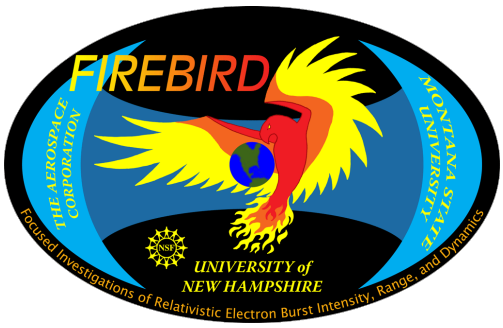
FIREBIRD



SMAP Verification Report

ODAR Mission Description
FB-A-0706
Rev 2.0

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1. Purpose

The purpose of this document is to summarize the ODAR inputs provided by the FIREBIRD mission in order to complete the requirements as set forth in section 3.2.10 of the SMAP CubeSat to PPOD ICD.

2. SMAP ODAR Inputs (3.2.10)

FIREBIRD – Montana State University – 1.5U CubeSat (Qty 2)

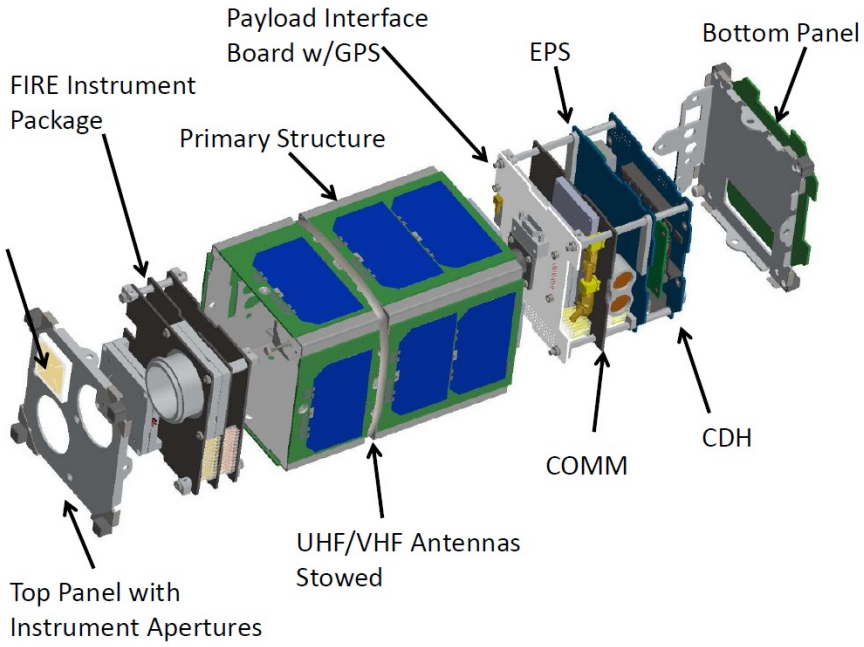

Figure 1 Exploded view of the FIREBIRD CubeSats

2.1 Mission Overview

FIREBIRD, which stands for **F**ocused **I**nvestigations of **R**elativistic **E**lectron **B**urst, **I**ntensity, **R**ange, and **D**ynamics, is funded by the National Science Foundation.

The mission is a targeted, goal-directed, space weather CubeSat mission to resolve the spatial scale size and energy dependence of electron microbursts in the Van Allen radiation belts. Relativistic electron microbursts appear as short durations of intense electron precipitation measured by particle detectors on low altitude spacecraft, seen when their orbits cross magnetic field lines which thread the outer radiation belt. Previous spacecraft missions (e.g., SAMPEX) have quantified important aspects of microburst properties (e.g., occurrence probabilities), however, some crucial properties (i.e., spatial scale) remain elusive owing to the space-time ambiguity inherent to single spacecraft missions. While microbursts are thought to be a significant loss mechanism for relativistic electrons, they remain poorly understood, thus rendering space weather models of Earth's radiation belts incomplete. FIREBIRD's unique two-point, focused observations at low altitudes, that fully exploit the capabilities of the CubeSat platform, will answer three fundamental scientific questions with space weather implications:

What is the spatial scale size of an individual microburst?
What is the energy dependence of an individual microburst?
How much total electron loss from the radiation belts do microbursts produce globally?

This mission is managed and built Montana State University with payload development taking place at the University of New Hampshire. Other mission and science partners include the Los Alamos National Laboratories and the Aerospace Corporation.

2.2 CONOPS

The CubeSats will deploy out of the P-POD and when the system turns on thereafter a 45 minute timer begins to tick. After 45 minutes, the flight computer will engage the antenna deployment sequence and the system will begin UHF beacon transmissions at a 15 second cadence. The payloads, which are solid state particle detectors, are powered on following the automated antenna deployment sequence and the mission will begin gathering science data. Periodic downlink of science telemetry will take place only when initiated by the ground station at MSU. After the initial contact is established with the CubeSats, the

beacon cadence is increased to a 30 second cadence. This mission is set to last 3 months nominally with an extended period of 6 months pending vehicle performance and operations funding.

2.3 Materials

The CubeSat structural components are made of the following aluminum alloys: 5052-H32, 7075-T6, and 6061-T6. It contains all standard commercial off the shelf (COTS) materials, electrical components, PCBs and solar cells. The GPS patch antenna radio uses a ceramic patch antenna and the UHF/VHF antennas are made of spring steel.

2.4 Hazards

There are no pressure vessels, hazardous or exotic materials.

2.5 Batteries

Characteristics of the batteries are shown in Table 1 The Tenergy ICR18650-2600 batteries are Underwriters' Laboratories (UL) recognized, as shown in Table 1. There are no modifications to the cell cases as tested by UL and they are considered safe for travel. The CubeSat is powered off the entire time it is at the launch site. There is no physical access to the CubeSat while integrated in the P-POD at the launch site, so it is not possible to perform battery charging operations at the launch site. They also contain overcharge/undercurrent circuitry protection.

Table 1 - Battery Specifications

Item	Description
Manufacturer	Tenergy
Model #	ICR18650-2600
UL Listing #	MH48285
Quantity of Batteries	2 (in series)
Maximum Voltage	4.2 Volts (per cell)
Capacity	1300 mAh (per cell)