Oregon Tech: TAP-B

The primary mission is to design a complex, multi-experiment payload emulating (downscaled) the methodology of a satellite or other space vehicle. Mission success will be defined as such that all systems and modular payloads function and collect data.

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Oregon Tech

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1.0 Mission Statement, Requirements, and Expected Results

- Design and construct a multi-experiment payload emulating the methodology of a satellite.

- Enable modules to have a “plug and play” type functionality with the canister.

- All data must be stored and if any one experiment fails all others should still receive power and store data.

2.0 Final Payload Design

**Layout:**
Each Plate is numbered 1 through 4, with 1 being the bottom plate. The first plate host 2 batteries and two modular bays (DMS, EDL). The second plate host 3 modular pays (REH, MEH, Video Camera) and brass plates for ballast. The third plate host the FOG and lead ballast. The fourth plate host the RSE and lead ballast. The central shaft supports collars and plates, houses wiring, and a cylindrical lead ballast.

**Isometric views outside of canister:**
Top view outside of canister:
Side views outside of canister:
Isometric view in canister:
Window views inside canister:
**Ballast:**

**Final mass budget** - Payload weighs approximately 17 lbs in canister with 3 lbs added for ballast.

Cylindrical lead weight through central column. Fastened to center of bulkhead on both sides. Weighs approximately 2 lbs.

Brass Plates (bottom of image) across from Rocket Energy Harvester on second plate. Attached with fasteners to heat sets. Weighs approximately 0.75 lbs.

Small lead weights (2 at top of image) were added where needed throughout the payload. Attached with adhesive. Weighs approximately 0.25 lbs.

**Central shaft:**
Central Shaft holds lead ballast and supports collars holding each plate with.

**Batteries:**

Batteries located on first plate.

**CAD:**

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Polycarbonate plates

Collars
Data Management System (DMS):

Raspberry Pi Zero-W: Microcontroller used to collect data from REH, MEH, EDL, and RSE.

Power Regulator: PCB used to regulate power to 5v

Data Bus: 4 USB cables (5v line disconnected)

SD storage: 32 GB Sandisk to store data

Changes from FMSR: None

5V Power Regulator:
EDL, MEH, RES, DMS, and VCS use this simple 5 volt regulator. The regulator is based based on the NCP1117 regulator and outputs a clean 5V and is capable of more than 500mA.
Rocket Energy Harvester (REH):
**Microcontrollers:** ATmega2560, ATmega16u2  
**RTC:** Adafruit DS1307  
**Gyroscope:** L3GD20H Gyroscope  
**SD Card Reader:** Adafruit MicroSD card breakout board  
**Accelerometer:** ADXL377  
**Databus:** USB with power disconnected and Tx and Rx lines connected to DMS  
**SD Storage:** 32GB Sandisk to store data  
**Changes from FMSR:** Slight modifications to the mechanical structures (gravitational) and vibration harvester), Protective zener diodes placed across the storage capacitors to limit stored charge.
Environmental Data Logger (EDL):
**Microcontrollers:** Arduino Nano
**SD Card Reader:** Adafruit MicroSD card breakout board
**Environmental sensor:** Adafruit BMP280
**Databus:** USB with power disconnected and Tx and Rx lines connected to DMS
**SD Storage:** 16GB Sandisk to store data
**Changes from FMSR:** None.
Fiber Optic Gyroscope (FOG):
Microcontrollers: Atmega328
SD Card Reader: Adafruit MicroSD card breakout board
Laser Diode: Philips 1312.8nm 5mW DFB Butterfly laser diode
Photodiode: JDSU ETX 75
Fiber: SMF 28
Reference Gyroscope: LY3200ALH
Changes from FMSR: None.
MESA Energy Harvester (MEH):
Microcontrollers: Arduino Nano
Power Supply: 5V Power Regulator (Team Designed)
SD Card Reader: Adafruit MicroSD card breakout board
Harvester: LTC3588 Energy Harvester
Databus: USB with power disconnected and Tx and Rx lines connected to DMS
SD Storage: 16GB Sandisk to store data
Changes from FMSR: None.
Radiation Shielding Experiment (RSE):

**Microcontroller:** Arduino Micro

**Power Regulator:** Designed PCB is used to regulate power to 5V for each geiger tube circuits and 9V from the power supply to power the RockOn Geiger Counter.

**Databus:** USB with power disconnected and Tx and Rx lines connected to DMS

**SD Storage:** 8GB Sandisk to store data

**Changes from FMSR:** None
3.0 Testing Results

A. Integrated Subsystem Testing Results

DMS - Testing:

Successful Tests:
- Data Transfer with 5 modules for full flight time
- Real time reconnection functionality
- .txt and .csv file writing capability
- T-3:00 functionality
REH - Testing:
Example of collected data:

- Items are columnised for MATLAB analysis at a later date.

RSE - Testing:

Successful Tests:

- Created three different shielding materials for Geiger Tubes with one unshielded.
- All Geiger Tubes reported radiation hits with varying frequencies seen from an oscilloscope.
- Individual circuits for each geiger tube is powered through the 5V regulator and outputting data to serial and the SD card.
FOG:

Fiber optic gyroscope characterized and working correctly. Has been spun up to -9.8 and 9.8Hz and was integrated during the shake test. Has been powered for multiple tests, one lasting for 50 minutes.

B. Full Mission Simulation Results
May 30 2018: Shake Test
Payload fully integrated except for DMS, payload fully powered. Tested with sine over random for vehicle level one in the thrust axis. All systems survived test except for one mosfet that was not correctly staked down, which has been replaced and staked down.
### 4.0 Launch Readiness

#### A. User Guide Compliance

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center of gravity in 1&quot; mid-can?</td>
<td>Yes</td>
</tr>
<tr>
<td>Contained in can</td>
<td>Yes</td>
</tr>
<tr>
<td>Connected to can by 4/5 bulkheads on top and bottom only</td>
<td>Yes, 4 bolts on top and bottom, center pipe physically rests against center mounting point.</td>
</tr>
<tr>
<td>Mass at 20±0.2lbs</td>
<td>19.91 lbs</td>
</tr>
<tr>
<td>Shared canister clearance</td>
<td>Not Sharing</td>
</tr>
<tr>
<td>No voltage on the can</td>
<td>No Voltage</td>
</tr>
<tr>
<td>No voltage on multipurpose port</td>
<td>Not using</td>
</tr>
<tr>
<td>Activation wires at least 4 ft</td>
<td>4 feet from wireway</td>
</tr>
<tr>
<td>Activation wire at least 24 gauge</td>
<td>22 gauge</td>
</tr>
<tr>
<td>Early Activation: current &lt; 1 A</td>
<td>200mA (Raspberry Pi)</td>
</tr>
<tr>
<td>1.SYS.2 Activation: current &lt; .1 A</td>
<td>0.028A. 0A with removal of arm LED</td>
</tr>
<tr>
<td>Battery Type</td>
<td>Lithium ion (will not charge at Wallops)</td>
</tr>
<tr>
<td>Liquids</td>
<td>No Liquids</td>
</tr>
<tr>
<td>High Voltage</td>
<td>350V GM tube, low current supply</td>
</tr>
<tr>
<td>Laser</td>
<td>Laser Paperwork completed</td>
</tr>
</tbody>
</table>

#### B. Integration Plan and Procedure

1. Verify the LiPo Batteries are fully charged (3.7-4.2V)
2. Verify the LiPo batteries are delivering power to the power board (measure at the power board)
3. Verify each Payload has there respective SD cards installed.
4. Install 5 screws to affix the bottom plate to the canister base plate.
5. As the layers are assembled verify each Power supply line is connected to the central power line.
6. Verify the REH, MEH, EDL, and RSE USB cables are connected as the layers are installed
7. Verify each layer has all four(4) spacers fastened as the layers are added.
8. Verify each layer is attached the the central column with two (2) screws.
9. Attach canister skin to the canister base plate using eight (8) screws.
10. Attach canister top plate using five (5) screws through the top and eight (8) screws through the side.

#### C. Action Items

- Assembly Procedure to be completed by Wednesday the 6th.
- Final Full Mission Simulation to be sent in by Saturday the 9th.
5.0 Conclusions

After Thursday June 7th, we will be ready to launch our payload at Wallops. For our remaining action items we need to create an assembly procedure and full system simulation. The assembly procedure will include checks for critical points of failure to avoid mistakes such as last year's team having disconnected batteries. The full system simulation will be ran again due to changes with the Rocket Energy Harvester RTC. The results will be emailed immediately after testing. Jean-Luce, Steven, Wilson, and Thomas will fly to Virginia on Wednesday June 13th, so Andy and Wilson will ensure that a checked bag is packed with the payload, mission binder, spare parts, and necessary tools is sent along with. At this point we are feeling very confident that our payload will integrate with ease at Wallops.

6.0 Appendices

Integration procedure in 4.0 section B.