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Appendix Information

Section 1 General Information

1.1 School Information

Clark College
1933 Fort Vancouver Way
Vancouver, Washington 98663
http://www.clark.edr

1.2 Project

ARP 142

1.3 Faculty Advisor

Keith Stansbury
CADD Department Head
kstansbury@clark.edu

1.4 Safety Officer

Erick (Mission Safety Officer)
Student
e.richards@students.clark.edu

1.5 Team Leader

Jason (Mission Director)
Student
j.petker@students.clark.edu

1.6 Team Structure

Tier 1

- Faculty Advisor - Keith Stansbury
  - Advisor and team oversight
- Oregon Rocketry Mentor
  - Team advisor and assistance with launch

Tier 2

- Team Leader - Jason
  - Oversees all design and team decisions
  - NASA point of contact
  - Final say
- Safety Officer - Erick
  - Safety briefings
  - Construction, testing, and verifications
  - Oversees preflight checklist and procedures
  - Risk assessment

Tier 3

- Chief Launch Vehicle Engineer - Ryan
  - Launch vehicle design lead
  - Oversees consistency of LV design including payload integration
  - Manages team of 5 students focusing on design of launch vehicle
- Chief AGSE Design Engineer -Bryan
  - Oversees design of Automated Ground Support Equipment
  - Works closely with LV Design Engineer to ensure compatible designs
  - Manages team of 10 students focusing on design of AGSE
- Financial Officer – Zachary
  - Design and maintain project budget
  - Request funding from school
  - Seek out sponsorship
- Educational Outreach Officer – Jesse
  - Set up outreach events at schools/clubs/institutions

1.7 NAR/TRA

Oregon Rocketry
http://www.oregonrocketry.com/
NAR Section 555 - OREO
TRA Portland 49

Section 2 Facilities/Equipment

Figure 2.1: Clark College Main Campus

Clark College is located in Southwest Washington and offers students a wide range of transfer degree programs including basic education, professional-technical, and transfer degrees. As one of the largest community colleges in the state, boasting over 14,000 students in attendance, Clark College has the capacity to offer an extensive array of programs well beyond an average community college. Further, Clark features one of the strongest engineering transfer programs in the state of Washington. Engineering transfer faculty at Clark College provides both educational and experiential backgrounds in aerospace, civil, electrical, material science, and mechanical engineering.

2.1 Facilities

Clark Aerospace will utilize the facilities on campus to design, develop and manufacture a launch vehicle and engineering payload for the 2012-2013 NASA USLI Competition.

Anna Pechanec Hall

Figure 2.2: Anna Pechanec Hall

Engineering and physics labs

- Mechanical Engineering Lab, APH 206
- Electronics Engineering Lab, APH 210
- Physics Lab, APH 107

Engineering & Physics Educational Staff

- Bachelors in Aerospace Engineering
- Masters in Mechanical Engineering
- Masters in Electrical Engineering
- PHD in Analytical Chemistry
- Masters in High Energy Physics
- PHD in Atmospheric Physics
- PHD in Mathematics

Hours of Accessibility

- Monday – Friday 8:00 AM to 5:00 PM
- Evenings & weekends – by appointment

Penguin Union Building

Figure 2.3 Penguin Union Building

The Penguin Union Building is the hub of the Associated Students of Clark College (ASCC) – the student government. The ASCC enables Clark Aerospace to operate as a chartered club, thus allowing students to pursue competitions like USLI. Funds provided by the ASCC also allow Clark Aerospace to host educational outreach events within the community.

Hours of accessibility

- Monday – Friday 8:00 AM to 5:00 PM

Applied Arts Buildings 4 and 5

Figure 2.4: Applied Arts Buildings 4 and 5

Computer and manufacturing labs

- CADD Labs, AA4 204 & 206
- Machining Technologies Labs, AA5 107 & 109
- Inspection Lab, AA5 110
- Materials Testing Lab, AA5 (room not separately numbered)

Hours of accessibility

- Monday – Friday 8:00 AM to 5:00 PM
- Evenings & weekends – by appointment

2.2 Equipment

Figure 2.5: Machining Technologies Labs

Machining Technologies:

CNC Machines:

- 5 axis mills
- axis mills
- multi-axis lathes

Manual Machines:

- mills
- lathes
- drill presses
- grinders

2.3 Computer Equipment

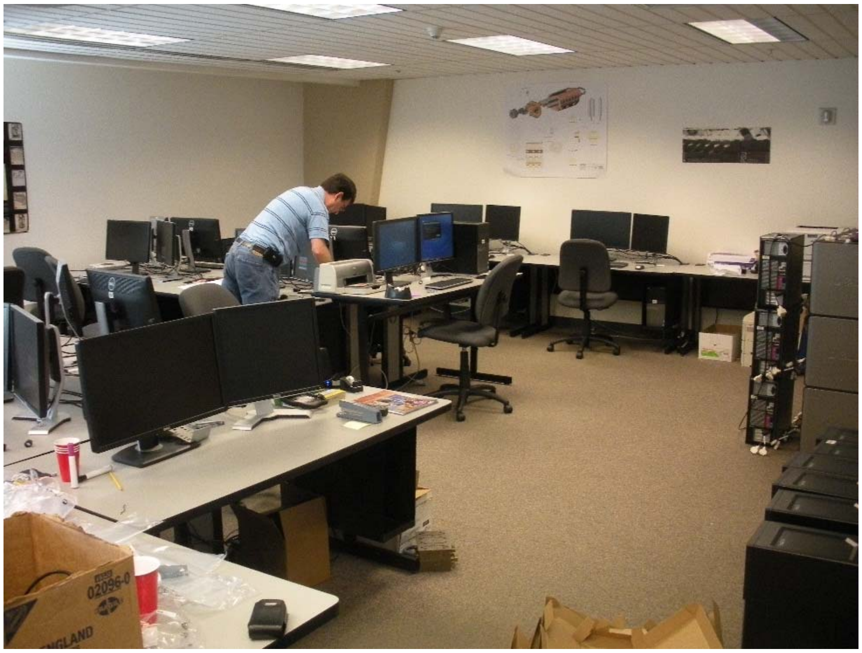

Figure 2.6: CADD Lab

The CADD labs are currently being upgraded and expanded to include more computer stations and provide students with the latest top of the line hardware and software systems.

Team Communications

Team Communications will be conducted through the following formats:

NASA Communications	• E-mail • WebEX Software
Team Announcements	• Team Website • E-mail • Twitter
Team Intercommunications and File Management	• E-mail • Google Drive • Skype

Design and Development

The following software will be available for the development and design of the Teams launch vehicle and AGSE.

- SolidWorks
  - SolidWorks Simulation
  - SolidWorks Flow Simulation
- Rhinoceros
- Linux
  - Ubuntu
- AutoCADD
- RockSim
- RASaero
- MPLAB
- MATLAB
- Excel
- Circuitlab

Web Site Development

- Adobe CS5
- Joomla! - layout and coding
- Photoshop - Image processing, web graphics and interface development
- Illustrator - web graphics development
- Flash - Graphic development
- Filezilla - web page content management

Documentation Development

- Adobe Creative Suite 5
- Adobe Acrobat X
- Microsoft Word
- Excel
- Google Drive

The primary format for documentation deliverables will be PDF.

2.4 Electrical Equipment

Figure 2.7: Circuits Lab

Electrical Equipment

- Two channel oscilloscope 60MHZ
- 18V power supply
- Digital LCR Meter

2.5 Digital Communication Laws and Regulations

All team members will understand and abide by the Architectural and Transportation Compliance Board Electronic and Information Technology (EIT) Accessibility Standards, 36 CFR Part 1194, and in particular the following:

Subpart-B Technical Standards:

1194.21 Software applications and operating systems. (a-l)

1194.22 Web-based intranet and internet information and applications.16 rules (a-p)

1194.26 Desktop and portable computers. (a-d)

3.1 Mission Safety Plan

While Clark Aerospace has a safety lead, **safety is the responsibility of each and every team member.** All team members have the ability and responsibility to call a halt to any activities that risk damage to the launch vehicle or have the potential to harm any crew member, onlooker, or bystander.

"A delayed launch will fly eventually. An obliterated rocket will never fly again."

3.1.1 Safety Officer

Mission Safety Officer - Erick

The safety officer's primary responsibility is to eliminate damage to the launch vehicle and ensure safe working conditions for the launch and design crew through a set of detailed procedures.
Specific responsibilities include:

- Assembly documentation review
- MSDS maintenance
- Pre-Launch briefings
- Emergency checklists
- Safety overwatch
- Restarting activities which have been safety halted

3.1.2 Facilities Safety Information

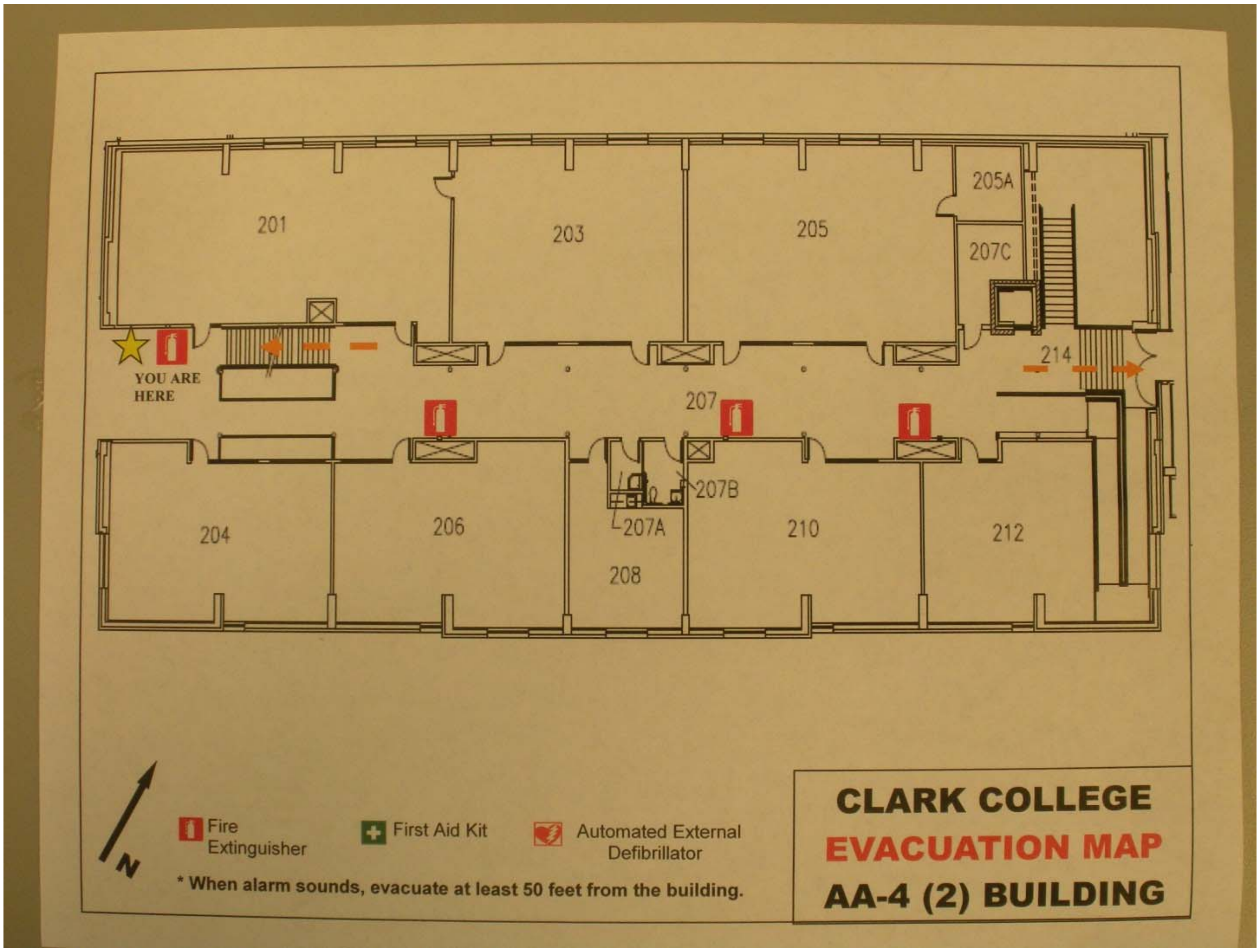

Figure 3.1: AA4 Evacuation Map

Figure 3.1, above, is an example of standard safety evacuation maps that are posted across the entire campus. The Machining Technology Labs have specific safety protocols and requirements. Any team members desiring to use machining technology facilities must be cleared by Machining Technology Department personnel prior to use. All other manufacturing work will be preceded by safety briefings.

In addition team work spaces will include emergency contact information (911 or any other emergency number).

No member of the team is allow to execute any physical activity relating to the build, maintenance, or repair of the launch vehicle alone. This will ensure any accidents have a safety observer.

3.1.3 Safety Plan

Safety Halt

Club members are required to call a “safety halt” to any activity in progress if they believe the activity presents an unnecessary risk to personnel or equipment. If a halt occurs prior to rocket ignition all electronics will be immediately reverted to a safe state. Only after all activity is halted will the issue be discussed. Safety halts will last a minimum of 30 seconds. If the issue is resolved quickly, all team members are expected to use the remainder of the 30 seconds to evaluate other safety hazards. Only the crew member that has called the safety halt, the safety officer, or the team lead can end the safety halt.

Cautions and Warnings in Documentation

Any activity called out in documentation which has a high potential of causing damage to vital components if improperly completed will be denoted as a Caution.

Any activity called out in documentation which has a high potential of causing personal harm to crew members or bystanders will be denoted as a WARNING.

Emergency Contacts

The safety officer shall develop and maintain a list of emergency contacts for each team member.

Personal Protective Equipment (PPE)

The safety officer shall define which PPE is required for each task to ensure the safety of crew members. As well, he shall ensure the proper maintenance of PPE. Finally the officer has the ultimate responsibility to ensure safety equipment is used properly.

Contingencies

For the purpose of this document, a contingency is an event that leads to the unsuccessful completion of the stated launch goals some time after countdown has begun.

The safety officer is responsible for developing and approving the following contingency checklists. These checklists must insure proper evidence is gathered to create a post contingency report and that proper steps are taken to ensure the safety of personnel and the environment in the launch/flight area.

Name	Start Event	End Event	Note
Contingency 0	Count Down	Ignition	Contingency 0 ranges from a launch pad abort to damage to the launch vehicle prior to ignition
Contingency 1	Ignition	LV leaves launch rail	Covers launch pad failures
Contingency 2	LV leaves Launch rail	Drogue chute deploy	Covers in flight failures
Contingency 3	Drogue chute deploy	Touch down.	Covers recovery failures.

Table 3.1 Contingencies

3.1.4 Risk Assessment

Dangers to the Mission

Possible Hazard	Probability	Possible Cause	Impact	Proposed Mitigation
Failure to meet critical milestones	Medium	· Students failing to deliver documentation on time	· Disqualification from competition	· Establish checkpoints in between deadlines
Delay in delivery of materials	Medium	· Lost package	· Delay In construction	· Monitor package · Double-check shipping information
Design changes	Low	· Improper calculations	· Delay in construction	· Double-check all design calculations
Improper construction of launch vehicle or payload	Low	· Not allowing adequate time for construction process and careful attention to detail	· Construction and testing setbacks due to remanufacturing	· Follow proper construction techniques · Level 1 certifications

Table 3.2: Dangers to the Mission

Launch Vehicle Construction

Possible Hazard	Probability	Possible Cause	Impact	Proposed Mitigation
Improper construction	Low	· Failure to follow proper building techniques	· Poor flight characteristic	· Follow proper construction techniques · Follow construction briefings
Exposure to dangerous materials	High	· Failure to adhere to safety protocols while handling materials	· Possible personnel injury or death	· Follow proper safety procedures · Use proper safety equipment
Injuries within the machining technologies lab	Medium	· Failure to follow proper safety procedures	· Personnel injury or death	· Know how to use the equipment before using it · Follow Safety rules of Lab

Table 3.3: Launch Vehicle Construction

Payload Construction

Possible Hazard	Probability	Possible Cause	Impact	Proposed Mitigation
Hardware failure	Medium	· Improper wiring	· Failure of payload to operate properly	· Proper testing and verification of schematics
Systems failure	Medium	· Software programing issues	· Failure of payload to operate properly	· Proper testing and verification of language and how it processes commands
Mechanical failure	Low	· Improper construction	· Failure of payload to operate properly	· Proper design and construction with correct hardware installation to drive mechanical systems

Table 3.4: Payload Construction

Launch Vehicle Testing and Verification

Possible Hazard	Probability	Possible Cause	Impact	Proposed Mitigation
Motor failure(CATO):	Low	· Improper assembly · O-ring failure · Casing burn through	· Damage to airframe structure · Loss of launch vehicle	· Proper assembly following manufacturer's instructions · Proper inspection of O-rings
Physical injuries and death	Low	· Airframe failure · Motor failure · Recovery system failure	· Loss of spectators or team members	· Proper procedures and safety guidelines followed for testing and launching
Airframe failure (shred)	Low	· Improper construction · Material failure	· Loss of launch vehicle · Possible physical injuries or death	· Proper construction · Follow checklist for inspection · Proper assembly of mechanical structures
Recovery system failure	Medium	· Early deployment · Failure to deploy due to improper packing · Tangle · Avionics failure · Shear pin failure · Incorrect shear pin size	· Loss of launch vehicle · Possible physical injury or death	· Proper design · Follow packing procedures · Use proper shear pins

Table 3.5: Launch Vehicle Testing and Verification

3.2 Team Mentor

The Team Mentor will perform the following duties for Clark Aerospace:

- Support all team members involved with the launch vehicle to obtain level 1 certification, and ensure the team understands and complies with the NAR high power safety code.
- Oversee the building of all reloadable motor systems that require a level 2 or 3 certification.
- Loading of the completed motor into the test fixture or launch vehicle at all of the following events:
  - Static motor testing
  - Test flights
  - Competition flights

3.3 Safety Briefings

Clark Aerospace will conduct safety briefings before any event that the team will be attending, as listed in section 3.1.1.

These events will include and not limited to:

- Testing and verification
- Construction
- Test flights
- Competition travel

The following is an example of a team safety briefing hand out:

Team Members Attending Brothers Oregon Launches

From: Mission Safety Officer

Erick

Please remember that Brothers Oregon is 4,639 feet above sea level and is located in the Oregon Desert. The weather conditions in Brothers have a broad range and it is advised that you bring a change of clothes for both cold and hot weather. We have been there in the middle of June with nice weather and woken up with snow on the ground.

Things to bring for both day trips and camping trips:

- Water
- Food
- Sunscreen
- Chair
- Additional shelter
- Cold weather clothes
- Hot weather clothes
- Hiking boots

Clark Aerospace has previously attended a launch in May and the weather was a bright and sunny 77°F. In June the launch site in Brothers Oregon received 3 inches of snow when only a few days earlier the weather conditions where in the 80's.

3.4 MSDS Information

Team MSDS Library

- Launch Vehicle
  - ProFire igniters
  - Cesaroni Pro-X rocket motor reload kits and fuel grains
  - FFFF black powder
- Construction Materials
  - J-B Weld professional hardener
  - J-B Weld professional resin
  - Hysol E-20HP epoxy adhesive hardener
  - Hysol E-120HP epoxy adhesive resin
  - Hysol E-120HP epoxy adhesive hardener

(For complete MSDS documentation please refer to Appendix E)

3.5 Laws and Regulations

Clark Aerospace shall comply fully with the following codes and regulations:

- NAR/TRA – High Power Rocketry Safety Code
- Oregon Rocketry – (OROC) Brothers, Oregon Launch Site Rules
- FAA – Federal Aviation Regulations 14 CFR, Subchapter F Subpart C
- NFPA – 1127 "Code for High Powered Rocket Motors"
- CFR – Code of Federal Regulation Part 55, Title 27 "Commerce Explosives"
- (http://www.access.gpo.gov/nara/cfr/waisidx_02/27cfr55_02.html)

3.6 Motors

Motor Purchasing

APCP motor reloads will be purchased online through the Clark College purchasing department in conjunction with a team member who holds a current level 3 high power rocketry certification with either TRA or NAR. These high power motor reloads will be purchased from Wildman Hobbies. Upon receiving the motor reloads at Clark College, the team will be contacted and a properly certified team member will take receipt of them and transport them directly to the team's storage facility.

Motor Storage

APCP motor reloads will be stored in a secure location on campus in a storage container that is safe for the storage of non-explosive flammable material. This storage facility is only accessible to authorized personnel that are certified to do so at the appropriate level. This differs from the previous year as both TRA & NAR have updated the storage requirements of APCP motors and reloads. With the conclusion of the TTRA/NAR-BATFE lawsuit in March of 2009 APCP is no longer considered an explosive and no longer needs to be stored in a type 3 or type 4 explosive storage magazine. However, FFFF black power, squibs, and E-Matches are still considered explosive and must be stored within the minimum of a type 3 storage magazine.

Motor Transportation

The Team Mentor will be responsible for all motor handling operations. Only level 3 certified team members will be allowed to handle, transport and assemble the reloadable motor system at the launch site and only under the mentor's supervision.

Transportation of Motor Reloads to Competition

Motor reloads will be drop shipped from Wildman Hobbies to a designated representative that will be at the launch in Huntsville. If a designated representative is not able to provide this service, the motor reloads will be shipped by UPS and the reloads will be picked up by the Team Mentor and placed into a portable storage container for safe keeping until competition use.

3.7 Safety Information

Written statement from team members

Each team member will read, understand, and follow all safety regulations listed in this document. Signatures for all currently available team members are found in Appendix F. Any additional members will add their signatures after they join the team.

- Range safety inspection of the launch vehicle shall be performed before it is flown. The team shall comply with the determination of the safety inspection.
- The Range Safety Officer (RSO) has the final say on all rocket safety issues. The RSO has the right to deny the launch of the launch vehicle for safety reasons.
- If the team does not comply with the safety regulations, the Clark Aerospace launch vehicle will be grounded.

4.1 Design Approach

This year, Clark Aerospace is trying to make the most of the competition by using tried and true designs in conjunction with experimental ideas to produce quality, custom designs. The team is focusing on making the AGSE and launch vehicle design innovative, while not wasting efforts on trying to overcomplicate and clutter designs.
Clark Aerospace had several discussions about where efforts should be focused, and on how the team's goals for the launch vehicle and AGSE can be best met, and many design ideas were suggested and evaluated.

Ultimately, the team kept the following goals in mind when designing the launch vehicle and payload for the competition:

- Integrate safety features that have real world application
- Reduce complexity and possible failures by limiting separation
- Design a quality launch vehicle that is reusable, serviceable, and repairable
- Integrate 3D printed parts to show application and effectiveness, as well as allowing for greater freedom in design and construction
- Reuse previous design features that worked well, while creating new innovation

4.1.1 General Launch Vehicle Dimensions

The Table and Figure below illustrate proposed design concepts for the Launch Vehicle:

Length	Forward Diameter	Aft Diameter	Projected Launch Vehicle Weight
129 in	8.005 in	5.150 in	45 lbs.

Table 4.1: General Launch Vehicle Dimensions

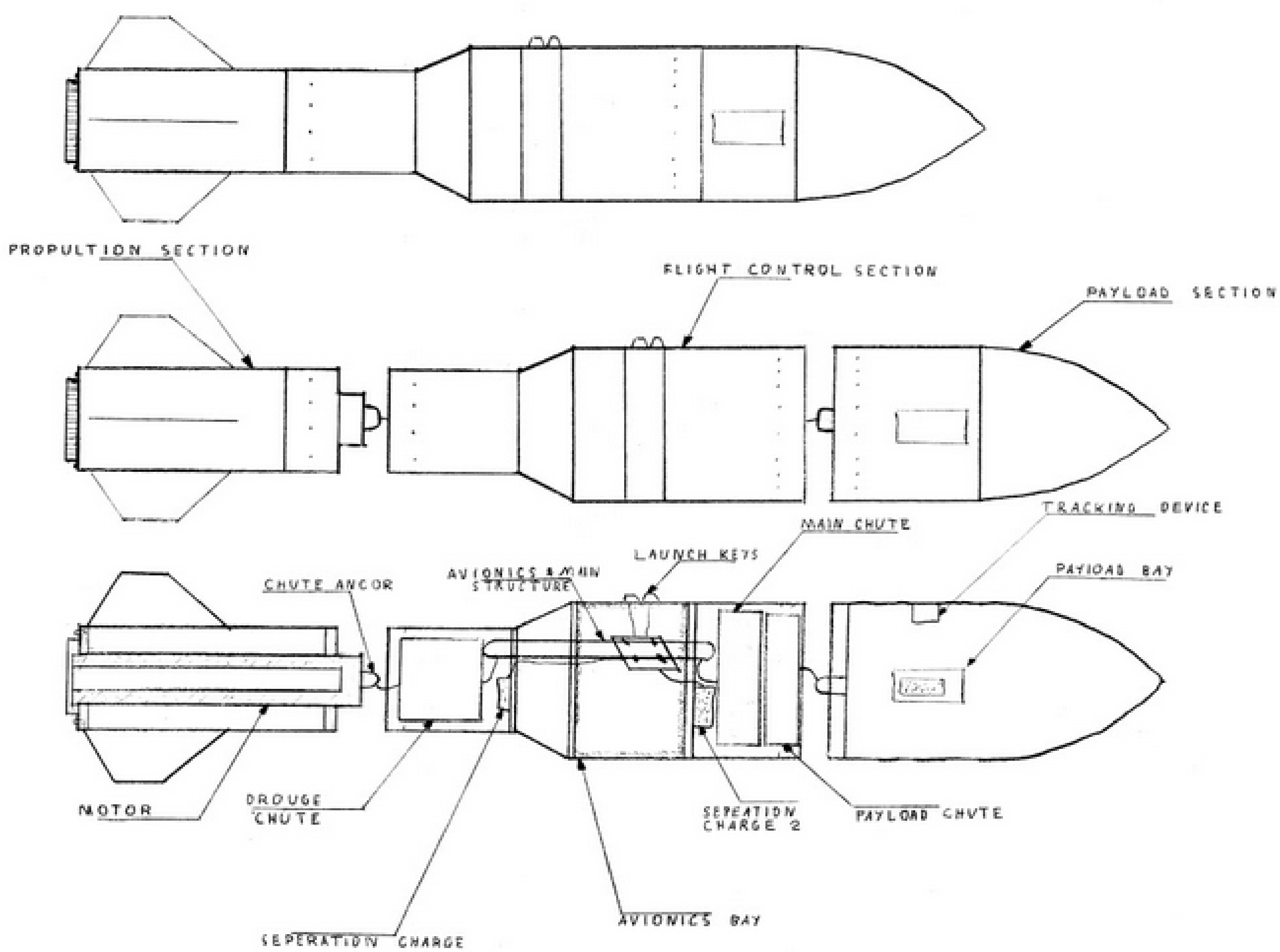

Figure 4.1: Launch Vehicle Concept (not drawn to scale)

4.1.2 Material Selection

The main airframe will use G12 Fiberglass purchased from an online vendor. The Team has used this material in the past and has become familiar with building launch vehicles constructed with G12 fiberglass. It also provides a rigid enough vehicle while still maintaining a light weight. The Team also considered using carbon fiber for construction but found that since the launch vehicle is not going supersonic, it would not need the extra strength that carbon fiber provides.

4.1.3 Construction Methods

Clark Aerospace will be constructing the launch vehicle using mostly traditional methods, keeping the launch vehicle simple while focusing most efforts towards the payload and AGSE design. Some aspects of the launch vehicle may be reused from previous successful builds such as the our airframe transition. The recovery system will be hand made using a method designed and tested in the 2014 NASA Student Launch.

4.1.4 Projected Altitude

The projected Altitude for the rocket is 2738 ft AGL. This was calculated by RockSim using a Cesaroni L1030 motor and the vehicle dimensions listed in Table 4.1. This is under the 3000ft limit by about 250ft but the Team feels confident that during the design process the target of 3000ft will be reached without going over.

4.2 Recover System

Clark Aerospace will design a dual redundant recovery system that will ensure the safe recovery of the launch vehicle and payload containment.

The recovery system will consist of a 2 stage deployment scheme with dual redundant altimeters. The launch vehicle will be separated into two different locations to supplement the deployment of an independent recovery system for the payload. At apogee the aft section of the launch vehicle will separate from the forward section via black powder charges. These two sections will be tethered together and will deploy the drogue chute. The drogue will stabilize the descent and limit the velocity of the launch vehicle to less than 100 ft/sec. At 1000 ft AGL another explosive event will separate the payload section from the midsection of the launch vehicle. This event will deploy the main chute along with the payload chute. These chutes will be designed to limit the velocity of the decent ensuring that 75 ft-lbs of force is not exceeded upon touch down.

Dual redundancy will be achieved by using two Raven 2 altimeters with separate power supplies. These altimeters will be housed in a separate avionics bay that will be centrally located on the launch vehicle.

Main Chute

- Type: High Power Toroidal
- Elliptical 16 gore design
- 168” diameter
- 550lb Paracord shroud lines
- Total weight: 60 oz

Drogue Chute

- Type: Standard Nylon Toroidal
- Elliptical 8 gore design
- 400lb Flat Nylon shroud lines
- Total weight: 8 oz

Payload Chute

- Type: Standard Nylon Toroidal
- Elliptical 12 gore design
- 72” diameter
- 400lb Flat Nylon shroud lines
- Total weight: 13.4 oz

4.3 Projected Motor Type and Size

Clark Aerospace has decided to use 54mm motor casings, as well as a Cesaroni L1030 motor, to reduce cost, as many of these components and reloads are already on hand from previous years, and thus will not need to be re-purchased.

Having a specific motor selection also allows the team to perform very specific analysis of the launch vehicle, to arrive at accurate conclusions, because the thrust curve is known, and the team has experience with this specific motor, having used it for previous projects.

4.4 Automated Ground Support Equipment (AGSE)

The AGSE will be the structure on which the Mars Ascent Vehicle (MAV) rests prior to launch, and it will consist of the following independent systems:

a. Payload Retrieval System
b. Payload Containment System
c. Outriggers
d. Launch Rail
e. Ignition System

The Payload Retrieval System (PRS) will consist of a six-degree-of-freedom arm with a grasping mechanism designed to securely contain the payload during delivery to the Payload Containment System. When not in use, the retrieval system will fold down against the body of the AGSE for protection from debris.

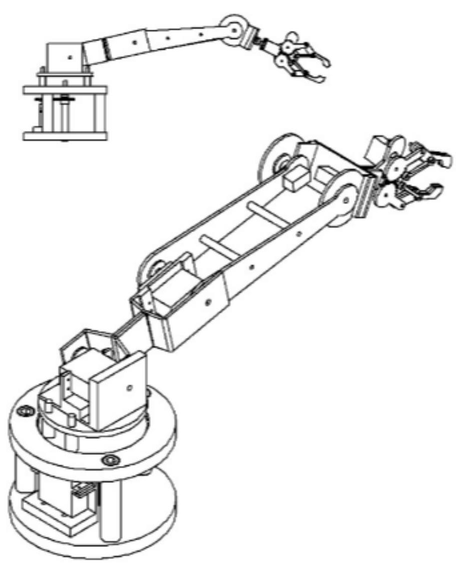

Figure 4.2: Payload Retrieval System (PRS)

The Payload Containment System (PCS) will consist of a section of the Launch Vehicle's fuselage (the sliding tray) which mechanically detaches and slides on rails outwards from the body of the Launch Vehicle. The Containment System will have a payload bay to which the payload is delivered by the Retrieval system. The payload will be placed and gently pressed down into the gripping mechanism connected to the sliding tray. The gripper mechanism will consist of two sets of grippers. These grippers will be under spring tension so that they close upon release. The gripper mechanism will be held open by small notches on the outside of the grippers. A small spring will keep the mechanism in the up position. When the payload is delivered to the gripper mechanism the mechanism will move down, allowing the notches holding the grippers open to release and close. As the gripper mechanism is pressed down it will be secured by small spring activated pins that snap into place and restrict any further movement

Figure 4.3: Payload Containment System (PCS)

Once the payload is secured, the Payload Containment System will be pushed back into the launch vehicle by the Retrieval System so that the outer surface of the Containment System is flush with the fuselage of the Launch Vehicle. As the sliding tray is pushed back, four spring activated pins will snap into place, mechanically restrained the Containment System.

The AGSE will feature a set of 3 outriggers which fold outwards and down to brace the body of the AGSE and provide stability prior to and during launch. These braces will also function as restraints closing over the body of the Launch Vehicle prior to their deployment.

The launch rail will be raised by means of an adapted Hearts mechanism to 5 degrees off vertical. Attached to the mechanism which raises the Launch Rail will be a blast shield to help protect the AGSE from debris kicked up by Launch Vehicle during launch.

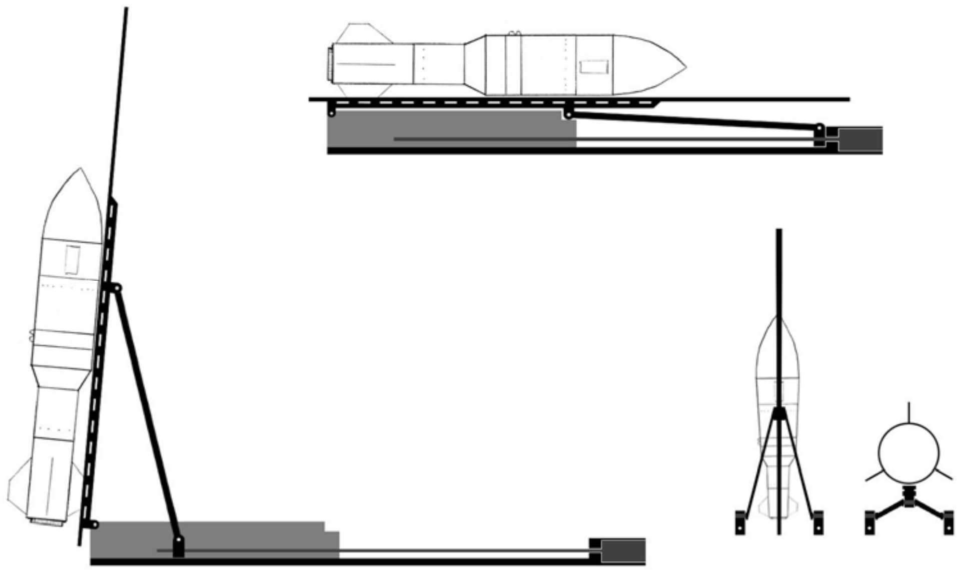

Figure 4.4: Launch Rail Raising Scheme

The Igniter will be delivered to the motor once the Launch Vehicle has been raised by means of a extending device which guides the igniter into place.

The systems described above will be controlled by a modularized control system consisting of the following: An AGSE control system which directs the deployment of the outriggers and the raising of the Launch Rail; a PRS control system which controls the robotic arm tasked with retrieval and delivery of the payload; a PCS control subsystem which opens and secures the payload bay; an Ignition control system tasked with the insertion of the igniter into the Launch Vehicle; and an Overwatch control system (OCS) that monitors each subsystem for proper operation and prevents the ignition system from coming online should any subsystem fail to complete.

The OCS will also relay the kill and pause commands to all subsystems should a safety concern be raised, and provide I/O on the status of the control system.

Preliminary Design Decisions

- Control systems and operating elements will be electrically powered. Hydraulic and pneumatic systems are not expected to be employed.
- An articulating robotic arm will retrieve and deliver the payload to the MAV payload bay.
- The payload will be contained and secured within the MAV via self-engaging mechanical systems, eliminating the need for an electrical subsystem within the MAV to perform this function.
- The payload Containment system will be mechanically locked and unlocked by the AGSE, eliminating the need for an electrical subsystem within the MAV to perform this function.

- Raising the MAV to launch orientation will be via an adaptation of e.g. Hart's linkage.
- Motor igniter will be positioned via flexible lifting element.
- Manual intervention will be required to arm and initiate autonomous operation, which will comprise:
- Payload retrieval and insertion into the MAV payload compartment via articulating arm
- Erection of MAV to 5° off vertical (orientation away from spectators will be established at initial pre-launch staging of AGSE)
- Insertion of motor igniter
- Autonomous operation may be paused and restarted via manual control at any time. Operational status will be indicated by an indicator lamp with a wide view angle.
- At the conclusion of autonomous operation, ignition system will remain UNARMED.
- Manual lockout controls will be provided for LCO to arm and commence launch sequence upon clearance by launch services official.

5.1 Educational Outreach Events

Washington State Science Olympiad

Clark Aerospace has been working with the Washington State Science Olympiad and has volunteered to help with all levels of competition this year. The team will be helping with aerospace related competitions at Coach's Clinics, speaking at schools and providing hands-on learning demonstrations with students that range from elementary through high school.

MESA

Clark Aerospace is in contact with the Director of MESA organizing volunteering events within the local schools levels middle school to high schools. Within these volunteering activities Clark's Aerospace club will be walking through the basics of flight as well as participating in hands on STEM activities.

Boys & Girls Club

Clark Aerospace annually volunteers with the Boys and Girls club of America with its pop bottle rocket activities. The team engages children in the basic concepts of rocketry and helps build rockets, then the following week they come to Clark College campus to launch their creations using our pneumatic pop bottle rocket launcher.

Local Middle and High Schools

Clark Aerospace will continue to provide pop bottle launches and will encourage them to engage in TARC, and ultimately, SLI.

Science In Action

Clark Aerospace will continue to participate in an event called Science in Action as a leader of a seminar. Science in Action is a day of hands on events, which specializes in showing how all of science, technology, engineering and math relate to one another.

6.1 Schedule of Event

Date	Event	Date Completed
September 11, 2014	Proposal requested by NASA	September 23,2014
September 23, 2014	Team meeting and schedule for proposal	September 23,2014
September 24,2014	Group brainstorm and reading of rules	September 24,2014
September 25,2014	AGSE design & payload containment system session	September 25,2014
September 26,2014	AGSE design session	September 26,2014
September 29,2014	Finalizing AGSE design	September 29,2014
September 30,2014	Launch vehicle design session	September 30,2014
October 1,2014	Proposal documentation meeting	October 1,2014
October 2,2014	Launch design finalization meeting	October 2,2014
October 3,2014	Proposal documentation drafting	October 3,2014
October 4,2014	Proposal documentation editing	October 4,2014
October 5,2014	Proposal documentation editing	October 5,2014
October 6,2014	Proposal delivered to NASA	October 6,2014
October 10-30,2014	AGSE and Launch vehicle refinement	
October 31,2014	Web presence established	
November 5,2014	PDR reports, presentation, and flysheet posted on website	
November 7-21,2014	PDR video teleconference	
December 1-30,2014	Payload containment refinement, AGSE development	
January 16,2015	CDR report, presentation, and flysheet posted on website	
January 21-31,2015	CDR video teleconference	
February 1-4,2015	CDR video teleconference	
March 16,2015	FRR reports, presentation, flysheet posted on website	
March 18-27,2015	FFR video teleconference	
April 7,2015	Team travels to Huntsville, AL	
April 7,2015	Launch Readiness Reviews	
April 8,2015	LRR's and safety briefing	
April 9,2015	Rocket fair and tours of MSFC	
April 10,2015	Mini/Maxi MAV Launch day, Banquet	
April 11,2015	Middle/High school launch day	
April 12,2015	Backup Launch day	
April 29,2015	Post-Launch Assessment Review posted	
May 11,2015	Winning team announced	

6.2 Critical Milestone Schedule

Deadline Date	Critical Milestone	Date Completed
October 6,2014	Proposal Deadline	
October 11,2014	Team selection announcement	
October 31,2014	Team web presence established	
November 5,2014	PDR reports, presentation, and flysheet posted on website	
November 7-21,2014	PDR video teleconference	
January 16,2014	CDR report, presentation, and flysheet posted on website	
January 21-31,2014	CDR video teleconference	
February 1-4,2014	CDR video teleconference	
March 16,2014	FRR report, presentation, and flysheet posted to website	
March 18-27,2014	FRR video teleconference	
April 10,2014	Mini/Maxi Launch day	

6.3 Budget Plan

Part	Quantity	Unit	Unit Cost	Total Cost
Nose Cone	EA	1	$30.00	$30.00
Forward airframe	EA	1	$66.00	$66.00
Aft airframe	EA	1	$66.00	$66.00
Motor guide	EA	1	$15.50	$15.50
Centering rings	EA	2	$5.00	$10.00
Coupler	EA	1	$22.00	$22.00
Fins	EA	3	$36.00	$108.00
Aero pack 54mm universal motor retainer	EA	1	$40.00	$40.00
Total cost of sub-scale Launch Vehicle components:				**$357.50**

Part	Unit	Quantity	Unit Cost	Total Cost
Nose cone	EA	1	$100.00	$100.00
Airframe material	EA	2	$150.00	$300.00
Airframe material	EA	2	$150.00	$300.00
Airframe coupler	EA	2	$118.00	$236.00
Aero Pack 75mm universal motor retainer	EA	1	$52.00	$52.00
L-Class Rocket Motor	EA	3	$600.00	$1800.00
Total price of full-scale Launch Vehicle Components:				**$2788.00**

Part	Unit	Quantity	Unit Cost	Total Cost
Arduino Uno	EA	3	$25.17	$75.51
TGY 1270HV Hobbyking Servo	EA	2	$32.50	$65.00
TGY S902 Hobbyking Servo	EA	2	$10.40	$20.80
Total price of AGSE Components:				**$161.31**

Part	Unit	Quantity	Unit Cost	Total Cost
Sugatsune ESR-3313-8 Drawer	EA	4	$10.88	$43.52
miscellaneous				$100.00
Total price of Launch Vehicle payload containment:				**$143.52**

Part	Unit	Quantity	Unit Cost	Total Cost
JB Weld	EA	3	$10.00	$30.00
Resin	EA	1	$60.00	$60.00
Hardener	EA	1	$60.00	$60.00
Carbon Cloth	EA	1	$38.00	$38.00
Carbon Tape	EA	5	$5.00	$25.00
Glass Cloth	EA	10	$4.00	$40.00
Foam Cores	EA	1	$20.00	$20.00
Resin flow mat	EA	5	$4.99	$24.95
Peel ply	EA	10	$5.50	$55.00
Stretchlon	EA	10	$3.10	$31.00
Seal tape	EA	2	$8.00	$16.00
One way vacuum cups	EA	1	$30.00	$30.00
6CFM bagging system	EA	1	$500.00	$500.00

Total price of Construction materials expenses:					**$929.95**
Travel Expense	**Unit**	**Quantity**		**Unit Cost**	**Total Cost**
Flight to Huntsville	Per Person	12		$563	$6756.00
Rental Car	Per Person/seats	2		$500	$1000.00
Meals	Per person	12		$350	$4200.00
Lodging	Rooms for 7 nights/8 days	7	7	$80	$3920.00
Total price of Travel:					**$15876.00**

Total Price of Competition	**$20256.28**

6.4 Funding

Clark Aerospace will be reaching out to the following northwest aerospace related companies and sources:

- INSITU
- Composite One
- Boeing
- SSA
- AACO Avionics
- Aerocenter
- Rapid Prototyping

ASCC (Associated Students of Clark College) one time funding request will also be submitted upon acceptance into the NASA rocketry competition for $15,000.

Current Team Funding	
ASCC one time funding	$15,000
IQ Credit Union donation	$5,000
Total funding Allocated towards Student Launch expenditures at start of competition:	$20,000.00

6.5 Community Support

- Expertise
- Additional equipment and supplies
- Services

Clark Aerospace plans on working with the Clark College newspaper, The Independent, to help publicize its efforts to the student body. Additionally, Clark Aerospace plans to work with local newspaper The Columbian and The Oregon, as well as the Vancouver Business Journal to publicize its effort to individuals and local businesses.

Clark Aerospace has already begun fundraising by contacting the following local aerospace-related companies and organizations, and will continue seeking donations as the year progresses.

- INSITU
- Composites One
- Boeing
- SSA
- AACO Avionics
- Aerocenter
- Washington NASA Space Grant Consortium
- Washington State

6.6 Major Programmatic Challenges and Solutions

Challenge	Solution
Failure to meet team specific critical deadlines	Establish checkpoint deadlines to allow verification of progress
Team Member leaves team	Team management pro-actively coordinated reassignment of duties
Failure to achieve testing and verification due to project complications	Schedule testing and verifications dates that allow secondary dates if needed
Loss of data	Establish multiple backup systems including Google drive, personal storage devices and hard drive files

6.6 Sustainability Plan

The goal of Clark Aerospace is to have a one-hundred percent reusable, except in the case of non-salvageable parts i.e. motors. This goal will also allow future teams to participate in NASA's Student Launch competitions for years to come. This goal also Clark to lower the cost of participation in future years. The current plan for maximizing total launch vehicle recoverability is to increase strength of the launch vehicle components.

The team wishes to expand its presence on campus with a dedicated room and facilities which will allow the growth of Clark Aerospace and potentially showcase Clark College as a significant regional educational institution for aerospace engineering transfer.