Milestone Review Flysheet

Institution	NC State University

Milestone	Critical Design Review

Vehicle Properties	
Total Length (in)	122
Diameter (in)	6.2
Gross Lift Off Weigh (lb)	49.6
Airframe Material	Fiberglass
Fin Material	Aircraft-Grade Birch Plywood
Coupler Length	12 in

Motor Properties	
Motor Designation	L2200G
Max/Average Thrust (lb)	697 / 504
Total Impulse (lbf-s)	1147
Mass Before/After Burn	10.5 / 4.9
Liftoff Thrust (lb)	562
Motor Retention	Retainer, engine block, centering ring

Stability Analysis	
Center of Pressure (in from nose)	89.5
Center of Gravity (in from nose)	77
Static Stability Margin	2.01
Static Stability Margin (off launch rail)	2.1
MaxThrust-to-Weight Ratio	14:1
Rail Size and Length (in)	1.5 x 1.5 x 96
Rail Exit Velocity	65.3 ft/s

Ascent Analysis	
Maximum Veloxity (ft/s)	672
Maximum Mach Number	0.61
Maximum Acceleration (ft/s/s)	434
Target Apogee (From Simulations)	5305
Stable Velocity (ft/s)	65.3
Distance to Stable Velocity (ft)	5.75

Recovery System Properties				
Drogue Parachute				
Manufacturer/Model		Fruity Chutes / Classic Elliptical		
Size		24 in		
Altitude at Deployment (ft)			apogee	
Velocity at Deployment (ft/s)			0	
Terminal Velocity (ft/s)			81	
Recovery Harness Material			Kevlar	
Harness Size/Thickness (in)			1	
Recovery Harness Length (ft)			25 ft	
Harness/Airframe Interfaces		Tubluar Kevlar Shock Cord / U-bolt with quick link		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	4000			

Recovery System Properties				
Main Parachute				
Manufacturer/Model		Fruity Chutes / Iris Ultra Toroidal		
Size		168 in		
Altitude at Deployment (ft)			700	
Velocity at Deployment (ft/s)			81	
Terminal Velocity (ft/s)			9.9	
Recovery Harness Material			Kevlar	
Harness Size/Thickness (in)			1	
Recovery Harness Length (ft)			25 ft	
Harness/Airframe Interfaces		Tubluar Kevlar Shock Cord / U-bolt with quick link		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	59.4	10.9		

Recovery Electonics	
Altimeter(s)/Timer(s) (Make/Model)	2 x Stratologger SL100
Redundancy Plan	Redundant charge fired 1 second after apogee
Pad Stay Time (Launch Configuration)	1 hour

Recovery Electonics	
Rocket Locators (Make/Model)	Big Red Bee 900 MHz GPS
Transmitting Frequencies	900 MHz
Black Powder Mass Drogue Chute (grams)	2.25
Black Powder Mass Main Chute (grams)	2.00

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Autonomous Ground Support Equipment (MAV Teams Only)	
Capture Mechanism	Overview
	N/A
Container Mechanism	Overview
	N/A
Launch Rail Mechanism	Overview
	N/A
Igniter Installation Mechanism	Overview
	N/A

Payload	
Payload 1	Overview
	The Payload Deployment System will detach the payload from the launch vehicle using a pyrotechnically activated tether-and-release device after the payload bay and fin can have separated. After payload deployment, the Target Differentiation System (TDS), controlled by a Raspberry Pi 3 Model B microcontroller, will control all autonomous tasking for the onboard TDS. The TDS will use a Raspberry Pi Camera Module v2 to capture images of the landing zone. The microcontroller will process the images onboard, locate the targets in the landing zone, and differentiate between them. Once landed, the servo-controlled Upright Landing System (ULS) will deploy and upright the payload from its landing orientation if it is not already upright. Telemetry data from the onboard orientation sensor will confirm the upright landing.
Payload 2	Overview
	N/A

Test Plans, Status, and Results	
Ejection Charge Tests	Black powder ejection charge testing will take place to confirm calculations. These calculations rely on a constant, which converts cubic inches of pressurized volume to grams of black powder, to find the ideal pressure for a certain separation force. Testing for the main recovery system will be conducted using the completed nosecone and avionics bay sections. Testing for the drogue chute will be conducted using the deployment test rig. Successive ejection tests will be performed based on the performance of the initial tests.
Sub-scale Test Flights	The launch vehicle successfully decoupled at apogee with a good release of the fin can section which then guided the payload and tethered drogue parachute out without impedance. During the descent, back towards the ground the ARRD failed to disconnect the payload from the rocket body. This caused the payload to remained bound to the launch vehicle the entire duration of the flight. The main parachute was programmed to eject from the nose cone section, but neither the main or backup charges ignited for the main parachute. This indicated improper wiring or altimeter malfunction. However, the Jolly Logic controlled payload parachute deployed at a pre-programmed altitude of 700 ft slowing the descent of the launch vehicle. Unfortunately, due to the main parachute failing to deploy, the rocket came down with more force than predicted. Impact resulted in the loss of one of the fins breaking off and two of the four payload legs coming detached from the payload body. However, all detached components were reclaimed during retrieval.
Full-scale Test Flights	The full-scale test flight will take place on February 25 or 26, 2017. The test will validate all launch vehicle and payload systems and provide complete confidence in mission success prior to FRR. The payload will implement a target differentiation system, parachute recovery system, and upright landing system. The launch vehicle recovery system timing and sizing wil lbe confirmed. Target apogee and altimeter accuracy will be tested and necessary weight adjustments will be made in the weeks preceeding FRR.

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Additional Comments