



2024 CU Boulder Collegiate Wind Competition Team

Turbine Design and Testing



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Competition Overview

This year's CU Wind Team will compete in the Collegiate Wind Competition (CWC) hosted by the National Renewable Energy Lab (NREL) in Minneapolis, May 5-9, 2024. Twelve finalist teams will test their small-scale offshore wind turbine and compete in five tasks as part of the turbine testing and design contest. This year's design builds off that of last year's CU CWC team, which placed third at the 2023 competition.

Competition Setup

- Wind tunnel with a competition-defined set of tasks
- Simulation of off-shore wind with foundation in sand & water (small scale)
- After commissioning the turbine must autonomously navigate through each task

Competition Scoring

Tasks & point values at each wind speed (m/s)

5	6	7	8	9	10	11	12	13	14	15-22
Power Curve (50 pts) - generate maximum power							Control of Rated Power (50 pts) - hold power & RPM constant			
	Durability (60 pts) - produce power for 3 minutes									
Foundation (40 pts) - minimizing foundation weight (50 pts) - highest wind speed before failure										
Safety (50 pts) - stop turbine & restart via both load disconnect & button press initiation										

Turbine Design

Rotor

Blade Shaft

- 7075 T6 aluminum
- 3 step down and snap ring design to keep structural integrity and tight tolerance fits with bearings
- Factor of safety for connection hole tear-out of 4

Turbine Blades

- 3D printed out of Nylon 12
- TSR 4 & SG6042 airfoil design

Nacelle

- Houses all critical components

Gear Motor Housing

Gear Motor

- Drives central miter gear to induce pitching

Gear Box

Miter Gears

- 1045 steel, 20 teeth
- Drives pitching system by a gear train
- Factor of safety of 8

Slip Ring

- Critical off-the-shelf electrical component housed in the nacelle
- Allows for power & signal transmission from rotating to stationary electrical components

Foundation

Installation Window

- Competition-specified height requirement
- Designed and tested to meet consistent installment to 1 cm precision
- Easily install with no hand contact with water

Suction Bolts

- Engage suction force following caisson installation

Suction Caisson

- Watertight steel welded caisson
- Industry standard offshore foundation design
- Factor of Safety 1.9

Emergency Stop

Disc Rotor

- Stainless steel 304 2b

Rotor Flange

Brake Piston

- 7075 T6 aluminum
- R6 sliding fit

Linear Actuator

- HiTech HLS12 (6V)
- 380:1 gear ratio
- 176N back-drive force

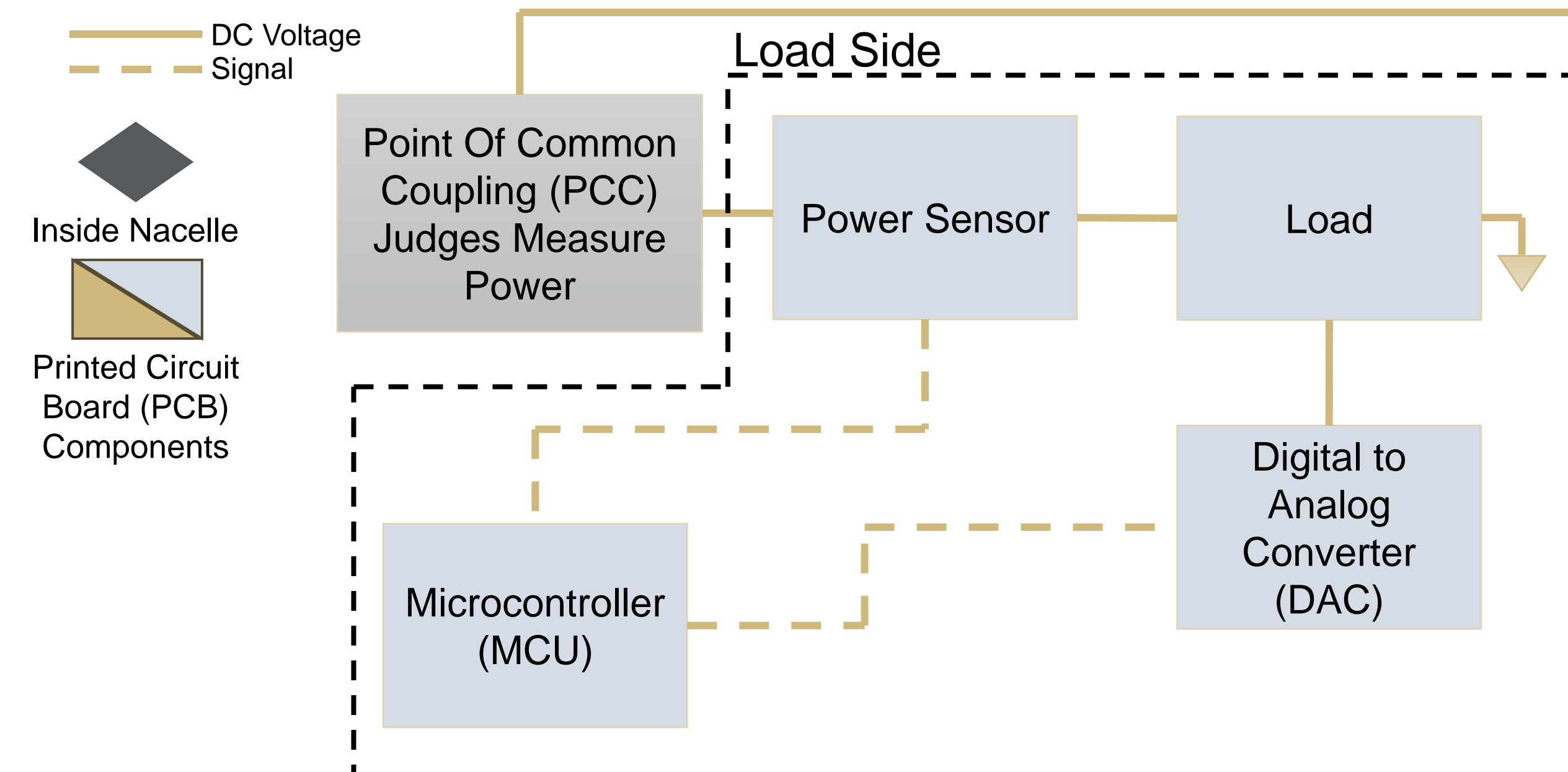
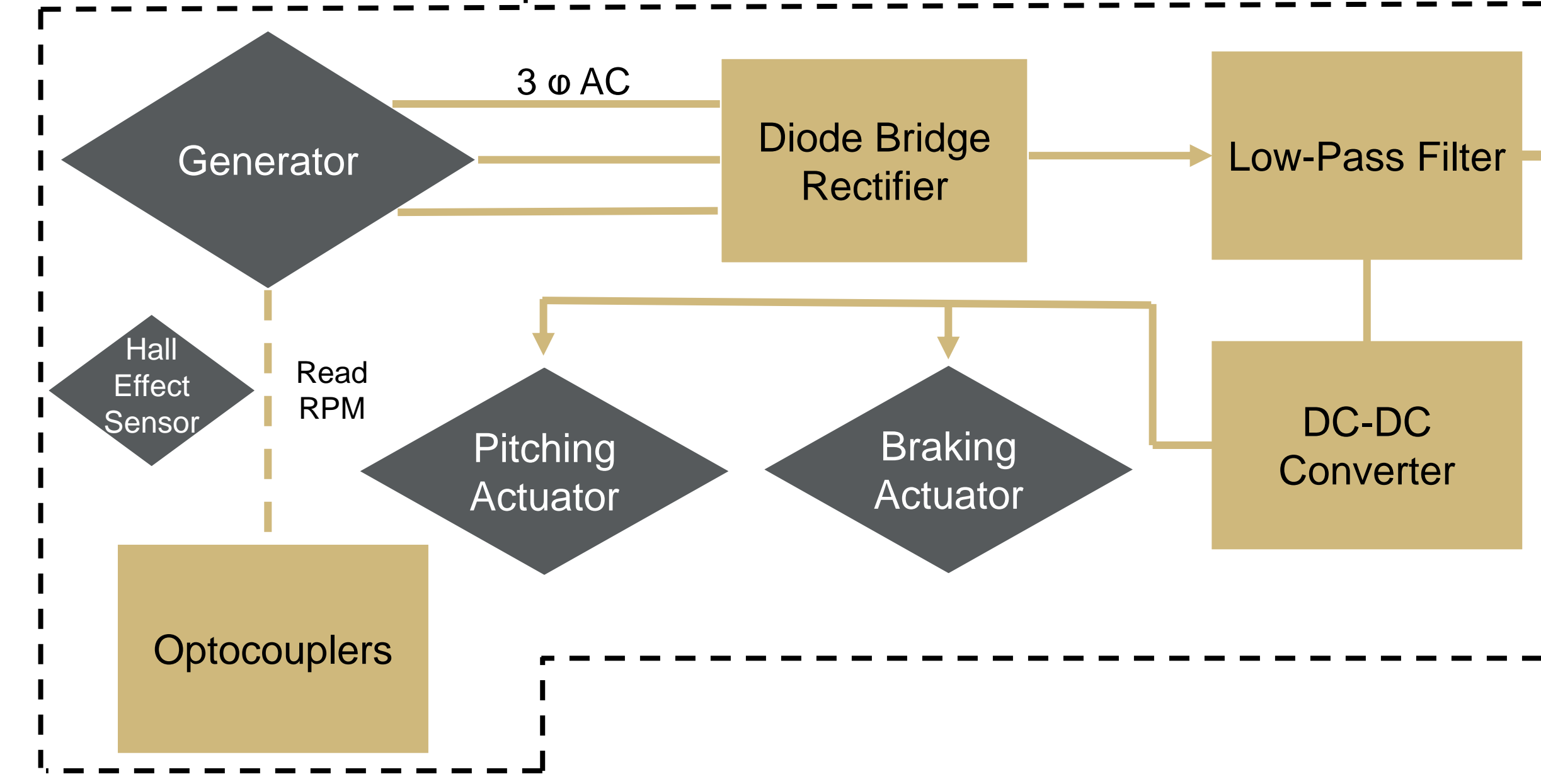
Brake Calipers

- 7075 T6 aluminum

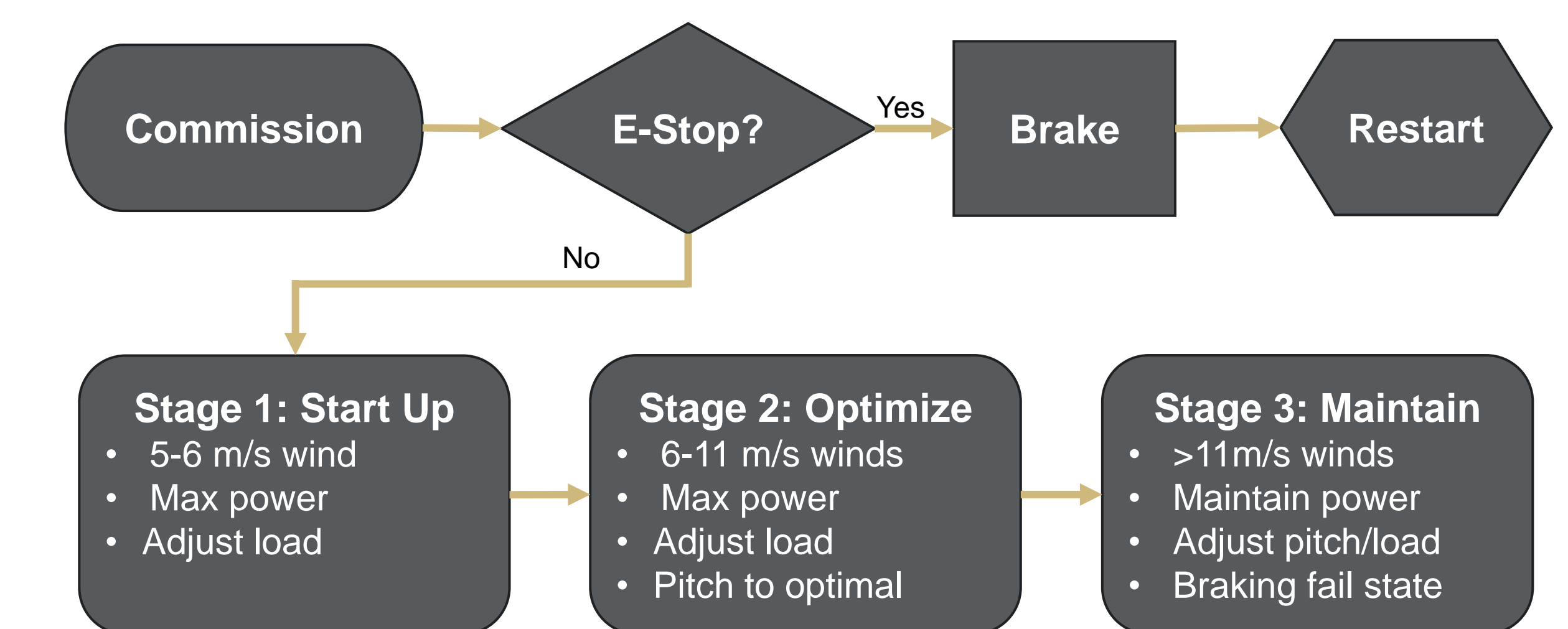
Bicycle Brake Pads

Electrical

Nacelle Electrical Components and Connection to PCB



Autonomous Controls



Testing

