Collegiate Wind Competition 2019

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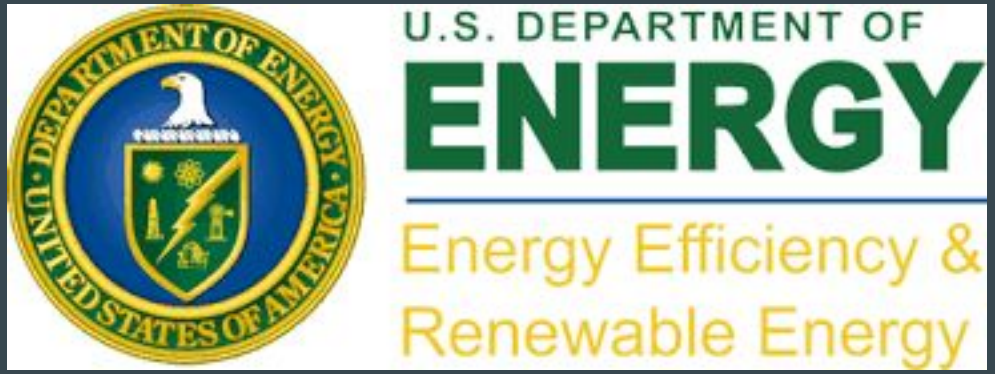
Project Description

- Collegiate Wind Competition- U.S. Department of Energy
  - Held in Boulder, CO for the 2019 competition
  - Fifth team representing NAU at the Competition
- Multidisciplinary Team



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Background

- Horizontal Axis Wind Turbine
  - Axis of rotation parallel to ground
  - Able to produce energy in strong winds

Figure 1: Horizontal Axis Wind Turbine [1]

- Vertical Axis Wind Turbine
  - Axis of rotation is perpendicular to ground
  - Produce energy in low wind speeds

Figure 2: Vertical Axis Wind Turbine [1]

Background

- Active vs. Passive Yaw Systems
  - Passive:
    - Short or no boom with large vane
    - Long boom with smaller vane
  - Active:
    - Use of motor to direct wind turbine
- Disc Brakes vs Dynamic Brakes
  - Disc:
    - Brake pad with stainless steel rotor disc
  - Dynamic:
    - Uses cogging torque from electric generator to brake

Benchmarking

- 2017 NAU Design
  - Single tail yaw
  - Four blade HAWT
  - Open Nacelle
  - Honorable Mention

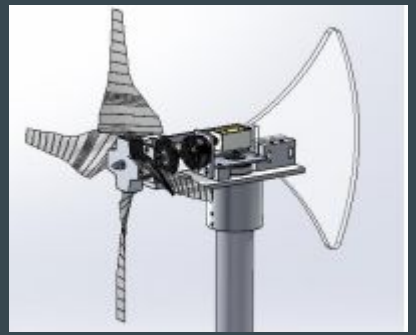

Figure 3: NAU ‘17 [4]

- 2018 NAU Design
  - Two Tail yaw
  - Three Blade HAWT
  - Open Nacelle
  - 6th out of 12 teams

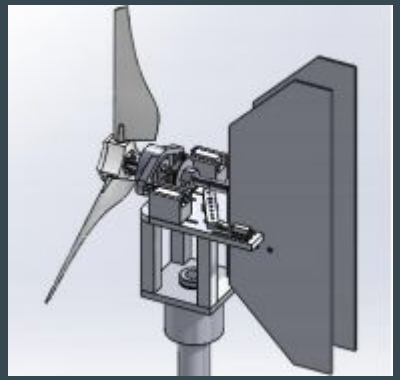

Figure 4: NAU ‘18 [5]

- 2017 PSU Design
  - Single Tail Yaw
  - Three Blade HAWT
  - Open Nacelle
  - Best Test Turbine

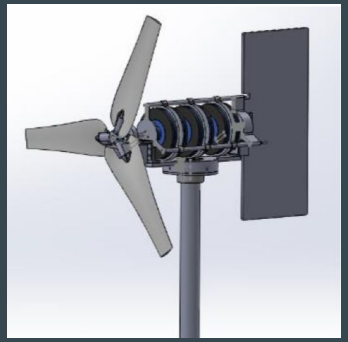

Figure 5: PSU ‘17[2]

Riley

Customer Requirements

- Produce power
- Minimize cost
- Compact & Portable design
- Strong & Durable
- No Two Tail Yaw Design

Engineering Requirements

- Rotor and non-rotor turbine area should enclosed 45x45x45 cm^3
- Turbine fits through 61x122 cm^2 door in one assembly
- Withstand wind speed of 20 m/s
- Cut-in wind speed between 2.5m/s and 5 m/s
- Tested between 5 and 11 m/s for 60 seconds
- Base plate no thicker than 16.1mm
- Base plate withstand 50 N-m

House of Quality

- Initial House of Quality
- Legend below for benchmark

A	‘17 NAU
B	‘18 NAU
C	‘17 PSU

		Engineering Characteristics									Benchmarking				
Improvement Direction		D	D	D	U	N/A	U	U	D	D					
Units		$	cm^3	m/s	°/s	cm^2	Ksi	#	lb	min					
Customer Needs	Customer Weights	Minimize Cost	Volume(45x45x45)	Cut-in Speed(2.5-5)	Yaw Rate(up to 180)	Area (61x122)	Yield Strength	Number of Cycles to Failur	Weight	Assembly Time	1 Poor	2	3 Acceptable	4	5 Excellent
Cost Effective	5	9				3	3	1	3	3			C	AB	
Compact	5	1	9			9		1	3	3					ABC
Optimize Efficiency	4	3		9	9	1		1						AB	C
Effective Direction mechanism	5			1	9		1	1					B	A	C
Easy Start up	5			9	1	1								AB	C
Strong	3	3		1	1		9	3	3					AC	B
Durable	3	3		1		1	9	9	3	3				AC	B
Lightweight	2	3					3	3	9				B	AC	
Portable	2		3			3		1	3	9					ABC
Raw Score		86	51	92	89	78	80	63	72	57	668				
Relative Weight %		12.87%	7.63%	13.77%	13.32%	11.68%	11.98%	9.43%	10.78%	8.53%	100%				
Rank Order		3	9	1	2	5	4	7	6	8					

Table 1: Initial House of Quality

Schedule

- Used Gantt project template in Excel
- Team is behind
- More tasks to be added as the semester progresses

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Website Setup	3	3	18		30%
Website Update(s)	6	70			0%
House of Quality	15	4	16	2	100%
Benchmarking	10	5	15	2	95%
Research Design(s)	10	10	16		45%

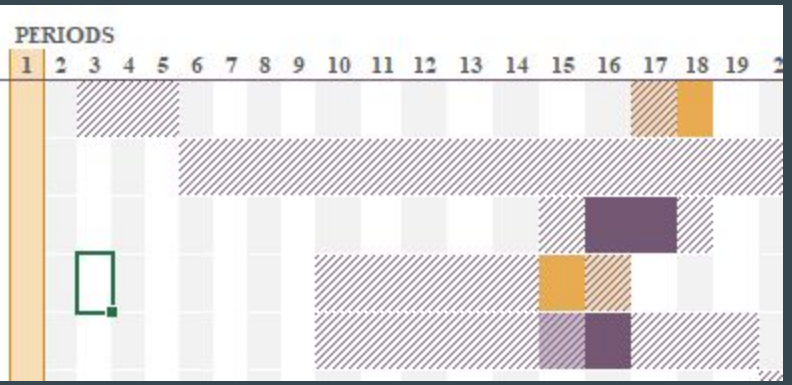

Figure 6: Portion of Project Schedule for Fall Semester

Budget

- $700 +/- $50
  - Previous teams have done the project for about $500
  - Past teams have not budgeted for testing supplies
  - Travel and Board funds have already been allocated

Faisal

References

[1] Windpower Engineering & Development, "Vertical Axis Wind Turbines vs Horizontal Axis Wind Turbines," 10 November 2009. [Online]. Available: https://www.windpowerengineering.com/construction/vertical-axis-wind-turbines-vs-horizontal-axis-wind-turbines/. [Accessed 16 September 2018].

[2] Pennsylvania State University, "2017 Department of Energy Collegiate Wind Competition," U.S. Department of Energy, 2017.

[3] Share America, "Communities win with renewable energy," 22 October 2014. [Online]. Available: https://share.america.gov/communities-green-power-winning-ways-one/. [Accessed 16 September 2018].

[4] Northern Arizona University, "Wind Turbine Technical Report," U.S. Department of Energy, Flagstaff, 2017.

[5] Northern Arizona University, "NAU Collegiate Wind Competition 2017-2018," U.S. Department of Energy, Flagstaff, 2018.