Milestone Review Flysheet 2020-2021

Institution	Auburn University

Milestone	PDR

Vehicle Properties

Total Length (in)	121
Diameter (in)	6.3
Gross Lift Off Weigh (lb)	53.875
Airframe Material(s)	8.5oz 2x2 Twill Fiberglass E Cloth, Twill 6K Carbon Fiber Cloth
Fin Material and Thickness (in)	Twill 12K Carbon Fiber Cloth (core), Twill 6K Carbon Fiber Cloth (linings), 0.125 in
Coupler Length(s)/Shoulder Length(s) (in)	(Nose cone/ 3 in), 2x (9 in/ 6 in)

Motor Properties

Motor Brand/Designation	Aerotech L2200G-PS
Max/Average Thrust (lb)	697/494.6
Total Impulse (lbf-s)	1147.42
Mass Before/After Burn (oz)	168/78.8
Liftoff Thrust (N)	2480.1
Motor Retention Method	Aeropack flanged motor retainer (bolted)

Stability Analysis

Center of Pressure (in. from nose)	88.549
Center of Gravity (in. from nose)	72.659
Static Stability Margin (on pad)	2.52 cal
Static Stability Margin (at rail exit)	2.565 cal
Thrust-to-Weight Ratio	10.35
Rail Size/Type and Length (in)	1515 Rail - 144"
Rail Exit Velocity (ft/s)	87.851

Ascent Analysis

Maximum Velocity (ft/s)	610.9
Maximum Mach Number	0.5501
Maximum Acceleration (ft/s^2)	394.93
Target Apogee (ft)	4000
Predicted Apogee (From Sim.) (ft)	4667.6

Recovery System Properties - Overall

Total Descent Time (s)	89
Total Drift in 20 mph winds (ft)	2,610

Recovery System Properties - Energetics

Ejection System Energetics (ex. Black Powder)		Black Powder, Mechanical
Energetics Mass - Drogue Chute (grams)	Primary	3
	Backup	3.5

Recovery System Properties - Recovery Electronics

Primary Altimeter Make/Model	Stratologger PerfectFlite
Secondary Altimeter Make/Model	Stratologger PerfectFlite
Other Altimeters (if applicable)	
Rocket Locator (Make/Model)	Featherweight GPS Tracker
Additional Locators (if applicable)	
Transmitting Frequencies (all - vehicle and payload)	TBD by CDR
Describe Redundancy Plan (batteries, switches, etc.)	An identical recovery deployment system exists through a second altimeter, second key switch, and second set of charges for each event. There exists a delay so that these secondary events do not occur at the same time as the primary event.
Pad Stay Time (Launch Configuration)	8hrs

Recovery System Properties - Drogue Parachute

Manufacturer/Model			Auburn University / Circular	
Size or Diameter (in or ft)			34 in	
Main Altimeter Deployment Setting			Apogee	
Backup Altimeter Deployment Setting			Apogee+1sec	
Velocity at Deployment (ft/s)			0	
Terminal Velocity (ft/s)			83	
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)			5/8 inch Tubular Nylon	
Recovery Harness Length (ft)			1x15, 1x10	
Harness/Airframe Interfaces		(2x) Quick Link to U-Bolt mounted in bulk plate		
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4

Recovery System Properties - Main Parachute

Manufacturer/Model	Auburn University / Hemispherical
Size or Diameter (in or ft)	6.5 ft
Main Altimeter Deployment Setting (ft)	750
Backup Altimeter Deployment Setting (ft)	650
Velocity at Deployment (ft/s)	83
Terminal Velocity (ft/s)	14.75
Recovery Harness Material, Size, and Type (examples - 1/2 in. tubular Nylon or 1 in. flat Kevlar strap)	5/8 inch Tubular Nylon
Recovery Harness Length (ft)	1x15, 1x10

Energetics Mass - Main Chute (grams)	Primary	4
	Backup	4.5
Energetics Mass - Other (grams) - If Applicable	Primary	
	Backup	

Harness/Airframe Interfaces	(2x) Quick Link to U-Bolt mounted in bulk plate			
Kinetic Energy of Each Section (Ft-lbs)	Section 1	Section 2	Section 3	Section 4
	70	30.17	14.4	60

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Payload

Payload 1 (official payload)	Overview: This year's payload system will consist of 2 active subsystems. The Mechanical Active Release System(MARS) will be responsible for the payload's retention and release at approximately 1000 ft AGL and subsequently the mounting of the tether system for the lander. The Fully-Active Levelling Lander System(FALLS) will be responsible for untethering itself from the MARS system, semi-autonomously flying itself to a desired landing zone using its own propulsive force, levelling itself to within five degrees of vertical, and finally capturing a 360 degree photo and relaying that to the ground team.
Payload 2 (non-scored payload)	Overview: An on-board altitude control system with four variable aerodynamic control surfaces is designed to fulfill the main goal of slowing the vehicle down by deploying the airbrakes and matching the flight appogee with the target apogee. The secondary mission is use the estimated realtime data to provide the payload with vehicle current state updates and serve as fallback system in case of altimeter failure. The collected flight will be used for post-mission analisys and future mission predictions.

Test Plans, Status, and Results

Ejection Charge Tests	The explosive separation of the recovery system is crucial to the deployment of the drogue and main parachutes. This separation is dependent on the pressurisation of the recovery tube by black powder charges in order to detach shear pins. The correct pressure must be reached by running through the process safely on the ground until the tube separates with the correct amount of force. If too little black powder is used,the tubes will not separate. If too much black powder is used, the explosion could damage the structure of the vehicle or its components. The correct amount of black powder will be recorded and used in launch. The subscale ejection testing was successfully completed on 10/23/20. The full scale ejection test will be attempted on 1/1/21, or at least a week before any planned launch.
Sub-scale Test Flights	The team will build and launch a complete sub-scale model of the launch vehicle. This launch will ensure the design of the launch vehicle is aerodynamically stable and robust.The recovery system will test its parachute deployment and staging. The payload system will house an altimeter and accelerometer to gather flight data such as max height and flight forces. The subscale launch has several planned dates depending on weather at SEARS 11/7/20 and HARA 11/14/20.
Vehicle Demonstration Flights	The full scale launch vehicle will be launched until all the systems operate as planned and all the criteria is met. A failed launch would occur unless the chutes deploy at the correct times, the payload successfully demonstrates a successful mission, all hardware is intact and reusable, and the target altitude is within a certain margin of error. If a failed test launch should occur, the team will analyze all data gathered from the launch and fix the point of failure that caused the unsuccessful launch. Future planned launches include but are not limited to: HARA 1/9/21 and SEARS 2/6/21, with preference to the earlier date.

Payload Demonstration Flights	The payload will undergo a significant amount of testing. The payload is a complicated drone system which requires it to be meticulously tuned. In this test the team will anchor the drone to the ground and actively tune it using the flight test software from a safe distance. This test will be carried out until the drone is effectively calibrated and enough flight data has been acquired. A flight test, drop test and range test will be completed at a date TBD. All of the systems responsible for the nosecone and payload jettison will be tested at a subscale launch. The FALLS for this will be inert, and the entire subscale mission will serve as a proof of concept for the MARS/NARS combination. A full scale payload will be ready for the first fullscale flight for a full mission verification.

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Transmitter #1			
Location of transmitter:	Altitude Control System		
Purpose of transmitter:	Low-range wireless link		
Brand	Xbee	RF Output Power (mW)	1
Model	XB24CAWIT-001	Specific Frequency used by team (MHz)	2400
Handshake or frequency hopping? (explain)	handshake		
Distance to closest e-match or altimeter (in)	8 inches		
Description of shielding plan:	Carbon fiber body and bulkplate		

Transmitter #2			
Location of transmitter:	Altitude Control System		
Purpose of transmitter:	Telemetry & GPS Tracking		
Brand	Adafruit LoRa Featherwing	RF Output Power (mW)	100
Model	RFM95	Specific Frequency used by team (MHz)	915
Handshake or frequency hopping? (explain)	handshake		
Distance to closest e-match or altimeter (in)	TBD; no less than 8 inches		
Description of shielding plan:	Carbon fiber body and bulkplate		

Transmitter #3			
Location of transmitter:	Payload bay (FALLS)		
Purpose of transmitter:	Transmits captured panoramic image		
Brand	Nordic Semiconductor	RF Output Power (mW)	1mW
Model	NRF24L01+	Specific Frequency used by team (MHz)	2400
Handshake or frequency hopping? (explain)	Handshake - Radios are pre-configured to communicate only with each other		
Distance to closest e-match or altimeter (in)	33 inches		
Description of shielding plan:	Carbon fiber bulkplates will separate the transmitter and any e-matches		

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