NASA'S FLOATING DRAGON BALLOON CHALLENGE

2022-2024

The FLOATing DRAGON Balloon Challenge is managed by the National Institute of Aerospace (NIA) on behalf of the National Aeronautics and Space Administration (NASA)

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CHANGE LOG

1. 8/2/22 – Change Made regarding eligibility of Foreign Universities
2. 11/7/22 – Change made regarding the use of hand drawings for the CDR submission
3. 11/7/22 – Change made to include an updated video with the CDR submission
4. 11/7/22 – Change to include Verification Matrix Template and inclusion in the CDR submission
5. 11/7/22 – Change to include Structural Analysis Example and inclusion in the CDR submission

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Overview

The FLOATing DRAGON (Formulate, Lift, Observe, And Testing; Data Recovery And Guided On-board Node) 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's) mission. Sponsored by NASA's Wallops Flight Facility's (WFF's) Balloon Program Office (BPO), the FLOATing DRAGON Balloon Challenge is open to teams of undergraduate and graduate college students who have an interest in aviation, ballooning, and guidance, navigation, and control (GN&C).

Through FLOATing DRAGON, teams and their faculty advisors will design and prototype ideas for a guided data vault recovery system. 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's BPO 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 Balloon 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.**

FLOATing DRAGON allows students to augment their coursework in a real-world research and application environment, working together as teams to develop data recovery systems for high balloon flight tests. Interdisciplinary team composition is encouraged, and Minority Serving Institutions are encouraged to apply.

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 receive a small monetary award ($5,000) to help off-set costs associated with the development and construction of their concept and will also receive a standardized equipment and hardware package from NASA, including the data vault payload.

A unique component of the FLOATing DRAGON Challenge is that each finalist team will also be paired with a NASA Mission Manager in the BPO 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.

The winning team may have an opportunity to integrate their system into official NASA development.

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Background & Context for the FLOATing DRAGON Challenge

Dropping objects from a balloon at high altitude is a hazardous operation, posing risks to aviation as well as people and structures on the ground. The ability to accurately target a specific point on the surface and navigate to that point is an important factor in minimizing the risk to the public, which is an important part of the NASA safety process. The drop system would have to demonstrate reliability and resiliency under extreme conditions of temperature, various wind profiles, and aerodynamic forces experienced during the descent to impact. The ability to perform this task reliably and consistently would provide for a high level of confidence to the science teams who need a mid-flight recovery of data as well, and to safety for protecting the public.

Upcoming missions, like SuperBIT and TAURUS, require physical data recoveries, since the amount of science generated during a flight is prohibitively large and cannot be reasonably telemetered back to Earth during a scientific balloon mission. Previous design teams have undertaken the development of an unguided, commanded data recovery system utilizing a single board computer and microcontrollers, a custom command/control interface, a 3D-printed enclosure, and a parachute to retrieve data during flights in Canada[1]. Others have experimented with guided descent systems at high-altitude[2][3] with moderate success, yet no turnkey system exists today for the ballooning application. Several aspects of the aforementioned could benefit from improvement before being integrated into a NASA-operated balloon flight. Student-led teams are desired to align with the NASA Science Mission Directorate (SMD) Strategic Plan[4].

FLOATing DRAGON Concept of Operations (CONOPS)

OBJECTIVE

In 2023, 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.

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.

In accordance with the Procedures and Guidance (820-PG-8700.0.1), 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. *Nominal signal details will be provided on or about August 15, 2022.* 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).

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[1] Sirks et al, Download by Parachute: Retrieval of Assets from High Altitude Balloons. Preprint for JINST. 2021.

[2] Lee, Seong-Jin, and Andrew Arena. "Autonomous parafoil return-to-point vehicle for high altitude ballooning." In AIAA Guidance, Navigation, and Control Conference, p. 0974. 2014.

[3] Chin, Jeffrey, Justin Niehaus, Debra Goodenow, Storm Dunker, and David Montague. "Flight Analysis of an Autonomously Navigated Experimental Lander for High Altitude Recovery." (2016).

[4] https://science.nasa.gov/about-us/science-strategy

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Design Guidelines

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

REQUIREMENTS AND CONSTRAINTS

1. **Initial Drop Altitude Range:** 33.5 to 36.5 km (110,000 to 120,000 ft)
2. **Weight:** Total system mass is limited to 10 kg (22 lbs) or less
3. **Shock:** Both the deployment subsystem and node must be able to survive a 10g shock or higher without yielding
4. **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
5. **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.
6. **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)
7. **Deployment:** Deploy when receiving a signal from the gondola.
8. **Mounting:** System must mount vertically to 2" Aluminum 'L' channel with (3) ¼-20 bolts on 100 mm (~4-inch) spacing
9. **Descent time:** 1.5 hours or less
10. **Accuracy:** Node should land within 0.25 km (820 ft) radius of the targeted coordinate
11. **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.
12. **Safety:**
    a. Fail safe is required in the event of loss of power (to the system)
    b. ***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).
13. **Compliance:**
    a. **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
    b. **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

PROHIBITED ITEMS

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

PROPOSED SOLUTIONS MUST CONSIDER

The design package must include a Concept of Operations (ConOps) that clearly describes the complete lifecycle, including all design assumptions and address fabrication, transport, deployment, and operations. Proposing teams should clearly identify their assumptions and provide rationale to support them. Below are some recommended assumptions, but teams can adjust them if a good rationale to do so is provided.

- Cost-effective solutions
- Operational use and simplicity. Teams are encouraged to avoid concepts that are extremely complex as this adversely impacts fabrication and reliability, and increases risk.
- 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

ATTENTION SHOULD BE GIVEN TO

- Supporting engineering analysis and justification of assumptions (e.g., analysis of critical systems, including but not limited to the aerodynamics, power system, and structure of the node)
- Detailed flight characteristic profiles for all phases of flight

KEY ELEMENTS THAT EACH FLOATING DRAGON PROJECT WILL BE EVALUATED ON

- Adherence to the requirements and constraints of the design competition
- Realistic assessment of project schedule and test plan
- Feasibility and uniqueness of the technology being developed

Participation Awards and Hardware

Although the expectation is that teams will be largely self-funded, each finalist team will receive a $5,000 monetary award to off-set some development and participation costs.

- The award will be made to the **university** to help facilitate the team's participation in the Challenge – whatever that may be. It is at the discretion of the team's faculty advisor to determine how that money is best utilized.
- FLOATing DRAGON stipends may not be used to support travel for federal employees acting within the scope of employment. (This includes co-op students with civil servant status.) Students attending military institutions such as the Air Force Academy are under the same constraints.

Finalist teams will also receive a standardized equipment and hardware package from NASA, including:

- The "data vault payload" which includes an iridium-enabled GPS tracker and Trident shock sensor (TRIG)
- Miniaturized DINGO package - Onboard accelerator and gyroscopes to analyze system performance
- Mechanical interface, electrical interface, and cameras for drop confirmation

Prize

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

How to Compete in the FLOATing DRAGON Challenge

1. Thoroughly review this document (and the challenge website).
2. Find a qualified advisor and a team of students with diverse skills.
3. Ensure that your team meets the eligibility requirements.
4. Submit a Notice of Intent (NOI) by the deadline.

5. Develop and submit a Preliminary Design Review (PDR) by the deadline.
6. PDR submissions will be reviewed and evaluated by the FLOATing DRAGON judges, with feedback provided to each team.
7. Teams will take that feedback into consideration, update their systems accordingly, and submit a final Conceptual Design Review (CDR).
8. CDR submissions will be reviewed and evaluated by the FLOATing DRAGON judges.
9. Selected teams will advance and begin development of their proposed technology.
10. Finalist teams will be paired with a NASA Mission Manager to collaboratively manage development of the technology.
11. Finalist teams submit a Software Design Review (SDR).
12. Finalist teams will participate in multiple reviews with subject matter experts as they prepare for the test flight.
13. Upon passing Pre-Integration Review (PIR), the finalist teams conduct on-site integration, flight, and testing of their technology at Ft. Sumner, NM.
14. Upon completion of flight, data is returned to the finalist teams.
15. Finalist teams submit a technical report and technical poster with experimental results.
16. The winning team may be given the opportunity to incorporate their technology into official NASA development.

Eligibility

The FLOATing DRAGON Program is open to full-time or part-time undergraduate and graduate students at an accredited U.S.-based community college, college, or university. Teams may include senior capstone students, clubs, multi-university teams, or multi-disciplinary teams.

Teams may enlist the support of industry in the form of mentorship, access to facilities, donation of in-kind materials, and/or sponsorship, so long as the core prototype and concept is a product of the university.

COLLEGIATE DESIGN TEAMS MUST INCLUDE:

- Team sizes vary widely, but must contain, at a minimum, one (1) faculty advisor at an accredited U.S.-based academic institution, and two (2) students from that institution who work on the project and are able to participate in the on-site testing activities in Ft. Sumner, NM in August 2023.
    - There is no limit to the number of participants on each team, however, **a maximum of four (4) students and one (1) advisor can attend the on-site testing activities in Ft. Sumner, NM.**
    - Please note that due to prohibitive restrictions and ever-changing security regulations, **foreign nationals will not be able to attend the on-site activities at Ft. Sumner, NM.** There will be no exceptions to this policy.
- One faculty advisor is **required** to attend the on-site testing activities in Ft. Sumner with each team and is a condition for acceptance into the FLOATing DRAGON Balloon Challenge. Teams who do not have a faculty advisor present during the testing will be disqualified from competing and stipends will be subject to return to NIA.

SPECIAL ELIGIBILITY CONSIDERATIONS

- An individual may join more than one team.
- A faculty advisor may advise more than one team.
- A university may submit more than one proposal.
- Team members may not be federal employees acting within the scope of employment (this includes co-op students with civil servant status)

ELIGIBILITY STATEMENT REGARDING FEDERAL CO-OP INTERNS

Federal Co-Op Interns may participate in FLOATing DRAGON anytime when they are on Leave Without Pay (LWOP).

Special note regarding funds: FLOATing DRAGON funds cannot be used to support travel for Civil Service Interns who are operating in an active federal work status (i.e., when they are working and receiving pay).

FOREIGN UNIVERSITIES

Change Made 8/2/22: Students attending foreign universities can participate ***only*** as team-members/collaborators with a U.S.-led collegiate team. The U.S. team's primary advisor and student team lead will be the main point-of-contact between the joint team and FLOATing DRAGON staff. All foreign partnering universities must have a faculty advisor whose role is to facilitate the relationship between the U.S.-based university and the international university.

- Please note that due to prohibitive restrictions and ever-changing security regulations, **foreign nationals will not be able to attend the on-site activities at Ft. Sumner, NM.** There will be no exceptions to this policy.

Dates and Deadlines

All deadlines must be met by 11:59 p.m. EST on the date specified below, unless otherwise indicated.

DATE	DESCRIPTION
Friday, April 29, 2022	Q&A #1 for interested teams (2:00-3:30 p.m. EST)
Thursday, September 15, 2022	Notice of Intent (NOI) Deadline with initial concept details
Wednesday, September 21, 2022	Deadline for teams to submit questions in advance of Q&A #2
Tuesday, September 27, 2022	Q&A Session #2 for interested teams (2:00-3:30 p.m. EST)
Thursday, October 20, 2022	Preliminary Design Review (PDR) Package Submission Deadline
Monday, November 7, 2022	Teams receive PDR Feedback
Sunday, January 8, 2023	Conceptual Design Review (CDR) Package Submission Deadline
Monday, January 30, 2023	Selection Announcements are made; Teams receive CDR feedback; construction begins for four (4) finalists
Thursday, February 9, 2023	Stipends are sent to Finalist Teams
Thursday, May 18, 2023	Software Design Review (SDR) Package Submission Deadline
Sunday, July 2, 2023	Mission Readiness Review (MRR) Package Submission Deadline
Tuesday, August 15, 2023	Integration and Testing at Ft. Sumner, NM
Monday, October 16, 2023	Flight complete, data returned to students
Sunday, December 3, 2023	Finalist Teams' Technical Paper and Digital Technical Poster Deadline
Monday, January 8, 2024	Kickoff meeting with ETD for official NASA development

Notice of Intent

Notice of Intent deadline: 11:59 p.m. EST on September 15, 2022

Interested teams are strongly encouraged to submit a Notice of Intent (NOI) to compete by the deadline in order to ensure an adequate number of reviewers. Teams who submit NOIs by the deadline will be invited to participate in an exclusive Q&A session with the judges prior to the proposal due date. Please visit the *Submissions page* on the FLOATing DRAGON website to complete the brief online NOI submission form.

The following information will be requested on the NOI submission form:

- University name
- Partnering universities (if any)
- Contact information for the faculty advisor and student team lead
- Synopsis of the concept (3,000 characters max) providing a high-level overview of the potential concept(s)

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Preliminary Design Review (PDR) Package

PDR submission deadline: 11:59 p.m. EST on October 20, 2022

PDR EXPECTATIONS

- PDR packages (aka, proposals) should be 15-17 pages in length
- Proposals should clearly articulate the innovation and design being proposed, including original engineering analysis planned and/or in progress.
- Submissions must be original, the work must be of the Candidates, and must not violate the rights of other parties. Each submitting team represents and warrants that the team is the sole author and owner of the submission, that the submission is wholly original, that it does not infringe on any copyright or any other rights of any third party of which the team is aware, and that the electronic proposal and video submission is free of malware.
- Teams will receive written feedback from the NASA reviewers, detailing specific areas that proposers need to address in the follow-up Conceptual Design Review (CDR) package.

THE PDR PACKAGE SHOULD INCLUDE:

A cover page with the following information:

- University name
- Project title
- Full names of all team members [including faculty advisor(s)], along with major course of study and academic level of each student (undergraduate or graduate)
- Graphic or image of part of your system

Quad chart:

- **Quad Chart** (please use the Quad Chart Template on the *Resources tab* of the *Challenge Details* webpage)
  A Quad Chart is a way for teams to display some standardized information that helps evaluators quickly compare many projects. For the FLOATing DRAGON Challenge, teams must use the provided template to create a quad chart and insert the chart into their PDR. Quad charts must address:
  - The project description/requirements
  - An image/graphic of the concept
  - Current status of the project
  - Risks/Issues
  - Milestones

The body of the PDR package should outline/include (max 17 pages):

- **Summary Statement (Not to exceed one page)**
  An overall summary of the technology, including a title of the project, an overview of the proposed technology design/solution, a one paragraph statement on the proposed test flight, and a statement of the impact the innovative technology concept will have on NASA science missions/goals.

- **Project Description (Not to exceed 10 pages)**
  - What technology are you going to develop, and why is it important?
  - Describe how the concept adhered to the design constraints and guidelines.
  - Review the design at a system level, going through each system's functional requirements (include sketches of options, selection rationale, selected concept, and characteristics).
  - Describe the subsystems that are required to accomplish the overall mission.
  - Describe the performance characteristics for the system and subsystems and determine the evaluation and verification metrics.
  - Define the technical risks of the proposed technology. Demonstrate planning of manufacturing, integration, and operations (include component testing, functional testing, or static testing).
  - Include a sketch or image of the proposed technology.
  - Describe any planned testing and expected results. What do you hope to learn?

  - Include expected velocity descent profile.

- **Capabilities Statement (Not to exceed two pages)**
  - The relevant university/company affiliation, past experience, expertise and capabilities of the team members and faculty
  - Relevant facilities available to the team (either at the university or another source the team has access to)

- **Major Milestone Schedule (Not to exceed 2 pages)**
  - Include project initiation, design, manufacturing, verification, operations, and major reviews

- **Detailed budget (Not to exceed 2 pages)**

PDR Video

As a part of the PDR submission process, teams will be required to include a 2-minute video. The intent is for the video to augment each team's PDR package by including animation, graphics, or other creative ways of showcasing unique aspects of their proposed concept.

- Videos are limited to a maximum length of 2 minutes
- Videos should be uploaded to YouTube, and teams will provide their video's YouTube URL on the online PDR submission form. Other types of video files will not be eligible for consideration.
- Videos need to be publicly viewable via a link. Videos should be "Unlisted" or "Public" on YouTube. **Troubleshooting Tip:** YouTube accounts sometimes need to be verified prior to being able to fully upload videos.
- All team members should appear in the video, if at all possible (still images are OK)
- Your university name and project title should appear in text at the front of the video
- Do not use music or images which may violate copyright law. You may use images created by NASA. **It is the responsibility of the team to follow copyright law. Neither NASA nor NIA can approve the use of copyrighted material.**

PDR FORMATTING GUIDELINES

Teams are responsible for the formatting and appearance of their PDR packages. Figures and tables should be legible without magnification. We recommend teams use image files with a *minimum* dpi of 150.

- PDRs should be 15-17 pages in length.
  - The Cover Page, Table of Contents, Quad Chart, and Appendices **do not count** toward the minimum or the maximum page limitations.
  - **Appendices are to be used for references and calculations ONLY.** There is no preference in citation formatting, but references must be formatted uniformly and correctly. Just listing a link to the source is not acceptable.
    - Note: Judges are not obligated to look at the appendices. Include important details in the body of your paper to ensure they are reviewed.
  - Papers should be single spaced and single column.
  - Margins should be a standard 1" (2.54 cm) all the way around (top, bottom, left, and right).
- Please use fonts common to Macintosh and PC platforms, i.e., Times, Times New Roman, Helvetica, or Arial for text, Symbol for mathematical symbols and Greek letters.
- Font size should be 11 or 12 pt.
- PDR packages must be submitted as PDF files.

TIPS FROM THE JUDGES

- ***Proof-read and edit your PDR package!*** Report quality can impact the judges' scoring. Poor grammar, typographical errors, etc. do not reflect well on your team, and you will be evaluated accordingly.
- **Where there aren't specific requirements listed, research and justify your assumptions.** An important part of conceptual design is the ability to make reasonable assumptions to address uncertainties, and to understand the consequences of those assumptions.

- A picture is worth a thousand words and a well-conceived graphic can convey multiple pages worth of text and convey a deeper understanding of the problem and solutions. Pictures are a plus. Show us your innovation!
- If some results/details are not available yet or are still being finalized, it is still valuable to indicate that you will have them and how you are determining them. If it is not mentioned, judges will assume it is not being addressed.
- Make use of published papers and reports available to you on your chosen theme. See the *Resources tab* of the *Challenge Details page* for a preliminary list of resources and recommended reading. Cite your references; plagiarism of any kind will not be tolerated.
- Judges will provide feedback from the PDR in the form of directed and recommended action items that will need to be addressed in the CDR.

SUBMITTING THE PDR PACKAGE AND VIDEO

To upload your PDR package and video (pdf file and link), please visit the *Submissions page* on the FLOATing DRAGON website to complete the online PDR package submission form. Teams are encouraged to review the *Resources page* on the FLOATing DRAGON website, which provides resources to assist in the development of your PDR package.

No revisions can be accepted after submission, so please proofread your PDR and video files very carefully before submission. If there are any technical problems with the content of your PDF package or video (for example, your file was corrupted or a URL link was broken), we will try to contact you immediately, so it is very important that you provide us with up-to-date contact information on the submission form. **Late submissions will not be accepted**, and the submission form will close promptly at midnight.

The following information will be requested on the PDR Submission Form:

- University name
- Partnering universities (if any)
- Project title
- Lead Faculty advisor & additional faculty advisor (if any) contact information
- Student team lead contact information, along with university name, major course of study and academic level of each student (undergraduate or graduate)
- Full names of all team members, along with university name, major course of study and academic level of each student (undergraduate or graduate)
- File upload for PDF PDR package document (Max 95 MB)
- URL link for team YouTube video
- A 2-3 sentence synopsis of the proposed project that briefly highlights any innovations (max 600 characters)
- Mailing address for stipend checks (for use if a team is selected as a finalist in the competition)
- Vendor W9 Form for the lead/primary university (to be completed by the accounting department at the university) and Point of Contact information.
    - A Template Vendor Form can be downloaded from the *Resources tab* of the *Challenge Details page.* Teams may receive a pre-filled W-9 form from their institution's accounting department; this form is equivalent to our “Vendor/W-9 Form," and is considered an acceptable substitution.

Conceptual Design Review (CDR) Package

CDR submission deadline: 11:59 p.m. EST on January 8, 2023

CDR PACKAGE EXPECTATIONS

- CDR packages should be 15-18 pages in length
- CDR packages should include everything that was requested in the PDR package, with updates clearly articulating how the team has addressed NASA’s feedback and open actions from their PDR.
    - Include an updated Quad Chart
    - Summarize any updates made and indicate how any PDR feedback was addressed.

- List all actions/recommendations from PDR and their resolution
- Include dimensioned drawings and specifications
- Describe verification analysis and testing results
    - Change Made 11/7/22: Teams must include a verification matrix (please use the Verification Matrix Template on the *Resources tab* of the *Challenge Details* webpage).
    - Change Made 11/7/22: Teams are required to include a structural analysis in their CDR submission to ensure they are addressing the required safety margins as set forth by the NASA Safety Office. Included is an example of a margins of safety table for things such as mass, thermal, and power limits which is useful for communicating at a glance how your design is robust and within constraints (please use the Structural Analysis Example on the *Resources tab* of the *Challenge Details* webpage).
- Provide details of the integration plan
- Demonstrate that the design can meet all system level functional requirements
- Change Made 11/7/22: Hand drawings are not acceptable at this stage of the competition.

SUBMITTING THE CDR PACKAGE

To upload your CDR package (pdf file), please visit the *Submissions page* on the FLOATing DRAGON website to complete the online CDR package submission form.

No revisions can be accepted after submission, so please proofread your CDR and video files very carefully before submission. If there are any technical problems with the content of your PDF package or video (for example, your file was corrupted or a URL link was broken), we will try to contact you immediately, so it is very important that you provide us with up-to-date contact information on the submission form. **Late submissions will not be accepted**, and the submission form will close promptly at midnight.

The following information will be requested on the CDR Submission Form:

- University name
- Partnering universities (if any)
- Project title
- Lead Faculty advisor & additional faculty advisor (if any) contact information
- Student team lead contact information, along with university name, major course of study and academic level of each student (undergraduate or graduate)
- Full names of any new team members since submitting the PDR, along with university name, major course of study and academic level of each student (undergraduate or graduate)
- An updated 2-3 sentence synopsis of the proposed project that briefly highlights any innovations (max 600 characters)
- File upload for PDF CDR package document (Max 95 MB)
- Change Made 11/7/22: URL link for team YouTube video

Change Made 11/7/22: **CDR Video**

As a part of the CDR submission process, teams will be required to include an updated 3-minute video. The intent is for the video to augment each team's CDR package by including animation, graphics, or other creative ways of showcasing unique aspects of their proposed concept.

- Videos are limited to a maximum length of 3-minutes
- Videos should be uploaded to YouTube, and teams will provide their video's YouTube URL on the online CDR submission form. Other types of video files will not be eligible for consideration.
- Videos need to be publicly viewable via a link. Videos should be "Unlisted" or "Public" on YouTube. **Troubleshooting Tip:** YouTube accounts sometimes need to be verified prior to being able to fully upload videos.
- All team members should appear in the video, if at all possible (still images are OK)
- Your university name and project title should appear in text at the front of the video

- Do not use music or images which may violate copyright law. You may use images created by NASA. **It is the responsibility of the team to follow copyright law. Neither NASA nor NIA can approve the use of copyrighted material.**

PDR and CDR* Evaluation Criteria

- Description of how prototype system will accomplish required tasks (Max – 20 points)
  - How well does the proposed concept align with challenge goals and objectives (i.e., safety, dropping the data with precision, cost-effective, simplicity, etc.)?
  - How compelling is the proposed concept's goals and objectives?
- Description of team's Concept of Operations (CONOPS) (Max 20 points)
  - Does the CONOPS account for all phases of balloon flight?
- Technical merit and feasibility of proposed plan (Max – 20 points)
  - Does the technology provide a viable method of returning the payload to the ground on target?
- Project plan capability – degree to which team can accomplish tasks (Max – 20 points)
  - Is the proposed implementation plan adequate and thorough?
  - How viable is the schedule of activities?
- Compliance and Review (Max – 10 points)
  - Has the team adhered to appropriate design constraints?
  - Has the team submitted a package that has been thoroughly proof-read?
- Innovation (Max - 10 points)
  - How innovative is the proposed solution?
  - How well does the proposed technology advance the state of the art?

** For CDR only: Are all the actions/recommendations from the PDR addressed? (Max - 20 points)*

Deliverables for Finalist Teams

TEAMS WHO ARE SELECTED AS FINALISTS WILL BE REQUIRED TO:

- Work collaboratively with NASA BPO Mission Manager and Technology Manager to refine their technology
- Submit a Software Design Review (SDR) Package
- Work with the assigned Mission Manager for your team to identify the required documentation for safety, qualify the mechanical structure, verify the power system, and schedule the mission
- Conduct an on-site integration, flight, and testing of their technology at Ft. Sumner, NM
- Incorporate flight data into a final technical report and digital technical poster that document the experimental results
- Provide a "From the Field" video report covering the launch, flight, flight, and recovery of the flown payload.

Details for these deliverables will be provided to the finalist teams after selection.

Resources

Please visit the *Resources tab* of the *Challenge Details page* on the FLOATing DRAGON website to find resources and information helpful for developing your FLOATing DRAGON technology.

Intellectual Property (IP) and Media Release

Proposers must acknowledge that they have read and agree to abide by the full Intellectual Property and Media Release Statements. A brief summary of each statement is below.

INTELLECTUAL PROPERTY - SUMMARY

In addition to any rights granted to NIA as applicable, recipients of monetary awards under the FLOATing DRAGON Balloon Challenge agree to grant to NASA and the Federal Government, as the source of awards funding, the Rights in Data and Patent Rights set forth in detail below. In summary, awardees agree to grant to NASA and the Federal Government (i) a license to use, distribute, reproduce, perform, display, and prepare derivative works, any data first produced by recipient in carrying out recipient's responsibilities under this award in which the recipient asserts copyright, or data for which copyright ownership was acquired under the grant for Federal purposes and to have or permit others to do so for Federal purposes only, and (ii) a license to practice or have practiced for or on behalf of the United States any invention of the recipient conceived or first actually reduced to practice in the performance of work under this award if recipient chooses to retain title to such invention, and NASA may elect to obtain title or patent such invention if recipient chooses not to do so, all as set forth more particularly in the below Rights in Data and Patent Rights provisions.

MEDIA RELEASE - SUMMARY

The recipients of monetary awards under the FLOATing DRAGON Balloon Challenge ("Teams") agree to give permission to be recorded, photographed and/or videotaped by or for NIA, NASA or their representatives or designees for the purpose of announcements and other outreach or informational purposes, including public announcements, concerning the Challenge.

The Teams further give permission to NIA, NASA or their representatives or designees to use, reproduce, prepare derivative works, publish, distribute to the public, perform publicly, and/or publicly display all deliverables, including excerpts and any ancillary material, which may include each team participants' names, affiliations (schools), images, voice, and/or likenesses. NIA or NASA may distribute the materials, including excerpts therefrom, and any ancillary material through a variety of media in existence now or in the future, including but not limited to print, television, websites, radio, or any other means. NASA may also permit a third party to exercise NASA's rights, including but not limited to the right to display or distribute the recording, including excerpts therefrom, and any ancillary material, in any manner NASA deems appropriate.

The teams also understand that this permission to use each participant's name, image, voice and/ or likeness in such materials is not limited in time and team participant will not receive compensation for granting this permission.

Teams acknowledge that NASA has no obligation to use any participant's name, affiliation, image, voice, and/or likeness in any materials produced by NASA, but if NASA so decides to use them, each participant waives the right to inspect or approve any such use.

Teams hereby unconditionally release NASA and its representatives from any and all claims and demands arising out of the activities authorized under this Media Release.

Contact Information

For FLOATing DRAGON inquiries, please contact the FLOATing DRAGON Program Team:

ROBIN L. FORD (PRIMARY CONTACT)	STACY DEES
	
Tel 240-472-4788 robin.ford@nianet.org	**Tel** 757-218-8313 stacy.dees@nianet.org

National Institute of Aerospace
FLOATing DRAGON Program Office
1100 Exploration Way
Hampton, VA 23666
https://FLOATingDRAGON.nianet.org
robin.ford@nianet.org