Integrated Subsystem Testing Review (ISTR)
March 29, 2020
• Section 1: Mission Concept and Interfaces
• Section 2: Design Overview
• Section 3: Subsystem Testing Status
• Section 4: Integrated Subsystem Testing Status
• Section 5: Plan for FMSR
• Section 6: Project Schedule
• Section 7: Project Management
• Section 8: Conclusion
1.0 Mission Concept and Interfaces

Nathan Clapp
Mission Overview: Mission Statement

• Create a virtual reality camera apparatus and record 360° video of the RockSat-X 2020 sub-orbital flight for NASA’s Education and Outreach program.

• Analyze the acquired 360° footage, post flight, using a machine learning algorithm to identify planetary properties.
Success Criteria

- **Minimum Success Criteria:**
  - Record footage from inside the payload in the event that the boom does not extend.
  - Receive telemetry data to ensure events executed properly.
  - Recovery of virtual reality video.

- **Comprehensive Success Criteria:**
  - Full extension and retraction of arm.
  - Recovery of camera and video.
Mission Overview: ConOps

- Rasp. Pi receives power
- Camera powered
- Video recording begins

- T ≈ 75s
  Altitude: 45 Miles
  **Event A**
  Camera Arm Motor Powered (by GSE)

- T ≈ 300 s
- Camera battery is depleted
- Camera shuts down and recording stops

- T ≈ 330 s
  Power Loss

- T ≈ 36s
  Altitude: 32 Miles
  End of Malemute Burn

- T ≈ 85s
  Altitude: 60 Miles
  **Event B**
  Payload Stops Rotating
  Camera Extends

- T ≈ 270s
  Altitude: 60 Miles
  **Event C**
  Camera Begins Retracting, video is backed up to Pi, recording continues afterwards.

- T ≈ 200s
  Altitude: ≈95 Miles
  Apogee

- T ≈ 3600-5400 s
  Chute Deploys

- T ≈ 450 s

Altitude

Time
Payload Location

Final Positions

Aft  UPR  Exp5Sys2  Exp5Sys1  Exp4Sys2  Exp4Sys1  Exp3  Exp2  Exp1Sys2  Exp1Sys1  Forward
• Our camera will extend from the west end of the payload

Pointing

Extendable Arm To The West

Zenith

FWD/Top

Nadir

West

East

Forward (north)

Aft (south)

East

West

180

0

90

270
### Activation Sequence: CCofCO and WV

<table>
<thead>
<tr>
<th>School</th>
<th>Start (sec only)</th>
<th>Start (min, sec)</th>
<th>Dwell (sec)</th>
<th>End (sec only)</th>
<th>End (min, sec)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE 1</td>
<td>CCofCO</td>
<td>T-300s</td>
<td>T-5min</td>
<td>Flight</td>
<td>Flight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Power to camera, flight computers, and non-motor systems</td>
</tr>
<tr>
<td>GSE 2</td>
<td>WV</td>
<td>T-180s</td>
<td>T-3min</td>
<td>Flight</td>
<td>Flight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Start on the computer for the experiments</td>
</tr>
<tr>
<td>TE-R</td>
<td>CCofCO</td>
<td>T+85s</td>
<td>T+1min, 25s</td>
<td>Flight</td>
<td>Flight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arm extension signal</td>
</tr>
<tr>
<td>TE-1</td>
<td>CCofCO</td>
<td>T+270s</td>
<td>T+4min, 30s</td>
<td>Flight</td>
<td>Flight</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arm retraction signal, also triggers data backup</td>
</tr>
<tr>
<td>TE-2</td>
<td>WV</td>
<td>T+196.1s</td>
<td>T+3min, 20s</td>
<td>118.9s</td>
<td>T+315</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Launch Suborbital Reentry Payload at apogee, WVU antenna deploy</td>
</tr>
<tr>
<td>TE-3</td>
<td>WV</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TBD</td>
</tr>
</tbody>
</table>

GSE 1: CCofCO T-300s T-5min Flight Flight Flight

POWER TO CAMERA, FLIGHT COMPUTERS, AND NON-MOTOR SYSTEMS

GSE 2: WV T-180s T-3min Flight Flight Flight

START ON THE COMPUTER FOR THE EXPERIMENTS

TE-R: CCofCO T+85s T+1min, 25s Flight Flight Flight

ARM EXTENSION SIGNAL

TE-1: CCofCO T+270s T+4min, 30s Flight Flight Flight

ARM RETRACTION SIGNAL, ALSO TRIGGERS DATA BACKUP

TE-2: WV T+196.1s T+3min, 20s 118.9s T+315 T+5min, 15s

LAUNCH SUBORBITAL REENTRY PAYLOAD AT APOGEE, WVU ANTENNA DEPLOY

TE-3: WV TBD TBD TBD TBD TBD
Pin Assignments: Power

- Power Pins are being shared with West Virginia Collaboration team
- Ground pins can be changed if needed
Pin Assignments: Telemetry

<table>
<thead>
<tr>
<th>Telemetry</th>
<th>Function</th>
<th>Intended Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analog 1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Analog 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Analog 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Analog 4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Analog 5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Analog 6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Analog 7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Analog 8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Analog 9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Analog 10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Parallel Bit 1 (MSB)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Parallel Bit 2</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Parallel Bit 3</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Parallel Bit 4</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Parallel Bit 5</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Parallel Bit 6</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>18</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Parallel Bit 7</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Parallel Bit 8</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Parallel Bit 9</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Parallel Bit 10</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Parallel Bit 11</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Parallel Bit 12</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Parallel Bit 13</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Parallel Bit 14</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Parallel Bit 15</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Parallel Bit 16 (LSB)</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Parallel Read Strobe</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>32</td>
<td>RS-232 Data (TP1)</td>
<td>Sensor Data</td>
</tr>
<tr>
<td>33</td>
<td>RS-232 GND (TP2)</td>
<td>Sensor Data</td>
</tr>
<tr>
<td>34</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>35</td>
<td>N/C</td>
<td>N/C</td>
</tr>
<tr>
<td>36</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Ground</td>
<td></td>
</tr>
</tbody>
</table>

- Telemetry pins are being shared with West Virginia Collaboration team
## Updated Power Budget

### VRSE - Power Budget

**Date**: 2/15/2020

<table>
<thead>
<tr>
<th>Wallops Power Line</th>
<th>Subsystem</th>
<th>Voltage (V)</th>
<th>Max Current (A)</th>
<th>Start Time (min)</th>
<th>Time On (min)</th>
<th>Watts</th>
<th>Ah</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSE1/2</td>
<td>Primary Camera Electronics + Sensors + Secondary Camera + Secondary Camera Electronics</td>
<td>5.0</td>
<td>0.20</td>
<td>-5</td>
<td>10.5</td>
<td>1.00</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Motor Hat + Motor</td>
<td>12.0</td>
<td>0.05</td>
<td>1.5</td>
<td>6</td>
<td>0.60</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>TER Signal to Retract Arm and Stop Recording</td>
<td>3.3</td>
<td>0.01</td>
<td>4.91</td>
<td>0.6</td>
<td>0.03</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>GSE 1/2 Total</strong></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>TE1/2/3/R Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.26</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td><strong>Total Power Capacity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Over/Under</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong># of Flights Margin</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24.9</td>
<td></td>
</tr>
</tbody>
</table>
# Detailed Weight Budget

## Total Mass Budget

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Total Mass (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom Arm</td>
<td>1.779</td>
</tr>
<tr>
<td>Primary Camera Housing (6061 Al)</td>
<td>1.011</td>
</tr>
<tr>
<td>Primary Camera Mount</td>
<td>0.116</td>
</tr>
<tr>
<td>Secondary Camera Box</td>
<td>0.310</td>
</tr>
<tr>
<td>Electrical Box</td>
<td>3.454</td>
</tr>
<tr>
<td>Base Plate</td>
<td>3.425</td>
</tr>
<tr>
<td>Primary Camera</td>
<td>0.24</td>
</tr>
<tr>
<td>Spool W/ reel wire</td>
<td>~0.3lb</td>
</tr>
<tr>
<td>Electronics (Including Secondary Camera)</td>
<td>1.307</td>
</tr>
<tr>
<td>Hardware (Screws, O-ring, Nuts, Bearings, etc.)</td>
<td>~1lb</td>
</tr>
<tr>
<td>Sealant</td>
<td>~0.3lb</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13.242</strong></td>
</tr>
<tr>
<td><strong>Over/Under</strong></td>
<td><strong>1.758</strong></td>
</tr>
</tbody>
</table>
2.0 Design Overview

Nathan Clapp
System Changes Since STR: Electrical

Actions assigned during STR

Testing
- Power
- Impact
- Centripetal acceleration
- Vertical acceleration
- Ambient heat tolerance
- Direct heat tolerance
- Heat off-put
- Cold tolerance
- Vibration
- Vacuum

*Due to payload and parts inaccessibility, testing has not yet been completed.

Updates since STR

- Added USB-C boards
  - Pi 4 has USB-C connection
- Removed rectifiers
  - Determined to be unnecessary
- Determined final D-subs
  - GlenAir’s lead time was too long. Will be using Conec D-subs.
- New secondary camera
  - Original camera didn’t work with lens package

Mission Objectives and requirements remain unchanged as a result of these revisions
System Changes Since STR: Programming

Actions assigned during STR

Testing
- Automated video transfer testing
- Camera pin control testing

Updates since STR
- Simulated auto video transfer has been tested

Mission Objectives and requirements remain unchanged as a result of these revisions

*Due to payload and parts inaccessibility, testing has not yet been completed.
Design Overview

Extension is that of 25.005 inches fully extended.
Design Overview
Design Overview
Hazardous Mechanical Items

Materials
- Sealant - Potting Compound
  - Used in d-sub connectors

Mechanical Operations
- Boom Arm Deployment
  - 3 inches in 10 seconds
  - Full extension
    - 18 inches (tested)
    - 25 inches (simulated)

Mechanical Interference
- Boom arm deployment will change the payload’s CG and MOI
Hazardous Electrical Items

- High voltage items/components
  - None

- Operational hazards
  - MadV Camera has Lithium ion battery (non removable)
Special Requests

- Top canister position
  - Request already granted

- TE events’ times to be specified based upon the following flight events
  - TE-R: The time the rocket is fully done with de-spin
  - TE-1: Power loss time, minus 35s (allows time for arm retraction)
NASA at Goddard Space Flight Center and Wallops Flight Facility are sponsoring our 360° camera project. Wallops is providing the unique opportunity to our team through COSGC to enhance the impact of our payload through design review and project funding.
3.0 Subsystem Testing Status

Shannon Walters-Dorchak
Subsystem Testing Status: Arm

**Mechanical**

**Completed testing:**

- On 2/21/2020 first extension with motor and code on 3D printed prototype → the mount broke during the test.
- The newest 3D printed arm components have been tested with the motor and code, but no data was recorded. The new components do move more smoothly both with and without the motor power.

**Incomplete testing:**

- Machined parts
- Extension post vibration test
- Heat test
- Impact test

First motorized extension
2/21/2020
Subsystem Testing Status: Arm

Programming

- Status/success of script to read TE-1 and TE-R pins.
- Arm scripts can successfully move the payload arm at a programmer-defined rate.
- We still need to calibrate the exact number of steps required by the motor for full extension, but this will take place once machined parts have been assembled.

GPIO Test Code

```python
import GPIO

GPIO.setup(out_channel, GPIO.OUT)
GPIO.output(out_channel, GPIO.HIGH)
print("output pin set to high")

if GPIO.event_detected(in_channel):
    print('output!')
```

Head of arm moving function

```python
def full_move(move_cmd, direction=0, running=1):
    kit = MotorKit()
    direction_map = [stepper.BACKWARD, stepper.FORWARD]
    step_count = 100
    status_array = []
    sleep_between_steps = 0.01
```
Electrical

Testing completed:
- Voltage regulator testing
- Motor testing
- Sensor testing
- Power testing (for acquired components)

Needs to be tested:
- Power (for ordered components)
- Ambient Heat Tolerance
- Heat Output
- Ambient Cold Tolerance
- Vertical Acceleration
- Centripetal Acceleration
- Impact
- Vibration
- Vacuum
Mechanical

**Testing completed:**
- Fit test on payload plate (using prototype)

**Needs to be tested:**
- Direct Heat Tolerance
- Direct Cold Tolerance
- Vertical Acceleration
- Centripetal Acceleration
- Impact
- Vibration
- Vacuum
- Waterproofing

*These tests need to be conducted using the machined aluminum, which we do not currently have.*
Subsystem Testing Status: Electrical Housing

Programming

- Telemetry
  - Incomplete
- Sensors
  - Code for sensors we physically have is done - requires calibration.
  - Code for non-present sensors is testable, but can’t yet be tested.
- Main Code
  - Some items have been packaged as libraries and can be imported, and pseudocode is finalized, but written code is incomplete.

```python
# start a mission timer before anything else
initial_time = time.perf_counter()

# basic imports
import board
import busio
import RPI.GPIO

# Motor stuff
from adafruit_motorkit import MotorKit
import Sensors.Distance_Code_vL53L0X as Dist
import Sensors.Temperature_Code_TMP006 as T6
import GPIO_Config.edge_detect_demo as Edge

def dist_create_input():
    i2c = busio.I2C(board.SCL, board.SDA)
    sensor = adafruit_vL53L0X.VL53L0X(i2c)
    return sensor

def dist_print_data(sensor):
    print('Range: {} mm'.format(sensor.range))
```
Mechanical
Completed Testing
Field of View was completed on 3/12/2020
- In 360 mode the view is fairly consistent. The direct view of the rocket is pictured below, as well as the side by side of the base video.
- The current 3D print of the housing prototype is a little loose and has been adjusted in CAD. We will re-run FOV with an adjusted print.

Incomplete testing
- Vibration test
- Vacuum Test
- Heat Resistance test
- Waterproof test
- Impact testing
- Power testing
- Video transfer testing
Subsystem Testing Status: Primary Camera

Programming Tested
  • Automated video transfer tests have been successful in a simulated environment. (Working scripts pictured below)

Needs to be tested
  • Camera control via exposed pins
  • USB data/power toggle
Subsystem Testing Status: Secondary Camera

**Mechanical**

Completed tests (using prototype assembly)
- Component fit test
- Payload fit test

Tests to be completed
- Vibration
- Vacuum
- Ambient heat tolerance
- Direct heat tolerance
- Cold tolerance
- Centripetal acceleration
- Vertical acceleration
- Impact

**Programming**

Completed tests:
- Initial recording test

Tests to be completed
- Long-term operation test (saving multiple videos over a recording session)
4.0 Integrated Subsystem Testing Status

Marieke Spiegleman
Integrated Subsystem Testing Status: Testing
Order

Order for subsystem integration and testing

1. Electrical Box
2. Boom Arm
3. Primary Camera
4. Secondary Camera
Integrated Subsystem Testing Status: Arm

Completed testing:
- Deployment
  - Ensure that arm will properly deploy and retract during the mission. Test showed possible liabilities and showed need for reel in order to help arm retract fully

Incomplete Testing:
- Video recording
  - Ensure arm will be able to deploy and retract with the camera and successfully get footage of the mission.
    - This will be done by connecting camera to electrical box components and running full system testing
- Reel Testing
  - Check that reel is fully capable of retracting arm fully (reel is still going through design process)
    - The reel will be attached to linear actuator and a cable will be run from the end of the arm to the reel making sure that they simultaneously release to assist arm

Testing Schedule:
- Further testing will be done when we receive machined parts/ when we once again have access to our hardware. A tentative schedule is laid out in the management section.
Full Power Testing

Purpose:
This test will demonstrate the functionality of the electrical system for powering the entire payload.

Steps:
- All electrical components, the primary camera, the secondary camera, and the stepper motor will be connected through the d-subs using 28 AWG PTFE wire.
- A power supply will be hooked up to the electrical system and 34 volts of electricity will be applied.

Results:
No results at this time

Test completion:
Due to the worldwide health crisis, the remaining components needed to finish setting up the electrical system have not yet arrived. Additionally, access to the campus workspaces has been temporarily suspended. Further testing will be done when we receive machined parts/ when we once again have access to our hardware. A tentative schedule is laid out in the management section.
Primary camera and housing

Testing Completed
- FOV Analysis
  - Check view that camera would have of rocket other bodies in video. Video properly showed direct view of where rocket would be located
- Arm attachment fit test
  - Testing case properly hooked up to arm attachment. Attachment tolerances need to be changed in order to properly secure camera to arm.

Incomplete testing
- Integrated video transfer test
  - Ensure that video is properly transferred within the case to the electrical box.
    - Subsystem will be run with arm deployment and run mock test of mission
- Power
  - Demonstrate union with electrical hookups
    - Subsystem will be hooked up to electrical housing via D-sub to electrical housing

- Testing would be ideal with machined aluminum parts

Testing Schedule:
- Further testing will be done when we receive machined parts/ when we once again have access to our hardware. A tentative schedule is laid out in the management section.
Integrated Subsystem Testing Status: Secondary Camera

Testing Completed

- Component fit test
  - Checking that dimensions for components were correct. Testing was 90% successful. Tolerance for camera hole had to be changed.

- Plate fit test
  - Testing that secondary camera would fit on payload properly and within restrictions. Camera on payload was too short to get full VOF so camera was made taller.

Incomplete testing

- Power
  - Demonstrate union with electrical hookups
    - Subsystem will be hooked up to electrical housing via micro USB. Power supply will deliver voltage to power-up camera and Pi Zero.

- Code
  - Verify code for camera operation is functional
    - Verify successful code run upon system startup, verify that video clips are saved at regular intervals, and ensure that video data can be read.

Testing Schedule:

- Further testing will be done when we receive machined parts/ when we once again have access to our hardware. A tentative schedule is laid out in the management section.
5.0 Plan for Full Mission Simulation Review (FMSR)

Marieke Spiegleman
Electrical Testing

• Tests still required:
  ○ Full electrical integration testing (pending parts)
    ■ Will perform upon campus opening (April 11th) and part delivery
  ○ Camera electrical control
    ■ Will perform upon campus opening (April 11th)
• No high voltage components
• Main VR camera is powered by a lithium ion battery (non removable)
  ○ Camera [battery] has been tested in STP conditions
  ○ Camera [battery] will be tested in vacuum chamber at close-to-zero PSI
• We will need electrical inhibits for arm extension and camera recording

• Further testing will be done when we receive machined parts/ when we once again have access to our hardware. A tentative schedule is laid out in the management section.
Mechanical Testing

Verification testing to be performed
- Structural: impact, vibration, waterproofing
- Vacuum
- Acceleration: centripetal and vertical
- Temperature Tolerance: ambient heat, direct heat, and cold

Deployment test plan
- Mock Testing plan - Plan is to simulate mission and test all aspects of the payload
  - Vibrations testing of payload as a whole will be done before to simulate vibration of the rocket
  - After vibration testing is done arm will be deployed
  - Camera will start recording and run for the same estimated time the real mission will go on for
  - Arm will retract
  - Testing will be analyzed afterwards for any contingencies
- Testing deployment would be beneficial with aluminum parts but due to circumstances testing will have to be done using 100% infill 3D-Printed prototypes

Mechanical Inhibits
- Having aluminium manufactured parts is needed for Wallops testing

Testing Schedule
Further testing will be done when we receive machined parts/ when we once again have access to our hardware. A tentative schedule is laid out in the management section.
Software Testing

Testing still required:
- Controlling main camera through its exposed pins.
- Telemetry.
- Additional/ more through sensor testing
- Secondary camera recording

Code needed:
- Code for controlling the main camera via its pins.
- Code is needed for telemetry.
- Secondary camera recording code

Testing Schedule:
- Further testing will be done when we receive machined parts/ when we once again have access to our hardware. A tentative schedule is laid out in the management section.

Inhibits:
- We will inhibit arm extension and camera recording during integration testing
System Level Testing

Tests to conduct
- Vacuum
- Acceleration: centripetal and vertical
- Temperature Tolerances: Ambient heat, Direct heat, and Cold
- Structural: Waterproofing, Vibration, and Impact
- Software: Pi 3B+ load test, Arm extension rate calibration, Arm code test (with TE line signals to GPIO), Sensor calibration testing
- Electrical: Power and Connections
- Mission Simulations

Testing schedule:
- Further testing can hopefully be conducted starting 4/12/2020 depending on the lifting of the stay in place orders, as well as campus closures.
Further testing can hopefully be conducted starting 4/12/2020 depending on the lifting of the stay in place orders, as well as campus closures. We hope to be able to get as much testing completed as possible before the FMSR date.

• What are the major hurdles going to be?
  ○ The biggest hurdle is going to be whether or not we can begin testing immediately after the current stay in place order expires. The hope is the order will be lifted as scheduled, and as many of us who can will be able to continue the testing process on the payload.
  ○ We are also waiting for our machined parts from Wallops, they are also operating with a skeleton staff, and a lot of our testing weighs heavily on machined parts.
6.0 Project Schedule

Shannon Walters-Dorchak
• The schedules for April, May and June are dependent on when the current stay in place order is lifted. Our current schedules are mapped out in the management section, by weeks without specific dates until we get further information about the stay in place order.
June Operations

- RS-X GSE:
  - For this test we will operate the payload normally, allowing the arm to extend and camera to record

- Sequence Testing:
  - For this test we will operate the payload normally, allowing the arm to extend and camera to record

- Wallops RFI testing:
  - For this test we will operate the payload normally, allowing the arm to extend and camera to record

- Vibration Testing:
  - For this test we will operate the payload with electrical inhibits, by switching our locking toggle switch we will turn off our arm, making sure that the arm is not electrically active during testing unless required

- Post Vibration Sequence Testing:
  - For this test we will operate the payload normally, allowing the arm to extend and camera to record
June Operations

- Aspects available for testing:
  - Arm
  - Camera system
    - Recording
    - timing
  - Sensor
  - Telemetry
  - Footage Transfer
- Aspects unavailable for testing:
  - None
- All features of our payload can be tested on the ground
  - None of our payload requires vacuum conditions to function.
7.0 Project Management

Shannon Walters-Dorchak
Payload Special Operations/Inhibits

- During some testing we will need to inhibit the extension of the arm, and the recording of footage on the cameras
  - Spin testing, shake testing, and moment of inertia are the tests that we will need to inhibit
  - We will be using locking toggle switches to turn on and off that functionality with our payload for easier testing in Wallops
## User Guide Compliance: Summary

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center of gravity in 1&quot; plane of plate?</td>
<td>1.527&quot; currently above plate (Will need to Ballast)</td>
</tr>
<tr>
<td>Weight 30.0+/− 1.0 (15.0 +/− 0.5) lbs?</td>
<td>13.242</td>
</tr>
<tr>
<td>Max Height &lt; 10.75” (5.13”)</td>
<td>5.051</td>
</tr>
<tr>
<td>Bottom of deck has flush mount hardware?</td>
<td>YES</td>
</tr>
<tr>
<td>Within Keep-Out Zone</td>
<td>YES</td>
</tr>
<tr>
<td>Using &lt; 10 A/D Lines</td>
<td>N/A</td>
</tr>
<tr>
<td>Using/Understand Parallel Line</td>
<td>N/A</td>
</tr>
<tr>
<td>Using/Understand Asynchronous Line</td>
<td>YES, at 19200 Baud</td>
</tr>
<tr>
<td>Using X GSE Line(s)</td>
<td>YES, GSE-1</td>
</tr>
<tr>
<td>Using X Non-Redundant PWR Lines (TE-1, TE-2, TE-3)</td>
<td>YES, TE-1</td>
</tr>
<tr>
<td>Using X Redundant Power Lines (TE-R)</td>
<td>YES, TE-RA</td>
</tr>
<tr>
<td>Using &lt; 1 Ah (&lt; 0.5 Ah for half payload)</td>
<td>0.04 Ah</td>
</tr>
<tr>
<td>Using &lt;= 28 V</td>
<td>Yes (Max Voltage is 12V)</td>
</tr>
<tr>
<td>Using RF (If yes, list frequency and TX Power)</td>
<td>No</td>
</tr>
<tr>
<td>Using deployable?</td>
<td>YES, but speed is under 1 inch per second</td>
</tr>
<tr>
<td>Whole team consists of US Persons</td>
<td>YES</td>
</tr>
<tr>
<td>Using ITAR and/or Export Controlled hardware</td>
<td>NO</td>
</tr>
</tbody>
</table>
Team Picture

Nathan Clapp, Spencer Madison, Marieke Spiegleman, Onterrio Morris, Cid Quezada, Sina Liufau, Segev Morgan, Tiffany Lovett, Mac Grove, Shannon Walters-Dorchak, Barb Sobhani, Caleb Christenson, Not Pictured: Jennifer Jones
Team Structure

Arm
- Cid
- Caleb
- Sina
- Nathan
- Mac

Camera: Primary
- Shannon
- Nathan
- Sina
- Mac
- Cid

Camera: Secondary
- Cid
- Mac
- Nathan
- Caleb

Electrical Housing
- Sina
- Mac
- Nathan
- Caleb
- Marieke
- Tiffany

PR & Admin
- Spencer (Project Manager)
- Marieke (Assistant Management)
- Caleb (Electrical Lead)
- Sina (Mechanical Lead)
- Nathan (Programming Lead)
- Shannon (PR and Fundraising)

Advisors
- Jennifer Jones
- Barbra Sobhani
Schedule: Main

March 2020
3/29 ISTR Integrated Subsystem Testing Review (ISTR)

April 2020
4/12 Full Integration Testing
4/17 Full Mission Simulation

May 2020
5/3 Full Mission Simulation Review (FMSR)

June 2020
6/1 Integration Readiness Review (IRR)
6/21-6/27 Wallops

July 2020
7/20 Before Flight Procedure Due
7/27 Launch Readiness Review (LRR)
7/30 Prepare Electronics for Travel to Wallops

August 2020
8/2-8/12 Wallops: Launch!
8/15 Analysis of Electronics for final report

September 2020
9/11 Rough Draft Report Due
9/30 Final Report Due
Schedule: Mechanical

**Week 1: Subsystem Testing (Arm and Electrical Housing)**
- Arm
- Electrical housing:
  - Temperature tolerance: direct heat and direct cold
  - Acceleration: centripetal and vertical
  - Structural: impact, vibration, and waterproofing
  - Vacuum

**Week 2: Subsystem Testing (Primary and Secondary Cameras)**
- Primary Camera
  - Updated FOV (with prototype housing)
  - Lens covers
- Secondary Camera
  - Temperature tolerance: ambient heat, direct heat, cold
  - Vacuum
  - Acceleration: centripetal and vertical
  - Structural: impact, vibration

**Week 3: Integrated Subsystem Testing**
- Arm
  - Camera deployment
  - Reel

**Week 4: Plan for FMSR Mechanical Testing**
- Vacuum
- Acceleration: centripetal and vertical
- Temperature tolerance: ambient heat, direct heat, and cold
- Structural: deployment, impact, vibration, and waterproofing

**Week 5: System Level Testing**
- Vacuum
- Acceleration: centripetal and vertical
- Temperature Tolerances: Ambient heat, Direct heat, and Cold
- Structural: Waterproofing, Vibration, and Impact
- Software: Pi 3B+ load, arm extension rate calibration, arm code (with TE line signals to GPIO), sensor calibration
- Electrical: Power and Connections
- Mission Simulations
Schedule: Electrical

Week 1: Subsystem Testing
- Electrical Housing
  - Power (for ordered components)
  - Temperature tolerance: Ambient cold, ambient heat and heat output
  - Acceleration: centripetal and vertical
  - Connections: vibration and impact
  - Vacuum

Week 2: Integrated Subsystem Testing
- Electrical System
  - Full power testing

Week 3: Integrated Subsystem Testing (con’t)
- Primary Camera
  - Power
- Secondary Camera
  - Power

Week 4: Plan for FMSR Electrical Testing
- Full electrical integration
- Camera electrical control

Week 5: System Level Testing
- Vacuum
- Acceleration: centripetal and vertical
- Temperature Tolerances: Ambient heat, Direct heat, and Cold
- Structural: Waterproofing, Vibration, and Impact
- Software: Pi 3B+ load, arm extension rate calibration, arm code (with TE line signals to GPIO), sensor calibration
- Electrical: Power and Connections
- Mission Simulations
Week 1: Subsystem Testing
- Arm
  - Motor extension calibration (dependent upon machined parts)
- Electrical Housing
  - Telemetry
  - Sensor code (for ordered components)

Week 2: Subsystem Testing
- Primary Camera
- Secondary Camera
  - Long-term operation test (saving multiple videos over a recording session)

Week 3: Integrated Subsystem Testing
- Primary Camera
  - Integrated video
- Secondary Camera
  - Code

Week 4: Plan for FMSR Software Testing
- Arm extension timing

Week 5: System Level Testing
- Vacuum
- Acceleration: centripetal and vertical
- Temperature Tolerances: Ambient heat, Direct heat, and Cold
- Structural: Waterproofing, Vibration, and Impact
- Software: Pi 3B+ load, arm extension rate calibration, arm code (with TE line signals to GPIO), sensor calibration
- Electrical: Power and Connections
- Mission Simulations
Budget: Overview

- Labor $46,500
- Travel Matrix: $28,700
  - June: $9,540
  - August: $11,960
  - Fundraising needed: $5,520
- Hardware: $1,521.63*
  - Boom Arm: $294.31
  - Primary Camera/Camera Housing: $570.67
  - Secondary Camera/Camera Housing: $156.54
  - Electrical Box: $500.11
- Launch Fee $14,000
- Overall Total: $95,371.63 *

* Does not include machined components. Waiting on quote.
Budget: Labor

- COSGC standard wage: $15.00/hr
  - Value provided by Chris Koehler of COSGC
- Expected time investment: 10hr/wk
  - Based on project length average
- Anticipated length of project: 31 wk/student
  - Timeline begins at project down select [Jan 8, 2020]
  - Timeline ends at project launch [Aug 11, 2020]
- Number of paid workers: 10 students

Total projected labor cost of project: $46,500
## Budget: Travel Matrix

<table>
<thead>
<tr>
<th>Trip</th>
<th>People</th>
<th>Days</th>
<th>Airfare ($600)</th>
<th>Per Diem ($40)</th>
<th>Lodging ($25/night)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>June (NASA)</td>
<td>6 Students</td>
<td>8</td>
<td>$3600</td>
<td>$1920</td>
<td>$1200</td>
<td>$6720</td>
</tr>
<tr>
<td>August (NASA)</td>
<td>6 Students</td>
<td>12</td>
<td>$3600</td>
<td>$2880</td>
<td>$1800</td>
<td>$8280</td>
</tr>
<tr>
<td>August (Fundraising)</td>
<td>4 Students</td>
<td>12</td>
<td>$2400</td>
<td>$1920</td>
<td>$1200</td>
<td>$5520</td>
</tr>
<tr>
<td>Advisors</td>
<td>People</td>
<td>Days</td>
<td>Airfare ($600)</td>
<td>Per Diem ($40)</td>
<td>Lodging ($50/night)</td>
<td>Total</td>
</tr>
<tr>
<td>June (NASA)</td>
<td>1 Advisor</td>
<td>8</td>
<td>$600</td>
<td>$320</td>
<td>$400</td>
<td>$1320</td>
</tr>
<tr>
<td>August (NASA)</td>
<td>1 Advisor</td>
<td>12</td>
<td>$600</td>
<td>$480</td>
<td>$600</td>
<td>$1680</td>
</tr>
<tr>
<td>Estimated Van Cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June: $1500</td>
<td>August: $2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Current total:**

$27,020
## Budget: Electrical Housing

<table>
<thead>
<tr>
<th>NAME</th>
<th>QTY</th>
<th>PRICE</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum 6061-T651</td>
<td>1 sheet</td>
<td>$11.94</td>
<td>$11.94</td>
</tr>
<tr>
<td>9 Point D Sub Connector Plug</td>
<td>2</td>
<td>$19.42</td>
<td>$38.84</td>
</tr>
<tr>
<td>9 Point D Sub Connector Connector</td>
<td>2</td>
<td>$20.56</td>
<td>$41.12</td>
</tr>
<tr>
<td>25 Point D Sub Connector Plug</td>
<td>1</td>
<td>$23.03</td>
<td>$23.03</td>
</tr>
<tr>
<td>25 Point D Sub Connector Connector</td>
<td>1</td>
<td>$23.35</td>
<td>$23.35</td>
</tr>
<tr>
<td>O-ring Cord Stock (X-profile, 3/32 fractional width)</td>
<td>3 ft</td>
<td>$2.64</td>
<td>$7.92</td>
</tr>
<tr>
<td>Transceiver Breakout Board</td>
<td>1</td>
<td>$5.95</td>
<td>$5.95</td>
</tr>
<tr>
<td>Raspberry Pi DC Motor Hat</td>
<td>1</td>
<td>$21.11</td>
<td>$21.11</td>
</tr>
<tr>
<td>Raspberry Pi 3 B+</td>
<td>1</td>
<td>$51.99</td>
<td>$51.99</td>
</tr>
<tr>
<td>Raspberry Pi 4 B</td>
<td>1</td>
<td>$61.98</td>
<td>$61.98</td>
</tr>
<tr>
<td>Accelerometer</td>
<td>1</td>
<td>$26.10</td>
<td>$26.10</td>
</tr>
<tr>
<td>Temperature Sensor (IR)</td>
<td>1</td>
<td>$9.95</td>
<td>$9.95</td>
</tr>
<tr>
<td>Distance Sensor</td>
<td>2</td>
<td>$14.95</td>
<td>$29.90</td>
</tr>
<tr>
<td>Micro USB Breakout Board (male connector)</td>
<td>2</td>
<td>$4.25</td>
<td>$8.50</td>
</tr>
<tr>
<td>Voltage Regulator</td>
<td>1 pkg</td>
<td>$11.55</td>
<td>$11.55</td>
</tr>
<tr>
<td>28 AWG PTFE Wire</td>
<td>1 box</td>
<td>$45.65</td>
<td>$45.65</td>
</tr>
<tr>
<td>Potting Sealant</td>
<td>2 tubes</td>
<td>$14.22</td>
<td>$28.44</td>
</tr>
<tr>
<td>1-72 x ¼” Screws</td>
<td>1 pkg</td>
<td>$6.82</td>
<td>$6.82</td>
</tr>
<tr>
<td>4-40 x ¾” Hex Drive Flat Head Screw</td>
<td>6</td>
<td>$3.21</td>
<td>$19.26</td>
</tr>
<tr>
<td>4-40 Flex-Top Locknut</td>
<td>2 pkg</td>
<td>$7.40</td>
<td>$14.80</td>
</tr>
<tr>
<td>RS2323 Transceiver Break-Out Board</td>
<td>1</td>
<td>$11.90</td>
<td>$11.90</td>
</tr>
</tbody>
</table>

Total: $500.11
<table>
<thead>
<tr>
<th>NAME</th>
<th>QTY</th>
<th>PRICE</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum 6061-T651</td>
<td>1 sheet</td>
<td>$11.94</td>
<td>$11.94</td>
</tr>
<tr>
<td>Aluminum Rod</td>
<td>1</td>
<td>$3.70</td>
<td>$3.70</td>
</tr>
<tr>
<td>28 AWG PTFE Wire</td>
<td>1 pkg</td>
<td>$45.65</td>
<td>$45.65</td>
</tr>
<tr>
<td>Braided Fiberglass Wire Sleeving</td>
<td>1 pkg</td>
<td>$45.00</td>
<td>$45.00</td>
</tr>
<tr>
<td>Heat Shrink: PTFE 2-1</td>
<td>2</td>
<td>$37.00</td>
<td>$74.00</td>
</tr>
<tr>
<td>Panel Mount Sleeve Bearing</td>
<td>1</td>
<td>$4.51</td>
<td>$4.51</td>
</tr>
<tr>
<td>Oil Embedded Mounted Sleeve Bearing</td>
<td>1</td>
<td>$9.73</td>
<td>$9.73</td>
</tr>
<tr>
<td>Power Toggle Switch - Motor</td>
<td>3</td>
<td>$7.25</td>
<td>$21.75</td>
</tr>
<tr>
<td>#8 Aluminum Washer</td>
<td>1 pkg</td>
<td>$0.046</td>
<td>$4.60</td>
</tr>
<tr>
<td>8-32 Flex-top Locknut</td>
<td>15</td>
<td>$1.748</td>
<td>$26.22</td>
</tr>
<tr>
<td>8-32 x 1-¾” Button Head Hex Drive Screw</td>
<td>2 pkgs</td>
<td>$8.65</td>
<td>$17.30</td>
</tr>
<tr>
<td>8-32 x 2-¼” Button Head Hex Drive Screw</td>
<td>1 pkg</td>
<td>$11.48</td>
<td>$11.48</td>
</tr>
<tr>
<td>¼”-28 x ¾” Hex Drive Flat Head Screw</td>
<td>1 pkg</td>
<td>$5.87</td>
<td>$5.87</td>
</tr>
<tr>
<td>¼”-28 Flex-Top Locknut</td>
<td>1 pkg</td>
<td>$12.56</td>
<td>$12.56</td>
</tr>
</tbody>
</table>

Total: $ 294.31
# Budget: Primary Camera/Housing

<table>
<thead>
<tr>
<th>NAME</th>
<th>QTY</th>
<th>PRICE</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MadV Camera</td>
<td>1</td>
<td>$299.99</td>
<td>$299.99</td>
</tr>
<tr>
<td>128GB Micro SD Card</td>
<td>1</td>
<td>$19.99</td>
<td>$19.99</td>
</tr>
<tr>
<td>28 AWG PTFE Wire</td>
<td>1 pkg</td>
<td>$45.65</td>
<td>$45.65</td>
</tr>
<tr>
<td>O-Ring Cord Stock (X-profile, 1/16 fractional width)</td>
<td>3 ft</td>
<td>$7.92</td>
<td>$7.92</td>
</tr>
<tr>
<td>Gasket Material</td>
<td>1</td>
<td>$7.95</td>
<td>$7.95</td>
</tr>
<tr>
<td>Phillips Screw: Passivated 18-8 Stainless Steel Pan Head (0-80 Thread, 5/16” Long)</td>
<td>1 pkg</td>
<td>$7.69</td>
<td>$7.69</td>
</tr>
<tr>
<td>Phillips Screw: Narrow Fillister Head (High-Profile, 2-56 Thread, ½” Long)</td>
<td>1 pkg</td>
<td>$4.13</td>
<td>$4.13</td>
</tr>
<tr>
<td>Locknut: Steel Flex-Top (Cadmium-Plated, 2-56 Thread, ¼” wide, 5/32” high) [for vibration]</td>
<td>1 pkg</td>
<td>$5.34</td>
<td>$5.34</td>
</tr>
<tr>
<td>Locknut: Mil. Spec. Distorted-Thread Flange (Low-Strength Steel, 2-56 Thread, MS-21042-02)</td>
<td>1 pkg</td>
<td>$12.23</td>
<td>$12.23</td>
</tr>
<tr>
<td>Analog to Digital Converter (10-bit) MCP3002</td>
<td>1</td>
<td>$2.30</td>
<td>$2.30</td>
</tr>
<tr>
<td>Analog Temperature Sensor</td>
<td>1</td>
<td>$1.50</td>
<td>$1.50</td>
</tr>
<tr>
<td>9 Point D Sub Connector Plug</td>
<td>1</td>
<td>$19.42</td>
<td>$19.42</td>
</tr>
<tr>
<td>9 Point D Sub Connector Socket</td>
<td>1</td>
<td>$20.56</td>
<td>$20.56</td>
</tr>
<tr>
<td>Aluminum 7075-T651</td>
<td>1 sheet</td>
<td>$64.92</td>
<td>$64.92</td>
</tr>
<tr>
<td>Quartz Glass</td>
<td>2</td>
<td>$12.68</td>
<td>$25.36</td>
</tr>
<tr>
<td>Potting Sealant</td>
<td>1</td>
<td>$14.22</td>
<td>$14.22</td>
</tr>
<tr>
<td>Power Toggle Switch - Camera</td>
<td>1</td>
<td>$7.25</td>
<td>$7.25</td>
</tr>
<tr>
<td>Micro USB Breakout Board (male connector)</td>
<td>1</td>
<td>$4.25</td>
<td>$4.25</td>
</tr>
</tbody>
</table>

Total: $570.67
## Budget: Secondary Camera/Housing

<table>
<thead>
<tr>
<th>NAME</th>
<th>QTY</th>
<th>PRICE</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raspberry Pi Camera</td>
<td>2</td>
<td>$25.25</td>
<td>$50.50</td>
</tr>
<tr>
<td>Raspberry Pi Zero W</td>
<td>1</td>
<td>$5.00</td>
<td>$5.00</td>
</tr>
<tr>
<td>Raspberry Pi Camera Lens</td>
<td>1 pkg</td>
<td>$89.99</td>
<td>$89.99</td>
</tr>
<tr>
<td>Ribbon Cable</td>
<td>1</td>
<td>$6.80</td>
<td>$6.80</td>
</tr>
<tr>
<td>Micro USB Breakout Board (male connector)</td>
<td>1</td>
<td>$4.25</td>
<td>$4.25</td>
</tr>
</tbody>
</table>

**Total:** $156.54
## VRSE: Arapahoe Community College, Red Rocks Community College
### Spring 2020 RS-X Contact Matrix

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Day Phone</th>
<th>Cell Phone</th>
<th>Receive Texts?</th>
<th>Email</th>
<th>Citizenship</th>
<th>Add to mailing list?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics Team Lead</td>
<td>Caleb Christenson</td>
<td>303-815-9714</td>
<td>303-815-9714</td>
<td>Yes</td>
<td><a href="mailto:cchristenson2@student.cccs.edu">cchristenson2@student.cccs.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Electronics/Management</td>
<td>Marieke Spiegleman</td>
<td>303-913-9155</td>
<td>303-913-9155</td>
<td>Yes</td>
<td><a href="mailto:marieke.spiegleman@gmail.com">marieke.spiegleman@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Software Team Lead</td>
<td>Nathan Clapp</td>
<td>303-263-0845</td>
<td>303-263-0845</td>
<td>Yes</td>
<td><a href="mailto:gnathanq20@gmail.com">gnathanq20@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Programming</td>
<td>Tiffany Lovett</td>
<td>913-709-4265</td>
<td>913-709-4265</td>
<td>Yes</td>
<td><a href="mailto:tlovettt6@student.cccs.edu">tlovettt6@student.cccs.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Mechanical Team Lead</td>
<td>Sina Liufau</td>
<td>714-402-7967</td>
<td>714-402-7967</td>
<td>Yes</td>
<td><a href="mailto:flufau@student.cccs.edu">flufau@student.cccs.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Advisor</td>
<td>Jennifer Jones</td>
<td>303-797-5839</td>
<td>720-985-5806</td>
<td>Yes</td>
<td><a href="mailto:jennifer.jones@arapahoe.edu">jennifer.jones@arapahoe.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Mechanical Team Lead</td>
<td>Cid Quezada</td>
<td>720-288-9305</td>
<td>720-288-9305</td>
<td>Yes</td>
<td><a href="mailto:Cide.quezada@outlook.com">Cide.quezada@outlook.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Mechanical/PR</td>
<td>Shannon Walters-Dorchak</td>
<td>720-233-0753</td>
<td>720-233-0753</td>
<td>Yes</td>
<td><a href="mailto:shannon.kathleen96@gmail.com">shannon.kathleen96@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Team Manager</td>
<td>Spencer Madison</td>
<td>970-208-6990</td>
<td>970-208-6990</td>
<td>Yes</td>
<td><a href="mailto:spencermadison@gmail.com">spencermadison@gmail.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Software</td>
<td>Mac Grove</td>
<td>303-903-3008</td>
<td>303-903-3008</td>
<td>Yes</td>
<td><a href="mailto:sta7chase7@icloud.com">sta7chase7@icloud.com</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
<tr>
<td>Advisor</td>
<td>Barbra Sobhani</td>
<td>303-914-6366</td>
<td>303-905-4716</td>
<td>Yes</td>
<td><a href="mailto:Barbra.Sobhani@mcc.edu">Barbra.Sobhani@mcc.edu</a></td>
<td>U.S.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Updated Availability Matrix

<table>
<thead>
<tr>
<th>Name: Master Availability Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time</strong></td>
</tr>
<tr>
<td>7:00 AM</td>
</tr>
<tr>
<td>8:00 AM</td>
</tr>
<tr>
<td>9:00 AM</td>
</tr>
<tr>
<td>10:00 AM</td>
</tr>
<tr>
<td>11:00 AM</td>
</tr>
<tr>
<td>12:00 PM</td>
</tr>
<tr>
<td>1:00 PM</td>
</tr>
<tr>
<td>2:00 PM</td>
</tr>
<tr>
<td>3:00 PM</td>
</tr>
<tr>
<td>4:00 PM</td>
</tr>
<tr>
<td>5:00 PM</td>
</tr>
<tr>
<td>6:00 PM</td>
</tr>
<tr>
<td>7:00 PM</td>
</tr>
<tr>
<td>8:00 PM</td>
</tr>
<tr>
<td>9:00 PM</td>
</tr>
<tr>
<td>10:00 PM</td>
</tr>
</tbody>
</table>
8.0 Conclusions

Marieke Spiegleman
Worries and Concerns

Concerns

• Availability for machined parts to be manufactured (due to COVID-19)
• Accessibility of payload and parts with campuses closed
• With classes going online many of us will have to put more time into classes and less time into RockSat

Mitigation:

• We plan to explore all manufacturing options, including the use of a third party outside of Wallops (if possible)
Questions:
• Any update on launch pushback / Wallops testing due to COVID-19