Project Auk

Tracy Furutani, NSC Rocketry Club

November 2019

The International Rocket Engineering Competition (IREC)

is held every June, sponsored by the Experimental Sounding Rocket Association (ESRA), now called the Spaceport America Cup

The Spaceport America Cup (IREC)

"In general, student teams competing in the IREC must design, build, and launch a rocket carrying no less than 8.8 lb of payload to a target apogee either 10,000 ft or 30,000 ft above ground level (AGL)."

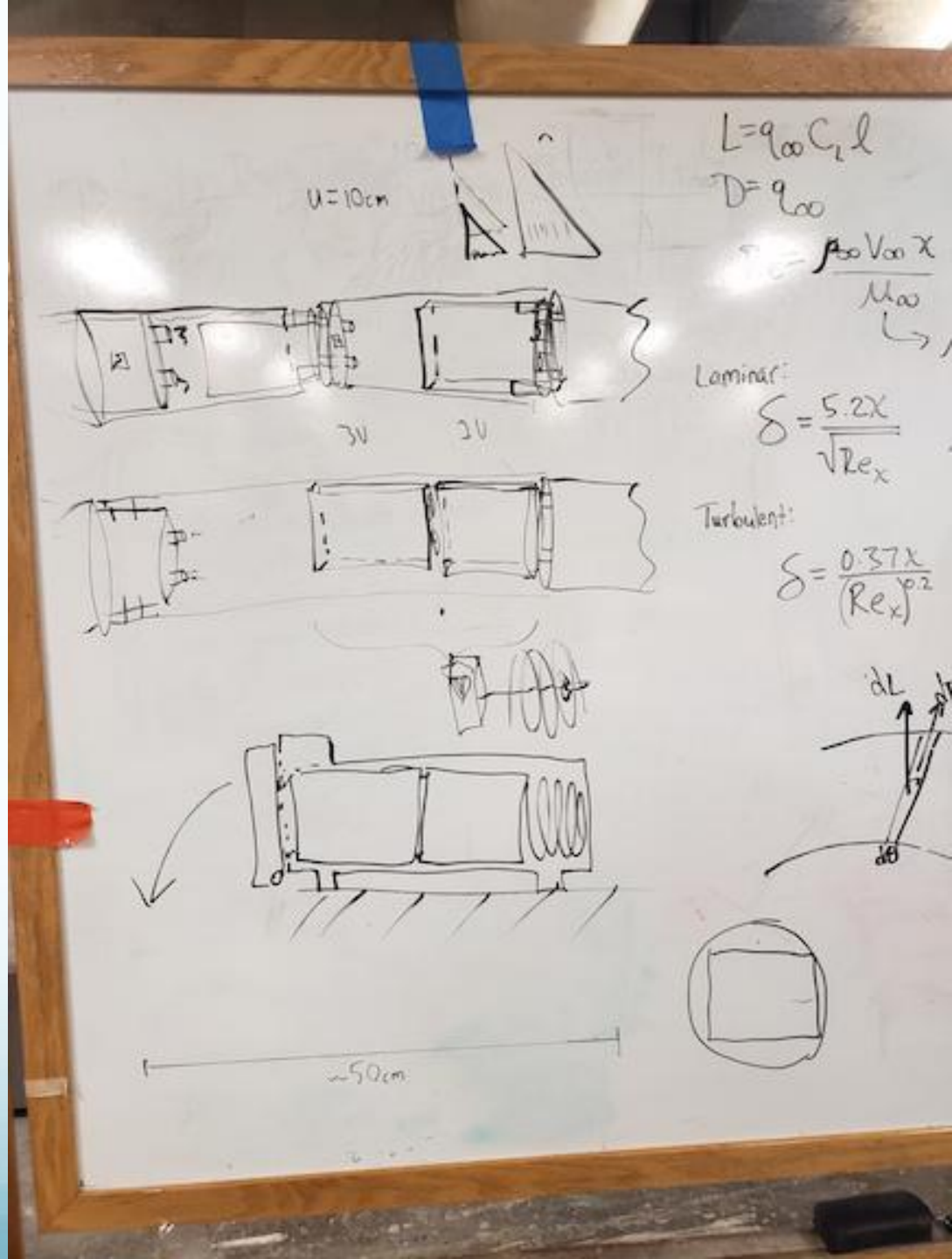
This year, the competition runs from **16 June to 20 June 2020**

The Space Dynamics Laboratory (SDL) Payload Challenge

"Encourage participants to create payloads that accomplish a relevant function and provide useful learning opportunities."

The competition

After your team decides to participate, then you must decide on what rocket design to use…this is not an easy choice, since, generally, there are no kits that are this size and will go to that altitude.



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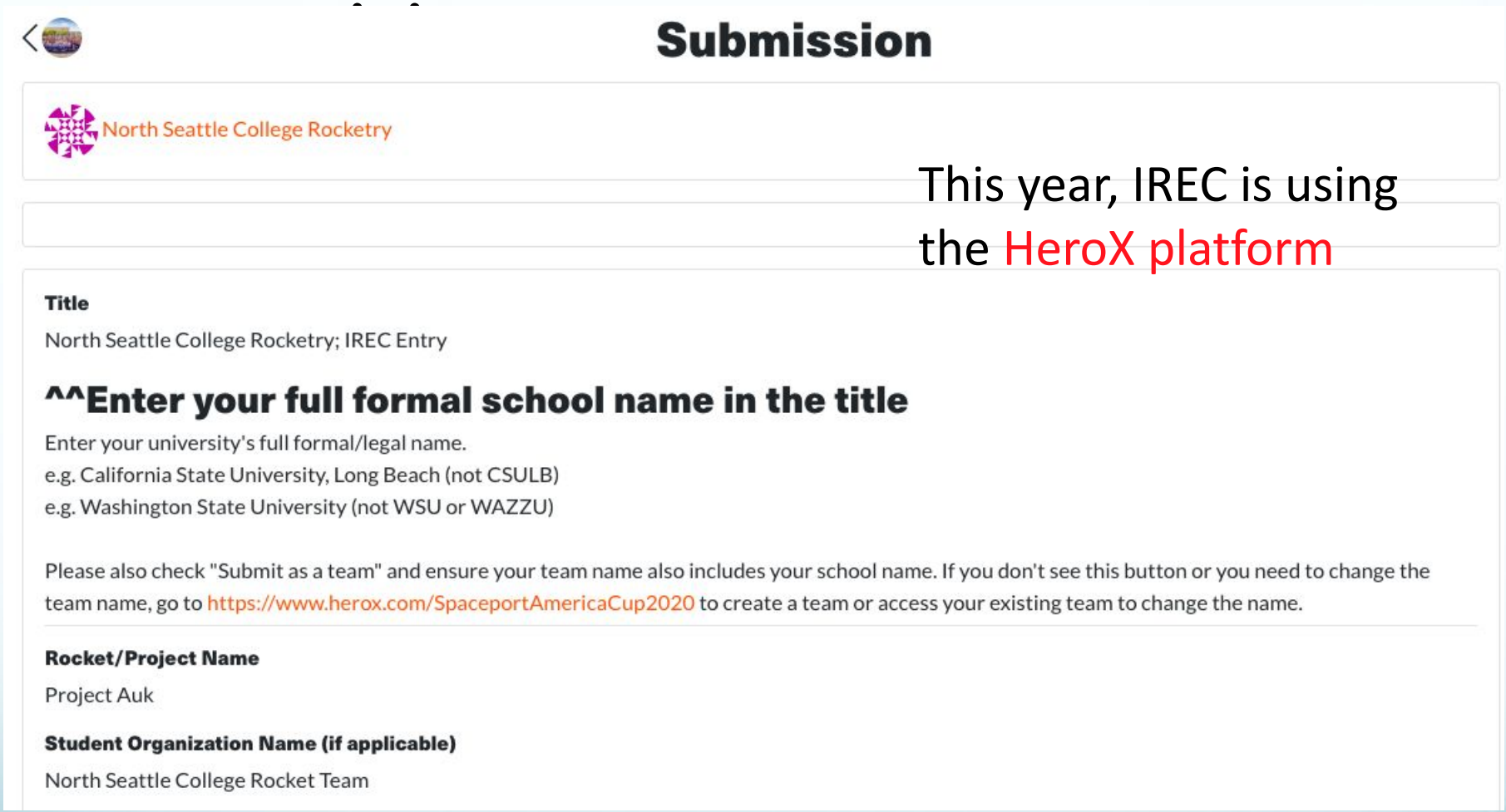
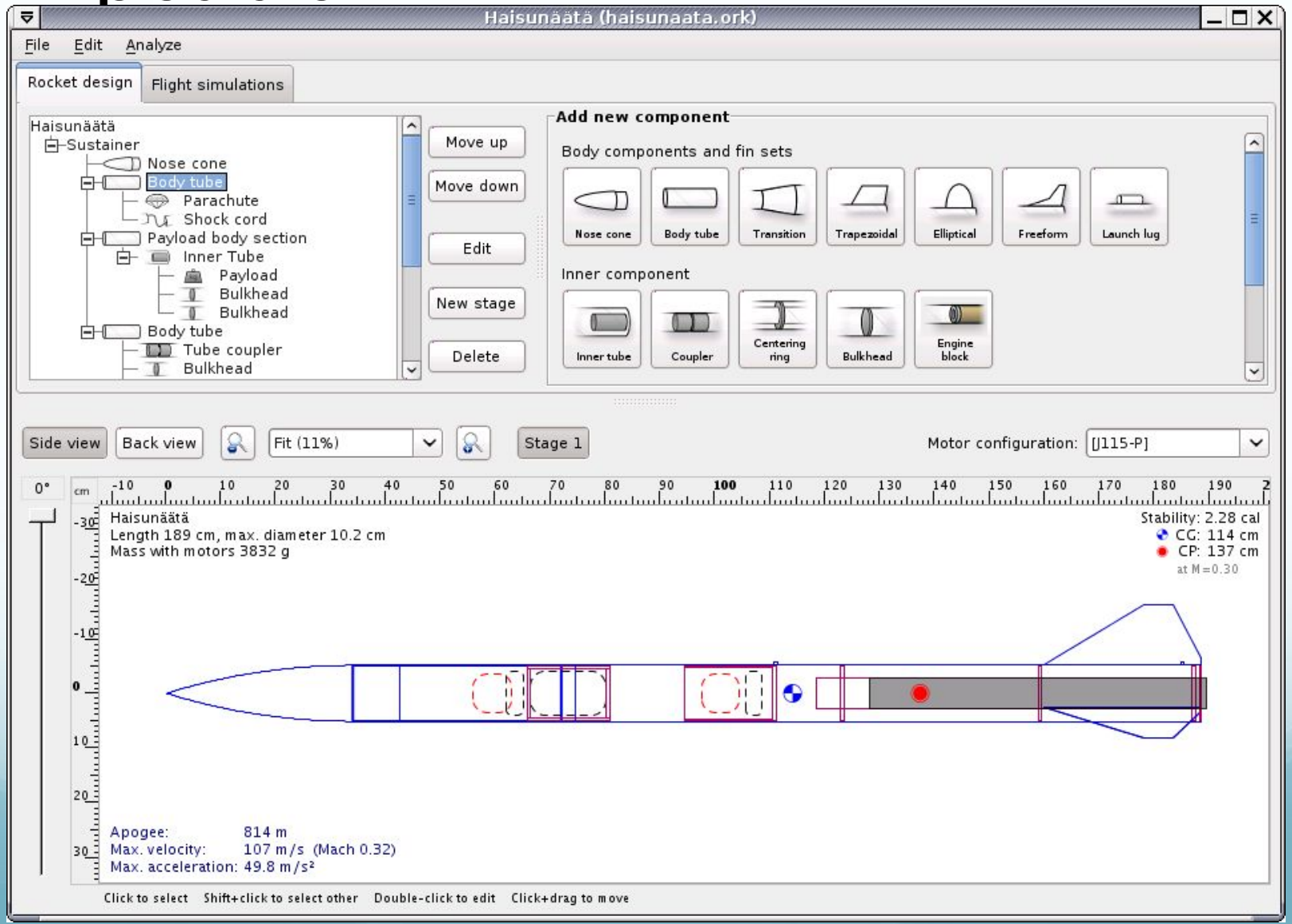


Throughout the year, the IREC judging committee requires lengthy technical reports, which makes sense, since you are sending a heavy

The competition

Using a simulation program (RockSim), your team must show the rocket's flight characteristics, including max altitude.



The competition

During April and May, the club tests the airframe, decoupling system, onboard computer and payload in a series of test launches at the Washington Aerospace Club's Mansfield site.

We will not be able to use this site this year, so we will most likely use the Oregon Rocketry Club's (OROC) Brothers, Oregon site.

Testing the rocket at Mansfield with an M motor

The competition

In the weekend after final exams in June, we drive the completed rocket and team members about 2200 km southeast to the New Mexico desert. This distance is similar to the distance from Blagoveshchensk to Shanghai.

The competition

The first day of the competition is the judging of the rockets: this is held at the Las Cruces Convention Center, and lasts all day.

The competition

The remainder of the week is spent at the launch site near Spaceport America. Teams set up a “camp” with their own tents and tables and vehicles. Temperatures range from 5°C at night to 40°C in mid-afternoon.

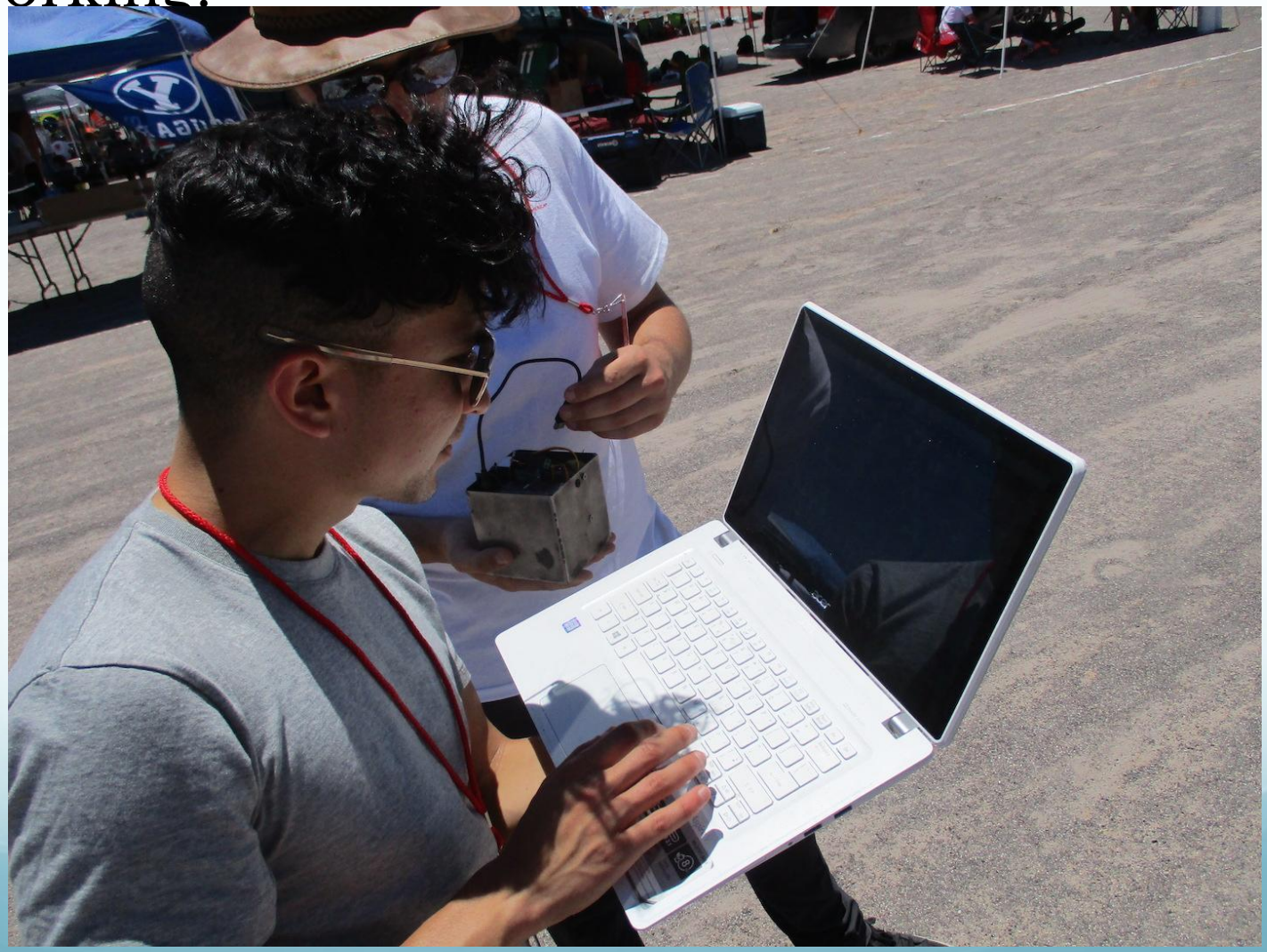
The competition

Teams competing, and launch times are precious

Flight #	Team ID	School or University	Category	Radio Freq	Flight Status
	41	Saint Louis University			
	42	Laval University			
	43	University of Calgary			
	44	Southern Utah University			
	45	University of Texas at Arlington			
	46	University of South Florida			
	47	McGill University	10k - COTS - All Propulsion Types		
	48	University of British Columbia			
	49	Queen's University			
	50	University of Minnesota - Twin Cities	30k - SRAD - Solid Motors		
	51	Polytechnic School of the University of Sao Paulo			
	52	New Mexico State University		906 MHz	
	53	University of Minnesota - Duluth			
	54	Oklahoma State University			
	55	University of Ottawa	10k - COTS - All Propulsion Types		
	56	Wrocław University of Science and Technology			
	57	Polytechnique Montreal	10k - COTS - All Propulsion Types		
	58	Polytechnique Montreal	30k - COTS - All Propulsion Types		
	59	Polytechnique Montreal			
	60	The Ohio State University	10k - SRAD - Hybrid/Liquid/Other		
	61	University of Illinois - Chicago		462.550	
	62	North Seattle College			
	63	Union College	10k - COTS - All Propulsion Types	915 mhz ch17	
	64	Universidad Aeronáutica en Quéretaro			
	65	University of Illinois - Chicago			
	66	Military Technical College			
	67	Military Technical College			
	68	Military Technical College			
	69	Washington State University Vancouver			
	70	University of Nevada - Reno			
	71	Purdue University			
	72	California State Polytechnic University - Pomona			
	73	Instituto Tecnologico de Aeronautica			

The competition

- Anything that worked in lab stop working!

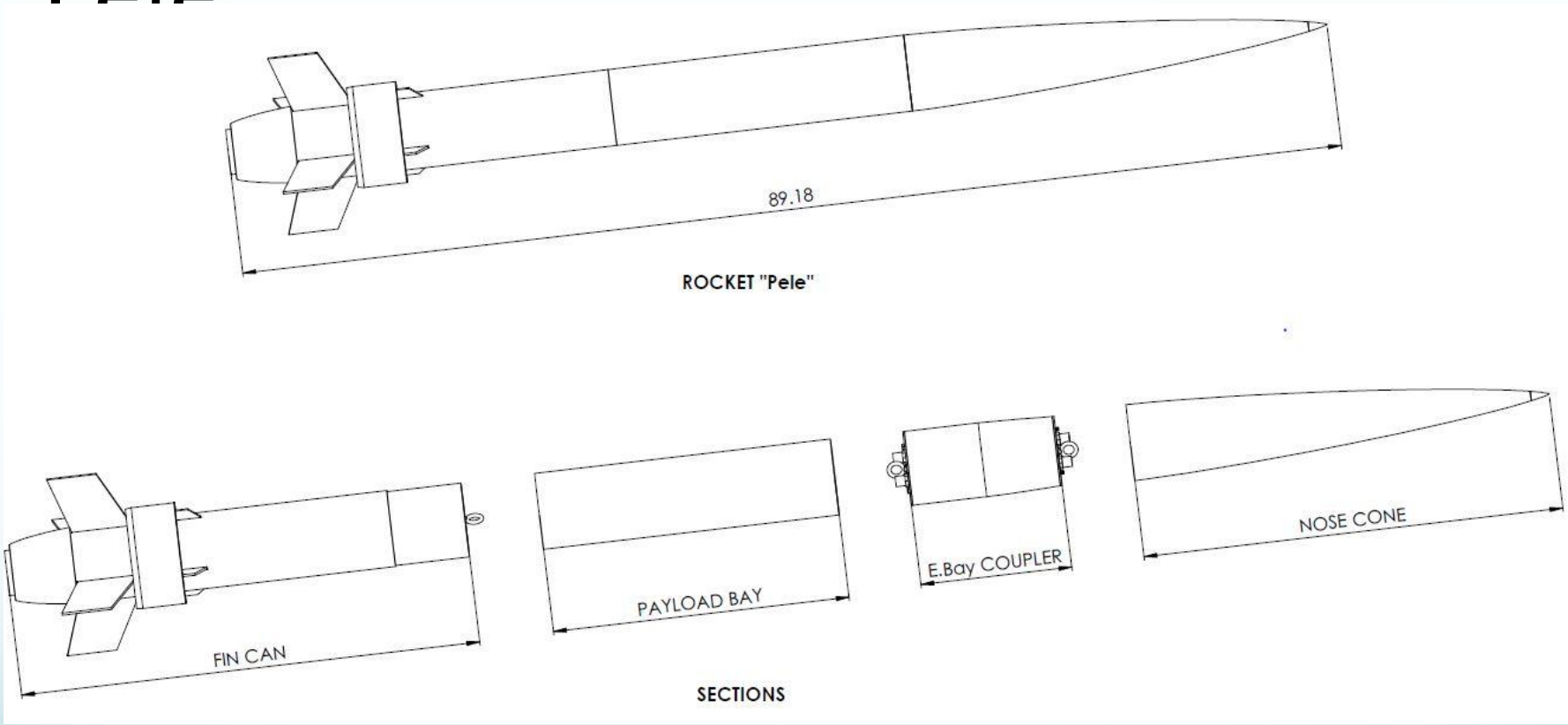


The competition

But it's all worth it when it launches...

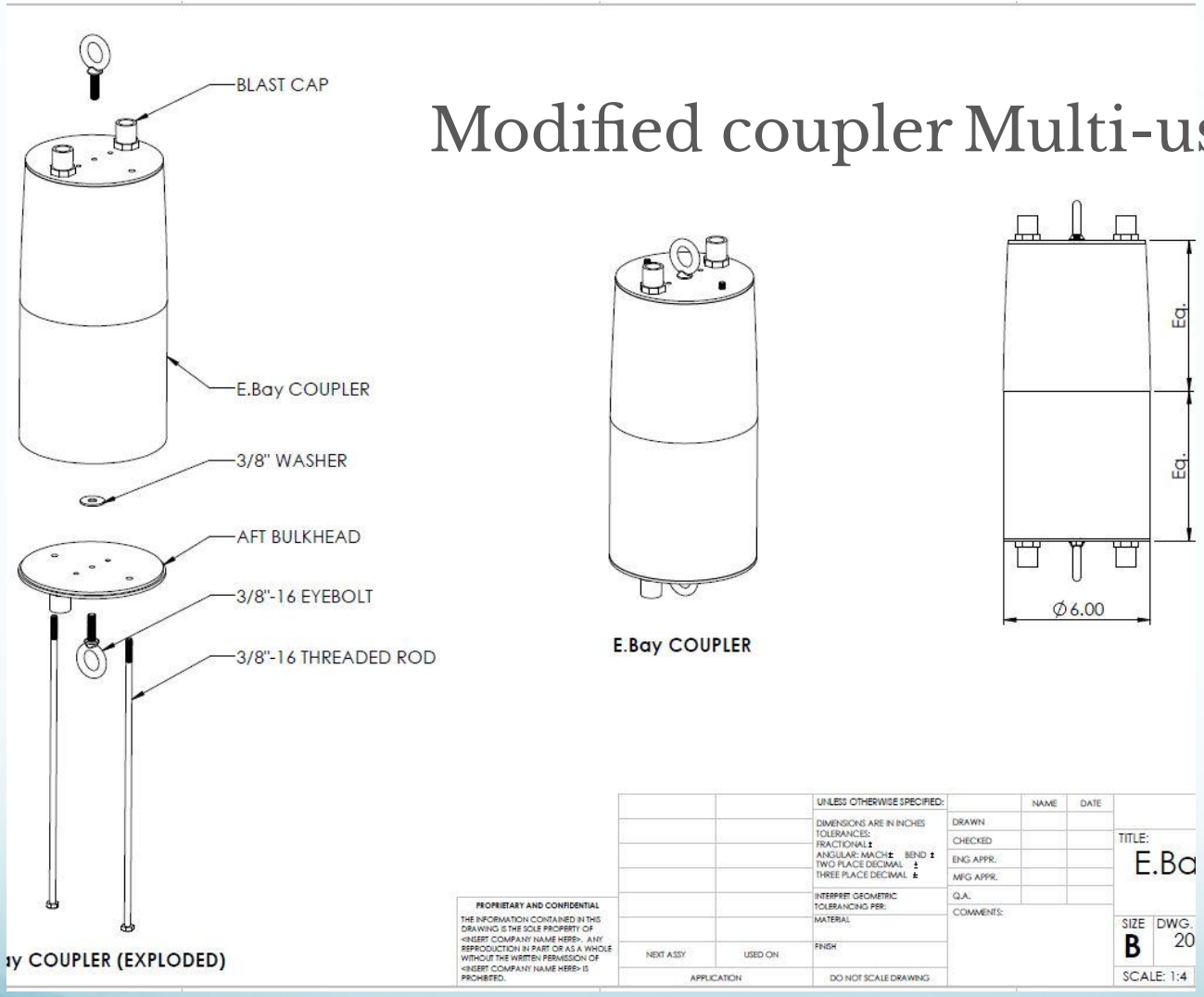
2017 Project Aquilla

2018 Project Pele

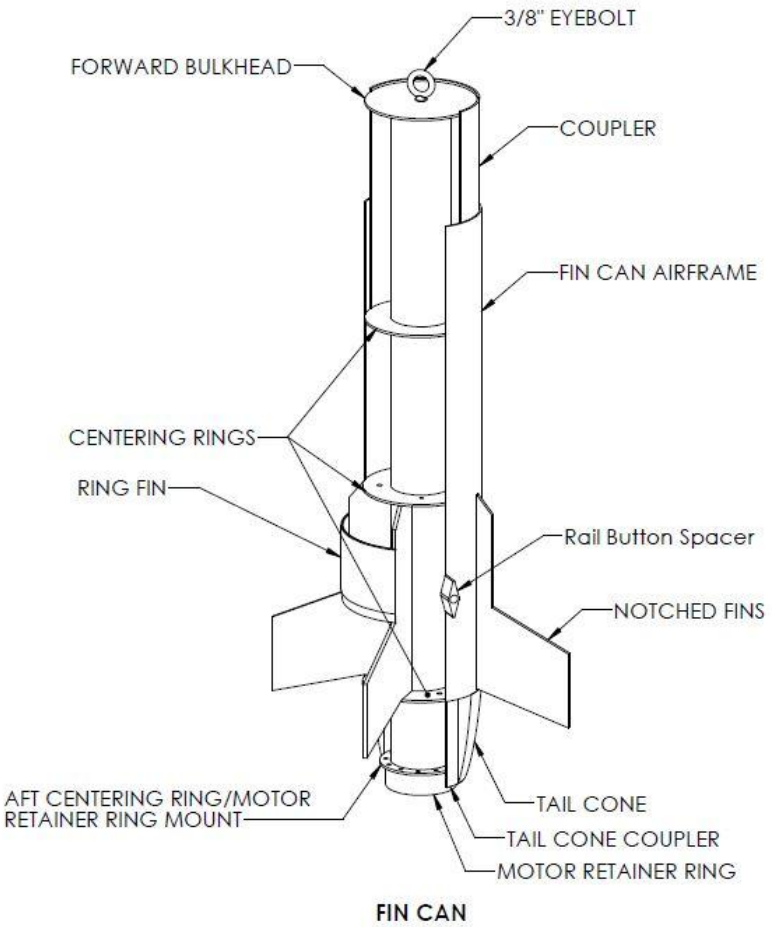


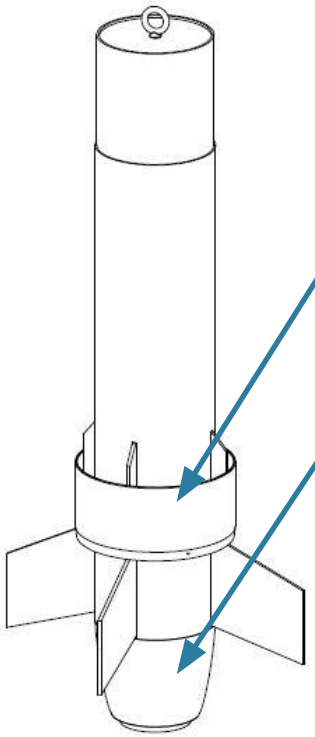
Details of the electronics bay

Modified coupler Multi-use fasteners



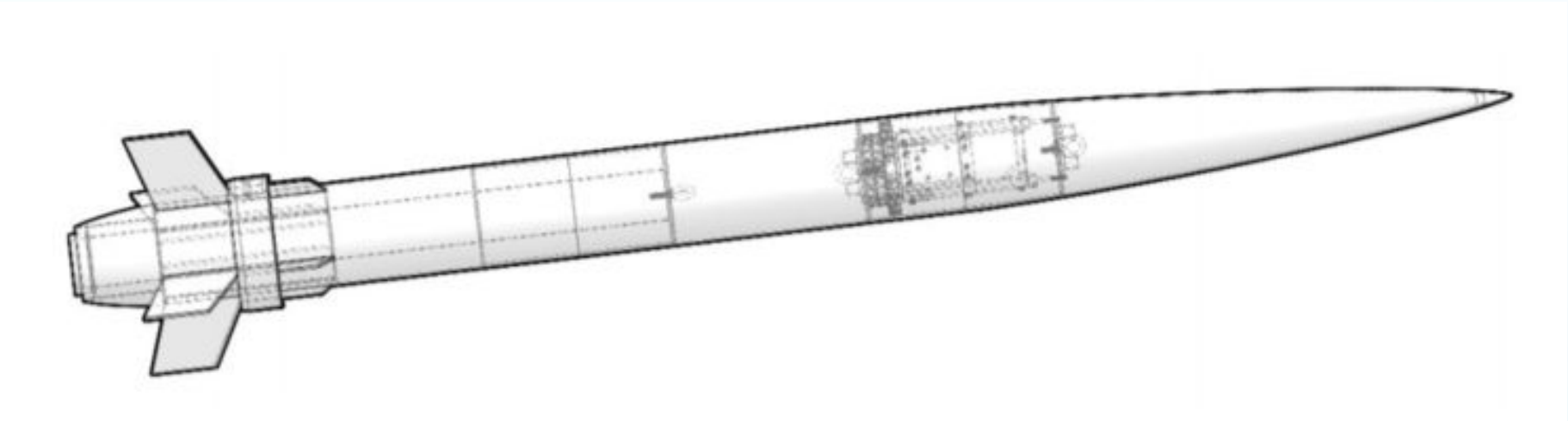
Details of the electronics





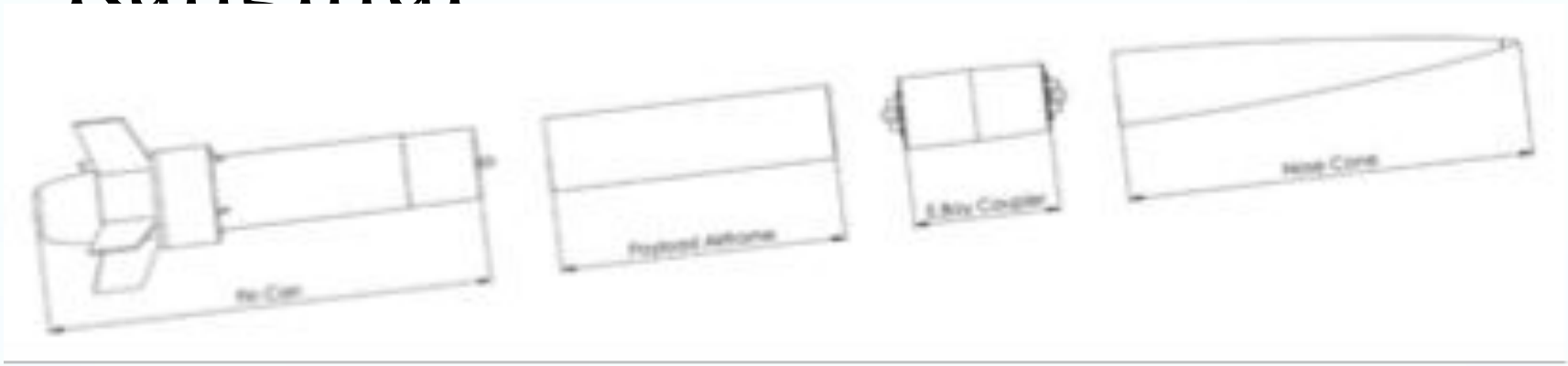
- Modular ring fin design
- Tail cone made of 3D printed carbon reinforced PLA

2019 Project Ranginui



Dimensions: 2.67 m long, 15.2 cm outer diameter

2019 Project Ranginui

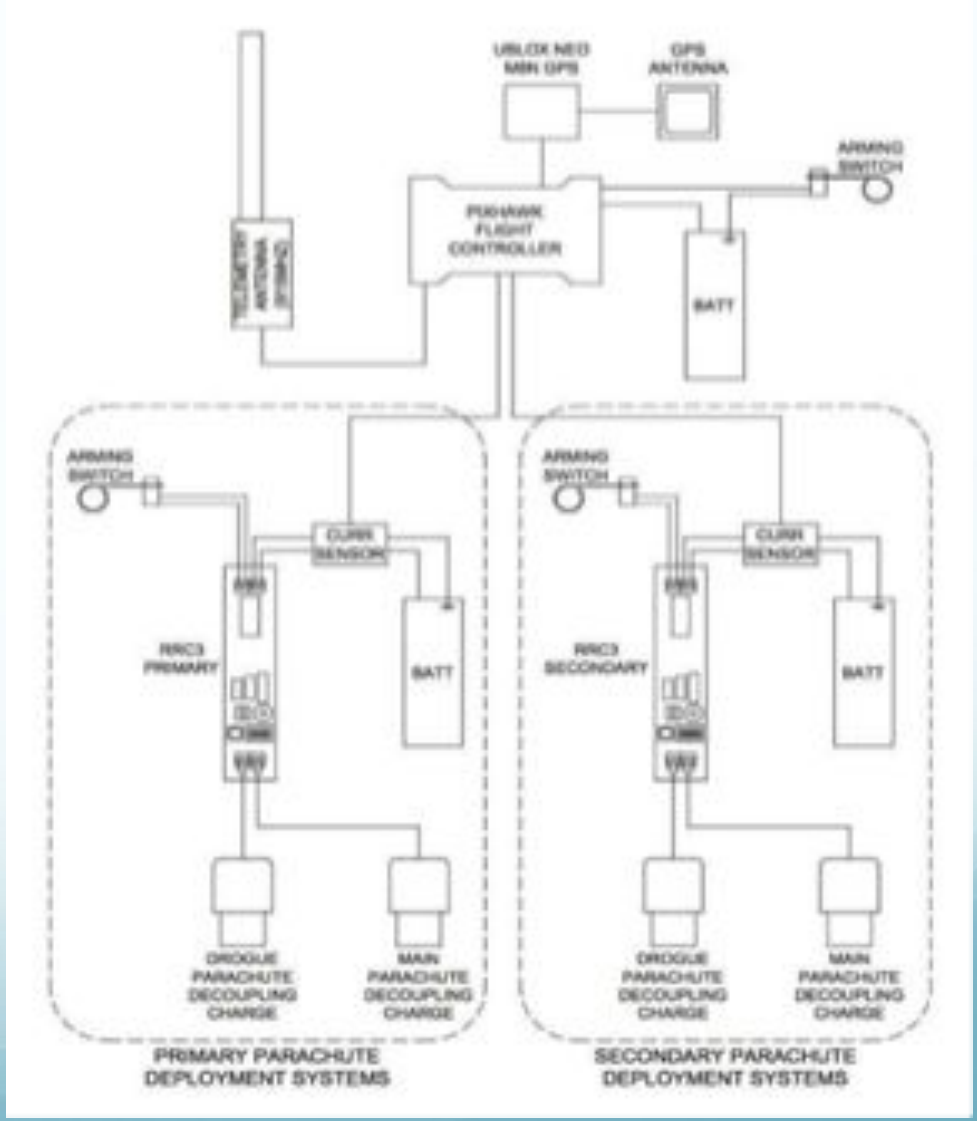


Single-stage, solid-motor (M2500), apogee separation via electronically-triggered black powder discharge, payloads also ejected by electronically-triggered black powder discharge

2019 Project Ranginui

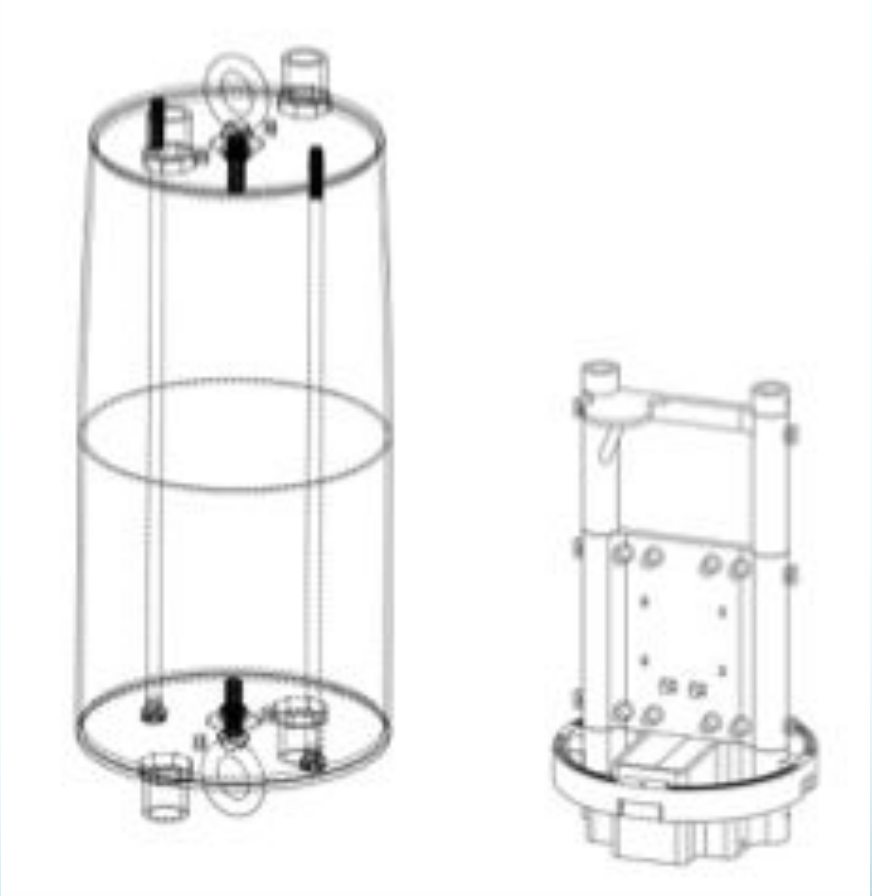
Two parachutes: the drogue (apogee deploy) and the main (300 m deploy), both with a back-up system.

GPS monitors altitude, with real-time telemetry sent to a base station laptop in camp.



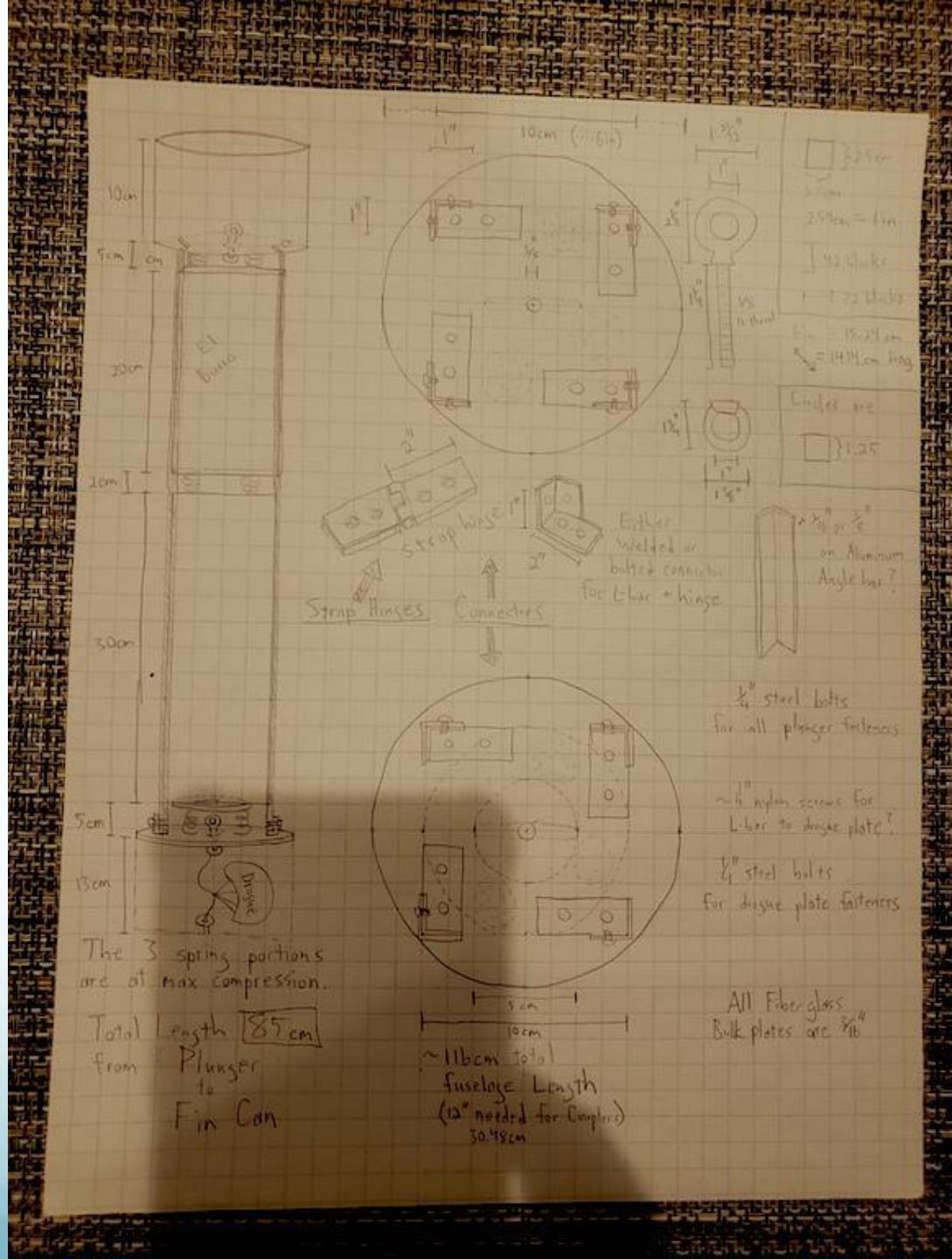
2019 Project Ranginui

Detail of the electronics bay (“e-bay”): secured with eye bolts on either side. The electronics is secured to the “sled” (right), and is shielded from the separation black powder charges (top and bottom)



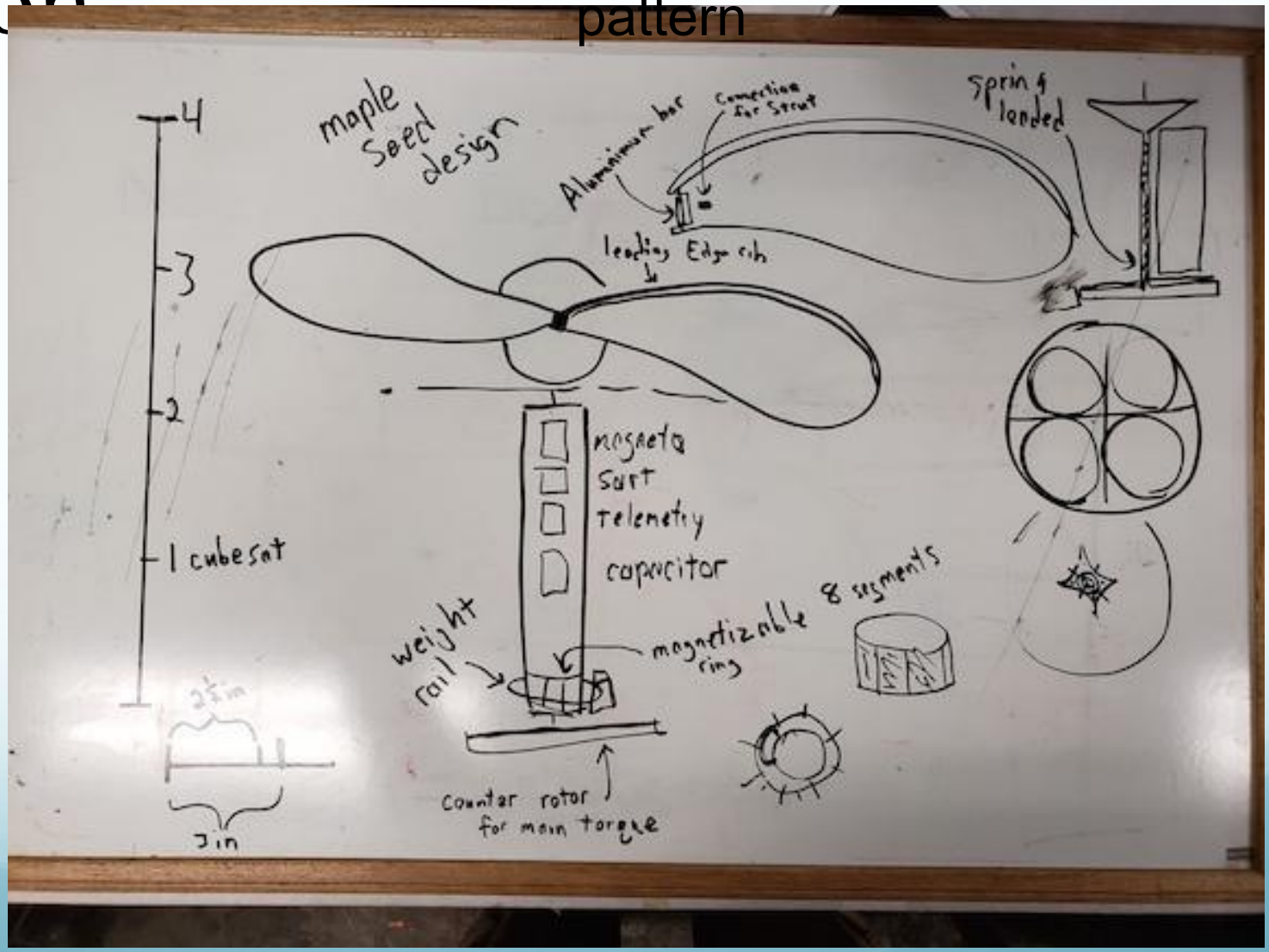
The payload section

The payload will be approximately 4 u in volume, with the “front” (coupler-side) 3 u reserved for the Amur State payload.



The payload section

The NSC payload is an autonomous glider with a preset spiral descent pattern



2019 Project Ranginui

The first day, at the Las Cruces Convention Center, the present-
ation went well. People liked the
idea behind the АмГУ payload.

2019 Project Rangimai

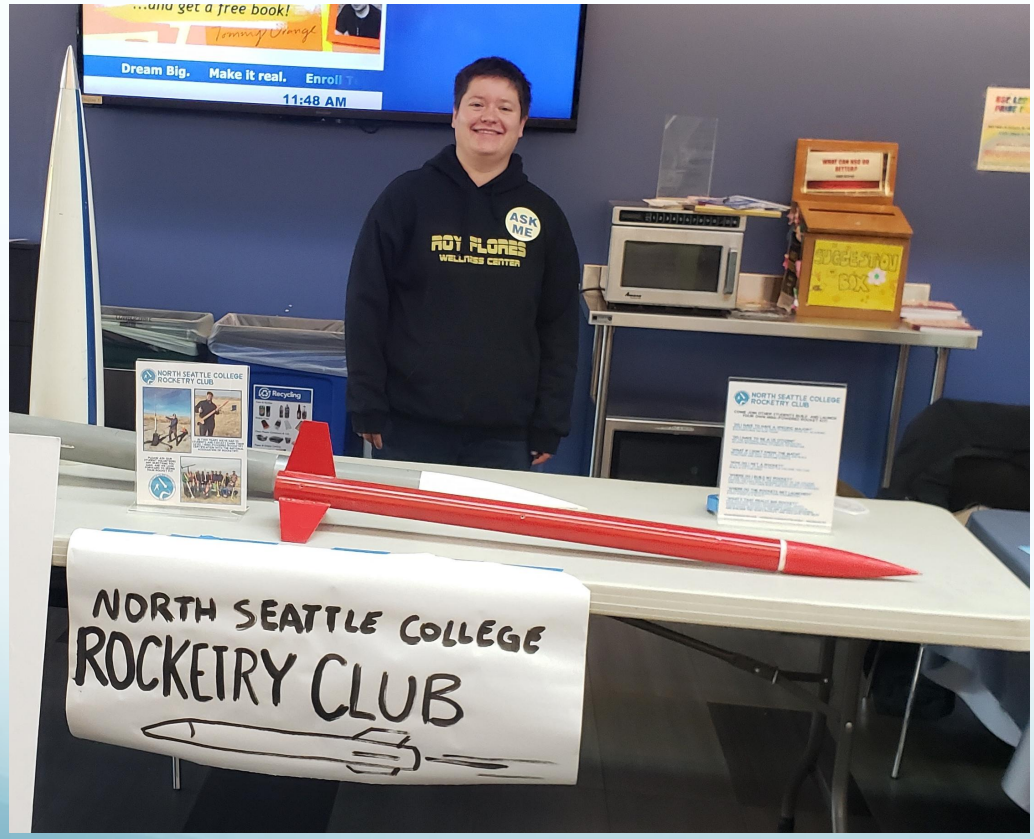
The result was less positive than we had hoped. When we arrived in New Mexico, we had still not tested the parachute deployment system. So we had to do that in someone's backyard.

2019 Project Ranginui

By the time we were ready to launch, the desert winds had started, and all launches were cancelled. Ranginui never left the launch-pad.

2020 Project Auk

Our team this year is Alex Langenstein and Matt Ehresman



2020 Project Auk

Therefore, this year, we decided to simplify the project that we could finish building and testing in Seattle by May. So we will make
a single-stage rocket and use a single M1850W motor (impulse = 7658.6 Ns) to achieve 10,000 feet altitude with a single “dummy” payload — or maybe yours!

Rocket Information

Overall rocket parameters

Airframe Length (inches)

105 = 2.7 m

Airframe Diameter (inches)

6 = 15.24 cm

Fin-span (inches)

6.6" fin height / 3-fins / 12.6" including airframe

Vehicle weight (pounds)

30 = 13.6 kg

Propellent weight (pounds)

15.5 = 7.0 kg

Payload weight (pounds)

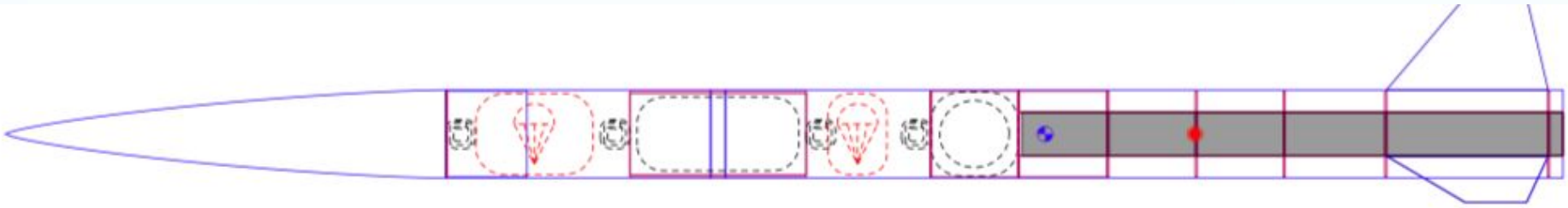
8.8 = 4.0 kg

Liftoff weight (pounds)

54.3 = 24.6 kg

Number of stages

1



2020 Project Auk

Rocket

Stages: 1

Mass (with motor): 19785 g

Stability: 1.7 cal

CG: 180 cm

CP: 206 cm

M1850W-0

Altitude	3151 m
Flight Time	206 s
Time to Apogee	24.2 s
Optimum Delay	17.8 s
Velocity off Pad	31.9 m/s
Max Velocity	292 m/s
Velocity at Deployment	20.8 m/s
Landing Velocity	5.93 m/s

Motor	Avg Thrust	Burn Time	Max Thrust	Total Impulse	Thrust to Wt	Propellant Wt	Size
M1850W	1354 N	5.41 s	2411 N	7366 Ns	6.98:1	3979 g	75/935 mm

What's next?

We will need some information from you!

- What is the final weight of your payload?
- What is the g load tolerance?
- What orientation will the payload need, and will there be a solid face on the forward end?
- What power will be required from the flight controller?
- Do your electronics have a back-up system?
- How will the payload be shipped? That is, how much assembly will the payload require once it arrives in Seattle?
- What data should we be recording?
- What do you consider a successful mission?