CALL FOR DESIGN & PROTOTYPE IDEAS FOR A GUIDED DATA VAULT RECOVERY

The FLOATing DRAGON (**F**ormulate, **L**ift, **O**bserve, **A**nd **T**esting; **D**ata **R**ecovery **A**nd **G**uided **O**n-board **N**ode) Balloon Challenge (aka, FLOATing DRAGON) was developed to provide increasing opportunities for academic research institutions to contribute to NASA's Science Mission Directorate's (SMD) mission.

There is a need for accessing data from upcoming balloon missions such as SuperBIT and TAURUS, which are proposing to collect prohibitively large amounts of telemetry data (i.e., terabytes). To overcome this challenge, data recovery systems can be developed which drop data vaults for recovery. NASA is actively playing a role in the design, testing, and maintenance processes of these data vault drops to increase public safety. The trade space for this type of data recovery systems is large, and there is room for many creative ideas for NASA to consider from the university community. **Through the FLOATing DRAGON Challenge, NASA seeks innovative ideas and prototypes for a guided data vault recovery system consisting of: 1) a deployer that can be mounted to a HASP-type balloon gondola; and 2) a node that can be dropped and fall gracefully to a pre-determined, safe waypoint for recovery.**

Initial participation involves the development of a Preliminary Design Review (PDR) submission package. After receiving feedback from the judges on the PDR, teams will have another opportunity to submit their final proposal via a Conceptual Design Review (CDR) package. Based on a review of the CDR submissions, approximately four teams will be chosen to build and test their data recovery prototypes. Each finalist team will be paired with a NASA Mission Manager in the Balloon Program Office at Wallops Flight Facility, who will provide technical guidance for several months to help refine the team's design and get it flight ready. Upon successfully passing a rigorous mission review process, finalist teams will ultimately be able to conduct a test drop of their data recovery system in Ft. Sumner, New Mexico in August 2023.

For full competition details, visit https://FLOATingDRAGON.nianet.org

IMPORTANT DATES

September 15, 2022
Notice of Intent (NOI) to participate deadline

October 20, 2022
Preliminary Design Review (PDR) submission deadline

January 8, 2023
Conceptual Design Review (CDR) submission deadline

January 30, 2023
Teams are notified of their selection status

August 15, 2023
Integration and Testing at Ft. Sumner, NM

ELIGIBILITY

FLOATing DRAGON is open to teams of undergraduate and graduate students studying at an accredited U.S.-based college or university. (See website for full eligibility requirements).

Interdisciplinary teams and Minority Serving Institutions are encouraged to apply.

PRIZES & AWARDS

Up to four teams will be selected as finalists, each receiving $5,000 and a hardware package from NASA.

The top winning team may have the opportunity to infuse their technology into NASA development!

FLOATing DRAGON Concept of Operations (CONOPS)

OBJECTIVE:

The FLOATing DRAGON Balloon Challenge (aka, FLOATing DRAGON) asks collegiate students to develop a concept and preliminary prototype for a system capable of delivering a data vault to the ground in a guided, safe manor without subjecting the data vault to a harsh environment.

DRAGON DELIVERABLES:

- One (1) deployment subsystem
- One (1) node subsystem
- One (1) final report containing an overview of the test flight, data collected, and system performance
- A folder containing all applicable data collected during the test fight

Teams will design their deployer to mount to a HASP-type gondola. The deployer will be commanded by an electronic signal provided by the on-board telemetry system provided by NASA's Columbia Scientific Balloon Facility (CSBF) to drop the node. In flight, teams will have up to two hours post-float to release their node. NASA will provide a trajectory predict and sounding file, and the teams will tell NASA when to drop the node. Once the node is released from the deployer with the data vault, it must autonomously select the predetermined waypoint and travel to the ground. Waypoints will be predetermined and approved by Flight Safety before being provided to the teams.

DESIGN GUIDELINES, REQUIREMENTS, AND CONSTRAINTS:

- **Initial Drop Altitude Range:** 33.5 to 36.5 km (110,000 to 120,000 ft)
- **Weight:** Total system mass is limited to 10 kg (22 lbs) or less
- **Shock:** Both the deployment subsystem and node must be able to survive a 10g shock or higher without yielding
- **Environment:** Must be able to withstand temperature ranges between -70C to +65 C; -30C nominal at 36.5 km (120,000 ft) or 4 mBar to 11 mBar
- **Dimensions:** The deployment subsystem must fit within 120 cm x 45 cm x 45 cm and be able to house the node subsystem until deployment.
- **The Payload (i.e., node subsystem)**: 1 x data vault: Volume 12.5 mm x 75 mm x 100 mm; 1 kg (will be provided to each finalist team)
- **Deployment:** Deploy when receiving a signal from the gondola.
- **Mounting:** System must mount vertically to 2" Aluminum 'L' channel with (3) ¼-20 bolts on 100 mm (~4-inch) spacing
- **Descent time:** 1.5 hours or less
- **Accuracy:** Node should land within 0.25 km (820 ft) radius of the targeted coordinate
- **Communications:** If using a computer or microcontroller, one physical point of communication (e.g., USB port, Ethernet port, etc.) is required on the outside of the deployment subsystem to verify operation post compatibility test.
- **Safety:** Fail safe is required in the event of loss of power (to the system). ***System must retain the node in the event of a failure to drop*** (i.e., an attempted deployment of the node which results in the node staying attached to the deployer).
- **Compliance:**
  - Structure must comply with the Gondola Structure Design Requirements (SDR) PG (820-PG-8700.0.1) design requirements for piggybacks (MOOs). See https://www.csbf.nasa.gov/docs.html
  - Software must demonstrate the ability to autonomously find and guide to the selected waypoint for simulated balloon trajectories and wind profiles (provided to the team) with >95% confidence. See SDR: https://www.csbf.nasa.gov/docs.html

SPECIAL ATTENTION SHOULD BE GIVEN TO THE RECOMMENDED DESIGN ASSUMPTIONS:

- Cost-effective solutions
- Operational use and simplicity
- Design for the appropriate environment
- Remote deployment from a NASA gondola
- Data rate requirements for data downlink (if necessary)
- Innovative design
- Effective packaging
- Credible fabrication and material selection

NOMENCLATURE

For the purpose of this document, the following applies:

- The "**payload**" is a data vault which stores scientific data (sensor measurements, images, etc.) which must be delivered to the ground intact and without damage.
- The "**deployment subsystem**" or "**deployer**" refers to the deployment box, tube, plate, etc., that physically mounts to the gondola. This subsystem is expected to stay attached to the gondola throughout the flight and interface to the gondola mechanically and via power.
- The "**node subsystem**" or "**node**" is the subsystem which is intended to detach from the gondola and deliver the payload to the ground.
- The "**prototype system**" refers to the entire student-provided system and includes the deployment subsystem and the node subsystem.

PROHIBITED ITEMS

- Thrusters
- Rocket motors
- Liquid propellants
- Rocket engines (i.e., no SpaceX-style or JPL sky-hook landing systems)
- Compressed gases (i.e., no balloons or blimps attached to the node)
- High-voltage sources greater than 50V
- Excessively large magnets (electromagnetic or otherwise)
- Batteries without UL certification
- Chutes/drag systems unallowable by FAA limits

FLOATing DRAGON is managed by the National Institute of Aerospace on behalf of NASA's Wallops Flight Facility's Balloon Program Office.

National Institute of Aerospace

https://floatingdragon.nianet.org