Milestone Review Flysheet 2019-2020

Institution	Purdue University

Milestone	PDR

Vehicle Properties

Total Length (in)	125
Diameter (in)	6
Gross Lift Off Weight (lb)	53.2
Airframe Material(s)	Filament-wound fiberglass
Fin Material and Thickness (in)	3/16 G10 Fiberglass
Coupler Length(s)/Shoulder Length(s) (in)	6, 14

Motor Properties

Motor Brand/Designation	Cesaroni Technology L1115-0
Max/Average Thrust (lb)	385.17, 251.56
Total Impulse (lbf-s)	1172.42
Mass Before/After Burn (lb)	9.71, 4.43
Liftoff Thrust (lb)	324.46
Motor Retention Method	Aeropack Motor Retainer

Stability Analysis

Center of Pressure (in. from nose)	94.348
Center of Gravity (in. from nose)	75.558
Static Stability Margin (on pad)	3.05
Static Stability Margin (at rail exit)	3.08
Thrust-to-Weight Ratio	5.77
Rail Size/Type and Length (in)	15-15, 144
Rail Exit Velocity (ft/s)	63.5

Ascent Analysis

Maximum Velocity (ft/s)	502
Maximum Mach Number	0.446
Maximum Acceleration (ft/s^2)	188
Target Apogee (ft)	4325
Predicted Apogee (From Sim.) (ft)	4325

Recovery System Properties - Overall

Total Descent Time (s)	88.8
Total Drift in 20 mph winds (ft)	2605

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		Black Powder (FFFFg)
Energetics Mass - Drogue Chute (grams)	Primary	3
	Backup	4
Energetics Mass - Main Chute (grams)	Primary	4
	Backup	5
Energetics Mass - Other (grams) - If Applicable	Primary	NA
	Backup	NA

Payload Deployment

Location: Air or Ground (if applicable)	Ground
Altitude of Deployment (if applicable)	N/A

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	Altus Metrum Telemetrum
Secondary Altimeter Make/Model	Missile Works RRC3+ Sport
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	Altus Metrum Telemetrum
Additional Locators (if applicable)	N/A
Transmitting Frequencies (all - vehicle and payload)	16, 435, and 902-928 MHz
Pad Stay Time (Launch Configuration)	3 hours
Describe Redundancy Plan (batteries, switches, etc.)	Fully redundant and independent systems with individual batteries, switches, wires, and ejection charges

Recovery System Properties - Drogue Parachute

Manufacturer/Model	Fruity Chutes Classic Elliptical			
Size or Diameter (in or ft)	24"			
Main Altimeter Deployment Setting	Apogee			
Backup Altimeter Deployment Setting	Apogee + 1 second			
Velocity at Deployment (ft/s)	0			
Terminal Velocity (ft/s)	98.4			
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)	1/2" Tubular Nylon			
Recovery Harness Length (ft)	2			
Harness/Airframe Interfaces	1/4" SS quick link through looped tether ends and 1/4" SS I-bolts through bulkheads			
Kinetic Energy (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	3416.8	948	1999.4	N/A

Recovery System Properties - Main Parachute

Manufacturer/Model	Skyangle Cert 3 XXL			
Size or Diameter (in or ft)	120"			
Main Altimeter Deployment Setting (ft)	800			
Backup Altimeter Deployment Setting (ft)	700			
Velocity at Deployment (ft/s)	138			
Terminal Velocity (ft/s)	11.2			
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)	1/2" Tubular Nylon			
Recovery Harness Length (ft)	40			
Harness/Airframe Interfaces	1/4" SS quick link through looped tether ends and 1/4" SS I-bolts through bulkheads			
Kinetic Energy (Ft-	Section 1	Section 2	Section 3	Section 4

Energy (Ft-lbs)	54.3	15.1	31.8	N/A

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Payload

Payload 1 (official payload)	**Overview** The primary payload experiment for the 2019-2020 PSP-SL team is an autonomous unmanned aerial vehicle (UAV), designed to collect a simulated lunar ice sample after the flight of the rocket. The UAV employs a quad-rotor design with foldable wings, allowing the UAV to fit inside rocket's airframe. The UAV is securely held inside the rocket with a sophisticated retention and deployment system. This system utilizes a worm-screw and stepper motor design to actively retain the UAV system inside the rocket throughout the course of the flight. The system uses a servo motor in conjunction with a 6 DOF IMU to reorient the internal structure of the payload bay after landing. The stepper motor finally separates the payload bay, exposing the UAV for flight. The UAV deploys from the rocket, beginning an autonomous search for an ice mining recovery area. The UAV employs a computer-vision system and grid-based search algorithm to look for recovery areas. After identifying a recovery area, the UAV descends, landing on the simulated lunar ice. The UAV actuates its cylindrical-scoop based ice mining system, storing more than 10 mL of ice. Finally, the UAV flies away from the recovery area, completing its mission.
Payload 2 (non-scored payload)	**Overview** The secondary payload experiment is a small camera, whose purpose is to record the flight of the rocket from on-board the launch vehicle. The footage from this camera will yield important data for PSP-SL regarding the conditions of the vehicle throughout the course of the flight. Additionally, the footage will be used for educational engagement in outreach events sponsored by PSP-SL in the greater West Lafayette community.

Test Plans, Status, and Results

Ejection Charge Tests	Airframe separation via ejection charge (black powder) ignition will be tested on the ground. Each canister will pass this test if its ignition results in at least six feet of separation of the avionics bay from the corresponding airframe, as well as full ejection of the corresponding parachute, for at least one amount of black powder equal to or greater than four grams for the upper airframe and three grams for the lower airframe. It is planned for this test to be conducted sometime in the month of November.
Sub-scale Test Flights	Data detailing a successful sub-scale launch will be compiled by the team's deadline of 01/03/2020. To obtain this data, the team will launch at this date at the latest; however, the team hopes to do so long before this date, and plans to have its sub-scale launch vehicle built by mid-November. Finishing construction by this time will give the team the opportunity to launch at four separate launch events: Midwest Power, two Rocketeers of Central Indiana sport launches, and an Indiana Rocketry launch.
Vehicle Demonstration Flights	Data detailing a successful full-scale launch will be compiled by the team's deadline of 03/01/2020. To obtain this data, the team will launch at this date at the latest; however, the team hopes to do so long before this date, and plans to have its full-scale launch vehicle built by late January. Finishing construction by this time will give the team a large amount of time to find a launch opportunity, since many launch dates for this time of year are tentative due to weather and the team wishes to stay flexible.
Payload Demonstration Flights	Ideally, payload will be demonstrated via flight concurrently with the vehicle demonstration flight, and thus plans for testing the payload's flight performance holistically will occur at the same time as the vehicle demonstration flight. If the payload does not fly successfully before the team's deadline for a successful vehicle demonstration flight, another flight will be conducted in which any payload problems from the first flight will be fixed and the payload can be successfully flown. The team's deadline for this specific flight will be 03/20/2020.

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Transmitter #1			
Location of transmitter:	Transmitter #1 is located in the upper-section of the payload bay, within the rocket's nose cone.		
Purpose of transmitter:	Transmitter #1 receives a deployment signal from the ground station, initiating the deployment of the payload.		
Brand	XBee	RF Output Power (mW)	165
Model	Pro 900-HP	Specific Frequency used by team (MHz)	902-928
Handshake or frequency hopping? (explain)	Transmitters #1 and #2 are assigned 64-bit addresses in the manufacturing process. Each transmitter will be programmed to only send and receive data from the other transmitter. In this way, a basic handshake will be made between each transmitter.		
Distance to closest e-match or altimeter (in)	48		
Description of shielding plan:	Shielded packaging and short connections		

Transmitter #2			
Location of transmitter:	Transmitter #2 is located at the ground-control station operated by the payload team.		
Purpose of transmitter:	Transmitter #1 sends a deployment signal to the payload, initiating the deployment procedure.		
Brand	XBee	RF Output Power (mW)	165
Model	Pro 900-HP	Specific Frequency used by team (MHz)	902-928
Handshake or frequency hopping? (explain)	Transmitters #1 and #2 are assigned 64-bit addresses in the manufacturing process. Each transmitter will be programmed to only send and receive data from the other transmitter. In this way, a basic handshake will be made between each transmitter.		
Distance to closest e-match or altimeter (in)	N/A		
Description of shielding plan:	Shielded packaging and short connections		

Transmitter #3			
Location of transmitter:	Transmitter #3 is located in the Telemetrum in the avionics bay		
Purpose of transmitter:	Transmitter #3 is responsible for recording the altitude of the rocket and triggering the ejection of the parachutes.		
Brand	TI	RF Output Power (mW)	40
Model	CC1120	Specific Frequency used by team (MHz)	435
Handshake or frequency hopping? (explain)	The transmitter will utilize a basic handshake between the altimeter and laptop on the ground to track the flight of the vehicle and deploy the parachutes when necessary.		
Distance to closest e-match or altimeter (in)	1.25		
Description of shielding plan:	Shielded boxing, short connections		

Transmitter #4			
Location of transmitter:	Transmitter #4 is located in the RRC3+ Sport in the avionics bay		
Purpose of transmitter:	Transmitter #4 is responsible for recording the altitude of the rocket and triggering the ejection of the parachutes. This is used as a redundancy to the Telemetrum.		
Brand	TI	RF Output Power (mW)	40
Model	MSP430	Specific Frequency used by team (MHz)	16

Handshake or frequency hopping? (explain)	The transmitter will utilize a basic handshake between the altimeter and laptop on ground to track the flight of the vehicle and deploy the parachutes when necessary.
Distance to closest e-match or altimeter (in)	1.25
Description of shielding plan:	Shielded boxing, short connections

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Transmitter #5			
Location of transmitter:			
Purpose of transmitter:			
Brand		RF Output Power (mW)	
Model		Specific Frequency used by team (MHz)	
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)			
Description of shielding plan:			

Transmitter #6			
Location of transmitter:			
Purpose of transmitter:			
Brand		RF Output Power (mW)	
Model		Specific Frequency used by team (MHz)	
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)			
Description of shielding plan:			

Additional Comments