Milestone Review Flysheet 2025-2026

Institution	North Carolina State University	Milestone	CDR

Vehicle Properties

Total Length (in)	110.09
Diameter (in)	6.12
Aspect Ratio	18.2:1
Gross Lift Off Weight (lb)	39.70
Ballast Amount (lb) / Material / Location	NA
Launch Vehicle Burn Out Weight (lb)	35.35
Launch Vehicle Landing Weight (lb) (same as burn out weight unless you're jettisonning something).	35.35
Airframe Material(s)	S2 roll-wrapped fiberglass
Fin Material and Thickness (in)	0.205", 1/8" honeycomb Nomex core and 0.40" carbon fiber face sheet laminates
Coupler Length(s)/Shoulder Length(s) (in)	Nosecone 7/3.5, Forward Avionics 11.5/4.5, Aft Avionics 11.5/6, Forward and Aft Airbrakes 9/4.5

Motor Properties

Motor Brand/Designation	Aerotech L1390G
Max/Average Thrust (lb)	370.89/312.48
Total Impulse (lbf-s)	887.77
Mass Before/After Burn (oz)	635/565.4
Liftoff Thrust (N)	1650
Motor Retention Method	Thrust Plate

Stability Analysis

Center of Pressure (in. from nose)	85.239
Center of Gravity (in. from nose)	64.629
Static Stability Margin (on pad)	3.37
Thrust-to-Weight Ratio	7.78:1
Rail Size/Type (1515 or 1010)	1515
Rail Exit Velocity (ft/s)	74.8
Effective rail length (distance traveled before forward button loses contact with rail).	60.1

Ascent Analysis

Maximum Velocity (ft/s)	626
Maximum Mach Number	0.559
Maximum Acceleration (ft/s^2)	276
Target Apogee (ft)	4600
Predicted Apogee (From Sim.) (ft)	4600

Recovery System Properties - Overall

Total Descent Time (s)	72.49 s
Total Drift in 20 mph winds (ft)	2126 ft

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	Silicdyne Fluctus
Secondary Altimeter Make/Model	Altus Metrum EasyMini
Other Altimeters (if applicable)	
Rocket Locator (Make/Model)	Silicdyne Fluctus
Additional Locators (if applicable)	
Transmitting Frequencies (all - vehicle and payload)	869.4625 MHz
Describe Redundancy Plan (batteries, switches, etc.)	Two altimeters, two batteries, two switches, primary and backup ejection charges for both main and drogue.
Pad Stay Time (Launch Configuration)	14.8 hours

Recovery System Properties - Drogue Parachute

Manufacturer/Model	Custom
Size or Diameter (in or ft) / drag coefficient	15 in. / 1.5
Main Altimeter Deployment Setting	Apogee
Backup Altimeter Deployment Setting	Apogee + 1 second
Velocity at Deployment (ft/s)	0 ft/s
Terminal Velocity (ft/s)	129.66 ft/s
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)	Kevlar, 1/2 in., Flat
Recovery Harness Length (ft)	19 ft
Harness/Airframe Interfaces	3/8" Steel U-bolts and 1/8" Kevlar Soft Links

Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	4190	4542		

Recovery System Properties - Main Parachute

Manufacturer/Model	Fruity Chutes Iris Ultra Compact
Size or Diameter (in or ft) / drag coefficient	120 in. / 2.2
Main Altimeter Deployment Setting	550 ft
Backup Altimeter Deployment Setting	500 ft
Velocity at Deployment (ft/s)	129.66 ft/s
Terminal Velocity (ft/s)	13.33 ft/s

Recovery System Properties - Energetics		
Ejection System Energetics (ex. Black Powder)		#FFF Black Powder
Energetics Mass / ejection charge force - Drogue Chute (grams) (lbf)	Primary	2.92 g, 456 lbf
	Backup	3.89 g, 608 lbf
Energetics Mass / ejection charge force - Main Chute (grams) (lbf)	Primary	2.75 g, 456 lbf
	Backup	3.66 g, 608 lbf
Energetics Mass / ejection charge force - Other (grams) (lbf) If Applicable	Primary	
	Backup	

Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)	Kevlar, 1/2 in., Flat			
Recovery Harness Length (ft)	17 ft			
Harness/Airframe Interfaces	3/8" Steel U-bolts and 1/8" Kevlar Soft Links			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	44.28	14.51	28.42	

Milestone Review Flysheet 2025-2026

Institution	North Carolina State University	Milestone	CDR

Payload

Payload 1 (official payload)	**Overview** The payload consists of two mechanisms: ZOMBIE, a self-righing lander, and GrAVE, the mechanism used to deploy it from the nosecone. After the launch vehicle has landed, GrAVE will use a set of rails, electronic latch, and lead screw pusher plate to eject ZOMBIE. At its top, ZOMBIE contains a compartment with amenities for four STEMnaut figures. Once deployed, ZOMBIE will then unfold four legs to self-right on the ground. ZOMBIE will then drill into the soil using an extending auger which will pull soil into an internal collection chamber. There, the soil will be tested with a 7-in-1 soil tester to collect pH, electrical conductivity, and Nitrate-Nitrogen readings. These readings will be timestamped and stored on an internal SD card.
Payload 2 (non-scored payload)	**Overview** The Air Brakes payload will be located near the top of the fin can section. This payload will increase the reference area of the rocket for greater drag for altitude control to reach a target altitude. It uses a Bang Bang control scheme with custom software, a custom INS System, Servo + Encoder assembly and Raspberry Pi to gather data, which is processed to get an accurate prediction of the peak altitude. After motor burnout, if the target apogee is lower than the predicted peak altitude, Air Brakes will deploy 4 symmetric fins, if not, the Air Brakes fins will retract. The apogee prediction algortihm utlizes a Runge-Kutta-4 method to predict the entire flight path up till apogee every other clock cycle of the Rasberry Pi.

Test Plans, Status, and Results

Ejection Charge Tests	Before each launch, a ground ejection test is conducted to validate the sizing and performance of the primary ejection charges. This procedure involves configuring the rocket in its final flight-ready state and simulating the separation events under ground conditions. If the vehicle does not achieve successful separation with the initial charge calculations, the ejection charge is incrementally increased by 0.2 grams, and the test is repeated. This iterative process continues until reliable separation is confirmed for both the drogue and main parachute deployment charges. The Subscale Ejection Test was completed on October 20th, 2025 in preperation for the Subscale Demonstration Flight. The results confirmed that the black powder charge sizes were adequate to shear the retention pins and initiate reliable parachute deployment during descent. Both drogue and main ejection tests were successful, and the corresponding black powder masses were documented for implementation in the Subscale Demonstration Flight.
Sub-scale Test Flights	The sub-scale test flight was succesfully completed on November 1st, 2025. The Fluctus reported an apogee of 1627 (ft), while the simulation predicted an apogee of 1664 (ft), indicating a 2.27% reduction in apogee. The percent error is relatively small, which bodes well for the fidelity of the simulations conducted. However, on launch day, a sudden gust of wind caused the vehicle to veer upwind, thereby reducing apogee and increasing overall flight times. The recovery system performed as expected, with the drogue deploying at apogee and the main parachute deploying at 550 (ft). An observed discrepancy was that the vehicle's descent rate under drogue was significantly lower than pre- dicted. The measured drogue descent velocity was 54 (fps), compared to a predicted value of 91 (fps), resulting in a longer descent time. This behavior is attributed to the fin can falling in a horizontal orientation during portions of the drogue descent rather than maintaining a vertical orientation directly under the drogue parachute. This configuration increased the effective area normal to the descent direction, thereby producing higher aerodynamic drag The Payload team tested data collection within the nosecone during launch. Air Brakes was be integrated into this Launch Vehicle, and this launch tested a recent structural redesign implemented on the system.

Vehicle Demonstration Flights	The Vehicle Demonstraition Flight is scheduled for February 21st , 2026, with a re-flight launch day on March 14th, 2026. In the case of inclimate weather, the launch days have backup dates of February 22nd and March 14th respectivly. The purpose of VDF is to ensure that the integrated launch vehicle meets all the Team Derived Requirements for success, as well as the given NASA Requirments.
Payload Demonstration Flights	The Payload Demonstration Flight is scheduled for February 21st, 2026, with a backup launch day on March 14th, 2026 if the team is not prepared to launch on the 21st. In the case of inclimate weather, the launch days have backup dates of February 22nd and March 15th respectivly. The purpose of PDF is to ensure that the finalized payload meets all the team derived requirements for success, as well as the given NASA requirments.

Milestone Review Flysheet 2025-2026

Institution	North Carolina State University	Milestone	CDR

Transmitter #1

Location of transmitter:	Avionics Bay		
Purpose of transmitter:	Launch Vehicle Tracking		
Brand	Silicdyne	RF Output Power (mW)	160 mW
Model	Fluctus	Specific Frequency used by team (MHz)	869.4625 MHz
Handshake or frequency hopping? (explain)	Fixed frequency, Alpha		
Distance to closest e-match or altimeter (in)	Combined GPS tracker and altimeter, one inch away from the backup altimeter.		
Description of shielding plan:	A sheet of aluminum foil will be placed between the transmitter and all other electronics on the Avionics sled.		

Transmitter #2

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 #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:			

Additional Comments

Milestone Review Flysheet 2025-2026

Institution	North Carolina State University	Milestone	CDR

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