to determine what tip speed ratio the blades will need to rotate at to produce certain amounts of power. Once the tip speed ratio is known, power output as a function of wind speed will be mapped so there will be an idea of how much power the generator will output at certain wind speed benchmarks. This will allow optimization of the rectifier and converter so that there will be optimal power outputs at the most important wind speeds..

Kory Joe – Bearings

There will be initially three bearing locations in which I will apply into my analytical analysis for the wind turbine bearing selection. The initial locations are:

- After the wind turbine rotor and before the disk brake.
- At the front portion of the attached generator.

- At the back portion of the attached generator.

Relevant loads on these bearings will initially include the worst case scenarios for:

- The wind thrust onto the rotor
- The weight of the rotor
- The weight of the shaft
- The torque from the brakes

Bearing selection for the analysis will be referenced to "Shigley's Mechanical Engineering Design" 10^{th} edition.

Evan Heiland – DC-DC Converter

For the analytical analysis, equations for an interleaved boost converter to calculate the component sizes will be used, i.e. the inductance and capacitance values. Last year's generator output values will be used to base as the input value for the DC-DC converter. From there the equations will determine what component values are required to achieve the optimum output from the converter. The calculated values will then be verified by using Simulink to test the input values.

Qian Zhao – PCB Board Circuit

For the analytical analysis, a data book on every component used in a boost converter design will be used to select preliminary components. The data book will also be used for some relevant calculations for the design. Then, circuit simulation will be carried out based on what the specific value is chosen through Multisim.