# Transcript of Q&A Session #1
# April 29, 2022

**OPENING SLIDE**

- **Robin Ford (RF):** Alright! Well, good afternoon. Welcome to the first Q&A Session for the FLOATing DRAGON Balloon Challenge. My name is Robin Ford, and I will be your meeting host. We are excited to host the first ever FLOATing DRAGON Balloon Challenge and can't wait to see what types of concepts you'll propose. NASA is strategically looking to engage universities as partners in its mission. The end desire is to incorporate some of the technology from this competition in future balloon missions as early as 2023. As a reminder, this session is being recorded, so kindly mute your mic if you're not actively speaking. Thank you.

**AGENDA SLIDE**

- **RF:** So, today we'll go through introductions, the challenge itself, both technically and programmatically. We'll give you the chance to ask questions, and then we'll go ahead and wrap up.

**NIA PROGRAM TEAM SLIDE**

- **RF:** So, as I've said before, my name is Robin Ford, and I'll be your main point of contact throughout the Challenge. Both Stacy and I are with the National Institute of Aerospace (NIA), and FLOATing DRAGON is managed by NIA on behalf of NASA Wallops Flight Facility's Balloon Program's Office.

**NASA SPONSORS SLIDE**

- **RF:** So, now I'm going to turn it over to our Sponsors, so they can introduce themselves. Andy, would you like to start?
- **Andrew Hynous (AH):** Sure, my name is Andy Hynous. I'm the Mission Operations Manager for the Balloon Program Office here at Wallops Flight Facility. I work with Sarah and Chris in the Balloon Program Office, and my job is to work with the science teams and make sure that they're prepared for their possible launches coming from future campaigns. That's the big thing of what we do is supporting science.
- **RF:** Alright, great! Chris or Sarah, would you like to introduce yourselves?
- **Sarah Roth (SR):** Sure, I'll go next. So, this is Sarah Roth. I'm the actual Chief Technologist for the Balloon Program Office. I'm excited to be working with Andy and Chris to get this Challenge up and running, and we're looking forward to seeing some of the creative solutions that the students will propose.
- **RF:** Thank you! Chris Yoder?
- **Chris Yoder (CY):** Hey! Good afternoon, everybody. So, my name is Chris Yoder. I'm a Pathways Intern here at BPO. I'm also one of Sarah's Balloon Technologists focused on kind of finding and developing the next technology that's going to carry us into the future with the BPO.
- **RF:** Thank you, Chris.

**NASA SUPPORT SLIDE**

- **RF:** We also have a few other people. Joseph Jones, would you like to introduce yourself? You're on mute.
- **Joseph Jones (JJ):** And now I'm not, thanks! My name's Joseph Jones. I'm an electrical engineer at Columbia Scientific Balloon Facility and have been here about 15 years doing balloon operations around the world.

- **RF:** Thank you! Robert?
- **Robert Salter (RS):** Morning, everybody. I'm Robert Salter. I'm [inaudible] contractor with the Columbia Scientific Balloon Facility and help to manage it and arrange some of the flights for everyone's science objectives.
- **RF:** Thank you so much. And, finally, Chris Shreves?
- **Chris Shreves (CS):** Hi, yes. I've been with NASA Wallops for over 30 years now and supporting the Balloon Program for about two-thirds of that. I'm a mechanical engineer by training with a lot of experience in structural design, flight platforms, mechanism design, and I also support the program with some level of technical oversight on technology development and safety protocols.
- **RF:** Thank you for joining. So, Chris, why don't you go ahead and tell us some more about the actual Challenge?

**FLOATing DRAGON SLIDE**

- **CY:** Sure thing! So, as Robin said, my name is Chris Yoder, and I'm here to talk a little about the background for the program as well as also kind of segue nicely into the Challenge that we have. So, next slide, please!

**AGENDA SLIDE**

- **CY:** So, just a quick overview. I'll try to be quick. Just 6 [inaudible] content slides before we kind of dive into the questions. Next slide, please.

**BALLOON PROGRAM OFFICE SLIDE**

- **CY:** So, a little bit about BPO. NASA's BPO is managed by Goddard Space Flight Center. We are located at Wallops Flight Facility on Virginia's Eastern Shore. We're about 2 hours both from Norfolk and D.C. and have a beautiful view of the Atlantic Ocean out of our office windows. With the help of CSBF, the goal is to launch 10 to 20 scientific balloon missions every year from all over the world. We do that from a couple of different spots. When we talk about CONUS missions, we launch out of our main base CSBF in Texas, as well as a remote site in New Mexico. We do long duration balloon, or LDB Missions, out of Sweden and Antarctica, and we also do ULDB Missions out of New Zealand, where we currently have a team stationed. There are two different types of balloons that we'll talk about. There's kind of our workhorse, traditional balloon, which is a Zero Pressure Balloon: helium lift gas, it's open at the base, and is limited by diurnal cycles to shorter durations through a series of essentially venting gas and dropping ballast to sustain altitude. The second type of balloon we launch is known as a Super Pressure Balloon: again, helium lift gas, except this one is a closed volume, has a lot better altitude stability over diurnal cycles, and thus can achieve longer duration missions, especially for those ULDB campaigns. Next slide, please.

**BALLOON SIZES SLIDE**

- **CY:** When we talk about balloon sizes, in case you're not familiar with the size of balloons we fly, volumes can range anywhere from 1 to 60 million cubic feet. An example of just kind of how big that actually is given here on the slide. For a 39 million cubic foot balloon, you can see at the point of launch off the pad, we're well taller than something like, for example, the Washington Monument, especially when you stretch out the flight train and gondola. Well, once we get to Float, we kind of settle into that altitude equilibrium. We've pressurized the structure fully. We're still pretty tall, still pretty large, and it is pretty impressive. You can see these balloons from the ground with the naked eye. Altitudes for Float generally range anywhere from 90 to about 160 thousand feet, depending on the size of the balloon and the payload mass. Payload weights anywhere from 500 to about 8,000 pounds, again, depending on exactly the configuration. Now, these payloads that we fly, these are provided by the science groups themselves. So, headquarters selects what missions are going to fly and what's going to be funded. They, then, come to us and we provide the vehicle and the operation services for them. These payloads can be anything from telescopes, high energy particle physics, coronagraphs. You name it, [inaudible]. It really just depends on the science objective to be achieved, etc., etc. Next slide, please.

**DATA COLLECTION – THE ISSUE SLIDE**

- **CY:** Now, with especially the long duration flights, the LDB and ULDB, there's a lot of good science that's being done, and science groups generally want kind of higher, heavier, longer in terms of what we can provide to them from a mission perspective. A fourth kind of avenue that's coming up now is really about the amount of data that can be collected, and some of these upcoming missions that are proposed are in the terabytes to hundreds of terabytes range, which really is prohibitively large to telemeter back to the ground, especially in over-the-horizon type mode. Now, the risk is that say we launch from someplace like New Zealand and we're flying over the Pacific Ocean and we have an emergency. If we have to bail and we have to bring that balloon down, essentially a loss of the experiment can mean a loss of science or a vast majority of science data for the science team, excuse me, which is really devastating, and we don't want that. We want to be able to mitigate that as best as we can in as many ways as we can. So, a number of science groups have started reaching out, talking about possible alternate methods, and one idea that comes up quite a bit is this idea of dropping data "vaults," if you will. The idea here is that you can periodically in the mission, say 30 days, 60 days, 90 days in, download all the data and the images to a specific data vault and, then, once you're over a targeted area where it's safe to do so, you can release that data vault from the gondola, and it fall down to a known waypoint for retrieval by a science group on the ground. Now, for us, it's a question of "when," not really a question of "if." This is really starting to gain a lot of traction outside of our program specifically, and we feel that we want to get out ahead of this need. We want to be proactive. We want to have an active role in the design, the development, the testing, and the implementation of such as system, based on our experience, what we know from all of our years of heritage, from a safety perspective, from an operations perspective, etc., etc. Next slide, please.

**CHALLENGE OVERVIEW SLIDE**

- **CY:** And that's really where this FLOATing DRAGON Challenge begins, if you will. So, the goal here kind of, as I've danced around it earlier, is to design and prototype ideas for data vault recovery systems for our specific platform going forward. The desire from all of this is a system which is guided that can "gracefully all" to a pre-determined, safe waypoint for recovery by a ground team. Obviously, whenever you're dropping things from especially high altitudes, like 110,000 feet like we are, there's a lot of concerns, especially for safety. You want that kind of accuracy to be very, very good, and so that's really kind of what we're looking at, is trying to leverage creative, new ideas to be able to dial in that radius of uncertainty and really be able to have solid confidence in our impact point. If you want to know more, I encourage you to check out the NIA's website. I'm sure most of you are already familiar with it because that's how you got here. But, in case you don't, it's here again on the screen, as well. Now, some folks have come to us and said, "Ok, that's great, but why student groups?" Student groups, for a couple of reasons, have some benefits that we really want to leverage here. So, first off, student groups have been flying with the Balloon Program for many years now and do so on a pretty regular basis. Two examples of this would be Cubes in Space and HASP Platform itself. We're a little different than that, we understand that, but we use that as an analog to show that students can achieve a flight test with us on this type of platform. The second one is that students, you guys are really on the cutting edge of technology. You're experimenting with new techniques and trades and things like that, and so we want to utilize that to move quickly and to test out this design space and really be innovative, really push the boundaries, see what we can do in a way that might take us a little longer to do, or something that may be is a little bit more advantageous for us and what we're staffed to do. We want you guys to really explore and really tell us what the best methods are, so that we can go down that path and really get the best, most efficient put-together design that we can. Next slide, please.

**CONOPS – ALWAYS FLY WITH SAFETY IN MIND SLIDE**

- **CY:** So, let's kind of talk a little bit about the CONOPS and how this would work. So, today, we're meeting here to talk about Q&A. We've issued this Challenge through NIA, and what we're looking for are teams of students to propose possible solutions to our Challenge. We then down-select, because as great as it would be take everyone with us, we do have limited resources and so we would need to down-select basically to four teams who show us their design is valid, innovative, creative, can meet the objectives, etc., etc., etc. And so, as we go through this process, as teams

submit CDR/PDR packages, etc., they'll have a review team made up of ourselves in the program, CSBF, ETD, which is our engineering directorate, safety, etc., always giving feedback in terms of trying to make sure we get the best package for that down-select possible. And then what these design packages are really going to focus on are kind of two pieces, what we call the Deployer and the Node. So, the difference between the two: the deployer is essentially everything that is going to house your system for a flight. This deployer will mount to the side of the gondola. It will have your computer, your batteries, your wiring, any communications equipment. Anything that you need needs to be housed within this deployer. The other thing it will house is the Node. The Node is what actually releases from the Deployer on command and delivers that data vault back to the ground. The big thing here is that, given some kind of weather data and some information on where you're flying, it needs to be able to autonomously select a waypoint, travel to the ground, and be within the specified dispersion, or the uncertainty, if you will. A little bit about how this would actually work on the day of flight, let's assume for a second that you're a part of the team that makes the final cut for the four, what we would do is bring you out to Fort Sumner and you would, on the day of launch, power on your systems, confirm operation, attach to the gondola, we'd roll out, launch, we descend to Float. And there's about an hour window post-float insertion, where we're looking to the student teams to tell us when to drop and over what location. It's then on you guys to then fly to said waypoint and demonstrate your technology in real-time. And that's kind of how we envision this working in terms of kind of a high-level thing. It's going to be done in coordination with flight safety. We want to make sure that safety is an integral part of this process as we go forward but still meet the technical and the design objectives, as well. Next slide, please.

**SCHEDULE – ORGANIZED AROUND THE SCHOOL YEAR SLIDE**

- **CY:** And then a little bit about our schedule just to kind of hit the high points. So, again, today we're talking about our first Q&A Session. We're looking for mid-September Notice of Intent and initial concept details from all the student teams who are interested. From there, we'll transition into a PDR/CDR Review Process, with the final down select coming at the end of January next year. At that point, any additional funding would be released to the teams which are selected and then we would have a series of two reviews, a software design review to prove out the software in some theoretical situations and then a mission readiness review package due just before July 4th holiday that would show exactly that you are ready, your system is ready, it is built, things like that. In August, we would do integration and testing at Fort Sumner with a final conclusion and the data returned to students by mid-October with the Final Report coming by essentially the winter holidays in '23. And then after this, that's really when we would transition any design ideas, concepts, data, things like that over to the engineering branch for further development kind of on our side and go forward. Next slide, please.

**TRANSITION SLIDE**

- **CY:** So, that's really all the bit that I've prepared myself and that I'm prepared to talk to. I guess, Robin, I'll turn it over back to you for questions.
- **RF:** Alright, so if you do have any questions, go ahead and just raise your hand. Go to the participants panel and right next to your name, you'll have the option to raise your hand, and we'll go ahead and call on people and start. Anyone have any questions? Steven.
- **(Steven Collicutt)** Yes. Hi, good afternoon. I'm a professor looking forward to leading some students in this and advising students in this. Two things that come to mind that are on the market already are [GPS-guided parafoil and the Balloon Drop [inaudible] from Near Space. Is there a reason these are not of interest, or how do those impact student design choices?
- **RH:** We have had some contact from Near Space, and we have looked at the provided off-the-shelf parts for guided parafoils and we welcome those kind of designs into this challenge. As far as for the parafoil designs, the off-the-shelf-components for the parafoil, what we've found is that those kind of deployer systems are typically rated for lower altitudes than what we're looking at here. We're looking to be flying anywhere from, like Chris said, from 95,000 to 120,000 feet, if not higher. But, the goal of what we're trying to do here is we want to explore the trade space and see what other options are out there, and we're looking for the academic community to really bring us what those options are so that we can really try to get the best technology available. Did that answer your question, Steven?

- **(Steven Collicutt):** Yes, that's very interesting. Thank you.
- **RH:** Okay! Great question, though. Thank you.
- **RF:** Do we have any other questions? Jeff King?
- **(Jeff King):** Do we have a nominal distance from drop point that we're looking at waypoints, or is that one of those student-determined [factors]? Like is this going to go 100 miles from a drop point?
- **CY:** Are you asking about the uncertainty to hit the waypoint or like how far we're going to have to fly from balloon to waypoint?
- **(Jeff King):** The second one. The uncertainty is probably a measure of performance. I'm looking at sort of the scope of the problem in the first place.
- **CY:** That one's a little more tricky to nail down. The reason is because the waypoints are going to be governed by population centers, in terms of away from cities, towns, things like that, looking for wide open spaces, where as the starting point for the balloon is really governed by the winds at the float altitude at about 110,000 foot mark over New Mexico in the fall timeframe. So, it's a little hard to quantify. We could do some studies and try to do that in a month or so, if that would be helpful to you.
- **(Jeff King):** Sorry, I think I understand the problem, but in terms of it would probably be helpful to have a nominal idea, Chris, to say we're looking at this is 100-mi problem or this is a 10-15-20-mi problem, and we don't know exactly what the answer is because you can't put a radius about it because the short answer is the wind might blow you in a direction you don't want to go, so now you're stuck.
- **AH:** So, we're going to end up with an operational drop area where we're going to be allowed to drop in, and that's going to be governed by our flight safety team. And so, like Chris said, inside that drop area we're going to have targeted waypoints or targeted locations that your system will have to determine which is the best one and go towards that one. So, as far as, how far away that is, we're not talking on the order of 100 miles. We're probably talking on the more 1-10 mile range, but you and your team are going to have to determine when you want us to release you. So, it'll be up to you guys to figure out when you need to drop to make your targeted location.
- **CY:** And just for some rough numbers, 110,000 feet is about 21 miles. So, we wouldn't be able to ask for something in 100 miles. It would have to be on the 1-10 quarter magnitude at the very most.
- **RF:** Alright, we have another question from Christopher Helmeric. Go ahead.
- **(Christopher Helmric):** I'm from the University of Alabama in Huntsville, and I've done a number of ballooning things. I would just maybe add to Jeff's discussion of things. If you were to drop something without any control from 100,000 feet, it sometimes goes with the wind as it falls. And so that will also add to its just innate cross range ability, so I think whatever system works best will have to take into account sort of its movement with the wind. So, for example, you could travel like 50 miles with just not doing anything, which is going with the wind. So, if that helps you in that understanding. That's just my comment.
- **RF:** Thank you. Do we have any other questions? And you can also put questions into the chat, too. Alright, Chris Yoder, would you like to finish up with your slides? You had some design requirements.
- **CY:** No, those were just back-up slides just in case we got specific questions about it, but I believe that material should be on the NIA's website, I think?
- **RF:** Correct, it is. Alright, so let's go ahead and proceed here.

**PROGRAMMATIC REMARKS (NIA) SLIDE**

- **RF:** Let's talk about some of the programmatic requirements. A few things to think about as you prepare to delve into the Challenge. Make sure you meet the eligibility requirements. I'm not going to read them all verbatim. They are listed in the Challenge Guidelines on page 6. But, at a minimum, each team must contain a faculty advisor and at least 2 students from that institution, and then once you proceed if you're selected for the on-site testing, there is a maximum of 4 students and 1 faculty advisor that can attend on-site. And unfortunately, due to security issues and such, foreign nationals will not be able to attend those on-site activities on Fort Sumner. Also, 1 faculty advisor is required to attend that on-site testing there at Fort Sumner. The next deadline is September 15th. That's when your're going to submit your Notice of Intent with initial concept details.

**PROGRAMMATIC REMARKS CONT'D SLIDE**

- **RF:** Also, make sure you thoroughly review the Challenge Guidelines. Carefully proof-read your submission. Pay attention to all of the design guidelines and constraints that Chris has been talking about. Start early and plan ahead to make sure you have all of the supplemental elements required, and a picture is worth a thousand words! Consider the use of charts, graphs, and images when appropriate. And finally, all deadlines are firm. There will be no extensions granted.

**FUTURE QUESTIONS? SLIDE**

- **RF:** If there aren't any further questions, a transcript of today's call will be available on the FAQs page of the website by close of business May 5th. This will include any questions we didn't get to. We will check chat and such like that. But as we move forward, if you have any further questions, please feel free to send them to me directly at robin.ford@nianet.org. Any questions received will be added to the FAQs page for the benefit of all. And if there is nothing else, thank you for attending today's Q&A Session. A second Q&A Session will be held on September 27th. Teams can submit advanced questions by September 21st. Any other last-minute questions or things you want to say, Chris or Andy or Sarah? Alright, if not, thank you all for joining, and we are dismissed!