

# Collegiate Wind Competition Mechanical Team

Soud Alsahli, Kory Joe, Devon Hardy, Spencer McMahon, Jacob Peterson, Dakota Sallaway



## **Project Review**

#### Collegiate Wind Competition (CWC)

- Sponsors: U.S. Department of Energy (DOE) & National Renewable Energy Laboratory (NREL)
- Client: David Willy & Karin Wadsack
- Build and test a small scale wind turbine

#### Mechanical Components

- Active Pitching Hub
- Blades
- Braking Mechanism
- Bearing
- Direct-Drive Shaft

- Nacelle
- Shaft
- Yawing Mechanism
- Tower





### Blades and Blade Roots

#### Blades

Final material: ULTEM 9085 Max deflection: 2.07 mm



#### **Blade Roots**

Final material: Stainless Steel T304 Length: 3.5 cm Diameters: 1, ½ cm



### Hub

6061 T6 Aluminum

- Bearing shaft (Round to triangle)
- Arm linkages (length)
- Blade mounts (No bushing)

3D Print PLA 40% infill

• Hub body (Shape change)



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### Shaft

Direct-Drive Shaft

- Still supplements surrounding components
- Aluminum 7075
- Lowest FOS w/ expected loads  $\rightarrow$  16
- M10x1 thread/loctite glue connection to the rotor
- Brake hex pinned to the shaft
- Interference fit/loctite glue connection to generator



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### **Brake/Shaft Bearing**

Braking System & Shaft Bearing (now one system)

- Ease of manufacturing for brake implementation
  - Shaft bearing is a part of brake system assembly
- Braking torque adequate for one pad set  $\rightarrow$  12Nm
  - Rotor torque → 3Nm
- Pin connection between brake hex and shaft
  - o Shear FOS based on weakest aluminum  $\rightarrow$  1.4
- Bearing can handle shaft rotation & expected loads
  - Manufactured to handle high rpm and moderate load applications



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### Nacelle

Raised frame nacelle

- Allows for larger slip ring capabilities
- Adds extra space for subsystems connections





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### Manufacturing Progress

#### What's Left to Manufacture:

- Tail plate
- Main Nacelle
- Brake Brackets
- Generator Mount
- Tail mount
- Shaft
- Blade mounts
- HUB

Material waiting to arrive:

- 20 x 20 x <sup>1</sup>/<sub>8</sub> inch plate (tail plate)
- 10 x 10 x <sup>3</sup>/<sub>8</sub> in plate (main Nacelle)
- 1 x ¼ inch angle iron 6 inches long (tail mount)
- 2 ½ x ¼ inch angle iron 6 inches long (generator mount)



### Plans for manufacturing

Get the parts approved and drawing files made/approved

Order the raw materials

Plan how each component is going to be manufactured

- Mill, Lathe or CNC
- What order, what processes are needed
- What fasteners are needed
- What and how are each parts are going to be connected

Each part is different and needs to be machined differently

## **Plans For Testing**

Preparations for competition tests to be completed

- Achieving a consistent output power at integer speeds ranging from 5 11 m/s
- Providing a power level, consistent with that of an 11 m/s wind, at varying wind speeds between 15 20 m/s
- Producing a 5 sec positive amperage level at startup between wind speeds of 2.5 5 m/s.
- Maintaining a 5 V load while experiencing a varied wind speed between 6 20 m/s
- Shutting down the wind turbine at any wind speed up to 20 m/s and restarting without manual actions by the team

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## Blade Redesign Contingencies

If blades fail during testing and pitching system does not function

#### **Blades failure**

- 1. Increase thickness
- 2. Use new airfoil design

#### **Pitching system failure**

- 1. Lock pitching mechanism in pitched position
- 2. Blade root redesign for fixed blade operation
- 3. Mating will be a press fit into hub

## Hub Redesign Contingencies

#### HUB

- Only actuate once
- Fix actuators
- Replace Hub with fixed pitch



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## Shaft Redesign Contingencies

**Root Cause Analysis** 

- Failure Location? (Rotor/Braking System/Generator)
- Why did it fail? (High Loads/Fatigue/Unexpected Situations)

Redesign Based on Cause:

- Increase Shaft Diameter
- Decrease Shaft Length
- Decrease Number of Connected Components
- Redesign Component Connections

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## **Brake Redesign Contingencies**

Possible Locations of Failure:

- Hub/pin connection to the shaft
- Disk
- Pad actuator

**Redesign Options** 

- Manufacture brake hub onto the shaft
  - Less parts = less chance of failure
- Use disk/spacer/disk assembly from King Motor
- Use different actuator material/increase size

### **Previous Expectations**

Responsibilities of project

- Soud/Kory Shaft Implementation
- Devon Blades and manufacturing
- Jacob Braking mechanism and yaw fin
- Spencer Hub with Pitching mechanism
- Dakota Structural components and Subsystems connections

#### Original Plan

- Finish manufacturing by March 1
- Begin testing march 2

**Current Standings** 

- The team is behind by several weeks
- Expecting to have final approvals within the week

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## Schedule for Completion

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|                 | Tower                  | 8d   | 03/02/18   | 03/13/18  
   
   
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|                 | Bearing Spacer         | 3d   | 03/06/18   | 03/08/18  
   
   
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|                 | Tower Sleeve           | 3d   | 03/06/18   | 03/08/18  
   
   
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|                 | Lower Mainframe        | 6d   | 03/06/18   | 03/13/18  
   
   
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|                 | Mainframe Spacer       | 1d   | 03/27/18   | 03/27/18  
   
   
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|                 | Top Mainframe          | 4d   | 03/27/18   | 03/30/18  
   
   
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|                 | Tail Fin               | 4d   | 03/19/18   | 03/22/18  
   
   
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|                 | Brake Mechanism        | 3d   | 03/20/18   | 03/22/18  
   
   
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|                 | Hub Body               | 2d   | 03/15/18   | 03/16/18  
   
   
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|                 | Actuator Shaft         | 3d   | 03/23/18   | 03/27/18  
   
   
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|                 | Actuator Arms          | 3d   | 03/23/18   | 03/27/18  
   
   
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|                 | Blade Mounts           | 3d   | 03/23/18   | 03/27/18  
   
   
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    3d       Blade Mounts     3d       Blades     11d       Blades     11d       Shaft     5d       shaft     5d       sting     1st Test       2nd Test     3d       4th Test     3d | Top Mainframe Material         9d         03/13/18           Yaw Material         9d         03/13/18           Hub Material         9d         03/13/18           anufacturing         21d         03/02/18           Baseplate         6d         03/02/18           Tower         8d         03/02/18           Baseplate         6d         03/02/18           Tower         8d         03/02/18           Bearing Spacer         3d         03/06/18           Lower Sleeve         3d         03/06/18           Mainframe Spacer         1d         03/27/18           Top Mainframe         6d         03/02/18           Tail Fin         4d         03/20/18           Hub Body         2d         03/15/18           Actuator Shaft         3d         03/20/18           Blade mounts         3d         03/23/18           Blades   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       Top Mainframe         4d         03/27/18         03/27/18         03/27/18         03/27/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18         03/27/18           Hub Body         2d         03/23/18         03/27/18         03/27/18         03/27/18           Actuator Arms         3d         03/27/18         03/27/18         03/27/18         03/27/18           Blade nouts         3d         03/</td> <td>Top Mainframe Material         9d         03/13/18         03/23/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18         03/23/18           anufacturing         21d         03/02/18         03/02/18         03/02/18         03/02/18           Baseplate         6d         03/02/18         03/06/18         03/06/18         03/08/18           Dearing Spacer         3d         03/06/18         03/08/18         03/08/18         03/07/18           Lower Mainframe         6d         03/07/18         03/27/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18         03/27/18           Top Mainframe         4d         03/27/18         03/27/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18         03/27/18           Tail Fin         4d         03/21/18         03/27/18         03/27/18         03/27/18           Actuator Arms         3d         03/23/18         03/27/18         03/27/18</td> <td>Node         Top Mainframe Material         9d         03/13/18         03/23/18         03/03/18</td> <td>Top Mainframe Material         9d         03/13/18         03/23/18         1           Yaw Material         9d         03/13/18         03/23/18         1         1           Hub Material         9d         03/13/18         03/23/18 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    03/27/18         03/08/18           Top Mainframe         4d         03/27/18         03/07/18         03/07/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/07/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18           Actuator Shaft         3d         03/27/18         03/27/18         03/27/18           Actuator Shaft         3d         03/27/18         03/27/18</td><td>Top Mainframe Material         9d         03/13/18         03/23/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18           anufacturing         21d         03/02/18         03/03/18         03/03/18           Baseplate
        6d         03/02/18         03/03/18         03/08/18           Tower         8d         03/02/18         03/08/18         03/08/18           Bearing Spacer         3d         03/06/18         03/08/18         03/08/18           Lower Mainframe         6d         03/02/18         03/08/18         03/08/18           Mainframe Spacer         1d         03/02/18         03/08/18         03/08/18           Top Mainframe         6d         03/02/18         03/03/18         03/08/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18           Mainframe Mechanism         3d         03/20/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/21/18         03/27/18</td><td>Top Mainframe Material         9d         03/13/18         03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18       03/23/18         Yaw Material       9d       03/13/18       03/23/18       03/23/18         Hub Material       9d       03/13/18       03/23/18       03/23/18         anufacturing       21d       03/02/18       03/02/18       03/02/18         Baseplate       6d       03/02/18       03/03/18       03/08/18         Basering Spacer       3d       03/06/18       03/08/18       03/08/18         Cover Mainframe       6d       03/02/18       03/08/18       03/08/18         Lower Mainframe       6d       03/02/18       03/08/18       03/08/18         Mainframe Spacer       1d       03/27/18       03/02/18       03/08/18         Mainframe Spacer       1d       03/27/18       03/27/18       03/02/18         Top Mainframe       6d       03/02/18       03/22/18       03/22/18         Mainframe Spacer       1d       03/22/18       03/22/18       03/22/18         Mainframe Mechanism       3d       03/20/18       03/22/18       03/22/18         Mainframe Mechanism       3d       03/21/18       03/22/18       03/27/18         Mainframe Spacer       1d       03/</td><td>Toy Mainframe Material         9 d         03/13/18         03/23/18         03/02/18<td>In Order         Top Mainframe Material         9d         03/13/18         03/23/18</td><td>Toy Mainframe Material         9d         03/13/18         03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18</td><td>Top Mainframe Material         90         03/13/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18     
   03/23/18         03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18</td><td>Top Mainframe Material       94       03/13/18       03/23/18</td><td>Top Mainframe Material       94       03/13/18       03/23/18</td><td>Top Mainframe Material       90       33/13/18       03/23/18</td><td>Top Mainframe Material       9d       03/13/16       03/23/16</td><td>Top Mainframe Material       90       93/13/18       03/23/18</td><td>Top Mainframe Material       90 313/18       03/33/18      
03/33/18       03/33/18       03/33/18       03/33/18       03/33/18</td><td>Top Mainframe Material       90       93/13/18       03/23/18</td><td>Top Mainframe Material       94       <math>331318</math> <math>332318</math>         Yaw Material       94       <math>331318</math> <math>332318</math>         Hub Material       94       <math>331318</math> <math>332318</math>         nufacturing       214       <math>302181</math> <math>302181</math>         Baseplate       64       <math>30218</math> <math>303018</math> <math>303018</math>         Tower       84       <math>30218</math> <math>303018</math> <math>303018</math> <math>303018</math>         Baseplate       64       <math>30218</math> <math>303018</math> <math>303018</math></td><td>Top Mainframe Material       90       93/378       93/2</td><td>Top Mainframe Material       90       91/3/18       93/3</td><td>Top Mainframe Material       90       91/31/8       03/31/8       03/23/8       0<!--</td--><td>Top Mainframe Material       9       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13</td><td>Top Mainframe Material       9       9/13/18       03/13/18</td></td></td></td<></td> | Top Mainframe Material         9d         03/13/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18           anufacturing         210         03/02/18         03/02/18         03/02/18         03/02/18           Baseplate         6d         03/02/18         03/06/18         03/06/18         03/06/18           Tower         8d         03/02/18         03/06/18         03/06/18         03/06/18           Tower Sleeve         3d         03/06/18         03/06/18         03/07/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18         03/27/18           Top Mainframe         4d         03/27/18         03/27/18         03/27/18         03/27/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18         03/27/18           Hub Body         2d         03/23/18         03/27/18         03/27/18         03/27/18           Actuator Arms         3d         03/27/18         03/27/18         03/27/18         03/27/18           Blade nouts         3d         03/ | Top Mainframe Material         9d         03/13/18         03/23/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18         03/23/18           anufacturing         21d         03/02/18         03/02/18         03/02/18         03/02/18           Baseplate         6d         03/02/18         03/06/18         03/06/18         03/08/18           Dearing Spacer         3d         03/06/18         03/08/18         03/08/18         03/07/18           Lower Mainframe         6d         03/07/18         03/27/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18         03/27/18           Top Mainframe         4d         03/27/18   
     03/27/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18         03/27/18           Tail Fin         4d         03/21/18         03/27/18         03/27/18         03/27/18           Actuator Arms         3d         03/23/18         03/27/18         03/27/18 | Node         Top Mainframe Material         9d         03/13/18         03/23/18         03/03/18 | Top Mainframe Material         9d         03/13/18         03/23/18         1           Yaw Material         9d         03/13/18         03/23/18         1         1           Hub Material         9d         03/13/18         03/23/18         03/23/18         1         1           anufacturing         21d         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         1 <td< td=""><td>Top Mainframe Material         9d         03/13/18         03/23/18</td><td>Top Mainframe Material         9d         03/13/18         03/23/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18           anufacturing         210         03/02/18         03/02/18         03/02/18           Baseplate         6d         03/02/18         03/09/18         03/02/18           Tower         8d         03/02/18         03/08/18         03/08/18           Bearing Spacer         3d         03/06/18         03/08/18         03/08/18           Lower Mainframe         6d         03/02/18         03/07/18         03/07/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/08/18           Top Mainframe         4d         03/27/18         03/07/18         03/07/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/07/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18           Actuator Shaft         3d         03/27/18         03/27/18         03/27/18           Actuator Shaft         3d         03/27/18         03/27/18</td><td>Top Mainframe Material         9d         03/13/18         03/23/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18           anufacturing         21d         03/02/18         03/03/18         03/03/18           Baseplate         6d         03/02/18         03/03/18         03/08/18           Tower         8d         03/02/18         03/08/18         03/08/18           Bearing Spacer         3d         03/06/18         03/08/18         03/08/18           Lower Mainframe         6d         03/02/18         03/08/18         03/08/18           Mainframe Spacer         1d         03/02/18         03/08/18         03/08/18           Top Mainframe         6d         03/02/18         03/03/18         03/08/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18           Mainframe Mechanism         3d         03/20/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/21/18         03/27/18</td><td>Top Mainframe Material         9d         03/13/18         03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18       03/23/18         Yaw Material       9d       03/13/18       03/23/18       03/23/18         Hub Material       9d       03/13/18       03/23/18       03/23/18         anufacturing       21d       03/02/18       03/02/18       03/02/18         Baseplate       6d       03/02/18       03/03/18       03/08/18         Basering Spacer       3d       03/06/18       03/08/18       03/08/18         Cover Mainframe       6d       03/02/18       03/08/18       03/08/18         Lower Mainframe       6d       03/02/18       03/08/18       03/08/18         Mainframe Spacer       1d       03/27/18       03/02/18       03/08/18         Mainframe Spacer       1d       03/27/18       03/27/18       03/02/18         Top Mainframe       6d       03/02/18       03/22/18       03/22/18         Mainframe Spacer       1d       03/22/18       03/22/18       03/22/18         Mainframe Mechanism       3d       03/20/18       03/22/18       03/22/18         Mainframe Mechanism       3d       03/21/18       03/22/18       03/27/18         Mainframe Spacer       1d       03/</td><td>Toy Mainframe Material         9 d         03/13/18         03/23/18         03/02/18        
03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18         03/02/18<td>In Order         Top Mainframe Material         9d         03/13/18         03/23/18</td><td>Toy Mainframe Material         9d         03/13/18         03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18</td><td>Top Mainframe Material         90         03/13/18         03/23/18</td><td>Top Mainframe Material       9d       03/13/18       03/23/18</td><td>Top Mainframe Material       94       03/13/18       03/23/18</td><td>Top Mainframe Material       94       03/13/18       03/23/18
      03/23/18       03/23/18</td><td>Top Mainframe Material       90       33/13/18       03/23/18</td><td>Top Mainframe Material       9d       03/13/16       03/23/16</td><td>Top Mainframe Material       90       93/13/18       03/23/18</td><td>Top Mainframe Material       90 313/18       03/33/18</td><td>Top Mainframe Material       90       93/13/18       03/23/18</td><td>Top Mainframe Material       94       <math>331318</math> <math>332318</math>         Yaw Material       94       <math>331318</math> <math>332318</math>         Hub Material       94       <math>331318</math> <math>332318</math>         nufacturing       214       <math>302181</math> <math>302181</math>         Baseplate       64       <math>30218</math> <math>303018</math> <math>303018</math>         Tower       84       <math>30218</math> <math>303018</math> <math>303018</math> <math>303018</math>         Baseplate       64       <math>30218</math> <math>303018</math> <math>303018</math></td><td>Top Mainframe Material       90       93/378       93/2</td><td>Top Mainframe Material       90       91/3/18       93/3/18      
93/3/18       93/3/18       93/3/18       93/3/18       93/3/18       93/3/18       93/3</td><td>Top Mainframe Material       90       91/31/8       03/31/8       03/23/8       0<!--</td--><td>Top Mainframe Material       9       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13</td><td>Top Mainframe Material       9       9/13/18       03/13/18</td></td></td></td<> | Top Mainframe Material         9d         03/13/18         03/23/18 | Top Mainframe Material         9d         03/13/18         03/23/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18           anufacturing         210         03/02/18         03/02/18         03/02/18           Baseplate         6d         03/02/18         03/09/18         03/02/18           Tower         8d         03/02/18         03/08/18         03/08/18           Bearing Spacer         3d         03/06/18         03/08/18         03/08/18           Lower Mainframe         6d         03/02/18         03/07/18         03/07/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/08/18           Top Mainframe         4d         03/27/18         03/07/18         03/07/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/07/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18           Actuator Shaft         3d         03/27/18         03/27/18         03/27/18           Actuator Shaft         3d         03/27/18         03/27/18 | Top Mainframe Material         9d         03/13/18         03/23/18         03/23/18           Yaw Material         9d         03/13/18         03/23/18         03/23/18           Hub Material         9d         03/13/18         03/23/18         03/23/18           anufacturing         21d         03/02/18         03/03/18         03/03/18           Baseplate         6d         03/02/18         03/03/18         03/08/18           Tower         8d         03/02/18         03/08/18         03/08/18           Bearing Spacer         3d         03/06/18         03/08/18         03/08/18           Lower Mainframe         6d         03/02/18         03/08/18         03/08/18           Mainframe Spacer         1d         03/02/18         03/08/18         03/08/18           Top Mainframe         6d         03/02/18         03/03/18         03/08/18           Tail Fin         4d         03/27/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/27/18         03/27/18         03/27/18           Mainframe Mechanism         3d         03/20/18         03/27/18         03/27/18           Mainframe Spacer         1d         03/21/18         03/27/18 | Top Mainframe Material         9d         03/13/18         03/23/18 | Top Mainframe Material       9d       03/13/18       03/23/18       03/23/18         Yaw Material       9d       03/13/18       03/23/18       03/23/18         Hub Material       9d       03/13/18       03/23/18       03/23/18         anufacturing       21d       03/02/18       03/02/18       03/02/18         Baseplate       6d       03/02/18       03/03/18       03/08/18         Basering Spacer       3d       03/06/18       03/08/18       03/08/18         Cover Mainframe       6d       03/02/18       03/08/18       03/08/18         Lower Mainframe       6d       03/02/18       03/08/18       03/08/18         Mainframe Spacer       1d       03/27/18       03/02/18       03/08/18         Mainframe Spacer       1d       03/27/18       03/27/18       03/02/18         Top Mainframe       6d       03/02/18       03/22/18       03/22/18         Mainframe Spacer       1d       03/22/18       03/22/18       03/22/18         Mainframe Mechanism       3d       03/20/18       03/22/18       03/22/18         Mainframe Mechanism       3d       03/21/18       03/22/18       03/27/18         Mainframe Spacer       1d       03/ | Toy Mainframe Material         9 d         03/13/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18         03/23/18 
       03/23/18         03/02/18         03/02/18 <td>In Order         Top Mainframe Material         9d         03/13/18         03/23/18</td> <td>Toy Mainframe Material         9d         03/13/18         03/23/18</td> <td>Top Mainframe Material       9d       03/13/18       03/23/18</td> <td>Top Mainframe Material       9d       03/13/18       03/23/18</td> <td>Top Mainframe Material         90         03/13/18         03/23/18</td> <td>Top Mainframe Material       9d       03/13/18       03/23/18</td> <td>Top Mainframe Material       94       03/13/18       03/23/18      
03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18</td> <td>Top Mainframe Material       94       03/13/18       03/23/18</td> <td>Top Mainframe Material       90       33/13/18       03/23/18</td> <td>Top Mainframe Material       9d       03/13/16       03/23/16</td> <td>Top Mainframe Material       90       93/13/18       03/23/18</td> <td>Top Mainframe Material       90 313/18       03/33/18</td> <td>Top Mainframe Material       90       93/13/18       03/23/18</td> <td>Top Mainframe Material       94       <math>331318</math> <math>332318</math>         Yaw Material       94       <math>331318</math> <math>332318</math>         Hub Material       94       <math>331318</math> <math>332318</math>         nufacturing       214       <math>302181</math> <math>302181</math>         Baseplate       64       <math>30218</math> <math>303018</math> <math>303018</math>         Tower       84       <math>30218</math> <math>303018</math> <math>303018</math> <math>303018</math>         Baseplate       64       <math>30218</math> <math>303018</math> <math>303018</math></td> <td>Top Mainframe Material       90       93/378       93/2</td> <td>Top Mainframe Material       90       91/3/18       93/3/18      
93/3/18       93/3</td> <td>Top Mainframe Material       90       91/31/8       03/31/8       03/23/8       0<!--</td--><td>Top Mainframe Material       9       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13</td><td>Top Mainframe Material       9       9/13/18       03/13/18</td></td> | In Order         Top Mainframe Material         9d         03/13/18         03/23/18 | Toy Mainframe Material         9d         03/13/18         03/23/18 | Top Mainframe Material       9d       03/13/18       03/23/18 | Top Mainframe Material       9d       03/13/18       03/23/18 | Top Mainframe Material         90         03/13/18         03/23/18 
       03/23/18         03/23/18 | Top Mainframe Material       9d       03/13/18       03/23/18 | Top Mainframe Material       94       03/13/18       03/23/18 | Top Mainframe Material       94       03/13/18       03/23/18 | Top Mainframe Material       90       33/13/18       03/23/18 | Top Mainframe Material       9d       03/13/16       03/23/16 | Top Mainframe Material       90       93/13/18       03/23/18 | Top Mainframe Material       90 313/18       03/33/18 | Top Mainframe Material       90       93/13/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18       03/23/18      
03/23/18       03/23/18 | Top Mainframe Material       94 $331318$ $332318$ Yaw Material       94 $331318$ $332318$ Hub Material       94 $331318$ $332318$ nufacturing       214 $302181$ $302181$ Baseplate       64 $30218$ $303018$ $303018$ Tower       84 $30218$ $303018$ $303018$ $303018$ Baseplate       64 $30218$ $303018$ | Top Mainframe Material       90       93/378       93/2 | Top Mainframe Material       90       91/3/18       93/3 | Top Mainframe Material       90       91/31/8       03/31/8       03/23/8       0 </td <td>Top Mainframe Material       9       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13</td> <td>Top Mainframe Material       9       9/13/18       03/13/18</td> | Top Mainframe Material       9       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13/8       03/23/8       03/13 | Top Mainframe Material       9       9/13/18       03/13/18      
03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18       03/13/18 |

Dakota Sallaway 3/12/18 CWC18 ME TEST TEAM

## Budget

Upcoming Fundraisers:

- Fundraiser tomorrow at Bigfoot Barbeque 4 to 9 PM
- Tuesday (27 March) at Pay'n Take

Total Income/Expenses	Amount (\$)
Income	1300.00
Expenses	266.80
Total	1033.20

Income Source	Amount (\$)
Gore	1300.00
Fundraisers	TBD
Total	1300.00



### Subsystems: Active Pitching Hub

- Industry pitching systems
  - Swash plate
  - Camshaft assembly

- CWC 18 Design
  - Combination of both the swash plate and camshaft designs



Spencer McMahon 3/12/18 CWC18 ME TEST TEAM

## Subsystems: Braking Mechanism





## **Braking Mechanism**





## **Braking Mechanism**



## Subsystems: Yaw Mechanism

Current State:

Maximizing available area

Reducing the weight





# Thank You

Any Questions?



CWC18 ME TEST TEAM 27