Milestone Review Flysheet 2020-2021

Institution	Purdue University
Milestone	FRR

Vehicle Properties	
Total Length (in)	88.2
Outer Diameter (in)	6.17
Gross Lift Off Weigh (lb)	52.0 (ballast)
Airframe Material(s)	G12 Fiberglass
Fin Material and Thickness (in)	G10 Fiberglass, 0.187
Coupler Length(s)/Shoulder Length(s) (in)	7, 5, 7

Motor Properties	
Motor Brand/Designation	Cesaroni Technology Inc. L1115
Max/Average Thrust (lbf)	385.48/251.78
Total Impulse (lbf-s)	1128.38
Mass Before/After Burn (oz)	9.63/4.39
Liftoff Thrust (lbf)	327
Motor Retention Method	Manufactured Support Structure (MFSS)

Stability Analysis	
Center of Pressure (in. from nose)	63.3
Center of Gravity (in. from nose)	44.5
Static Stability Margin (on pad)	3.05
Static Stability Margin (at rail exit)	3.04
Thrust-to-Weight Ratio	6.1
Rail Size/Type and Length (in)	1515, 96
Rail Exit Velocity (ft/s)	55.8

Ascent Analysis	
Maximum Velocity (ft/s)	550
Maximum Mach Number	0.5
Maximum Acceleration (ft/s^2)	206
Target Apogee (ft)	4100
Predicted Apogee (From OpenRocket) (ft)	5089 (perfect conditions)

Recovery System Properties - Overall	
Total Descent Time (s)	85.1
Total Drift in 20 mph winds (ft)	2496.3

Recovery System Properties - Energetics		
Ejection System Energetics (ex. Black Powder)		Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	2
	Backup	3
Energetics Mass - Main Chute (grams)	Primary	3
	Backup	4
Energetics Mass - Other (grams) - If Applicable	Primary	N/A
	Backup	N/A

Recovery System Properties - Recovery Electronics	
Primary Altimeter Make/Model	Altus Metrum TeleMetrum
Secondary Altimeter Make/Model	PerfectFlite StratoLoggerCF
Other Altimeters (if applicable)	BMP280
Rocket Locator (Make/Model)	Altus Metrum TeleMetrum
Additional Locators (if applicable)	EggTimer Rocketry EggFinder TX
Transmitting Frequencies (all - vehicle and payload)	434.55, 911, 915, and 923 MHz
Describe Redundancy Plan (batteries, switches, etc.)	Fully redundant and independent systems with individual batteries, switches, wires, and ejection charges
Pad Stay Time (Launch Configuration)	3 hours

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 + 2 seconds		
Velocity at Deployment (ft/s)		0		
Terminal Velocity (ft/s)		89.9		
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)		3/8" Tubular Kevlar		
Recovery Harness Length (ft)		30		
Harness/Airframe Interfaces		1/4" SS quick links through looped tether ends and 1/4" SS eyebolts through bulkheads		
Kinetic Energy of Each Section (ft-lbs)	Section 1	Section 2	Section 3	Lander
	1890.5	1175.5	2653.9	N/A

Recovery System Properties - Main Parachute				
Manufacturer/Model		Rocketman High Performance CD 2.2 Parachute		
Size or Diameter (in or ft)		144"		
Main Altimeter Deployment Setting (ft)		900		
Backup Altimeter Deployment Setting (ft)		700		
Velocity at Deployment (ft/s)		89.9		
Terminal Velocity (ft/s)		15		
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)		3/8" Tubular Kevlar		
Recovery Harness Length (ft)		60		
Harness/Airframe Interfaces		1/4" SS quick links through looped tether ends and 1/4" SS eyebolts through bulkheads		
Kinetic Energy of Each Section (ft-lbs)	Section 1	Section 2	Section 3	Lander
	52.6	32.7	74.3	13.7

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Payload	
Payload 1 (official payload)	Overview The primary payload has been designed to meet the challenge requirements as outlined in the Handbook. The PLS consists primarily of a deployable Lander Subsystem—or just "Lander"—and its associated Retention and Deployment Subsystem (R&D). The R&D contains the Lander within the Payload Bay until time of deployment, handing all associated flight loads which would otherwise be transferred through the Lander itself. When activated, the R&D ejects the Lander by mechanical means—without producing an additional independent section of the vehicle. The Lander will be fully deployed from the launch vehicle after the deployment of the vehicle's main parachute, no lower than 500' AGL. Afterward, the Lander will descend to the ground at a non-ballistic rate through the use of a parachute. Once grounded, the Lander will begin a coordinated orientation sequence, up righting itself within the required bounds. Afterward, the Lander's onboard Panoramic Image Capture Subsystem (PICS) cameras will be activated, take a picture of its surroundings, and transmit the data to the Payload Team's Ground Control Station (GCS) for image processing and display.
Payload 2 (non-scored payload)	Overview The secondary payload has been designed to meet the additional technical requirements as outlined by PSP-SL. The ABCS consists of a mechanical apparatus capable of being integrated with the airframe of the vehicle. This device actuates linkages connected to sectioned plates in order to affect the aerodynamic cross-sectional area of the vehicle after the vehicle's burn has completed, producing increased drag. An internal control system is being developed to monitor flight conditions, and through a closed-loop control system, the control system will actuate the mechanical device to produce the desired amount of drag. The control system will utilize flight conditions to predict the current amount of drag required for the vehicle to attain the desired apogee and will modulate the mechanical system to that end. This system is being implemented to increase the team's apogee score and is something that the team has not done in previous years. Furthermore, due to the lack of experience with this form of control system on a high-powered rocket, the team has decided to dedicate much effort towards ensuring flight safety and stability.

Test Plans, Status, and Results	
Ejection Charge Tests	Airframe separation via ejection charge (black powder) ignition was tested on the ground. Each canister passed this test if its ignition resulted in at least six feet of separation between the two respective airframe sections, as well as full ejection of the corresponding parachute and no component damage, for at least one amount of black powder equal to or greater than three grams for the upper airframe and two grams for the lower airframe. This test was conducted on the 17th of February, and all systems passed satisfactorily.
Sub-scale Test Flights	The team had a subscale test flight for 11/7/20. This vehicle will be a 1/2 length model of the full-scale vehicle. The teamused this flight to gather data about payload altimeters, and the effectiveness of the vehicle's hemispherical nosecone. The vehicle launch was done at the Purdue Dairy Farms when the team had finished construction and verification.

Vehicle Demonstration Flights	The team launched its full scale VDF by 02/27/2020 to ensure that all flight analysis can be conducted before FRR is due. This flight was able to verify the successful integration of the various vehicle systems, and the protocols required to assemble them. The team launched this flight from Purdue Dairy farms. The team intends for the ABCS was active during this flight.
Payload Demonstration Flights	The team intends to complete its payload demosntration flights on March 19th with a backup date of March 21st. The team will launch this flight from Purdue Dairy farms, enabling extremely flexible scheduling. The team intends for the ABCS to be active during this flight as well.

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Transmitter #1			
Location of transmitter:	Lander		
Purpose of transmitter:	To transmit images and GPS data to the Ground Control Station (GCS)		
Brand	XBee	RF Output Power (mW)	250
Model	XBee-PRO 900HP	Specific Frequency used by team (MHz)	915
Handshake or frequency hopping? (explain)	The transmitter will use handshake. A predetermined message will be sent to the GCS and the GCS will respond with a confirmation message. Once the confirmation message has been received, the XBee will send the data.		
Distance to closest e-match or altimeter (in)	20		
Description of shielding plan:	The XBee-PRO 900HP has a metatallic case to protect itself from electromagnetic and radio frequency interference.		

Transmitter #2			
Location of transmitter:	Avionics Bay		
Purpose of transmitter:	To record the altitude of the rocket and trigger the ejection of the parachutes		
Brand	TI	RF Output Power (mW)	40
Model	CC1200	Specific Frequency used by team (MHz)	434.55
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 #3			
Location of transmitter:	Booster Coupler		
Purpose of transmitter:	Independent section location		
Brand	EggTimer Rocketry	RF Output Power (mW)	40
Model	Eggfinder TX C1	Specific Frequency used by team (MHz)	923
Handshake or frequency hopping? (explain)	The transmitter will utilize a basic handshake between the tracker and its receiver.		
Distance to closest e-match or altimeter (in)	12		
Description of shielding plan:	For the duration of flight, large amounts of recovery and assembly hardware will reduce interference from the transmitter and the avionics system.		

Transmitter #4			
Location of transmitter:	Payload Coupler		
Purpose of transmitter:	Independent section location		
Brand	EggTimer Rocketry	RF Output Power (mW)	40
Model	Eggfinder TX C1	Specific Frequency used by team (MHz)	911
Handshake or frequency hopping? (explain)	The transmitter will utilize a basic handshake between the tracker and its receiver.		
Distance to closest e-match or altimeter (in)	12		
Description of shielding plan:	For the duration of flight, large amounts of recovery and assembly hardware will reduce interference from the transmitter and the avionics system.		

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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
The PSP-SL Project Voss Launch vehicle will make use of a closed loop aerobraking system to control the vehicle's apogee.