Presentation Script.

Slide 1

Hello and welcome to our presentation. Our project is on Materials Testing for Heatshield applications during Cubesat Re-entry with passive demise. The long-term aim would be to provide a commercial platform that could become an industry standard for testing materials for heatshield purposes.

Slide 2

Here is the outline of our presentation.

Slide 3

Here’s a summary of our objectives. Our Primary or “Critical” objectives are, as already discussed, providing a commercial platform for testing heatshield materials. For the mission to be any sort of success we’ll need to successfully transfer test data back to earth before demise occurs, otherwise all we’d be doing is dropping a very expensive brick out of low orbit for nothing. Our third critical objective is to ensure the CubeSat fully demises before reaching Earth, to avoid any potential damage due to ground impact. We’ll ensure that this occurs using Thermite, which will be discussed later on.

Slide 5 – CubeSat design.

I’ll quickly talk you through some of the key design parameters and goals for our Sat. Firstly the 8U Sat in a cube configuration is important as the symmetrical shape promotes tumbling, hopefully ensuring even testing on all faces. Aluminium alloys are commonly used in aerospace applications due to their relatively high strength and low weight. Naturally the CubeSat will be coated in our test material. If this material can’t be transmitted through, we’ll need to replace a central portion of each face with a known ablative that can be transmitted through to ensure we can still communicate. We anticipate a mass of around 12kg, for which a central COM is critical for even tumbling and effective control with the reaction wheels. The on-board computer and comms array will be prioritized for centrality to keep transmission going as long as possible.

Slide 7 Launch

We’ve decided on RocketLab for our launch provider, mainly due to their altitude flexibility. Their rideshare can deploy at least as low as 400km, or even lower – which we have inquired about but haven’t received a response. They also have the capability to deploy to several different altitudes in the same launch, meaning that we can jump on any rideshare and guarantee our target altitude will be available.

Slide 8 Vibrational analysis

It’s important our CubeSat survives launch, and one major risk is from the vibrational environment. To simulate this, the Sat was modelled as having discrete floors, where all mass was concentrated, and the columns supporting them as lateral springs. We could then setup a simple system of matrices to represent this configuration. This allows us to determine the natural frequencies for the and simulate the system in time using signals sampled from the power spectral density of the launch as an input. We can then use this to test different geometries prior to manufacture. This example shows a 5 second simulation of a 5-floor configuration, using 50 sampled signals, and L section columns for symmetry in 2 axes. The highest displacement recorded is naturally on the highest floor in the order of magnitude of 10^-4. Its important to note that this model doesn’t consider damping and is therefore an upper bound on expected behaviour.

Slide 20 Risks and Budget

I’ll quickly run through the risks and budget. There is a small, but quantifiable risk of colliding with other satellites, which should still be a low risk due to the short timeframe of our mission. Our biggest risk by far is collecting an insufficient amount of date due to internal temperatures getting high too quickly, causing critical electronics to fail, preventing the collection/transmission of data. Again, there would be a small risk of Earth impact, which is being eliminated by our use of thermite to force demise.

The costs at this stage our sadly still largely estimates. RocketLab is yet to respond with a number, so our mission cost is estimated from EnduroSat’s cost calculator. Furthermore, most of our chosen components weren’t listed with a price, so our component costs are estimated from a few known components. Compared to these costs, we expect manufacture and transport to be almost negligible. So overall cost would be in the ballpark of half a million pounds.

Slide 21 future work

From a mechanical perspective, a model of the cubesat and its frame still needs producing to guarantee all selected components fit in an appropriate manner and ensure the Sat will survive launch.

We would also like to come to more of a precise budget.