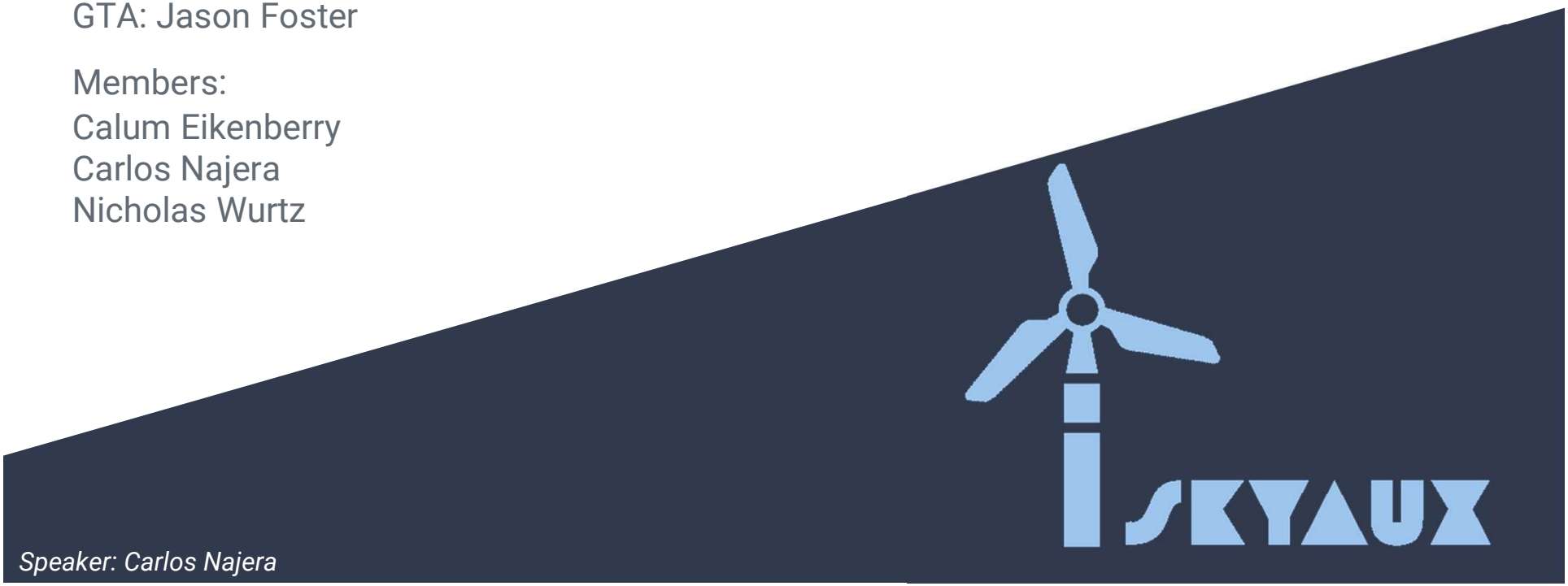
CWC SkyAux

Client: Dr. Venkata Yaramasu

GTA: Jason Foster

Members:
Calum Eikenberry
Carlos Najera
Nicholas Wurtz



Speaker: Carlos Najera

Introduction

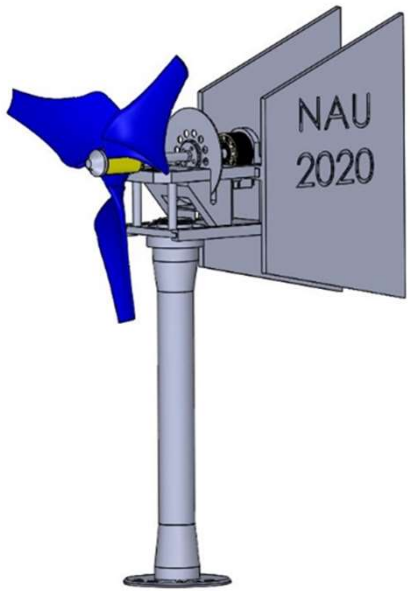
Department of Energy Collegiate Wind Competition

Speaker: Carlos Najera

- CWC 2020 was a wind turbine competition in Denver Colorado.
- NAU's team consists of 4 sub-teams (2 ME, 2 EE).

Description	Possible Points	Score
Technical Design Report (200 points)		
Concise, readable, and descriptive with logical flow	15	
Presents and communicates technical information clearly and intelligently	15	
Design objective description for test turbine	20	
Static performance analysis	20	
Mechanical loads analysis and associated safety factors (including yaw system if present)	20	
Electrical analysis (including both loads and storage element)	20	
Controls analysis (including storage element)	20	
Software documentation and description (including storage element if applicable)	20	
Engineering diagrams including mechanical and electrical drawings	25	
Results from laboratory and/or field testing	25	
	Subtotal	
Private Q&A Session (50 points)		
Demonstrated understanding of technical design during Q&A	50	
	Subtotal	
	Total	

Project Motivation



- Generate interest in renewable energy in undergraduate and graduate students.
  - Students gain deeper understanding of renewable energy systems.
- Improve efficiency of wind turbines through creative new designs.
  - Allow college students to test new and experimental designs safely and with professional guidance.
- Represent NAU in national competition that will showcase accumulated knowledge of our college careers.

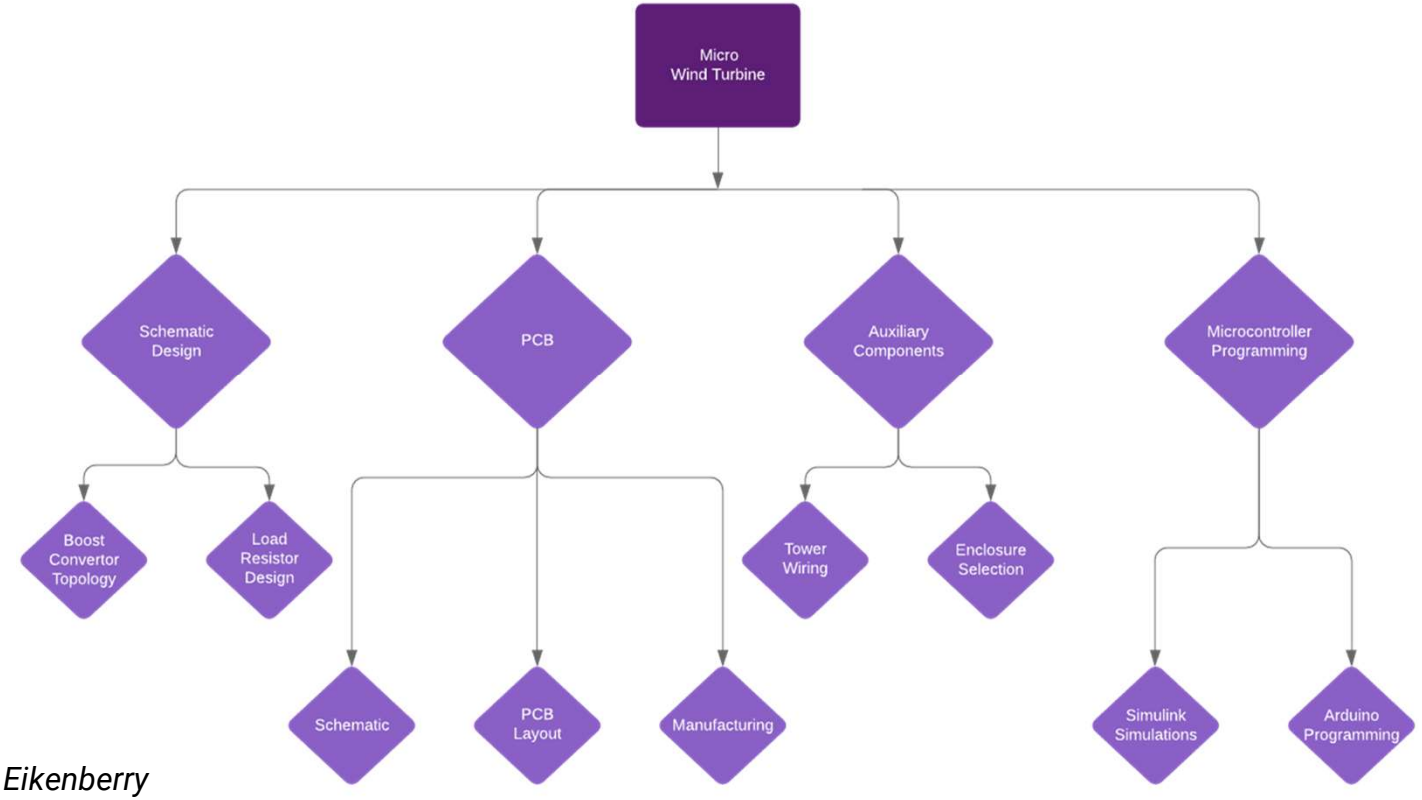
Speaker: Nicholas Wurtz

Project Approach

Speaker: Nicholas Wurtz

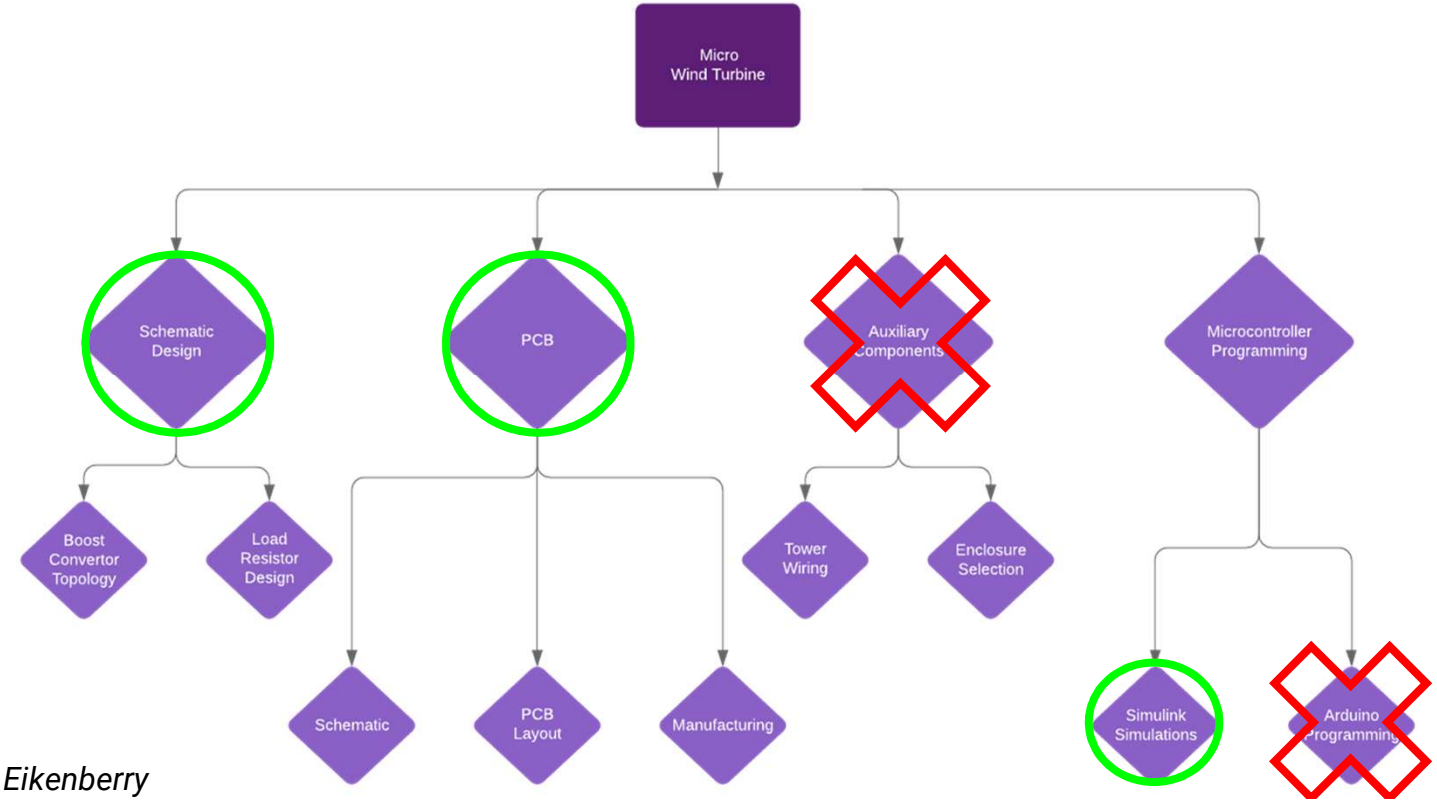
- Assess the expectations presented by the Department of Energy (DOE).
  - Low cut-in speed design.
  - Multi-faceted brake system.
  - Synchronous boost topology.
- Meets needs of client.
  - PCB design (component spacing, routing).
  - 3 phase synchronous AC motor.
  - Low forward voltage components.

Current Work Breakdown Structure



Speaker: Calum Eikenberry

Current Work Breakdown Structure



Speaker: Calum Eikenberry

Prototypes

Three-phase Full-bridge Rectifier

- FUS45-0045B
- Simulink model

Enamel Enclosure Mounting

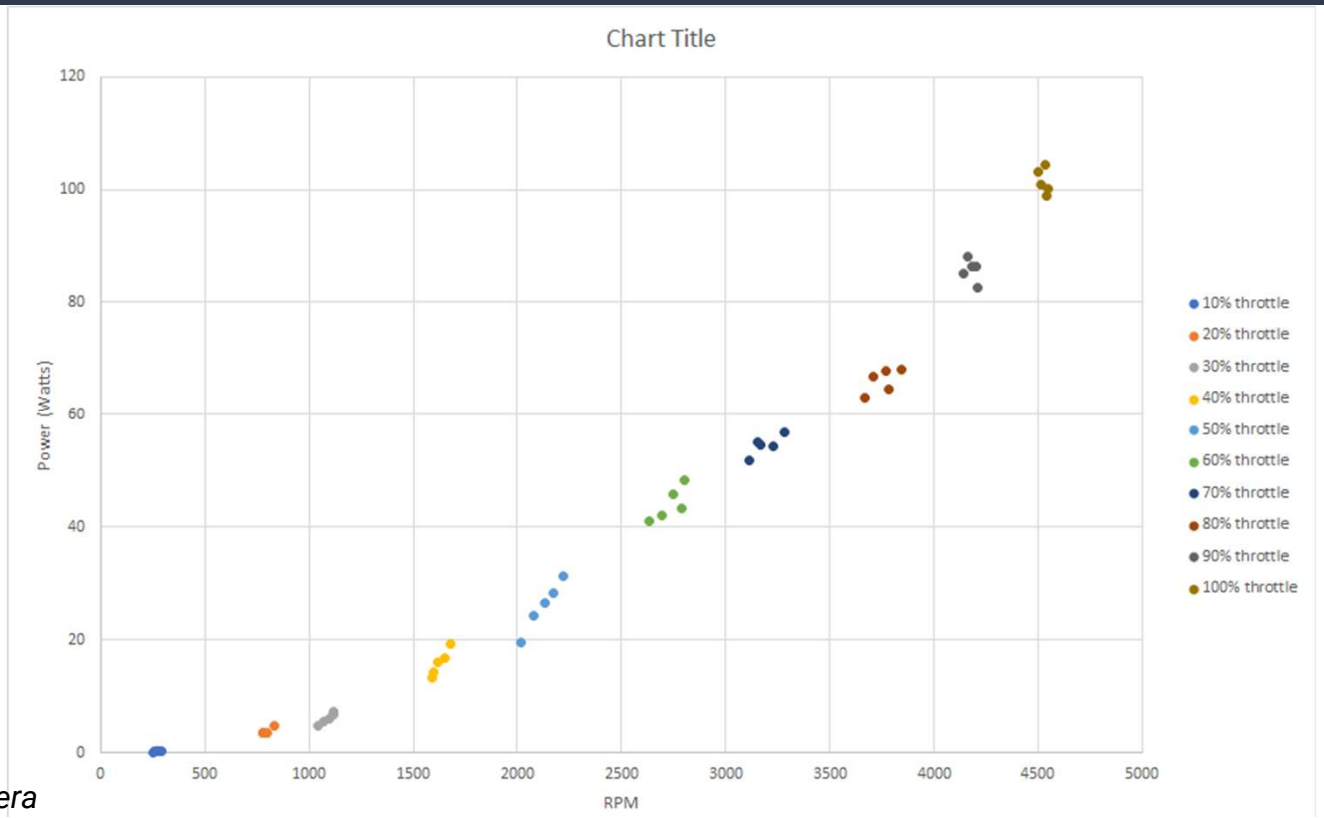
- Reuse of old enclosure
- Aluminum backing, plastic mounting screws
- NEMA-1 Standards

Turbine Generator

- 3-Phase AC
- Used with drill for early-stage testing
- Dynamometer used for late-stage testing

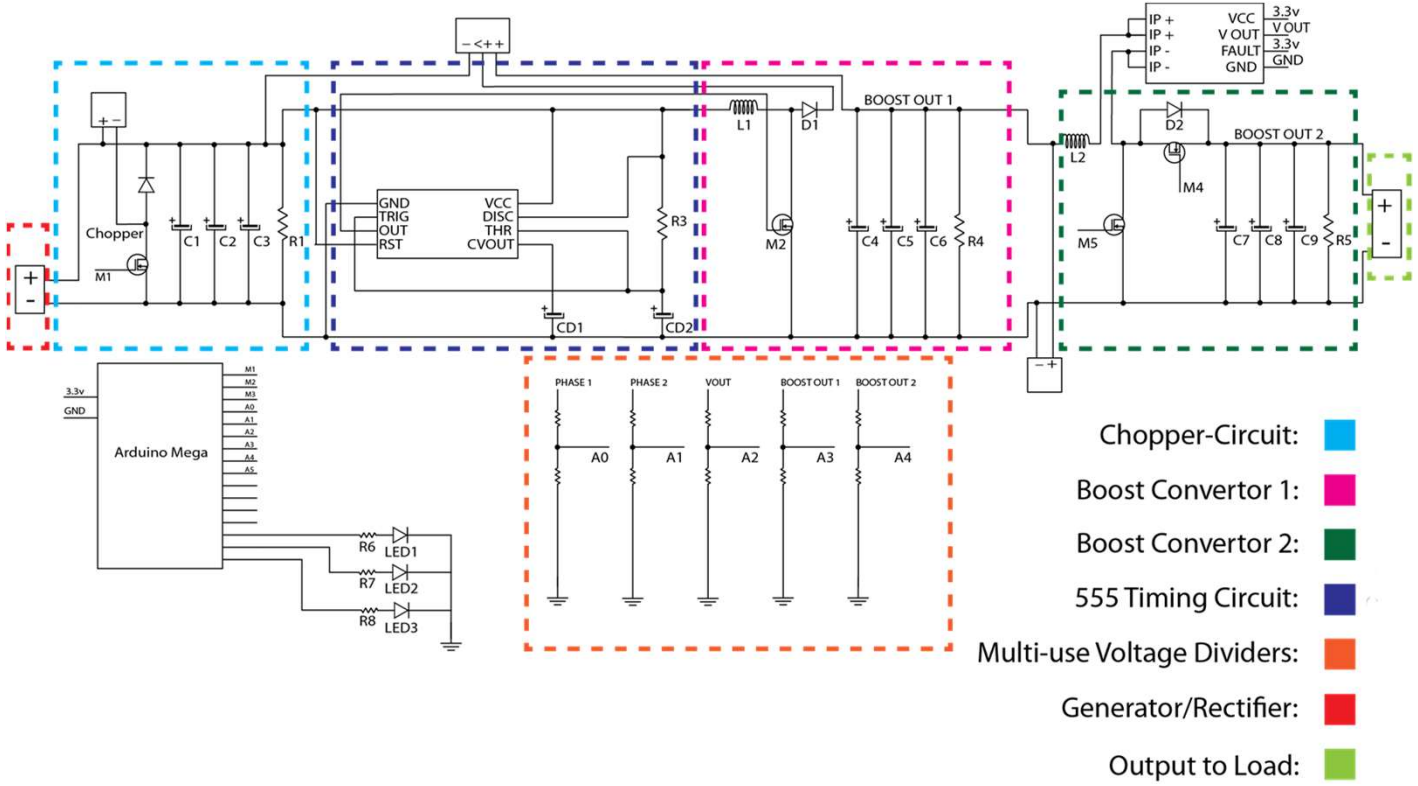
Speaker: Carlos Najera

Power Curve



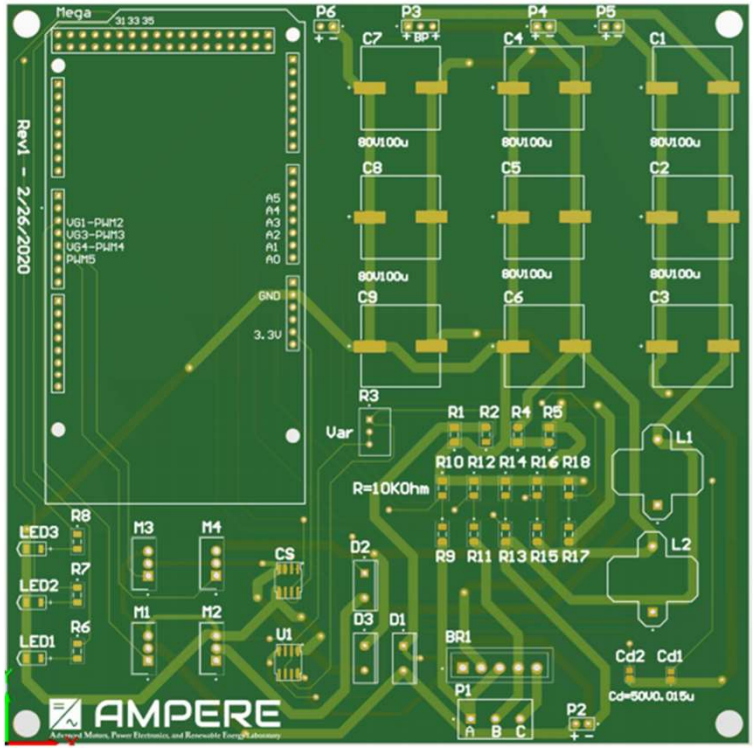
Speaker: Carlos Najera

Schematic Design



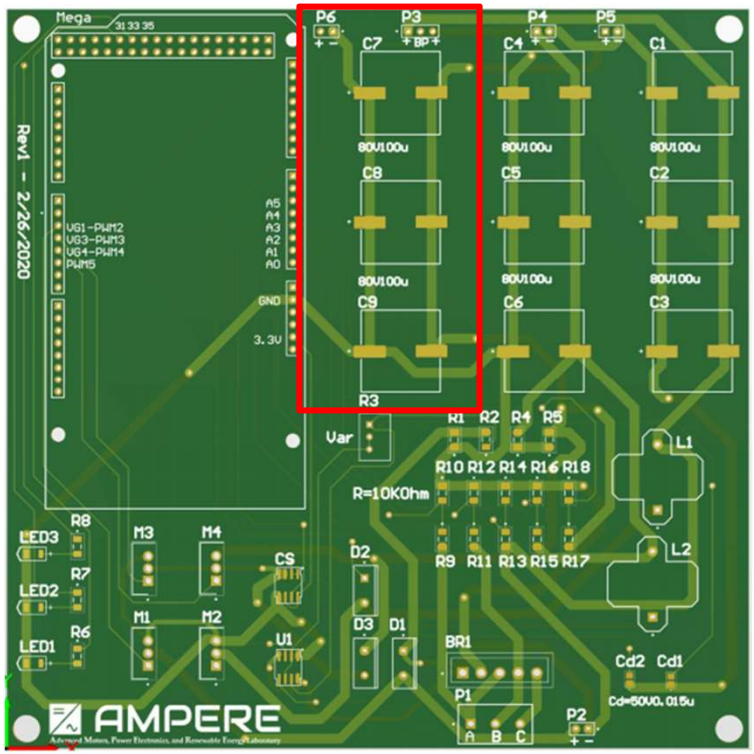
Speaker: Calum Eikenberry

PCB Testing Features



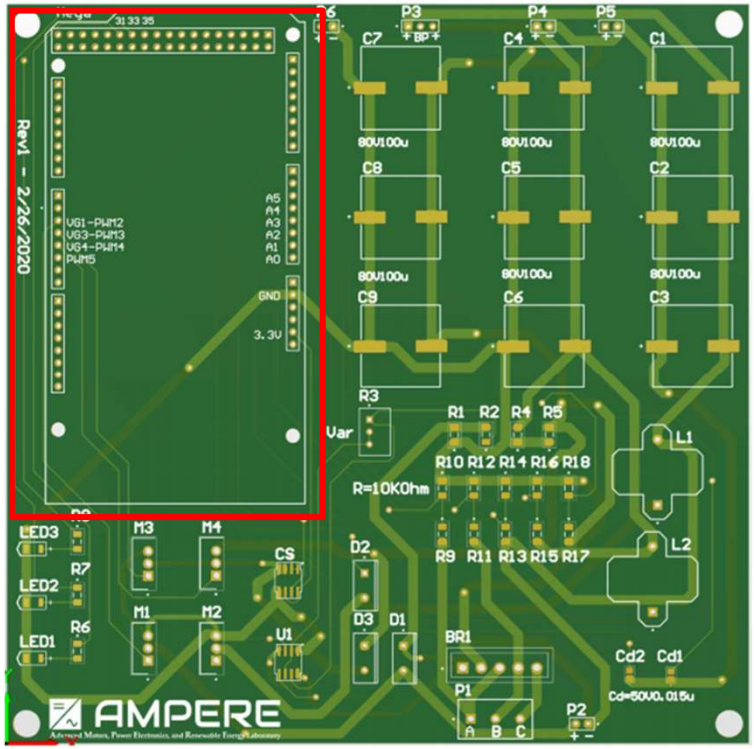
Speaker: Calum Eikenberry

PCB Testing Features:
Additional Capacitors



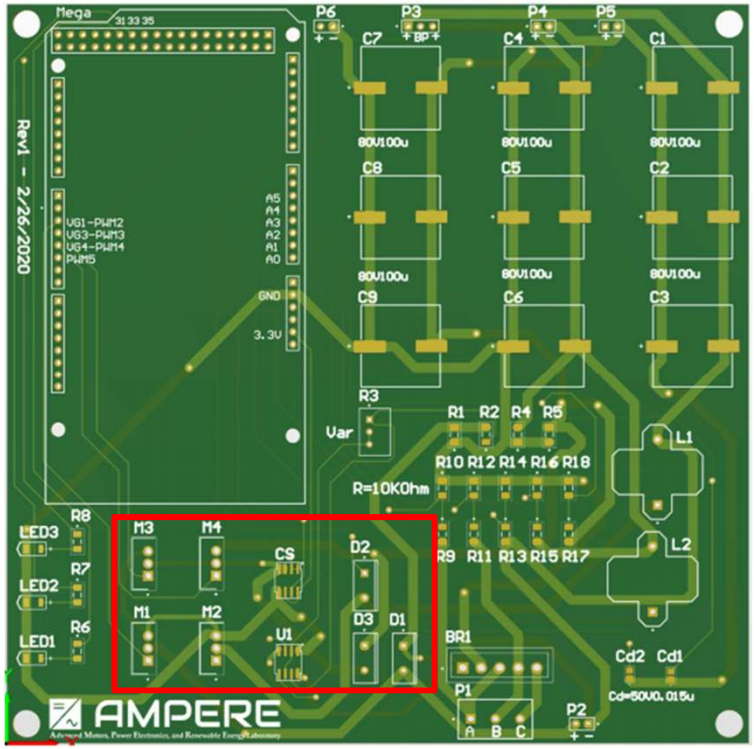
Speaker: Calum Eikenberry

PCB Testing Features:
Arduino Mega Vias



Speaker: Calum Eikenberry

PCB Testing Features:
Mosfet and Diode Footprints



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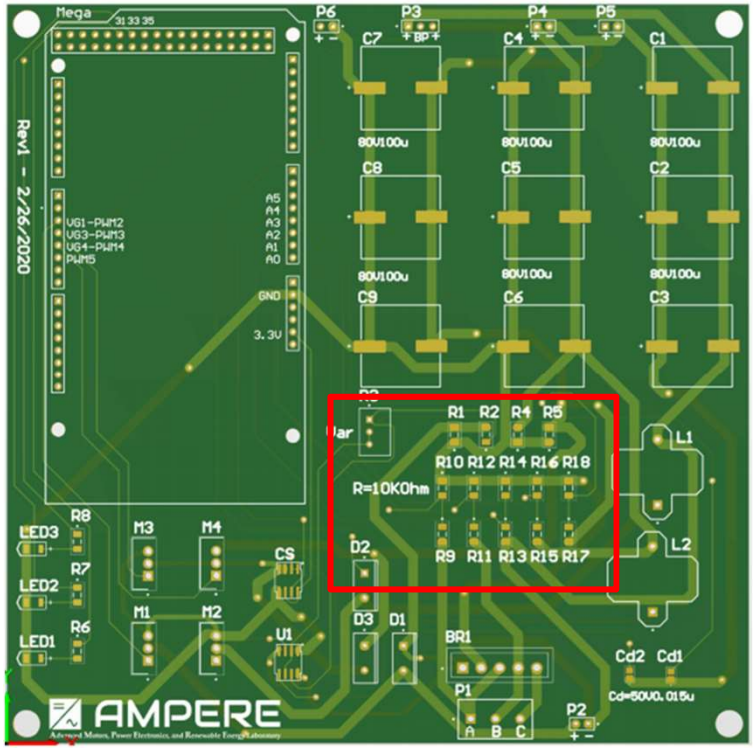
PCB Testing Features:
1206 Resistors and Inductors



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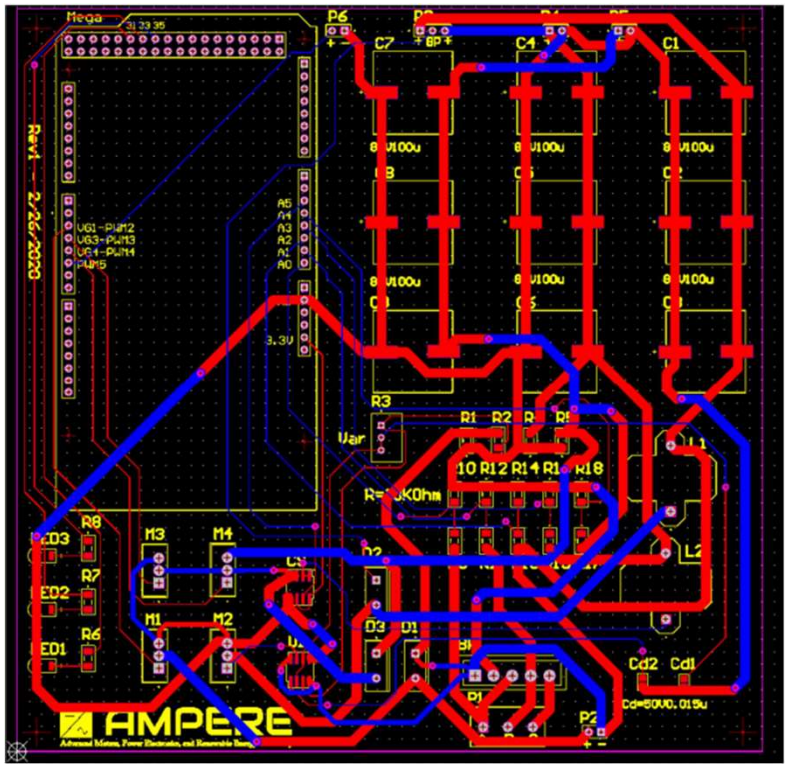
PCB Routing:
Communication vs Power



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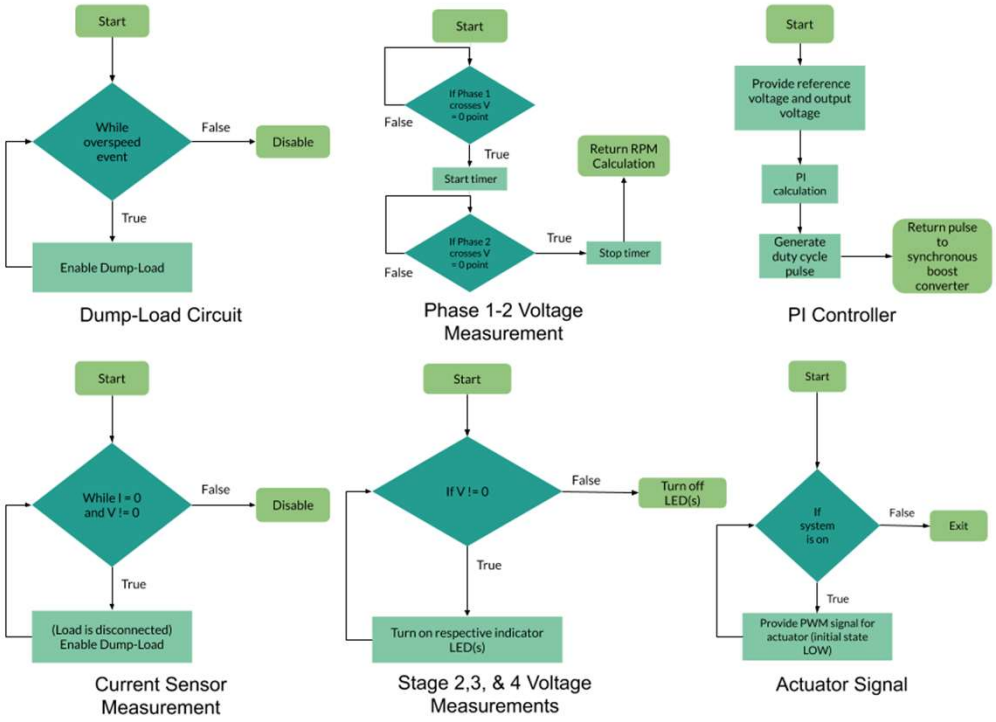
Microcontroller Programming



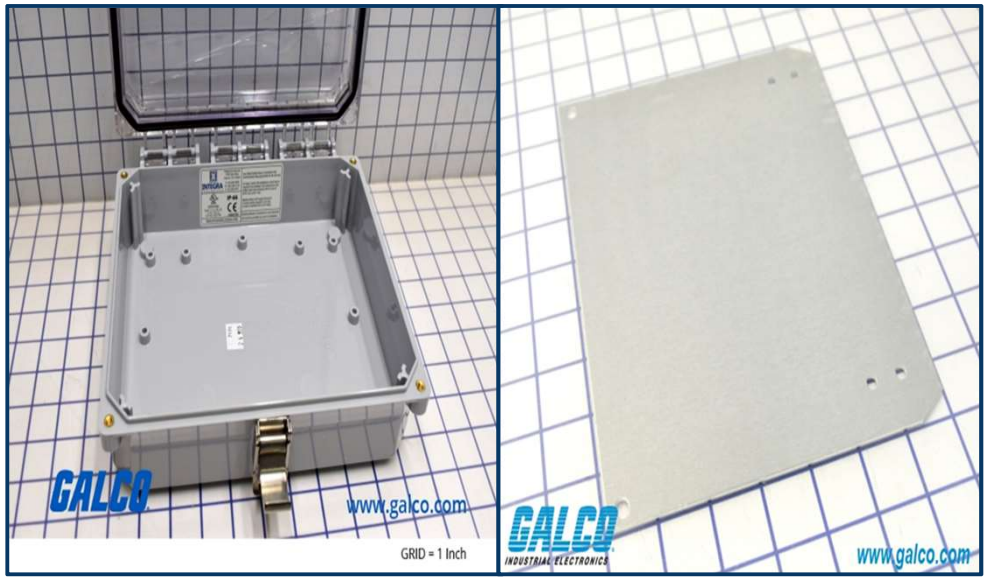
- Designed in conjunction with the DC-DC team.
- Intended to provide visual feedback.
- Implements three brake systems.
  - Button press.
  - Disconnection from PCC.
  - Power above determined limit.

Speaker: Calum Eikenberry

Enamel Enclosure

Protection against contact with the enclosed equipment
Protection from objects and personnel from shock hazard
Protection against a limited amount of falling dirt
Protection against accidental contact with live parts

- Original idea vs New idea.
- Aluminum sheet.
- Plastic mounting screws for PCB and Aluminum plate.
- Meets NEMA-1 standards.



Speaker: Nicholas Wurtz

Design & Aesthetics

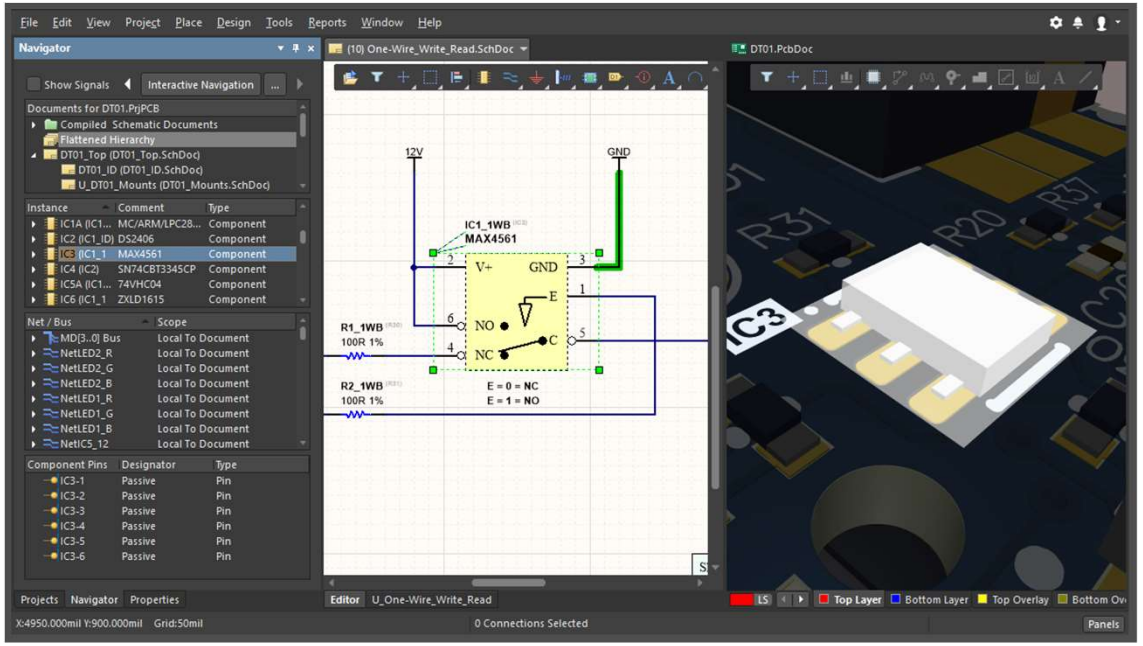
- Main aesthetic design aspect will be designs that will go onto the tower itself once a final design is chosen.
- ME team intended on creating an engraved plaque.
- Enamel enclosure was to contain the bulk of our designs.

Speaker: Carlos Najera

Assisting Other Teams

- Client has requested we assist other teams.
  - Designing unique footprints.
  - Schematic design.
  - Layout and routing.

- Training juniors within the software environments.
  - Altium Designer
  - Simulink
  - Arduino IDE



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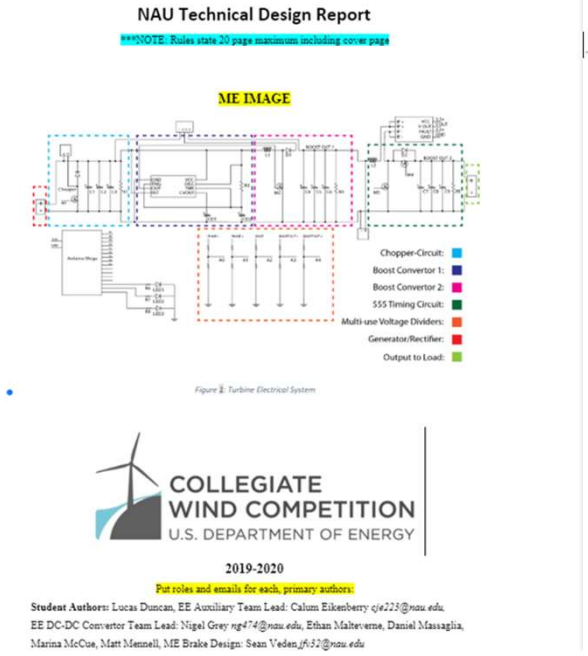
Documentation



NAU Technical Design Report

***NOTE: Rules state 20 page maximum including cover page

ME IMAGE

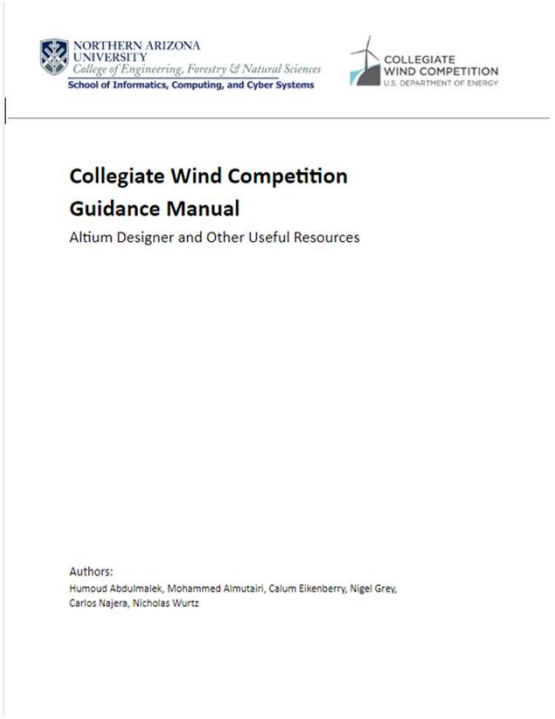
Figure 2: Turbine Electrical System

COLLEGIATE WIND COMPETITION
U.S. DEPARTMENT OF ENERGY

2019-2020

Put roles and emails for each, primary authors:

Student Authors: Lucas Duncan, EE Auxiliary Team Lead: Calum Eikenberry *cje223@nau.edu*
EE DC-DC Convertor Team Lead: Nigel Grey *ng474@nau.edu*, Ethan Malteverne, Daniel Massaglia,
Marina McCue, Matt Mennell, ME Brake Design: Sean Veden *jfv52@nau.edu*



NORTHERN ARIZONA UNIVERSITY
College of Engineering, Forestry & Natural Sciences
School of Informatics, Computing, and Cyber Systems

COLLEGIATE WIND COMPETITION
U.S. DEPARTMENT OF ENERGY

Collegiate Wind Competition
Guidance Manual

Altium Designer and Other Useful Resources

Authors:
Humoud Abdulmalek, Mohammed Almutairi, Calum Eikenberry, Nigel Grey,
Carlos Najera, Nicholas Wurtz

Large amounts of post COVID-19 Pandemic meeting time has been dedicated to the reporting of progress, design decisions, and illustrating.

Speaker: Calum Eikenberry

Challenges & Difficulties

The Problems

- Learning new software.
- Communication errors with the client.
- Difficult to digest competition rules and milestones.

The Potential Solutions

- User Manual.
- Form a great top-level understanding of the rules and work one's way down.
- Make sure one's understood ruleset are consistent with client expectations.

Speaker: Nicholas Wurtz

Carlos Najera

- Lead for aesthetic design of CWC components.
- Schematic creation and illustration for the CWC and Dr. Yaramasus' other research needs.
- Research aid in parts selection for PCB components.
- Primary researcher on load resistor selection and load circuit design.

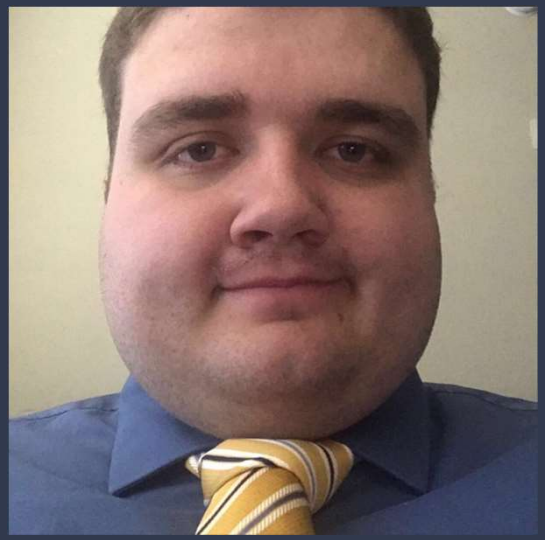
Speaker: Carlos Najera

Calum Eikenberry

- Team lead for the Auxiliary Sub-Team.
- The creation of the CWC2020 User Guidance Manual for the CWC2021 Team.
  - This includes image guides for multiple programs and techniques.
- Lead the PCB design process.
  - Assisted other teams in learning the programs.
- Maintained communication with the Principle Investigator David Willy and the Collegiate Wind Competition staff.

Speaker: Calum Eikenberry

Nicholas Wurtz



- Lead researcher for enclosure.
  - Includes idea for using older enclosure to cut costs and time.
- Assisted with PCB design.
  - Routing and submitting orders.
- Assisted with component selection for PCB.
  - Rectifier, voltage and current sensors, 1206 footprint component selection.
  - Researched external wiring for outside the enclosure.
- Assisted with illustration work for final reports.

Speaker: Nicholas Wurtz

Final Product

The best course of action is to prepare future teams and point out our own pitfalls.

- Physical
  - PCB manufactured and in AMPERE Lab.
  - Components purchased for future testing.
- Digital
  - Simulations within MATLAB Simulink.
- Preparing 2021 CWC
  - User manual will continue progress until next year.
  - Final product will assist with understanding research requirements, software, and hardware limitations.

Speaker: Nicholas Wurtz

Closing

- A concise final schematic.
- Minimal physical project realization.
- A greater appreciation for wind energy.
- Still preparing for competition in June.

Speaker: Calum Eikenberry