Milestone Review Flysheet 2019-2020

Institution	North Carolina State University

Milestone	FRR

Vehicle Properties

Total Length (in)	108.06
Diameter (in)	6.17
Gross Lift Off Weigh (lb)	47.5
Airframe Material(s)	Fiberglass
Fin Material and Thickness (in)	Aircraft Birch Ply/0.25
Coupler Length(s)/Shoulder Length(s) (in)	11, 12 / 6.25

Motor Properties

Motor Brand/Designation	Aerotech L1520T-PS
Max/Average Thrust (lb)	396.79/352.50
Total Impulse (lbf-s)	835
Mass Before/After Burn (lb)	47.5/43.5
Liftoff Thrust (lb)	334.2
Motor Retention Method	Retainer, Engine Mount, Centering rings

Stability Analysis

Center of Pressure (in. from nose)	78.76
Center of Gravity (in. from nose)	59.25
Static Stability Margin (on pad)	2.17
Static Stability Margin (at rail exit)	2.21
Thrust-to-Weight Ratio	7.42
Rail Size/Type and Length (in)	1515/144
Rail Exit Velocity (ft/s)	70.1

Ascent Analysis

Maximum Velocity (ft/s)	497
Maximum Mach Number	0.45
Maximum Acceleration (ft/s^2)	290
Target Apogee (ft)	4420
Predicted Apogee (From Sim.) (ft)	3775

Recovery System Properties - Overall

Total Descent Time (s)	79
Total Drift in 20 mph winds (ft)	2303

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		Black Powder
Energetics Mass - Drogue Chute (grams)	Primary	2.3
	Backup	2.7
Energetics Mass - Main Chute (grams)	Primary	5.5
	Backup	6
Energetics Mass - Other (grams) - If Applicable	Primary	N/A
	Backup	N/A

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	PerfectFlite StratoLoggerCF
Secondary Altimeter Make/Model	PerfectFlite StratoLoggerCF
Other Altimeters (if applicable)	-
Rocket Locator (Make/Model)	Eggfinder GPS Tracking System
Additional Locators (if applicable)	-
Transmitting Frequencies (all - vehicle and payload)	***Required by CDR*** (Complete on pages 3 and 4)
Pad Stay Time (Launch Configuration)	3 hr
Describe Redundancy Plan (batteries, switches, etc.)	Fully independent, dual redundant altimeters, with sepearate batteries, switches, ematches, and black powder charges.

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Fruity Chutes 24-inch Compact Elliptical	
Size or Diameter (in or ft)			24 in	
Main Altimeter Deployment Setting			Apogee	
Backup Altimeter Deployment Setting			Apogee + 1 second	
Velocity at Deployment (ft/s)			0	
Terminal Velocity (ft/s)			88	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in Tubular Kevlar	
Recovery Harness Length (ft)			40	
Harness/Airframe Interfaces		U-bolt with quick link		
Kinetic Energy (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	2142.4	1516.5	1468.4	

Recovery System Properties - Main Parachute

Manufacturer/Model			Fruity Chutes 120 in Iris UltraCompact	
Size or Diameter (in or ft)			120 in	
Main Altimeter Deployment Setting (ft)			500	
Backup Altimeter Deployment Setting (ft)			450	
Velocity at Deployment (ft/s)			88	
Terminal Velocity (ft/s)			14.7	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 in Tubular Kevlar	
Recovery Harness Length (ft)			40	
Harness/Airframe Interfaces		U-bolt with quick link		
Kinetic Energy (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	60	42.4	41.1	

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Payload	
Payload 1 (official payload)	Overview
	Once the payload team comes within 30 feet of the rocket, the payload integration lead will connect to a Bluetooth module within the electronics bay of the integration system through a smart phone. Once a connection has been established, the primary deployment motor and retenting motor will be controlled through an application that interfaces with microcontrollers, Blueterm. With Blueterm, the deployment and unlocking processes can be initiated. After the rover has been fully extended from the body tube, the rack gear locking mechanism will rotate and the rover will be free. The rover team lead will utilize a control to drive the rover to the nearest ice collection site. Once the rover is directly over the ice, the two servos attached to their respective scoop will engage, scooping a minimum sample of 10 mL of ice. Once the team has confirmed that the sample size is sufficient, the rover will then proceed to drive a minimum of 10 linear feet from the collection site, thus completing a sucessful collection mission.
Payload 2 (non-scored payload)	Overview
	N/A

Test Plans, Status, and Results	
Ejection Charge Tests	In order to ensure that the altimeters used for ejection charges onboard the rocket execute correctly, altimeters will be placed in a vacuum chamber and will be hooked up to an LED. If the LED illuminates at the correct pressure, then it will be deemed worthy for flight. Black powder ejection charge testing will take place to confirm calculations performed in the PDR. These calculations rely on a constant to find the ideal pressure for a certain separation force. Testing will start with the calculated amount of black powder loaded into a mock-up of each section that is weighted and connected appropriately. Further tests will be performed until the sections separate by the appropriate amount.
Sub-scale Test Flights	The subscale flight is scheduled for November 16, 2019. During this flight, the primary mission system designs will be validated and any failures will be accounted for in future documentation. The subscale payload will simply be a simulated weight in the payload bay. Upon landing of the subscale, a full-scale mock-up of the payload will simulate deployment in the location that the subscale lands. The launch vehicle will also test recovery systems and altimeter accuracy will be validated.
Vehicle Demon-stration Flights	The full-scale test flight will take place on February 22, 2020. This test flight will validate all launch vehicle systems and provide confidence in mission success prior to FRR. Launch vehicle recovery system timing and sizing will be confirmed and target apogee and altimeter accuracy will be tested. All systems performed as expected.
Payload Demon-stration Flights	The payload demonstration flight will take place with the full-scale vehicle demonstration flight on February 23, 2020. The flight has qualified as a sufficient payload demonstration flight. The BURRITO was fully retained.

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Transmitter #1

Location of transmitter:	Within the electronics housing of the payload integration system.		
Purpose of transmitter:	Transmits to the SLI team that the rocket has landed, asking for team confirmation before initiating deployment sequence		
Brand	Olinex LTD.	RF Output Power (mW)	3.98 mW
Model	HC-06	Specific Frequency used by team (MHz)	2400 MHz
Handshake or frequency hopping? (explain)	operates on a 2400MHz spread spectrum		
Distance to closest e-match or altimeter (in)	38 in		
Description of shielding plan:	The transmitter will be placed inside of an 3D printed PLA electronics housing lined with foam		

Transmitter #2

Location of transmitter:	Inside of nose cone, forward of nosecone bulkhead.		
Purpose of transmitter:	Transmits location data to the field recovery team during the descent and recovery of the launch vehicle		
Brand	Eggtimer Rocketry	RF Output Power (mW)	100mW
Model	Eggfinder GPS Tracking System	Specific Frequency used by team (MHz)	913MHz
Handshake or frequency hopping? (explain)	Fixed Frequency, ID 3.		
Distance to closest e-match or altimeter (in)	60		
Description of shielding plan:	Multiple bulkheads, centering rings, and payload components are located between the transmitter and recovery electronics		

Transmitter #3

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 #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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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