

# Milestone Review Flysheet 2019-2020

**Institution** Purdue University

**Milestone** CDR

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

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

Motor Properties	
Motor Brand/Designation	Cesaroni Technology L1115-0
Max/Average Thrust (lb)	385.48, 251.78
Total Impulse (lbf-s)	1128.38
Mass Before/After Burn (lb)	9.63, 4.22
Liftoff Thrust (lb)	324.46
Motor Retention Method	Aeropack Motor Retainer

Recovery System Properties - Recovery Electronics	
Primary Altimeter Make/Model	Altus Metrum Telemetry
Secondary Altimeter Make/Model	Missile Works RRC3+ Sport
Other Altimeters (if applicable)	N/A
Rocket Locator (Make/Model)	Altus Metrum Telemetry
Additional Locators (if applicable)	N/A
Transmitting Frequencies (all - vehicle and payload)	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

Stability Analysis	
Center of Pressure (in. from nose)	94.348
Center of Gravity (in. from nose)	75.569
Static Stability Margin (on pad)	3.04
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

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)	31.3			
Terminal Velocity (ft/s)	131			
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)	20			
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
	6151.1	1677.6	3674.7	N/A

Ascent Analysis	
Maximum Velocity (ft/s)	534
Maximum Mach Number	0.48
Maximum Acceleration (ft/s^2)	200
Target Apogee (ft)	4325
Predicted Apogee (From Sim.) (ft)	4389

Recovery System Properties - Overall	
Total Descent Time (s)	88.8
Total Drift in 20 mph winds (ft)	2605

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)	131			
Terminal Velocity (ft/s)	13.5			
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-lbs)	Section 1	Section 2	Section 3	Section 4

Recovery System Properties - Energetics		
Ejection System Energetics (ex. Black Powder)	Black Powder (FFFFg)	
Energetics Mass - Drogue Chute (grams)	Primary	2
	Backup	3
Energetics Mass - Main Chute (grams)	Primary	5
	Backup	6
Energetics Mass - Other (grams) - If Applicable	Primary	NA
	Backup	NA

Energy (ft-lbs)	65.4	17.8	39.1	N/A
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### Payload

	Overview
Payload 1 (official payload)	<p>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.</p>
	Overview
Payload 2 (non-scored payload)	<p>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.</p>

### Test Plans, Status, and Results

Ejection Charge Tests	<p>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 five grams for the upper airframe and two grams for the lower airframe. It is planned for this test to be conducted on the 12th of January.</p>
Sub-scale Test Flights	<p>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.</p>
Vehicle Demonstration Flights	<p>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.</p>
Payload Demonstration Flights	<p>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.</p>

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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 Telemetry 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)	1.5		
Description of shielding plan:	Shielded boxing, short connections		

Transmitter #4			
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:	

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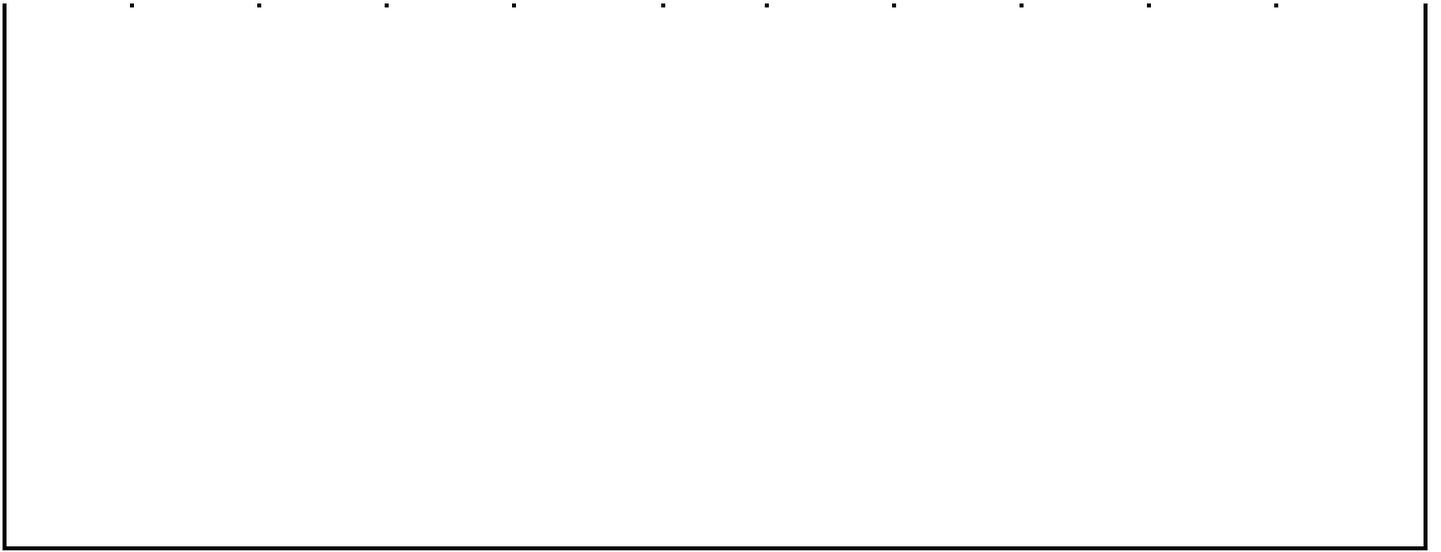
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Transmitter #5			
Location of transmitter:			
Purpose of transmitter:			
Brand		RF Output Power (mW)	
Model		Specific Frequency used by team (MHz)	
Handshake or frequency hopping? (explain)			
Distance to closest e-match or altimeter (in)			
Description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



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