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I) Summary of PDR Report

- **Team Summary**
    - **Team Name -** Team Tesla
    - **Address** - 1490 Roth's Church Road PA 17362
    - **Team Mentor -** Brian Hastings NAR #96571, Certification Level 2
- **Launch Vehicle Summary**
    - **Mass of Vehicle** - 20.61lb
    - **Length of Vehicle**- 85.25in
    - **Motor Choice**- K-570
    - **Recovery System**- Two PerfectFlite StratoLogger cf's igniting 3.5 grain charges
- **Payload summary**

- **Payload Title**- assent intake generation system A.I.G.S
- **Payload Summarization-** This year's payload, for Spring Grove's team TESLA is designed to test the rate at which airflow through a turbine will generate current on the accent of the vehicle.

II) Changes Made Since Proposal

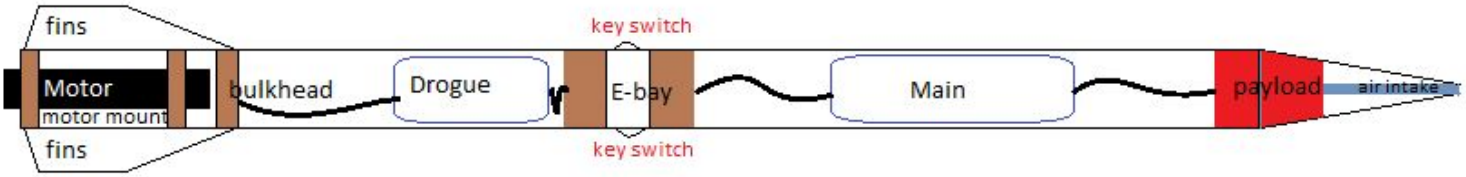
- **Highlight of Changes Made Since Proposal and the Reason for those Changes**
    - **Changes Made to Vehicle Criteria -** The length of the rocket has increases from 63.75 inches to 83.25 inches. The motor size has also changed since the proposal. We decided to downgrade in motor size because we were worried about going

over the one mile limit. We are now set to use a K-570 motor. The overall weight of the rocket has also increased due to the increase in length.

- **Changes Made to Payload Criteria -** None.
- **Changes Made to Project Plan -** Added sales dates and fundraising options were added in order to help reach our funding goals.

III) Vehicle Criteria

- **Selection, Design, and Verification of Launch Vehicle**
  - **Mission Statement-** Our mission as Team Tesla is to design, build, and launch a rocket safely which is able to reach a target height of 5,280 feet while collaborating as a team in order to complete the project within the given timeline effectively.



  - **Review of Design At A System Level-** Every system is vital as they all work together in order to provide a safe and successful launch.
    - **Nosecone and air intake**

      The nosecone is designed to act as a ram air intake while directing any excess air around the rocket in order to reduce as much drag as possible. At Its peak there will be a hole drilled in order for a air transfer shaft to direct air to the payload.

    - **payload**

      In relation to the airframe, the payload is designed to connect the nosecone to the front body tube for launch and to act as an anchor point

for nylon shock cord to be run to the nose cone to keep it from being lost with the ejection of the main chute.

- **Front Body Tube-**

  The front body tube of the rocket will be made out of 4 inch fiberglass wrapped phenolic body tube. The front half of the rocket will house the payload and and the main parachute. The payload will be in the nosecone of the rocket and a U-Bolt with be attached to the bottom of it to connect it to the recovery systems of the rocket. A nylon shock cord will run from to payload to the main chute and then from the main chute to the ebay. The main chute will be ejected out of the nose cone of the rocket

- **Ebay-**

  The ebay acts at a body tube coupler for both the forward and rear body tubes as well as initiating separation and deployment of the main and drogue chutes. It also acts as an anchor point connecting both the nose cone and rear body tube with nylon shockcord.

- **Rear Body Tube-**

  4 inch fiberglass wrapped phenolic tube. The rear body tube will house the motor of the rocket along with the fins and part of the recovery system. The back half will house a Ceasaroni K570 motor. This motor will be housed in a motor mount made out of ½ inch thick wood centering rings and BT300 PML body tube or bluetube.The PML body tube is

lighter than the bluetube but the blue tube is stronger. The strength of the bluetube is not worth the extra mass so most likely our motor mount will be made of PML. A ½ inch bulkhead will be put on the front section of the motor mount. A ¼ inch U-Bolt will be inserted into this bulkhead allowing for connection to the recovery system of the rocket. The drogue chute will be housed in the back half of the rocket, so a nylon shock cord will run from the motor mount to the drogue chute and then from the drogue chute to the ebay. The fins will be placed on the very end of the back half of the rocket. The rockets back half exterior will consist of 3 trapezoidal fins printed in ABS material, which are then attached to the back-half with screwed inserts through the PML body tube into the motor mount.

- **Motor mount-**

  Designed to adequately secure the motor to the launch vehicle's rear body tube and provide an anchor point for the 3D printed Fins.

- **Motor selection-**
  - Cesaroni K-570

- **Centering rings and motor mounts-**

  mounts and rings will be made of ½ inch thick laminated plywood which will be cut to the proper size on our facilities CNC Router

- **3d printed Fins-**

  The fins will be placed on the very end of the back half of the rocket. The rockets back half exterior will consist of 3 trapezoidal fins printed in ABS material, which are then attached to the back-half with screwed inserts through the PML body tube into the motor mount.

- **Mass Statement** -

  The mass of the ballast in the final design to be flown in Huntsville will not be more than 10% of the rocket mass without the ballast. A full scale version of our rocket will be launched prior to the Flight Readiness Review in its final configuration. The full-scale version of the rocket will be identical to the design that was made prior to the launch, and is the same design that was approved by our safety officer. This flight should include the testing of the payload within the vehicle, but if not, mass simulators will be placed at the same approximate location of the payload. Either a full-scale motor or a motor that will closely simulate the predicted velocity and acceleration of the full-scale motor will be used during this flight as well. The vehicle at this launch will also be in its completely-ballasted arrangement as that of what will be flown down in Huntsville. This flight's success will also be documented on the flight certification form by a Level 2 or Level 3 flight observer and will also be recorded in the Flight Readiness Review. The components of the rocket launched during the full-scale flight will not be modified unless approved by the NASA

Range Safety Officer. Lastly, the rocket will not use forward canards, forward firing motors, motors that eject titanium sponges, hybrid motors, or a cluster of motors or multiple stages.

- **Mission Success criteria**

  There are several factors needed for mission success. The mission would be considered a success if the rocket reaches an altitude of at least 4500 feet and no higher than 5280 feet, since the team recognizes that there are still uncontrollable sources of error involved with this project. The rocket must maintain a straight stable path and the rocket must also be recoverable within a 2500 foot radius of the launch pad for mission success. The mission will also be successful if the payload collects useable data and the launch is conducted safely without catastrophic failures.

  -estimated component weights(lb)

  -front body section- 6.8 lbs

  -payload- 3.0 lbs

  -electronics bay- 2.2 lbs

  -rear body section- 8.0 lbs

-Recovery Subsystems -

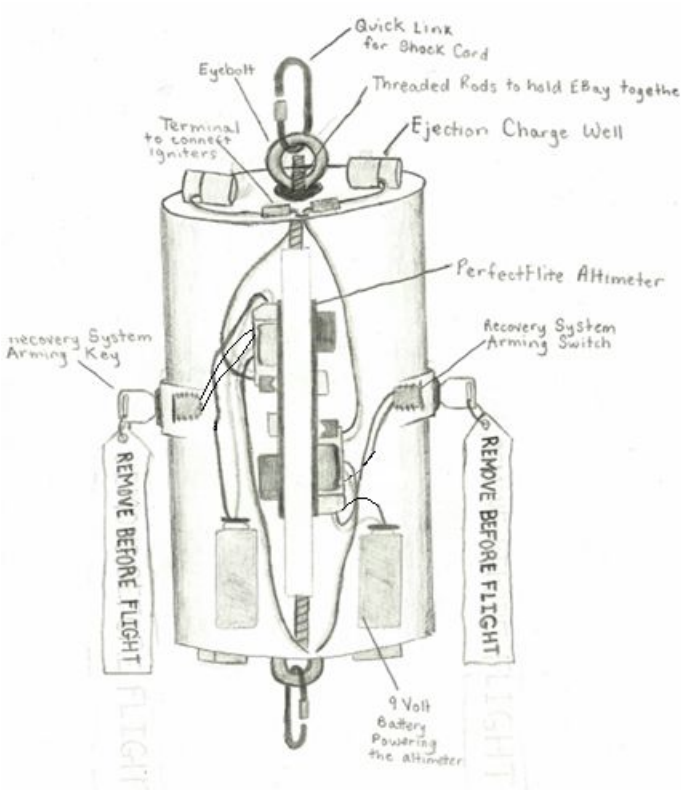
- **Ebay-**

  The ebay will be made of 4 inch PML coupler tube with ¼ inch bulkheads on each side of the tube. All of this will be held together by 2 ¼ inch all-thread rods with one wing nut on each side. A ⅛ inch wooden sled will ride on the inside

of the ebay held in place by the all-thread rods. On that wooden sled 2 altimeters will ride on either side to give redundancy to the ejection system. Each altimeter with be attached to its own key switch. The key switches will be mounted on the outside of the coupler tube. Each wooden bulkhead will have two ejection charge caps made out of the same material as PVC pipe. The two ejection caps are required to achieve redundancy. The blast from these two ejection charges will provide the force needed to separate the rocket and eject the drogue and main chute. One charge on each end of the ebay will be wired to one altimeter. The other two charges will be wired to the other altimeter. Each ¼ inch bulkhead will also be fitted with a ¼ inch U-Bolt allowing for nylon shock cord to be connected to it.

A)power in terminals.
B)Switch.
C)Main.
D)Drogue.
E)PC Data Transfer port.
F)Audio addon port.
G)Speaker
H)Program switch

The above picture is the schematic for the recovery systems altimeter. There will be a 9-volt battery connected to a StratoLogger Altimeter. Bellow you can see that each altimeter will then be connected to two separate igniters that will be placed above and below the electronics bay housing. Ejection charges will be placed onto these igniters. The entire system then will be grounded to the chassis of the electronics bay.



For redundancy, there will an additional altimeter and two additional igniters and ejection charges to ensure the separation of the rocket. These altimeters will be armed from the outside of the rocket before launch using an electric key-switch that will be wired up to the altimeter to allow for arming of the altimeters and accurate deployment of the payload and parachutes.

The recovery system is capable of deploying a 36 inch drogue parachute at apogee by initiating rocket body separation in front of the electronics bay. It will deploy a 72 inch main parachute at 600 feet during rocket descent by initiating rocket body separation in the back of the electronics bay. It will also set off a second ejection charge in case the first one does not fire, or does not completely separate the rocket body components. The recovery system will be able to record the maximum altitude of the rocket and verbally output this reading. It will be capable of reading the voltage of batteries operating the electrical components and verbally outputting this reading to ensure its function. The recovery system will be able to check for continuity within itself and its components, to ensure the correct operation of its electrical mechanisms. It is planned to be able to output a signal, perceptible by a tracking device, in order to foster rocket recovery. The system must be capable of separating parts of the rocket without damaging any of its parts. Most importantly, the system must make the rocket recoverable and reusable. The altimeters were selected for the recovery system (PerfectFlite StratoLogger) because they are capable of fulfilling all of these requirements as demonstrated in previous years use. The motor retention system should be able to take the launch vehicle and its components to an altitude of 5280 feet. At the same time, the system's intention is to be able to be ignited by a simple electronic ignition system. The rocket airframe is going to house all parts of the rocket needed for launch. It should also provide rigid stability to the rocket as a whole. The airframe will be smooth and aerodynamically sound with little air resistance

other than that from the payloads air intake system. This rockets overall frame should also be able to provide the needed strength to survive the landing and make the rocket reusable, provided a functioning recovery system. The rocket airframe should also be able to maintain the intended Flight path with minimal deviation from its simulated path. Fiberglass-wrapped phenolic tubing from Public Missiles Ltd was chosen to complete this task because of its rigid stability and strength. It also provides minimal air resistance during flight. The fins will be made from 3D printed ABS fins which will be capable of withstanding the higher velocities attained by the rocket, while remaining impervious to the high intensity of he being expelled from the rocket motor, as shown in previous years.

-Mission Performance Predictions
-Mission Performance Criteria -

Rocket Analysis

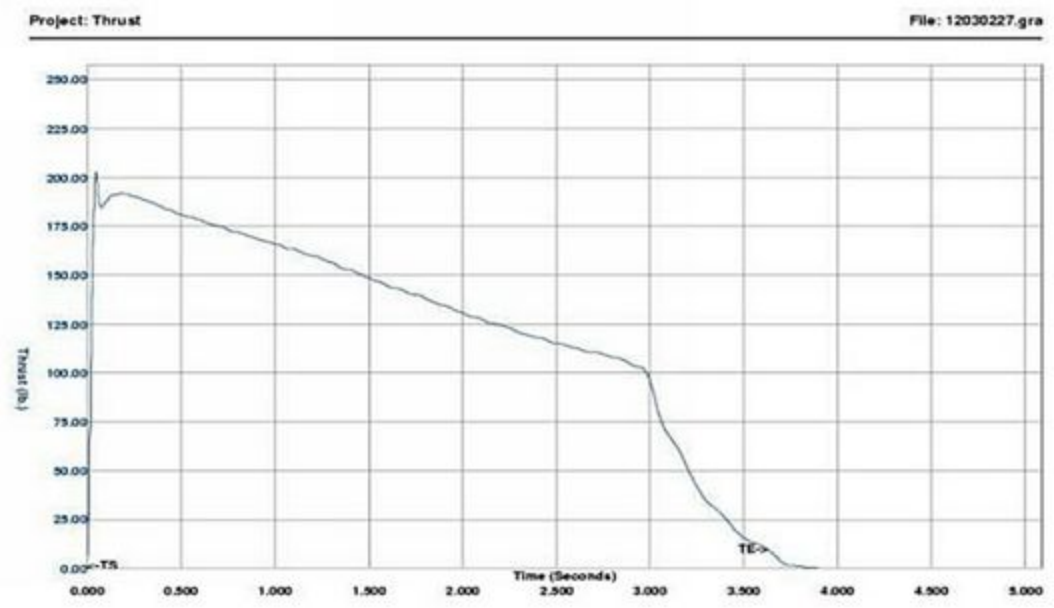
Currently our 85.25 inch rocket is projected to reach a height of 5326.97 feet. This value is a value based off of acceleration and rail exit velocity that is calculated from the computer data program Rocksim. This value is slightly over the value of 5,280 feet because we are fully expecting a drag increase from the predicted and expect an overall height to drop.

- **Simulated Motor Thrust Curve and Verification vs Load -**

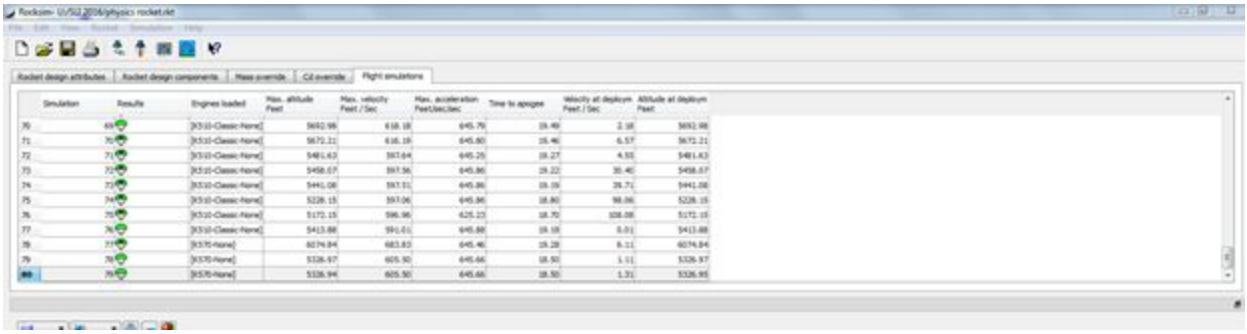
Pro54 2060K570-17A

Motor Data

Brandname	Pro54 2060K570-17A	**Manufacturer**	Cesaroni Technology
Man. Designation	2060K570-17A	**CAR Designation**	2060-K570-17A
Test Date	12/3/2002		
Single-Use/Reload/Hybrid	Reloadable	**Motor Dimensions mm**	54.00 x 488.00 mm (19.21 in)
Loaded Weight	1685.00 g (58.98 oz)	**Total Impulse**	2062.90 Ns (464.15
Propellant Weight	990.00 g (34.65 oz)	**Maximum Thrust**	892.67 N (200.85 lb
Burnout Weight	652.00 g (22.82 oz)	**Avg Thrust**	574.00 N (129.15 lb
Delays Tested	29 - 6 secs	**ISP**	212.50 s
Samples per second	1000	**Burntime**	3.59 s
Notes	Classic™		



- **Flight Profile Simulations -**



- **Altitude Predictions -** predicted altitude is 5326.97 ft which will likely be lower do to increased drag from the payloads intake system.
- **Stability Margin**
    - **Static Stability Margin (during flight)= 2.14**
    - **Static Stability Margin (off launch rail)= 2.38**
- **Center of Pressure**
    - **55.4802 in back from nose**
- **Center of Gravity**
    - **46.9082 in back from nose**
- **Relationship of Locations- There is a 8.572 inch separation between the CG and CP. With a body tube diameter of 4 inches this separation yields a margin of 2.14 during the launch.**
- **Calculations of Kinetic Energy of Sections of Vehicle (Ft-lbs)**
    - **Kinetic Energy (drogue deployed)**
        - **Section 1: 82242.2199**
        - **Section 2: 17877.2722**
        - **Section 3: 18601.7544**

- **Kinetic Energy (main)**
    - **Section 1: 399.0831**
    - **Section 2: 867.497**
    - **Section 3: 902.6526**

- **Calculations of Drift**
    - Given that each section (rear body tube, e-bay, and front body half) will be tethered to one another, the whole vehicle will be calculated as a single section.

      -wind speed of 0mph- Max Drift radius of 0 ft

      -wind speed of 5mph- Max Drift radius of 740 ft

      -wind speed of 10mph- Max Drift radius of 1480.36 ft

      -wind speed of 15mph- Max Drift radius of 2221.56 ft

      -wind speed of 20mph- Max Drift radius of 2961.74 ft

-Interfaces and Integration

- **Payload Integration Plan**
    - The payload structure will consist of a 3d printed chamber designed to have the intake plate and top half of the air chamber inserted firmly into the nosecone leaving the lower half of the air chamber and the base-plate

to be inserted into the front body tube section. These components will be held together securely with pop rivets to allow for easy disassembly while safely joining these components.

Our vehicles nose cone will have an intake hole at its peak which will be connected to the top of the payloads' intake plate via a cylindrical tube that will transfer airflow into the payload through its intake plate and thus into the air chambers' past the turbine and thanks to the 3d printed exhaust cone, that will mount onto the payloads base plate, air will be directed out of the sides of our vehicle. The air will escape from corresponding exhaust ports at both, the base of the air chamber and the front body tube. This exhaust methode is key to our rockets design as it will drastically decrease drag created by the air intake, allow continuous flow of air through the payload, and keep our vehicle from building up unwanted and possibly catastrophic pressure in the forward section of our vehicle on its accent.

- **Internal Integration of Launch Vehicle**
    - Team Tesla's rocket is designed to be comprised of three separate sections, each attached together with nylon shockcord. These sections of shock cord

are attached to the rocket compartments as follows. Firstly starting from the base of the payload which will have a ¼in u-bolt secured through the base plate. Both the nose cone and front body tube section will be firmly connected onto the payload via rivets thus connecting the front half and nosecone too the Ebay section at the center of the launch vehicle with with nylon shock cord. in the front body tube between the ebay and payload the main chute will be attached to the nylon shock cord via quick links. On both sides of the ebay there will be a ¼in u-bolt which nylon cord will be able to attach too. between the rear of the ebay and the back half of the rocket's body tube where a I-bolt or U bolt will be secured to a ½in thick bulk head. Between the back bulkhead and ebay a section of shock cord will attach to our main chute via quick links such as used on the drogue chute.

- **Launch Vehicle to Launchpad Integration**
    - All systems will be capable of being set up within two hours from the time that the Federal Aviation Administration flight waiver opens. The rocket will be able to remain in its launch ready state on the launch pad for a minimum of one hour without any of its on-board components becoming

inoperational. Our rocket will be capable of being launched from either a 8 foot long 1 inch rail or an 8 foot long 1.5 inch rail, thus allowing for the use of multiple launch platforms. The rocket motor will be capable of being initiated by a 12 volt DC firing system. It will not require any external circuitry or specialized equipment from the ground to initiate the launch, other than what will be provided. The rocket propellant is comprised of an ammonium perchlorate composite, commercially available as approved by the National Association of Rocketry, Tripoli Rocketry Association, and the Canadian Association of Rocketry. The rocket and motor combination that we will use will not exceed an impulse of 2,560 Newton-seconds.

- **Safety**

Preliminary checklist of final assembly and launch procedures:

1. Test data logger in Payload
2. Payload intake needs unblocked
3. Insert rivets into payload, nose cone, and front body tube
4. Check wiring in ebay section
5. Check altimeters in ebay
6. Fold drogue parachute properly
7. Fold main parachute properly
8. Observe and monitor the building of motor by our mentor
9. Put payload in top body tube then pack drogue parachute
10. Pack main chute in bottom section of body tube
11. Connect both body tubes with ebay section
12. Put shear pins in ebay and holding rocket together
13. Test key switches
14. Take rocket to pad with igniter
15. Place rocket on pad and arm altimeters, then remove key switches

16. Place igniter in motor

- **Student Safety Officer**

    - Spring Grove's Student safety officer for team Tesla is David Williams. For more personal information about David, feel free to read his bio at the beginning of this document. David was chosen as team Tesla's safety officer because he was the only one on the team who was over the age of 18. David's job as student safety officer is to make sure the production of the rocket and everyone involed is safe Also he is the first one to make contact with the rocket. David is a big part of team Tesla's rocket production. Without the supervision from David, the rocket may be constructed unsafely and could even have some life threatening flaws to it. David is essential to Team Tesla and a great representative as the Student Safety Officer.

- **Potentially Hazardous to personnel materials tools**

    - Include the power tools in our wood lab, epoxy, and spray paint. Included in this section are material safety data sheets for the Z-Poxy hardener and resin as well as the Krylon Spray Paint. There are also the safety procedures for all of the power tools.

      Materials Safety Data Sheets

      Z-Poxy Resin

      http://web.mit.edu/rocketteam/www/usli/MSDS/Z-Poxy%20Resin.pdf

      Z-Poxy Hardener

      http://web.mit.edu/rocketteam/www/usli/MSDS/Z-Poxy%20Hardener.pdf

      Krylon Spray Paint

      http://www.krylon.com/document/SDS/en/US/724504018179

Goex Black Powder

http://www2.epa.gov/sites/production/files/2015-05/documents/9530608.pdf

- **Conceivable failures in our proposed rocket design**

  These include but are not limited to adhesion failure, breaking of bulkheads or centering rings, and using a motor that is unable to carry the rocket and payload to the proposed height. Also, the rocket may be unstable or the structural integrity of the body tube is not great enough to handle the high forces and pressure that it will undergo. Ways to mitigate these happenings are using an adhesive, such as epoxy with a long curing time, which will be strong enough to adhere the components without the bond breaking. We will choose a material thick enough to suit the needs of these components by testing them under high-stress situations. The stability will be checked on the rocket program and the fins will be substantial enough to keep the rocket stable without over-stability occurring. The tubing we are planning to use is wrapped in a fiberglass exterior so the structural integrity should not be an issue.

Problems that may arise in payload integration include the payload being too large for the selected tube, not being able to properly attach to the shock cord, and insufficient space due to other interior parts. To lower the risk of coming across these errors or other unforeseen errors we will check that the exterior diameter of the payload and the interior diameter of the body tube and see that they will fit together.

We will design the payload so that it will easily attach to the shock cord and it will be safely attached. When designing the rocket the size of the payload and other apparatuses will be taken into account and then verify there is enough room for all the parts inside the rocket to avoid complications.

Failures that may arise in the launch operations are a motor delay, the ejection charge not being set off, and having an ejection charge that is not powerful enough to break apart the rocket to provide a safe decent. To help prevent these we will ensure that our NAR representative properly build or rebuilds the motor as well as using the proper launch mechanisms. To mitigate ejection charges not being set off we will redundantly wire the system so that there are two wires that will ensure that the ejection charge does go off or possibly even having multiple ejection charges. We will use the proper amount of black powder in our ejection

charge so that it will break apart the rocket to provide a safe decent.

- **Operator's Safety Protocols for Equipment**

Framar Band Saw- Before operating the bandsaw, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the blade or the band saw. Also, obtain an instructor's permission to use the machine and ensure that safety glasses are covering your eyes. When cutting, make sure adjustment knobs are tight; the upper blade guard should be around one eighth of an inch above the material being cut. Do not force any material through the blade, attempt to cut a radius smaller than the blade will allow, and do not back out of long cuts. Keep fingers on either side of the cut line, never on the line. If necessary, use a push stick or scrap block to guide the material through. Do not allow bystanders to stand at the right of the machine, because if the blade breaks, it may hit them. Never leave the machine until the blade has come to a complete stop. If an injury should occur during the usage of the band saw, stop the machine, step on the break to stop the blade quickly, inform an instructor of the injury,and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Router- Before operating the router, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the router or router bit. Also, obtain an instructor's permission to use the machine and ensure that safety glasses are covering your eyes. Ensure that the power switch is in the off position before plugging in the router. Then, check to make sure that the bit is firmly

secured in the chuck and that the piece being worked on is firmly secured and that the intended path of the router is free of obstructions. Hold the router with both hands and apply constant pressure. Never force the router or bit into the work. When changing bits or making adjustments turn off the router and unplug it from its power source. If an injury should occur during usage of the router, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Delta Radial Arm Saw- Before operating the saw, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the blade. Also, obtain an instructor's permission to use the radial arm saw and ensure that safety glasses are covering your eyes. Make all needed adjustments, such as adjusting the blade guard and kickback fingers, while the power is off. Test to see if leaf guards are properly working and that the blade does not extend past the edge of the table. Always firmly hold materials against the fence and pull the blade completely through the material and return blade behind the fence before removing the material and starting another cut. If too much of the table is cut away then the instructor must be notified for the table to be replaced. Wait for the blade to stop before leaving the machine. If injury occurs during usage of the saw, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Planer-Surface Sander- Before operating the sander, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the machine. Also, obtain an instructor's permission to use the sander and ensure that safety glasses are covering your eyes. Turn on the saw dust collection system. Check all material for loose knots, nails, staples, or any other loose, foreign objects. Never force a material through the planer; after insertion the machine will automatically feed it through. The operator should wait on the other side of the machine to receive the material. Select a proper machine depth and speed for the material being used. Never attempt to plane more than an eighth of an inch of material in one pass. Do not look into the machine at surface level or try to clean debris while the machine is turned on. Always stand to the side, because the possibility of kickback always exists. If injury occurs during usage of the sander, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Dewalt Compound Miter Saw- Before operating the saw, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the blade. Also, obtain an instructor's permission to use the saw and ensure that safety glasses are covering your eyes. Make all changes to the saw and saw blade while the power is off and the plug is disconnected from its power supply. Hold the material firmly against the fence and the table. Allow the motor to reach its full speed before attempting to cut through the material. Make sure that all guards are functioning properly. If injury occurs during usage of the Miter Saw, turn off the machine, inform an

instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Jointer- Before operating the jointer, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that may become caught in the blade. Also, obtain an instructor's permission to use the jointer and ensure that safety glasses are covering your eyes. Turn on the saw just collection system. Make all changes or adjustments to the jointer while the power is off. Use a push stick or scrap block if your hands could come within two inches of the blade. Do not attempt to take off more than one eighth of an inch at a time. The minimum length of material that can be cut with the jointer is double the size of the blades. If injury occurs during usage of the jointer, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Hand Sanders- Before operating the hand sanders, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that could become caught in the machine. Also, obtain an instructor's permission to use the hand sanders and ensure that safety glasses are covering your eyes. Replace the sandpaper while the sander is off and unplugged. Only use sand paper that is in good condition and properly installed. Place the material that you intend on standing on a flat surface and sand slowly over a large area. Wait for the sander to stop oscillating before placing it on a secure resting surface. Never carry any corded tool by the power cord. If injury occurs during

usage of the hand sanders, turn off the machine, inform an instructor of the injury, and then have the rest of the students in the classroom sit outside in the hallway to avoid being in the way of instructors and medical personnel helping the student.

Electric Drills- Before operating the drill, remove all jewelry, confine long hair, and remove or roll up long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Replace the bit while the power is off, install the bit properly and make sure the chuck is tightened and the chuck key is taken out. Never drill without first marking the hole with an awl. Ensure the material is clamp securely and drill with even pressure. Never carry any corded tool by the power cord. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Drill Press- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Replace the bit while the power is off, install the bit properly and make sure the chuck is tightened and the chuck key is taken out. Firmly secure material with vises or clamps. Adjust the table to avoid drilling into the table and pick the correct bit and properly sharpened. If drill becomes stuck turn of machine and inform instructor. Select proper speed for the material. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

CNC Router- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Turn on the saw dust collection system. Make all adjustments while machine is off. Material must be firmly secured before the project is run. A person needs to be with the machine during the entire operation. Check the spindle rotation, speed, and depth of cut are all correct before starting the machine. Only clean machine while it is off and make sure all setup tools are cleared from the table. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student..

Oliver Table Saw- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in blade. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Turn on the saw dust collection system. Make all adjustments while machine is off. Gullets of the blade must clear the top of the material. Never use the miter gauge and the fence at the same time, miter gauge for cross cutting and fence for ripping. Use extra caution while using a dado cutting head. Always use a push stick when your hand may come close to the blade and have another person to catch the material that was just cut. Do not leave the table until the blade stops. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Belt Sander- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in machine. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Check that there is adequate tension in the belt and that it is not torn. Keep material on the table at all times. Keep fingers away from sandpaper. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Disc Sander- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in machine. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Check that the disc was properly installed and that it is not torn. Keep material on the table at all times. Keep fingers away from sandpaper. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Powermatic Drum Sander- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in machine. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Use proper drum for the radius that is being sanded. Keep material on the table at all times. Keep fingers away from sandpaper. If injury occurs during usage turn off machine, inform instructor of injury,

then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Craftsman Reciprocating Saw- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in blade. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all changes with the power off and plug disconnected from the power supply. Firmly secure all material to a workbench or table. Allow the motor to reach its full speed before cutting through the material. Hold saw with both hands while using. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Craftsman Circular Saw- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in blade. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all changes with the power off and plug disconnected from the power supply. Firmly secure all material to a workbench or table. Before cutting; check that the cut line is not above the table. At least one person must be holding the material being cut off. Allow the motor to reach its full speed before cutting through the material. Hold saw with both hands while using. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

CNC Lathe (EMCO Concept Mill 55, Lab Volt 5400 CNC Mill, a Lab volt Automation 5500-B0)- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in bit. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all adjustments while machine is off. Material must be firmly secured before the project is run. A person needs to be with the machine during the entire operation. Check the spindle rotation, speed, and depth of cut are all correct before starting the machine. Only clean machine while it is off .If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Victor Metal Lathes- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in work. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Make all changes with the power off. Center the material so that it will not spin off center. Firmly secure all material to a machine. Use proper speed for the task at hand. Use the correct and sharpened tools. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Paasche FABSF-6 Spray Booth- Before use turn on ventilation system and wear proper protection. Use the correct spray for the material and do not inhale. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of

the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Miller Spot Welder- Before operation put on proper clothing, welding mask, gloves, and apron. Obtain instructor permission. Do not look at the welding torch unless wearing a welding mask. Ensure the proper solder is being used and materials are secured. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Baldor Grinder/Buffers- Before use put on safety glasses, check the spark shield is intact, and obtain instructor permission. Keep hands away from spinning wheel. Adjust the tool rest to the proper height and always use it. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Tennsmith Sheet Metal Cutter- Before operation remove all jewelry, confine long hair, and remove or roll long sleeves or any article of clothing that may become caught in work. Also, obtain instructor permission and ensure that safety glasses are covering your eyes. Do not attempt to cut material thicker than the machine is rated for. Make sure the material and blade are free from debris. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

Gravograph LS100 30 Watt Laser/Engraver/Cutter- Before operation; ensure that the laser is focused, the vent fan is on, and the right speed and power are selected for

the material. Obtain instructor permission before use. Never look directly into the laser. Stay at the laser throughout the entire process. If machine cuts unwanted area or malfunctions turn off and alert instructor immediately. If injury occurs during usage turn off machine, inform instructor of injury, then have the rest of the students in the room go into the hallway to avoid being in the way of instructors helping the student.

- **Environmental Factors**
    - As the Spring Grove SLI team, being environmentally friendly is one of our major concerns. Our project is very environmentally safe and has little environmental concerns. The only way our rocket would affect the environment would be if the rocket got lost after launch and became unrecoverable. The burning of the black powder and motor can produce potentially irritating, corrosive, or toxic gases. However, the amount of toxic gases released should be very minimal with the amount of black powder that we are using, making the launch still environmentally friendly. If the rocket was to be unrecoverable the environment would be slightly affected. Animals who consuming the potentially hazardous parts could be affected. We make sure most of our rockets are recoverable by making them land in a 2500 foot radius.

The environment may affect our vehicle in many different ways. Humidity may cause the rocket not to travel as high. Gusts of wind will cause rocket to travel far away

from launch pad when parachutes are deployed. Rain will hurt electronics if they get wet. Any type of wet landing surface like a creek, pond, or lake may damage electronics or payload data.

Risks	Probability of Risk *(1-5)	Impact on Project Progress	Mitigations
The rocket parachute does not deploy and rocket returns unsafely to the ground.	3	We lose a rocket and must build another one, losing work time and time to launch.	The team will carefully insert the parachute and make sure there is enough heat shields the

			ground material to prevent flame up.
Injury could occur while using coping saw.	2	A leave of absence of a team member could occur due to minor or severe injury and possibly delay the rocket-building progress.	The team will be aware of limbs and fingers when using this tool.
Injury could occur during Exacto knife usage.	5	A small injury could occur, possibly delaying the rocket-building progress.	The team will carry the knife in cautious matter, cut away from oneself, and be aware fingers when using this tool.
Accidental combustion of rocket materials	3	In addition, possible injury and a delay of rocket-building progress could occur.	The team will keep 25 feet away from electrical outlets, open flame, and the indoor magazine.
Allergic reactions to chemicals involved in rocket production	2	Minor or severe chemical burns of team members and possible delay of rocket progress could occur.	The team will make all students aware of each other's allergies and stay away from possible allergens.
Electrocution during electrical outlet usage	1	Minor or severe injury could occur.	The team will only use electrical outlets if hands are dry and static free. The team will keep fingers away from prongs.
Adhesion to materials or self	4	Minor injury and very minor delay of rocket progress could occur.	The team will exercise proper caution when handling adhesive material and will not use too much of the material.
Injury during laser engraver usage	2	Possible combustion of rocket materials could lead to reordering of materials and delay progress.	The team will make sure the laser is on the proper power, speed, and focus settings, and ensure that the exhaust fan is on.

Injury during drill press usage	2	Severe injury and delay of progress could occur.	The team will keep clothing, hair, and body parts away from the drill bit and use safety glasses.
Tripping and falling hazards	3	Minor or severe injury, delay of rocket progress could occur.	The team will make sure the walking path is clear and keep clutter off of floor.
Abrasions and bruises caused by belt sander	2	Minor injury and delay of progress.	The team will keep hands and clothing away from the sandpaper.
Burning caused by soldering iron usage	2	Minor injury and delay of progress.	The team will use soldering iron in a proper manner and use safety gear.
Premature ignition of rocket motors	2	Possible minor or severe injury, the need to reorder rocket motors, and delay of rocket progress.	Ensure that only the proper level certified personal handle the rocket motors and installations as well as reloads.
Team estrangement because of lack of cooperation	1	Delay of rocket progress.	The team will talk calmly and will not fight with one another. The team will respect each other and themselves.
Going over-budget	5	Delay of rocket progress due to the need for more time to fundraise	The team will carefully use all materials, order only the parts needed, keep track of materials, and use the budget wisely. The team will be diligent in fundraising endeavors.
Misuse or mishandling of hazardous materials	2	Minor or severe injury, leave of absence for team member affected, and delay of progress	The team will follow all safety code regulations, laws, and instructions.

Unforeseen rocket design complications	4	Delay of rocket design and rocket building progress	The team will design a stable rocket based on the locations of the center of pressure and center of gravity. The team will also have a NAR representative check rocket design.
Unforeseen payload design complications	3	Delay of payload design and production.	The team will design a payload that will be effective for the size body tube that is used and double-check that the components of the payload are properly wired and attached.
Complications during transportation of participants and materials to SL or practice launch sites	3	Delay of rocket progress due to rocket repairs or cancellation of practice flights because of extensive damage.	The team will make sure that the launch date is known in advanced and that all specifications are planned out well in advanced. The team will pack the rocket well and make sure it is secure during transportation.
Accidental partial or complete destruction of building site	2	Damage to work environment, additional expenditures for repairs, possible progress delay.	The team will ensure that safety guidelines from NAR and the MSDS are being followed.
Team communication failure	3	Rocket/payload may be built incorrectly or too many of one part may be made, causing a slight to major delay of progress or loss of material.	Every team member will have access to other members' email addresses and have the ability to talk during the school day.
Shortage of rocket building materials	2	Major delay due to the need to order new material and wait for it to ship.	The team will double-check all materials before ordering and enforce a checklist while parts are being used.

Commitment complications among team members	2	Loss of time or team member if the complication is too great.	The team will make sure all team members make this their first priority and plan accordingly.
Inhalation of dangerous fumes	2	Minor to severe injury, time lost taking student to ER, delay of progress.	The team will wear proper safety gear, exercise proper use of fume hoods, and be aware of surroundings.
Accidental ingestion of rocket materials	1	Minor to severe injury, delay of progress, possible loss of material.	Only experienced students should work with dangerous materials under proper supervision.
Motor ignition delay	3	Launch delay, loss of motor if it does not ignite, minor to severe injury if motor ignites while personnel are approaching rocket.	The team will only use commercially available and Range Safety Officer-approved igniters.
Rocket catches fire on the launch pad	2	Possible loss of rocket, minor to severe injuries if fire is not properly extinguished.	The team will bring a fire extinguisher suitable for the needs of the fire and according to the MSDS of the motors being used.
Cancellation of launch due to poor conditions	4	Delay of testing.	The team will plan multiple days to launch, be flexible in scheduling practice launches, and practice patience.
Motor ignition failure	3	Delay of launch testing and rocket progress.	The team will ensure that commercially available igniters and motors are used and follow the NAR High Power Safety Code, which outlines what to do during motor ignition failure.

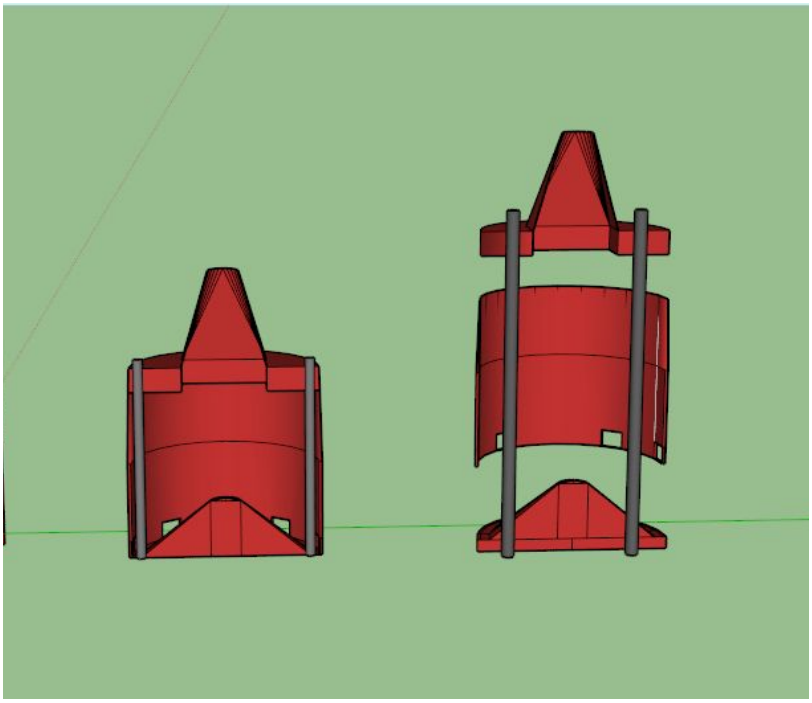
Premature Detonation of Black Powder Charges	2	Partial destruction of rocket and/or premature parachute deployment.	All black powder will be handled by professionals and the team will check that the charges are set for the correct time.
Team members becoming sick before or during the trip to Huntsville.	3	Loss of manpower and possible loss of team leaders and/or safety officer	Team members will be well informed and be able to cover multiple roles in the project if needed.
Pieces of the rocket falling off of the rocket during launch	2	Damage to the rocket and danger of injury to the people and processions on the ground.	Check all aspects of the rocket before launch and delay launch if repairs are needed.
Cancellation of Huntsville due to unforeseen causes	1	Ending of the program for this year or the event being held at a later date.	Follow through with the current program and launch separately.

IV) Payload Criteria

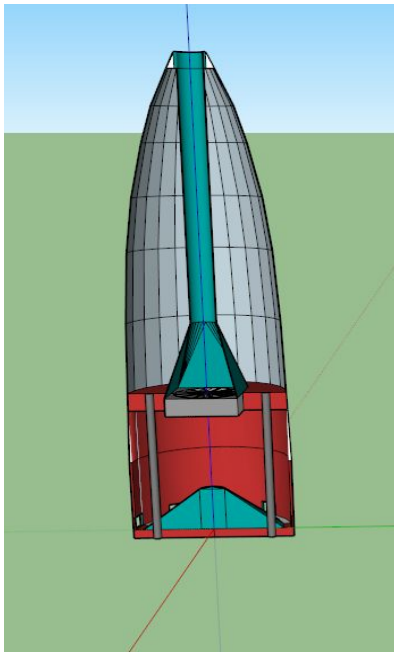
- **Selection, Design, and Verification of Payload**
  - **Review of Payload Design and Systems-**

    - This year's payload for the Spring Grove SL team will test how airflow through a turbine will generate a current. The payload will have a small computer fan placed into a bulkhead and then wired to an ammeter lower in the payload. The airflow for the turbine will be generated by the rocket on its way up to apogee. The

turbine we will be using will be a small computer fan because it already has a small motor attached to it. A small tube will be placed directly above the turbine in the nose cone and will run directly to the tip of the nose cone so air can flow to the turbine. The tube running from the tip of the nose cone towards the fan will have a funnel inverted over the turbine to maximize airflow. Approximately 3 inches below the bulkhead holding the turbine we will place another bulkhead to seal of the payload. Small spill holes will be drilled between these two bulkheads so the air has somewhere to escape to after it runs through the turbine. The complete payload should be no longer than a foot when it's completed, the smaller size of this payload will make it easier for the nosecone to eject off the rocket when the parachute deploys. It will be built out of fiberglass coupler tube built for a 4 inch diameter rocket so the fit should be nice and smooth. The payload will be half in the nose cone and half in the body tube, it will be inserted in the nose cone and pop riveted in place before each launch. The placement of this payload is vital to the experiment, without easy access to the nosecone there would be no way for us to get airflow to the turbine in the payload. The placement is also important when it comes to deploying the parachutes, last year the placement of the payload made it very difficult for the main chute to come out. This year the payload is smaller and won't be held into place so tightly allowing for easier deployment.



This screenshot shows a side view of the nosecone and payload. You can see two pieces of all thread running from the bottom bulkhead the whole way to the top, these pieces of all thread will be responsible for holding the payload together. The cone shaped pieces on the two bulkheads serve to direct the airflow. The cone on the bottom bulkhead directs the airflow out of the spill holes at the bottom of the payload.



In this screenshot you can see the way that the payload will fit together and the way it fits in the nose cone. If all goes smoothly the payload should word as an extension of the nose cone. In this picture you can more clearly see the spill holes cut into the bottom of the payload.

The main objective of the payload is to find the relationship between wind speed and current produced. the payload to be considered a success it will need to collect data the duration of the whole flight. We're hoping that once we recover the rocket we'll have a smooth curve graph of our data charting the correlation between speed and current. We expect that as the rocket accelerates upward the wind speed through the payload will increase, in turn increasing the speed on the impeller. As the impeller speed increases the current produced will increase. The graph should look somewhat like the normal curve after the flight. The current will increase as long as the motor is burning and then start to decrease once the motor is fully burned.

On launch day payload preparation should be relatively easy. The computer fan and ammeter will slide completely out of the payload so they can be checked before each launch. The

payload won't require any external power sources which will make the wiring easy. The only wiring in the payload will be the ammeter and the computer fan. The ammeter will be wired in series with the computer fan so it can collect data from the fan.

Safety with this payload should not be an issue. As long as the payload is securely connected to the nosecone there won't be any issues. Before each launch the team will check over the payload to make sure everything is secure and structurally sound. The main payload compartment will be attached to our nosecone with pop rivets before each launch. A bulkhead on the bottom of the payload will have a U-Bolt on it connecting it to the recovery systems of the rocket.

- **Payload Concept Features and Definition**

    - We on team tesla believe that this a unique form of energy generation that is quite unheard of and thus have decided to pursue its research and development. It is significant because the energy collected via this method could be used to power onboard systems for future small scale missions or vehicles propelled by fuel and thus convert such energy into electrical energy .
    - the complexity of creating proper airflow through the payload as to create as little drag as possible as well as get the greatest current collection rates possible without reaching tolerances of parts such as max RPMs of the turbine, makes this experiment suitably challenging for this level of team.

- **Science Value**
    - The objective is to collect energy on assent and calculated the rate at which it is collected.
    - the payload will be considered a success as long as data is recovered and a collection rate is extrapolated from the data.
    - the experiment will collect data on the vehicles assent then record that data for later viewing, at which point a rate of generation can be calculated. rather than trying to calculate data from changing air density and intake rates with a changing acceleration.
    - accuracy will mainly be affected by the friction created from the bearings within the turbines generator itself and the airflow through the turbine.

V) Project Plan

- **Status of Activities and Schedule**

  - **Budget**

Item:	**Cost (In Dollars):**
Travel to Huntsville	6000.00
Food for All Trips:	2354.00
Practice Trips to Maryland	840.00
Lodging in Huntsville	3600.00
Nose Cone	19.95
Body Tubes	399.80
Rocket Mount	4.99
Fast-Hardener	43.94
Resin	84.96
Shock Cords	47.80
Large Parachute	188.00
Small Parachute	113.00
Centering Rings	55.88
Bulkheads	70.54
Motor Casing	149.95
Reload	531.80
Reload	265.90
Couplers	74.00

Motor Mount Tube	9.95
Engine Retainers	72.76
U-Bolts	15.84
Quick-Links	14.88
Altimeters	1119.03
Batteries for E-BAY	25.46
Materials for Fins	70.38
Wires	30.78
All-Threads	6.40
Key-Switches	106.68
Subscale Rocket	500.00
O2 Sensor	123.05
Camera	99.99
Battery Holder	5.60
Spark Plug Wires	47.39
Exhaust Gasket	20.63
Spark Plugs	23.04
Pipe (for behind converter)	65.00
Replace spark plugs and wires	40.00
Muffler Clamp	3.50
Fuel Pump	144.50
Replace Fuel Pump	65.00

Clay	16.08
Soda Bottle Preforms and Caps	27.99
Grit Paper	12.85
Alkaline Batteries	29.98
Nylon Webbing	25.49
9 Volt Batteries	14.55
Sanding Paper	5.81
Coping Saw	17.97
3 Volt Batteries	6.44

-Funding Plan

In order to receive the necessary funds in order to successfully complete this project our team intends to cover the costs through a combination of fundraisers, donations and sponsors/grants all of which will be completed and then sent to our financial advisor for approval. Our club will be taking part in fundraisers throughout the year to help finance our endeavor. Current fundraisers that will be taking part includes "Nuts About Granola" (information is located at (www.nutsaboutgranola.com), selling cotton candy at local sporting events, Bonus Books (information is located at www.bonusbook.com), and we are currently brainstorming other options to continue to fundraise that are not yet official. Our clubs are currently accepting all donations and bring donation jars to all the events that we are planning to take part in.

-Timeline

- August 7, 2015: Request for Proposal (RFP) goes out to all terms
- September 11, 2015: Electronic copy of completed proposal due to project office by 5pm
- October 2, 2015: Awarded proposals announced
- October 7, 2015: Kickoff and PDR Q&A
- October 23, 2015: Team web presence established

· November 6, 2015: Preliminary Design Review (PDR) reports, presentation slides, and flysheet posted on the team website
· November 9-20, 2015: PDR video teleconferences
· December, 2015: CDR Q&A
· January 15, 2016: Critical design review (CDR) reports, presentation slides, and flysheet posted on the team website
· January 19-29, 2016: CDR video teleconferences
· February 3, 2016: FRR Q&A
· March 14, 2016: Flight Readiness Review (FRR) reports, presentation slides, and flysheet posted to team website.
· March 17-30, 2016: FRR video teleconferences
· April 13, 2016: Teams travel to Huntsville, AL; Launch Readiness Reviews (LRR)
· April 14, 2016: LRR's and safety briefing
· April 15, 2016: Rocket Fair and Tours of MSFC
· April 16, 2016: Banquet; launch day
· April 17, 2016: Backup launch day
· April 29, 2016: Post-Launch Assessment Review (PLAR) posted on the team website
· May 11, 2016: Winning team announced

- **Team Schedule**- As far as get-together's go, there are two types: meetings and sessions. The meetings will be discussions conducted by the Team Captain and Co-Captain with the entire, including supervision and comments from them. Sessions will only be for team members to allow them to work without advisor

help as a team, though an advisor will supervise them. The schedule will include general and formal meetings, briefing, group sessions, bonding sessions, work sessions, and construction sessions.

- **general meetings** are where tasks will be assigned and the information of when they need to be completed and turned in. These meetings will be informal and quite short, they will be held prior to the work that is going to be done that day.

- **formal meetings** will have a considerable and strict agenda to discuss everything that needs to be done. This will include the progress on certain tasks or problems that have come up throughout the course of the week. Team members and advisors can share their thoughts and discuss them as a team. Team members and advisors can also ask any general questions about the project and/or concerns and can discuss them during these more formal meetings.

- **Briefings** will be informative meetings consisting of a collective report of all work that has been completed and progress on any unfinished tasks. These will be used to inform the team of any changes to the project's budget, schedule, fundraising, and other changes rather than focusing on what needs to be done.

- **Sessions** will be somewhat of a counseling type of meeting. These will be used to address personal problems and challenges that have come up during the completion of the project. Team members may share personal problems that are outside of the project that are affecting their ability to work well, or explain problems that are preventing them from attending meetings. Other team members can then help in completing their part of the project. Since these are only held with team members, they can discuss how they feel about something else another team member has done, or if something another has done that has upset them in some way in order to best resolve the issue at hand. The sessions will allow the team members to get help in solving personal affairs and dealing with problems within or outside of the project to relieve as much stress as possible. These will help the team understand what is going on with other team members and grow together and help each other. The sessions will be more serious than the others, and are largely going to influence the project as we need everyone to be working at their best cooperatively. Not having this will make the project more stressful not only for those directly having problems, but for the entire team as well.

- Part of our effort to make our team grow together and cooperate well, special bonding sessions will be held to improve the bond between team members and

advisors. These are designated to help build relationships outside of the project. We will do various activities such as watching movies about science in general as well as more specifically aerospace, and other group favorite movies that we can watch together. As stated earlier, we need to have an open and friendly environment and atmosphere within our teams and these sessions and/or activities are crucial to that kind of team development and maintaining a pleasurable experience for all involved.

- Work sessions will be used for working on any and all of the reports needed throughout the project. This will present the opportunity for team members to ask others questions about their part and allows for clarification if need be. This will also be used as a progress check to see what needs to be done and see what has been completed. It will give the chance for the two teams to work together and assist as needed within the time being.

- Construction sessions will be used later in the project to actually build the tangible rocket itself. Team members will be paired to work on building specific parts of the rocket or payload. This prevents mistakes and accidents from happening and builds progress within itself. The partners are in case an accident does happen, so that the other partner will be there ready to help if needed. Construction will have adult supervision, so partners can inform them immediately if something requires attention or assistance. Both team members must read and abide by all safety rules regarding the operation of tools, for both their safety and their partner's.

-Meeting Times, Session Times, and Proposed Schedule

- Meetings and sessions will be held on several different dates; general meetings will be held every day when the team is capable of meeting together, typically before work sessions and before/after school hours. Formal meetings will be mandatory meetings that will be ideally held once a week from about 3:00pm to 5:00pm. Briefings will also be mandatory, as they are ideally held every Friday from 3:30pm to 4:30pm. Group sessions will be held every other week on the day that is more convenient for the team at the time. Work sessions will be held during any of the available times after school, allowing for convenience for each team member. Construction sessions, once that point in the project has been reached, will be held once or twice a week with Friday being our official construction day. Extra days will be assigned as needed later on in the project to assure that we stay on schedule. Partners must be present during the construction sessions for a team member to be able to do any work on their designated task.

These construction sessions will also be under close supervision by an adult so in case any of the aforementioned issues arise.

- **Community Support-** To publicize our project, our team will be contacting local television stations like FOX 43 of the FOX Corporation and WGAL 8 in the Susquehanna Valley like we have done in previous years as well as contacting local radio stations like 107.7 and 105.7. Lastly we will contact local newspapers to spread the word of the Spring Grove Rockets. We will be sending each of these kinds of organizations information about us and asking if they were willing to spread awareness about our club. We will also be using our own SL website to notify the public about the project and to post updates. We plan on making presentations to both our middle school and intermediate school about our project and the clubs offered at our high school to help get the kids more into and aware of the great possibilities that SLI provides. We also intend to create posters to put around our school and local businesses to promote and encourage sponsorship and donations.

- **Sustainability Plan-** We intend to keep our SL club together now and into the future through a combination of many plans and elements. We intend to maintain all of our current relationships by send them regular reports, maintain an active dialogue with them and taking their feedback into account. Our current relationships are with several certified NAR members, Advanced Application Design and the Engineering Society of York. Now in keeping a steady stream of new members coming into the club we will primarily recruit new members from our TARC teams who have had past experience in rocketry but we are willing to accept anyone who wants to join and is willing to put in the work. We will be using a combination of announcements, posters, and our website to get the word to potential club members. We intend to engage the students of Spring Grove Area School District in our club and mission through a series of assemblies and workshops. Lastly we intend to keep a steady stream of funding coming in through fundraisers, donations and sponsors/ grants. This will all ensure that our club is maintained well into the future. We also plan to:

  A) Avoid safety hazards is to have team members and supervisors read the all operation manuals for the tools and products that will be handled during the completion of our project before proceeding with any of such devices or products, while following the enclosed safety plan.

B) Address if a team member is comfortable with using a tool at any time or not.

C) Raise enough funds for our project we will be holding public outreach programs for funding and support we will be contacting local businesses for grants such as our local power company's (MetEd's)

D) Stay on budget, we will keep track of all funds being used and track whether the prices of materials are within the projected coast by researching for the best pricing of the materials. If going over budget is inevitable, due to rising prices of materials, we will raise more funds from companies using our progress on the project to incite sponsorship from more companies and businesses.

E) In order to make it to Huntsville, we want to work with people, local businesses, and corporate sponsors in and around the Spring Grove area. We plan on spreading awareness of our rocketry programs at Spring Grove to every adult and student in the area, to accomplish this we would like to create hands-on learning experiences for kids in our community to explore and learn more about the rocketry field.

F) We will also be holding public out-reach and funding programs at school and local events to help with awareness of our project to get the attention of adults of our community.

G) We hope to have small groups work together and build small scale rockets, each group will have an SL member directing the group to help teach the students to build the small rocket. If feasible, we may launch the said rockets (if they are deemed safe to fly). We want to provide fun hands on experience for our students so more students will be interested in joining TARC and potentially even SL in the future.

H) In order to spread public awareness, we are planning to contact television stations, such as FOX and our local news channels, to see if they are interested in making a short segment on the SL program of Spring Grove High School. We will also contact local radio stations such as 107.7 and 105.7 to see if they are interested in speaking on behalf of our program here at Spring Grove.

- **Educational Engagement**- Educating the community about our SLI project is of utmost importance. Without the support of our community, the SLI project would be near impossible. Our community has also been very supportive in the STEM programs and clubs offered throughout the school district. As a whole, we have worked very hard to earn their respect and support and we hope to continue that positive relationship through the SLI project this year.

  Similar to last year's team, we plan to focus our education of the SLI project and STEM programs to the younger students attending Spring Grove. We can help them discover the intriguing world of rocketry all while promoting STEM programs. We plan to host presentations in the elementary, intermediate, and middle schools to inform students of what exactly we do in SLI and how they can be involved when they reach high school. These presentations are key to the continuation of STEM programs because they inspire the next generation to get involved and represent Spring Grove at its best in future programs and teams.

  NASA would like us to focus on students in grades 5 through 9 specifically. In addition to the presentations, we have created a middle school TARC team for this age group of students. This will give middle school students the chance to experience rocketry first hand by allowing them to design, assemble, and launch their very own rocket. Rocket designs will need to be in accordance with the 2016 Team America Rocketry Challenge (TARC) specs. The students will be in one group, containing about four or more students, and work as one team to accomplish the task. Since these students do not have much

knowledge of rocketry, a brief seminar will occur before the start of their designing and constructing. This seminar will provide them with the basics of rocketry and the overview of the TARC program. This will help to ensure the success of the first Spring Grove Middle School TARC Team.

As mentioned above, many of the students do not have much, if any, prior knowledge of rocketry. Therefore, a couple SLI team members will be assisting them with the project. The SLI mentors will be able to show them how to properly use tools and inform them about safety precautions throughout the building process. Test launches are important to make sure the rocket they designed will be appropriate for the TARC competition. With these launches, we hope the students will be inspired to keep revising their rocket to make it better each time. This will also help them to learn to work as an efficient team and enhance their interest in the rocketry and STEM programs at Spring Grove.

Throughout the year, the students will be encouraged to ask questions about TARC, SLI, and rocketry in general. As an SLI team, we will also be able to give them a more in depth look at the SLI project. They will be able to see the various write ups we create and the designs of the payload and rocket. By giving the middle school TARC team this experience, we hope it will encourage them to join the SLI program and continue with their love of STEM programs when they reach the high school level.

Students will meet after school about once a week in order to work on their TARC rocket and design. We will also hold a meeting for parents and students to inform them more about our SLI project and the TARC competition.

VI) Conclusion

We have made progress on the project following our initial proposal. Improvement in write ups and designs are our main goals for the future reports. With improvement comes critique and with that being said, we will be very open to any suggestions and ideas presented to us about the project. To make these changes, more in depth research will be done on each aspect of the rocket and the rocket design. This research will help to ensure that our SLI team is showcasing our best works and efforts throughout the entirety of the project. It will also allow us to work more closely as a team and heighten our knowledge of the SLI project as a whole. Support from the community is a huge factor in the success of this program. Without them, the SLI project will be almost impossible to complete. Education to the community about the project is key in gaining this support. We will encourage all students to get involved with the SLI team in STEM programs. Presentations, seminars, rocket launches, and a variety of workshops will allow students to experience rocketry first hand. We want all students to know that they have the potential to succeed at whatever they so desire, such as being a rocket scientist or an engineer in their future. Our support for the students will help gain us the respect and support of the community.

As a team, we plan to continue to do research on the various aspects of the rocket, the materials needed for building, and the safety regulations included in each step of the project. We will

follow safety procedures to prevent all injuries while constructing and launching the rocket. We will encounter a multitude of expenses however, our fundraising plan, sponsorships, and grants will ensure our success. Fundraisers are already underway here in Spring Grove and we have applied for multiple grants. Test launches will be coming up in the near future. These launches will help to make sure that our project is safe, successful, and reproducible. With the support of everyone, we are excited about the opportunity to travel to Huntsville, Alabama in the spring to unveil our final project to the world.