



Lunar Deep Freeze Challenge: Learn More with NASA

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SPEAKERS

Nick Kacsandi, TechConnect Ventures, Chad Hammons, NASA

- N** Nick Kacsandi, TechConnect Ventures 00:05
All right, good morning, afternoon, evening, depending on when and where you're listening to this, if it's the live or recorded version. Welcome to the informational webinar for the TechConnect Ventures, Lunar Deep Freeze Challenge sponsored by NASA. My name is Nick Kacsandi. I'm the Executive Director for TechConnect Ventures. I'll be the host and moderator for this webinar. I'm sure you're all really excited to, you know, sit through, should I say over the moon to sit through yet another presentation of someone on your computer for the umpteenth time over the bad past many months. But hopefully, at the end of the discussion, we'll be able to provide you everything that you guys need to break away and come back to us with some really game changing solutions for this really cool NASA problem.
- N** Nick Kacsandi, TechConnect Ventures 00:54
Before any of you prematurely log off, I promise what keep the puns in really bad jokes to a minimum from here on out. I know that puns can cause an icy reception with some people. And we wouldn't want you all to give us the cold shoulder or freeze us out before we get a chance to finish. So, I swear I'm done.

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Nick Kacsandi, TechConnect Ventures 01:12

Anyway, the goal of today's webinar is to provide you all with information that you're going to need on the background to the challenge, the nature of the technical need, an overview of the opportunities for you to participate. And so ultimately, our agenda is going to touch on a lot of these items. After which we'll share some information about the challenge. We want to tell you about the rules, the eligibility, participation guidelines and instructions for how to submit your solutions to this challenge. We also want to make sure that we answer your questions, we actually received a lot of them in advance over e-mail. So, what we'll be doing is kind of going through the process and then answering some Q&A. Before we jump into the discussion, just one note, so everybody's aware: we will be recording the webinar along with all the questions today. The recording and a transcription will be made available on the challenge website and in the challenge FAQ in the next couple of days. With that in mind, if we don't get to your questions right away, they will be answered after the fact. So, we'll get to everything at some point. So, let's get started. For those of you who aren't familiar with us at TechConnect Ventures, we are the open innovation and challenges branch of TechConnect. If you're you're familiar at all with TechConnect, you'll know us as the innovation and emerging technologies events company. We host events such as Smart Cities Connect, TechConnect World Innovation Conference, Defense TechConnect the SBIR and STTR Innovation Conference, and quite a few others. We're really pleased to be one of the featured vendors that was awarded in the recent NASA Open Innovation Services II contract. Really what that is, is a great opportunity that's being sponsored by the Center for Excellence of Collaborative Innovation and the NASA Tournament Lab, which is a branch of that. They're giving a lot of great opportunities to leverage the power of open innovation, solve really tough problems, both inside NASA and across the other government agencies, as well. So, we're really grateful for this opportunity. We're going to be the primary challenge execution manager throughout this process, meaning that we're going to work hand-in-hand with NASA here to execute this to the best we can. NASA is providing the challenge the technical problem and the expertise. And really, we're the engine behind the scenes making sure that your submissions and solutions make their way to the team at NASA. The biggest thing we want to take home today for you guys at least is the fact that this, this opportunity is for you guys to bring your expertise, your concepts, your novel capabilities, and bring them to NASA, your best technologies, your best ideas so that we can try and solve this tough problem in a way that hasn't been thought or hasn't been executed before. At any point during the webinar, if you do have a question, please feel free to go ahead and submit it to us. There's a chat box provided. You can also visit the challenge web page, or you can email us at challenge@techconnectventures.com with the subject line "webinar question". We would appreciate that just for sorting purposes. We'll do our best to collect and answer as many of them as we can today. But don't worry if we don't answer them. Like I said, we'll be compiling everything and getting those responses

back to you in the FAQ, transcript and/or recording after the fact. So, now that all of that is out of the way, I would like to introduce our featured NASA speaker. He's joining us on the webinar from the gateway operations integration and utilization office at NASA Johnson Space Center, Chad Hammons. Chad, if you wouldn't mind a quick introduction for everyone and then we can move right into sort of just a general introduction to challenge a bit about its relation to the Artemis mission and ultimately really the problem that we're trying to solve.



Chad Hammons, NASA 04:59

Okay, intro for me: my name is Chad Hammons, I think you mentioned that and you pretty much, you know, said where I work, the gateway utilization office, we're really trying to look at the best science that we can get from gateway. And that the kind of what gateway adds to Artemis. Artemis, we usually talk about kind of the whole mission, which crosses the Orion vehicle, the gateway, and the lander. And we'll get into that - why those three vehicles are important and all part of this challenge architecture that we're looking at.



Chad Hammons, NASA 05:29

Not sure did you want an overview of kind of the the mission that we're looking at, and why this how this challenge fits into it?



Nick Kacsandi, TechConnect Ventures 05:34

Yeah, that would be a really good place to start, just so people have some context.



Chad Hammons, NASA 05:38

Okay. So, you know, we're heading back to the moon - that's a great thing. We're gonna put the first woman and another man back on the moon. And we're going there to do science, not just to kind of land there. We're going to the lunar south pole This time, it's interesting, because there there are spots on the lunar south pole - some craters - that don't get sunlight ever; they're permanently shadowed regions. So, extremely cold, you know, the vacuum of space, no sunlight. And we can assume we've got some, you know, really cold samples there that may be collecting frozen volatiles, things like maybe water but maybe also methane, CO2. And we're interested in getting those samples, bringing them back and analyzing them. And the way we need to do that is to keep those samples frozen. And that's definitely a real challenge for us in this Artemis architecture, we need a need to keep those samples below 150 degrees, so they stay frozen. That's really the key

thing, when we're looking at getting these samples intact back to the lab, where we can, you know, analyze them without melting and losing all these volatiles which are naturally going to either return to a vapor or mist or something that is going to be hard to contain. When you look at the the composition of those samples.

 Chad Hammons, NASA 06:52

The challenge that we have is that our white hardware that we've used up to this point for ISS - for the freezers, we have an ISS - are pretty large pieces of equipment. You know, they're designed to be robust and designed to operate in zero G, but they use a lot of power; they take up a lot of space; and they need a lot of cooling. We have things like Melfi on ISS, which is a pretty large freezer. But it's something the size of a person six feet tall, three feet deep. And the vehicles that we talked about when I said we've got a Orion, we've got to Gateway, we've got the lander, well, Gateway is not going to be as big as ISS, it's pretty small. Orion is going to be something more akin to a lunar module, a module, you think like the old Apollo days, it's going to be bigger than an Apollo capsule but not huge. So that you can think about an Apollo capsule, you may have seen on TV, you can't put a freezer size thing into one of those capsules and still have all your room for your people in your spacesuits and everything else, the lander is going to be equally as constrained. And that's going to be constrained not only by volume but also mass. Whatever we put in that vehicle has to have enough we have to have enough propulsion to get all that mass back up off the surface of the Moon and get it at least the Gateway, then we can transfer it Orion. And that's really a kind of another sticking point for what we're trying to do. That lander only has a certain amount of mass that it can leave the surface of the moon with. And so if we're targeting 100 kilograms of samples, if we want those samples to be cold, we want them to be frozen. Every kilogram of mass that we use to have in the freezer, everything that we use to keep it cold is going to take away from the samples we bring back. So if we take you know, 50 kilogram freezer and put it in that vehicle, even if we could make it fit in the volume, that cuts our science in half; we're using half of our mass allocation to support keeping the samples cold. We really want to minimize that number as much as possible. So we can bring back as much science as possible. We'll have as much of the frozen as we can get maybe up to 10 kilograms, hopefully, and then everything that's left over allocation will be, you know, we'll assume ambient temperature samples, but we're focusing on those frozen samples for this challenge.

 Chad Hammons, NASA 09:10

Hopefully, that's kind of at least a good overview. I'm going to a few details there.

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Nick Kacsandi, TechConnect Ventures 09:15

Yeah. And we'll get into more I'm sure. So that's no, that's perfect. Um, just a quick reminder, everybody: questions that come up be sure to go and submit them into the chat box at the bottom. Again, you can also submit them via email if you don't have time or the thought process right now. We'll be taking questions up until about 5 pm today before we compile and put into the final transcripts. So yeah, great. So we appreciate the overview, Chad. You know, ultimately, what we kind of decided is that the unique thing about this challenge is that there's kind of two different ways that NASA is looking to address it one's from more of a holistic approach and the other is more of the innovative concepts that could enable a future system or enable it or enable, you know, proposed approach or system for this time around. So that kind of brings us to the the next section that we wanted to talk about is the fact that, for those of you who have checked out the website or had time to look through, we have two challenge categories that we're featuring the first of the categories is we're calling it very, inspirationally category one. And that's the small transportable cryogenic containment systems. This is different from category two, which is more of a opener broader innovation approach. But to start with, I figured the the best way to do this, let's focus on challenge category one, we can come back to category two in a couple of minutes. And talk about what the difference between the two is.

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Chad Hammons, NASA 10:46

Yeah, I think the well let me just kind of start with why we have two categories, if you don't mind. I think it's I think it's important to kind of recognize that what we're looking at is very complex, like, we recognize that we know that the solution space we're dealing with is is a technical challenge, it's going to be pretty difficult to put together something that can go end-to-end, from the surface of the Moon, through three different vehicles land on Earth, and keep all this in the samples at the right temperature, meet all the power requirements for these modules that are that have, certainly at very small power margins. And again, we already talked about the mass. So we recognize that. Now, that doesn't mean we don't think we're up to the challenge. And we want to see if we can get any single point solutions or set of solutions, and then come up with that has these great ideas that will take us from the Moon back to the Earth and keep our samples frozen. And I think that's really what category one is looking at, does somebody have an entire solution, or set of ideas that will take us from point A to point B across all the vehicles? I was gonna say, I was just going to kind of, you know, get a preview for category two those because we recognize this is such a challenge, technically, we're looking for technologies that will enable any piece of this.



Chad Hammons, NASA 12:04

It's not that we're anticipating not getting any solutions for category one. But if we're looking for any kind of the solutions that will help us with any piece of the puzzle along the way, if we can find a technology, a material science, an idea, something that enables us to lower the power or to have passive cooling longer or no active cooling with less mass, whatever it may be, if we come up with even a component solution that helps improve any of our other designs, then that's great information, we'll make sure we collect that as well.



Nick Kacsandi, TechConnect Ventures 12:37

Yeah, that's, that's great. And what I was just starting to say is that we've actually taken the, the effort to define those two as separate technical specifications categories, the award mechanisms have been broken out differently for each of them. So we're recognizing that both of them are inherently sort of different challenges, really, I mean, they're answering the same problem, but we're coming at it from two different angles. And I think it's a unique mechanism. We're really interested to see how these things go. But I want to jump over and kind of focus in on some of the specs for category one here.



Nick Kacsandi, TechConnect Ventures 13:15

So as you guys can see on the on the page, there's a couple of items here from the specifications, a couple of things for the design specs, a full list is available on the website, there are a couple of different places that you'll be able to link to it or find it. So, we strongly recommend that anyone who has an interest in this challenge, take a couple of minutes and go through and look at both category one and category two, we definitely don't want to scare you away. If you see these more aggressive specifications in category one, it's still highly likely that your technologies or capabilities would be a good fit for two. So please evaluate both of them will describe some of the other unique features of the challenge here in a little bit. But sorry for that, that kind of diversion. But Chad, go ahead, if you wanted to, we could just run through a couple of these items focusing on maybe you know, why we have them in there or what the actual problem is behind this rack.



Chad Hammons, NASA 14:11

Yeah, that's fine, I can kind of step through these. So the the temperature one hopefully makes a lot of sense. We need to keep these volatiles frozen and make sure they maintain that state through the their entire transit. So that's why we have the temperatures minus 150 and keep them there stable for at least two weeks. That two weeks should take us from the surface of the Moon through the various points in transit to the Earth. Once we

get back to the Earth, then we're expecting to have supply content, you know, some equipment on hand when we retrieve the capsule that we can put those samples in at that point. So we just need to go those those two weeks. That kind of also explains the end-to-end transport across the different vehicles.

C Chad Hammons, NASA 14:51

The operating conditions. Variable gravity is an interesting challenge in and of itself when you talk about designing equipment operate in zero G. We have the added kind of wrinkle in here of going down to the lunar surface. So you have a variable gravity, you're not just dealing with zero G and you're also dealing with reentry loads. So whatever goes up has to come down in this case, I would say at the other way, whatever we want to come down has to go up, because launch loads may be more of a challenge, the re-entry is going to come down on a human vehicle, it's meant to be a much smoother ride. But launch, it's probably gonna go up on a cargo vehicle there, you're going to have loads up to 10 G, you're really looking at vibration and kind of shock loads. So that's why you've got the the launch loads up to 10 G. Whereas even on re-entry, in a human capital, you may not expect to see 10 Gs, but that's going to be a challenge. The external temperatures, those are just ambient environments, the same thing with the pressure, you're looking at the kind of the environment that humans can operate in, I am just catching a typo on the slides, because I think it says from 19.2 to 14.7 psi, but I think that's actually 9.2 to 14.7 psi. Yeah, it's just a range.

C Chad Hammons, NASA 16:08

That's a that's just the range of pressures. 14.7 is ambient here, and then being that we're designing for these capsules, that are they're gonna be going EVA, we may have some reduced pressure kind of regimes where you had your humans in the loop, but you're not at Earth ambient pressures. So that's kind of where we have the external pressures there. The mass for target for category one is 20 kilograms. And the reason for that, like I talked about the beginning, is we're very mass limited. And we don't want to give up more than about 20% of our total samples, to have the samples come back frozen, we don't, we want to be able to, again, have the majority of our mass allocations go to bringing science from the Moon back to Earth. And so this is really kind of targeted, where we think we can hit and get away with only using about 20 kilograms of mass. The dimensions on the inside: so the samples themselves are going to go into a container. And the reason we do is we don't we're worried about those volatiles interacting with whatever containment we put into, that's a challenge that is outside the scope of everything we're doing here. So you can assume that we're going to give you a container that's been designed by the EVA tools, folks by the cryo lab, guys who have - gals in this case - who have designed those

containers that they're not going to interact with the volatiles, they're going to keep them safe, they're going to keep them contained. And so that is going to assume to be a cylinder, that's going to be about 20 centimeters in diameter, about 30 centimeters long. And so that's kind of what you can consider the the sample size that you need to keep cold will be a container about that big. We've got low power, and I say, or zero external power, because passive cooling would be would be awesome, simply because active cooling takes mass. But whatever it is, we've talked about why that is give me the power aspect is we haven't talked about too much. You think about ISS, as these giant football field sized solar arrays, they've got a lot of power, the vehicles that we're dealing with are not going to have those, we're going to be on much stricter power margins. And there's not huge allocations for science, just because a lot of the power is going towards your life sports equipments, your computers, things like that. So the lower power, the better we fit into the overall architecture across all the vehicles. And I think you've got a link there to kind of describe the vehicles in general. Right. So I won't go into that too much. I was, as I mentioned, though, no hazardous materials, because we are going to be inside the vehicles with the crew. So I know we've we've seen some questions and FAQ. And I think we'll get to that maybe we can mention at some point anyway, the "can I use this" "can I use that" if your talking about anything that is venting, anything that is going to be putting contaminants, you have to remember that the crew is sitting in a pretty tight tin can and in an enclosed environment, with whatever they're they're hauling back. So it needs to be completely safe for for the crew.

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Nick Kacsandi, TechConnect Ventures 19:07

Right. And just to reiterate, this is a snapshot of the specifications that are on the web page, we go into more detail. Like Chad mentioned, there are links on the webpages that are going to take you to more info on Artemis and Orion and Gateway and HLS. So we wanted to make sure that everybody had an easy avenue and all of that if you're not already familiar, just from a referential standpoint, but certainly be sure to check in on all of the deeper specs, we definitely get into some more detail there, which will be helpful for you as you sort of think about your designs or approaches to this. And certainly like we've mentioned a bunch of times if you have questions either today or at some point during the process, feel free to plug them into the chat bot on this on this webinar page or go ahead and submit them at challenge@techconnectventures.com. We happy to answer them as quickly and efficiently as we can. So, overall, I'd like to take us in kind of shift over to talk a little bit about category two. Like we said, this is more of the, the innovative, not the innovative approach so much as the innovative enabling technologies, maybe, but I'll let Chad go ahead and give some more insight.



Chad Hammons, NASA 20:19

Yeah, I think the the key is on this, like we said is you're not looking for that end to end. So if you can meet any of these categories in these these specifications in some new novel way, an application of a technology that we haven't seen before thought of emerging technologies, emerging materials, those are the kind of things that we're looking for something that will enable us to reach temperatures, again, minus 150. Such a key requirement across all the challenges. But, past that, something that reduces our mass, our size, or volume, or power requirements, you know, reduce or eliminate, again, something that could increase the duration of time, you know, passive cooling is an interesting idea when you look at it, because again, we're talking no power. But it's such a lot of the types of passive cooling that we have used historically on spaceflight have pretty short durations. They're meant to get something from ISS back to Earth. So it's a much shorter trip to three days. At this point, we're looking for something that's going to make a trip 14 days back, so that anything that can take some technology and increase it across part of a thing. So we know what "I can get you from HLS to Gateway completely passively", or "I can get you from gateway back to Earth". So your transit on Orion is passive, or you know, increases some duration technology, the passive cooling side, something like that, we still have our limitations on mass. So we have that 20 kilograms there, we're still at the same containment sample, the sample container, so the specifications are going to be the same. I think and this is where we add that operation within three to five years, because this category opens up low TRL, options, technology readiness level options. So like I mentioned, the emerging technologies, it still has to be enough, developed enough that we can take this and put it online within three to five years so that when our missions start going, you know, to the Moon through Gateway and Orion back to Earth, that we have this this technology ready to bring these samples back with us. And then I think we've got there the power specifications as well, what we have on gateway, what we have on the different vehicles, I think those are all laid out online to kind of broken down vehicle by vehicle.



Nick Kacsandi, TechConnect Ventures 22:32

Right? Absolutely. And so we're seeing some questions, we know that there's a couple of people inquiring about deeper specs and things like that. We'll try and get to some of these things as we get into the Q&A section. Again, if we don't get to your specific questions sit tight, it'll come up quickly. But we're gonna move on. So from a technical standpoint, hopefully you all understand a bit about where the direction of this is headed. You know, certainly we're trying to answer really tough, really tough problem, doing our best to make sure that we give you a lot of different avenues to engage and incentivizing those in a pretty cool price structure as well. So what I'd like to do is more the operational side of the challenge discussion. This is going to give you guys some insights into the

timeline and how to submit and some of the requirements and eligibility which quite obviously, everybody has interest in. So the first thing here, if you haven't seen on the website, or you're not as familiar, we're looking at the challenge timeline.

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Nick Kacsandi, TechConnect Ventures 23:31

We opened up for submissions about a month ago, just under a month ago, we've been doing some socialization, and we're now socialization and we're now at the informational webinar. The deadline is November 12. As you can see, at 7:59 pm, we wanted to get everybody as much time as possible to get these things in before we start running into the holiday deadlines and issues and lack of calendar availability. Our evaluation process actually takes that into account, which is why you can see that from the deadline to the winners announcement actually is almost a two month timeframe. But if you subtract out end of year, holiday disruptions and things, it's actually much more like a month to a month and a half process. So we know that that's maybe a little bit longer than most would like to wait to find out if they've won. But we are trying to be cognizant of the fact that you may not be in the office and we'd hate to call your office and not be able to get you, so evaluations will take place from the 13th through mid December, at which point we'll go through some quick selection. We'll be notifying those top winners, making sure that we can collect all the necessary paperwork that we need to make sure that you get your awards. We'll get to some of that information here in a little bit. And certainly as we go through the process, you know if people have questions, we'll definitely be able to answer those throughout this up until the point that we sort of close the project out with the announcement.

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Nick Kacsandi, TechConnect Ventures 24:57

So the big thing that everybody's asking about is the award. And how we divide them up, a total price for price person \$40,000 has been allocated for this, it's divided evenly between the two challenges. So category one and category two, both have \$20,000 allocated. However, we've focused in the awards, conscious of the fact that one of the challenges probably a little more extensive in terms of the technical depth, versus the more innovative approach, or the more innovative singular concept in category two. So for category one, we're going to have two awards at \$10,000 each, again, total prize pool of \$20,000. And for category two, it's going to be four awards at \$5,000 per. These are certainly not guaranteed two submissions. But the best solutions that are evaluated based on the criteria that we're going to discuss in a couple of seconds here, those are the ones that are going to be weighted to the top, the evaluation is going to take place by a team of NASA experts. So you can be you can be assured that it's not people like me who are reviewing this, it's certainly going to be people more like Chad and his team are doing

it. The couple of things to also understand is that there are some adjacent awards that are going to be available. It's more around the opportunity to engage with the NASA team to talk about your proposal. Talk about your solution. Certainly they're interested to learn more from you, I'm sure that you probably have questions. There will be recognition and announcements on our website through the challenge webpage, will be socializing that in a, you know, a general announcement as well. And then, you know, obviously, there could be opportunities for future collaboration, nothing is guaranteed. I'm sure Chad and every other NASA person here wants me to reiterate that. But certainly, we want you guys to come in with the idea that this is something worth your while. So there's a lot of a lot of cool stuff happening a lot of cool opportunity. That's that that's going to be generated out of this.

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Nick Kacsandi, TechConnect Ventures 26:59

And I do want to point out, too. So this is a question that has come up a couple of times already. By accepting awards, there is a requirement, there is an assignment of rights, I'm going to read it off the paper, so I get it absolutely correct: "award winners, you will retain your IP for the solution, however, you're going to sign an agreement, which assigns NASA royalty free, non exclusive, irrevocable worldwide license to the IP generate". That's a standard procedure, it gives them the opportunity to use what you're doing. But certainly we do want you to understand that there is an agreement to accept an award. More details are available in the challenge rules and the challenge guidelines on a web page, we strongly recommend that everybody takes the time to read through those understand that. If questions come up, by all means please socialize them back to us, we want to make sure that everybody has the the correct understanding of what's at stake. But again, you you aren't signing over and losing your idea, your concept of your IP by accepting an award. And again, this is pretty standard for most challenge type engagements. So we're trying to keep it as simple as possible.

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Nick Kacsandi, TechConnect Ventures 28:12

So the awards are going to be allocated based on the strength of the proposals relative to all of the other others that are received. This is a competitive prize-based competition. So for each category, your submission is going to be weighted against the others that we receive for that category. That's the best way to make sure that we're getting the best of the best out of you guys. So category one is necessarily focused a little more on the near term applicability. It's, you can see it's weighted more heavily for performance design and the quality of the proposal, as opposed to category two, which is focused a little more heavily on the innovativeness of the concept, the nature of the technology, and its application to to NASA's and use. These are going to be scored by the NASA experts, like I

mentioned, they're going to be evaluating everybody based on this same set of criteria. Category one will be assessed in its own bucket, category two, and it's bucket. So you're not going to have to worry about, you know, bleed over of criteria or miscommunications. Certainly, we want to make sure that everybody's is captured correctly. So the submission page will have the opportunity to submit to individual tracks. And as you go through the process, again, you can let us know if there are questions or issues with the site. I'm Chad, I'm not sure if you have any comments on the overall scoring or why we've set it up this way, but I'm sure people might be interested to know.



Chad Hammons, NASA 29:42

I think you covered most of the things that I would have said about it. Um, I think this may be one good place where we're looking at this rubric to kind of point out that category two, we talked about those those specifications, but it's really should be evident in the scoring that those are targets. Because performance is not your top weighted thing, it's the novelty of the innovation. And I think that's so important for this category two. You know, I even I've talked about this temperature over and over again, it's minus 150. How it's so important to keep things cryogenically frozen. But we've acknowledged on our side, you know, what if we can't get there, minus 80 is better than minus nothing. You know, it comes to a few have some innovative way in, you don't quite meet what we're calling specifications, you still might have a winning design for category two. If you've got something that's innovative, it's novel, it's something we've never seen something that I thought about an application a way that of doing business, the science that we haven't considered, you need to submit that. And you know, category two would be a great place for it.



Nick Kacsandi, TechConnect Ventures 30:47

So that actually raises an interesting question, which we can just address here, it's come up a couple of times already. But for category one, if someone proposes a technology or a solution that applies to say, to two vehicles, the transfer between HLS and Gateway, or from Gateway to Orion, and it addresses both of those, is that more of a category one response? Or is that more of a category two?



Chad Hammons, NASA 31:15

So when you say both vehicles, so I kind of see it as the three parts. We've got HLS, we've got gateway, we've got Orion, you're saying if they can meet kind of two of the three vehicles?

N Nick Kacsandi, TechConnect Ventures 31:24
Two of the three vehicles. That's the question.

C Chad Hammons, NASA 31:27
I think if you're only looking at two, the three vehicles, category two might be the better place for you. I just think category one, there's so much emphasis in how we've set up the the performance specifications and how we set up the scoring that we're going to be looking for, again, those end to end designs from the surface of the Moon, we come back to UVA, you don't have to be a vacuum, but we come back in HLS, but a sample container into whatever you've created your design proposal. And it needs to be at minus 150. From there until splashdown there. So that's the best place for category one, if you can meet pieces of that, but not all of it. I think it can be more competitive in category two.

N Nick Kacsandi, TechConnect Ventures 32:17
So it seems like we may have watched. Chad, can you can you pause for a second? I think we had a glitch there. So I was staring aimlessly at the screen. Oh, we lost you about the last 20 seconds.

C Chad Hammons, NASA 32:30
Oh, I hate that. I don't know exactly where I was where I was talking. I was on a roll though some of the best things I've said so far.

N Nick Kacsandi, TechConnect Ventures 32:38
I think I think basically where you were it was it was simply laying out that the solution base, the emphasis is so heavily towards. Can you get us an approach that hits every single bucket along the way, whether it's through multiple approaches, or multiple systems, that people who have something that might only apply to one or two of the vehicles are best suited to come in and say "here's my approach" in category two.

C Chad Hammons, NASA 33:04
Yeah, that's kind of I think what I was wrapping up with there may be the part that got cut off is I think it'd be more competitive, it's going to be more beneficial for you to kind of be a winner in category two, if your design doesn't quite go into end.

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Nick Kacsandi, TechConnect Ventures 33:16

Yeah. And so, you know, as the challenge manager, then I will also say there's there's no limitation on submitting or participating in both of these categories. So, if you feel like your solution, not being an end to end or not being a whole thick guy universal solution is worthy enough to submit to category one, you're more than welcome to do so understanding that it will be weighted against a different set of criteria. But the way that we've set this challenge up the way that we've arranged the opportunity you certainly as a solution provider, as an innovator, you can submit to both categories, you can submit multiple solutions, you can submit multiple components or materials. We're not trying to be too limiting in terms of the innovations that are coming back because it is such a complex issue. And there's so many different areas that you as a solver as the the experts out may be able to conceptualize a new a new technology or a new approach that we just hadn't thought of before. Okay. So now we get into the the boring stuff from a technical perspective but the important stuff for anybody who's actually going to submit.

N

Nick Kacsandi, TechConnect Ventures 34:31

So to participate in the challenge, there's a there's a couple of requirements, by all means, again, I'm going to re emphasize probably for the third or fourth time here, please go to the challenge web page and view the entire rules and participation guideline documents. There's a lot of great information that probably answers 95% of the questions that you might have. Certainly we're getting a lot of them through the chat, but certainly a lot of them have come through email already, but it's really important that you read the rules. The agreement, the participation, all of that stuff, so that you understand exactly what's going on. From an eligibility perspective. This is something that being a NASA challenge a lot of people have asked about. So any participant over the age of 18, is welcome to join the challenge. There are some limitations, as you can see on the screen export control, countries, individuals affiliated, as you can see are under contract with Chinese entities that would create a weird bilateral relationship between NASA and the Chinese entity or government. And then obviously, from from our side, employees of TechConnect Ventures, TechConnect and all of our affiliates. Because of the way that this challenge has been arranged, there's actually not a limitation on contractors, even NASA employees in participating in the challenge. However, the way that the award mechanism would work out would be different. So we're definitely encouraging anybody and everyone who has a solution. Certainly, you're welcome to participate. But please check with your employer, check with your organization to make sure that it's within the terms of your contract, employer agreement, student agreement, anything like that, before you do submit, we are not responsible for that eligibility, we will do our own screening. But we want to make sure that if you submit, you actually actually have the opportunity to win awards again, or any eligible participant if your entry is selected, but you're not eligible for award because you

work for NASA, or you work for a contractor who has an agreement with NASA is working on this problem somewhere else or you simply your employer will not allow you to win, you can still be selected as a winner, you can still be acknowledged, you can still receive some of maybe the the non-monetary incentives that come along with the process. But the prizes obviously, we're not going to be able to allocate. Any questions that come up with that in terms of you know, in practice, you're certainly welcome to ask us but for the most part, that's something that's going to have to be a conversation internally with your organization or with your team, which does bring up a another set of questions that's come through.

N

Nick Kacsandi, TechConnect Ventures 37:17

You can submit as part of a team's you can submit as part of multi organization consortium or group of individuals or group of collaborative partners. That's all completely valid and viable. We welcome all of that. The difference with those between individual submitters or single organization submitters is that those teams have to sign a single point of contact, that is the person who will be considered to be the winner to whom the award is issued, we can't divide or divvy up awards between five people in one team. So as you submit, make sure that the person who's responsible the person who is the point of contact is that primary principal, whatever you want to call them, because they're the person who we're going to contact about this. That's the organization who's likely to be assigned to your work. And then any distribution, any sharing or any other teaming issues that's all firmly in your own, in your own ballpark to sort out those conversations distributions.

N

Nick Kacsandi, TechConnect Ventures 38:22

From a submission standpoint, so entries have to be submitted online, they have to be submitted through the challenge webpage, all of this information is again available on the challenge website, we can look at it any, anytime, the link that's available here, and you should be getting it in any of the communications. It has to be submitted digitally, it has to be submitted through the web form that we've provided, you will have the opportunity to select the category that you want to submit to at which point you'll fill out and upload any of that information that you have available. You can attach almost any file that you would like, provided that it's not malicious, to this challenge. We highly highly encourage people to submit more standard file types PDFs, Word docs, JPEGs, things that are broadly viewable. There is not a requirement for 3D renderings, CAD files and that sort of thing with this challenge. It's actually probably preferable to have the graphic image of that rather than the more intensive renderings. Just because most submissions probably are not like that. Chad, if you have any commentary on that, or any reference for them

about those types of go ahead.



Chad Hammons, NASA 39:36

I um, I think it's an interesting idea when we're looking at you know, these kind of challenges. Being an engineer, it's, it's great to look at schematics and these 3D rendered CAD drawings and things like that. But we're designing a solution for a system of space vehicles that are still being designed themselves. So I think trying to come up with a drone or rendering a 3D you know, CAD model of here's what my, you know, equipments gonna look like this is it. And then we realize well, but the the place we've gotten in the spaceship to fit it is just this much smaller, then you end up having to redesign everything. So that's why we've got some reference volumes and things like that and the the specifications online. But we're not asking for those CAD drawings because again, I can't guarantee you that our reference volume today is not going to be a different dimension tomorrow. The these these vehicle designs are, it's still a lot of discussions going on about the best way to build the lander to you know, to arrange the insides of Orion. And so it's just probably one step too far for what we're we're asking for. Yeah.



Nick Kacsandi, TechConnect Ventures 40:48

One thing that we do want to highlight here is that there is a submission webform that has a lot of different fields available to fill out. Certainly we understand that not every submission not every entry submit address every single box, you may have a solution that comes most of the way but simply don't have the assessment for how it performs under microgravity, we understand that. So there will be a lot of sort of variability and diversity in the ways that you can answer and the information that you can submit. However, we understand that we can't be fully prescriptive through that webform to capture everything about your idea. So there is a strong encouragement from our side to say, if you have the ability to put together a four page four to six page description of your technology that encapsulates the true essence of what you're trying to provide maybe expounds on details that weren't fully outlined within that web form. We're really encouraging people to do that. We don't have any limitations on including graphics in that if you have supporting your supplemental details, data, any sort of analysis, any sort of proof of concept that you maybe already have for the technology. Use that as a great opportunity to expand on your submission to propose additional information, or a different additional tracks to solve this sort of problem. Because we do want it to be as unique to you as possible. And the teams will be evaluating those supplementals as they come in, we do have a hard limit on six pages in terms of that proposal. If you submit something that is seven pages, or 50 pages, our team is unfortunately going to have to screen down to the first six pages, we do not want to have Chad's team investigating and reviewing hundred

page documents. So I will stress again, the challenge guidelines and the challenge specs, outline what the submission limitations are on that, please stick to that as much as possible, because we will cut off those proposals at the patient length indicated. And so just a couple other items, obviously all submissions have to be in English, there isn't a cost to participate, you will you will not be charged anything you do not have to pay us anything to win an award. You just have to submit your ideas. And again, this is really important, your entry should only include non-confidential information, please do not brand or tag anything as proprietary sensitive, classified confidential, we will not be able to share that that is an immediate disqualification to be considered. So please be sensitive to that in your response. But otherwise, go for it. We're really excited to see how this thing is going to be shaping up.

N

Nick Kacsandi, TechConnect Ventures 43:33

Again, we've had questions coming in, we've had lots of people sort of funneling us, funneling us their inquiries through a couple of different avenues. We're going to try and get to some of them right now. A lot of it is process based. And we answered some of that, but I'll try and I'll try and speed through it as much as possible. There are a couple of technical ones in here. But let's go ahead and try it.

N

Nick Kacsandi, TechConnect Ventures 43:53

So for one question, how do we contact people about the challenge? How do you communicate? Obviously, if you're able to submit in any sort of questions or any sort of inquiries right now through the chat bot do that. But you can communicate with us through the contact section on the challenge web page, or you can send us an email anytime that challenge@techconnectventures.com. Those are the two best ways to get us information in front of us. We will try and respond as quickly as possible. We've got a pretty high volume of inquiries coming in. So please bear with us. One of the things that's come up and again, you can submit multiple entries, you can submit to both categories, you can win awards for both categories. I'm not sure that I mentioned that earlier, but it's definitely on the table for very highly viable technologies that may be answered. You know, a different type of approach a different question for category one versus category two. Certainly, we are excited we are more than happy to award the best of the best if it's you both, so be it. Yeah. I don't know what else to say about that.

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Nick Kacsandi, TechConnect Ventures 45:05

Um, a couple of questions, you do not need to have a background in cryogenics to answer or respond to this to this challenge. Certainly, we expect that they're going to be plenty of

you out there who do have that sort of background. However, if you're able to conceptualize a unique concept outside of that, there is no, there is no eligibility criteria around a background in cryogenics. Around a backward background in space or aerospace applications. Anyone is from the public, public domain there, you're welcome to submit another one.

N

Nick Kacsandi, TechConnect Ventures 45:40

No, we do not require you to submit prototypes, or working demonstrations of a technology with this, like Chad just described, this is still something that is actually in development on its own. So there's not a need for you to demonstrate the technology actually is working today, if you can provide that in some sort of description. Or if you can make reference to it, by all means that you're welcome to do so in a web form in the supplemental submissions. We are not accepting video uploads or submissions. That's not part of what we're trying to do right now. So if you have a really cool visual effect, unfortunately, you're gonna have to try and screencap it or describe it as best you can.

C

Chad Hammons, NASA 46:22

I think, Nick on that one, too. We've got the the TRL definitions that NASA uses on the website, right?

N

Nick Kacsandi, TechConnect Ventures 46:29

Yes, we do.

C

Chad Hammons, NASA 46:30

Yeah, I think that'll be useful, especially in terms of things that, again, we're not looking for things that are working today, especially for the second thing, we're looking at innovative things, but I think we do have a category on there to characterize our TRL. And and those definitions will hopefully help people kind of figure out where they are on that scale that reason.

N

Nick Kacsandi, TechConnect Ventures 46:52

Another question? So yeah, we know that there's a pretty broad range of specifications, operating requirements between the various the to challenge categories, entries do not have to address all of them. But the more you can address, the more likely your solution will be, will be evaluated towards the high end. Obviously, there's a difference between

category one and category two in terms of the types and nature of specs that you can probably answer, but your entry isn't going to be disqualified just because you can't fill out one checkbox. That's that's something that we definitely want to stress. And we know especially for category two, there may just be areas that you can't, you don't have an answer to where you don't have that information.

N

Nick Kacsandi, TechConnect Ventures 47:41

Here's one for Chad, there are a lot of safety restrictions lifted. Just for clarification, can people propose systems that utilize normal typical cryogenic substances like liquid nitrogen, supercritical CO2, any of that stuff?

C

Chad Hammons, NASA 48:00

Yeah. So the safety considerations are kind of, unfortunately, very black and white, there's not a lot of gray space there. If it's not safe for the crew members who are inside the vehicles with the the solutions. They're not going to be they're probably not going to win the challenges. Again, we look at kind of like venting, you mentioned liquid nitrogen, I think was one of the things that was in that question. Liquid nitrogen is great for cryogenics here on Earth, because you can take that that liquid nitrogen, and it kind of boils off in transit, they're shipping containers, that is very interesting, you can ship these samples across the US using liquid nitrogen and maintain them at minus 150. Temperature that kind of keeps coming up, and so it caught my ear, but the whole time it's blowing off nitrogen, well, when you're an enclosed environment, you're boiling off the nitrogen inside of the capsule, and it's got nowhere to go. So you're either increasing the pressure inside the vehicle, or you're displacing other gases, if you maintain the pressure the same, you're probably displacing the oxygen that the crew needs. And that's really gonna be the problem with any of those kind of supercritical you know, gases or liquids that turn into gases, venting, things like that. They're unfortunately just really not going to be - I'll just say this way - anything that does any kind of venting, as a way of maintaining cooling is probably not going to be a viable solution for us, unfortunately.

N

Nick Kacsandi, TechConnect Ventures 49:28

So another question here. Are we able to submit academic papers related to our work? I'm assuming that question is in reference, can you submit? Can you submit your own research or your own papers as support for the support for the proposal? Yes, you can include attachments that explain your proposed solution with your submission.

N Nick Kacsandi, TechConnect Ventures 49:53
There's another: will the same team be evaluating category one and category two challenges or is it going to be a different group?

C Chad Hammons, NASA 50:03
For us to be the same team. So we're gonna have a panel of judges that's looking at all of our submissions, that are really kind of able to capture the expertise that we need on both the samples that we're looking for the the kind of heritage spaceflight technology, so looking at kind of the, the space unique aspects of these solutions. And so it'll be the same team looking at both categories.

N Nick Kacsandi, TechConnect Ventures 50:29
So here's another solutions outside of the aerospace industry, such as shipping and food storage, other things like that. Are those eligible for submissions? Are those of interest to the NASA?

C Chad Hammons, NASA 50:42
I'd say yes, you know, I just made mention of this shipping container that I saw the other day, when I first started, we first started looking at solutions for this problem. And I think that's really what's great about this type of platform, this type of crowdsourcing is because we all just the nature of our jobs, we tend to live in a bubble. And our bubble is very much it's aerospace, it's spaceflight, typically ISS heritage. And so the further you get outside of that, the less we're probably going to know about it, which is why your ideas are so important to us. So let's say, "yes", absolutely bring those type ideas, those applications and get them into the challenge. I think that's going to be the the, the the kind of, again, unique aspect that is going to be outside of our realm of knowledge inside of human knowledge. And that's, you know, that's exactly what we're looking for.

N Nick Kacsandi, TechConnect Ventures 51:35
Alright, so we've answered it a good number of the questions that are coming through. So one question, this is more process related. So people asking if you'll be able to find out your score based on the evaluation criteria outlined on the website. So, no, we will not be published, publishing, or publicizing final scores will simply simply be alerting the winners based on that final assessment by Chad and his team.

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Nick Kacsandi, TechConnect Ventures 52:01

Another - aside from the prize pool - or the other, are there any other awards eligible? Yeah, we talked about that. It's also outlined on the website, there are cash prizes, which will be distributed. But the winners will also have the opportunity for recognition announcements there, even a invitation to join a quick teleconference with, with Chad to chat and/or his team, I guess, to talk through some of the details of your response and hopefully, help better inform them as well.

N

Nick Kacsandi, TechConnect Ventures 52:29

Um, couple more on the prize pool: so what happens to the prize pool of pool with fewer awards are given in in one particular category. So the prize pool is fixed at \$40,000. For this challenge 20,000 allocated each category, we're going to try and stick to that as much as we can. Obviously, the nature and strength of the submissions will dictate a bit of that, per the challenge rules NASA and TechConnect, reserve the right to alter the awards if we if we deem it necessary. Based on the participation today and what we've seen coming in, I don't know that it's going to be necessary to change it. But as you can see, in the in the rules, there's a clear outline of position on awards and things. In the event that nothing were to come in. There's no obligation to award but certainly we don't think that that's going to be a problem.

N

Nick Kacsandi, TechConnect Ventures 53:26

So just scrolling through apologize for this awkward silence towards the end. There are a couple more. Um, Chad, you already mentioned this, but I think it probably bears repeating. is the temperature of attaining, negative 150 C and absolute requirement for both challenges? Or would you be interested in something that part of the way?

C

Chad Hammons, NASA 53:49

So I would say yes, to both those but let me explain. For category one, I think that temperatures can be really important we are looking that's that's our category for the the solution. In the end, that minus 150 is going to be really important because again, if you think back to the slide we had on how we're waiting our proposals that the performance of your submission is the largest way to categorize the largest weighted category. And so that that temperature is going to drive a lot of the scoring of those submissions, and we are looking for solutions that meet everything in that category. Now, category two, though, is not necessary. That's not necessarily the same, like we kind of I think we've talked about a little bit so far is I would consider that more of a target. You know, if we

can find something that hits minus 150, that's great. But the the point of that second challenge is to find new technologies. So you can consider that minus 150 a target, the closer we get to it, the better. But if you don't meet that minus 150. That doesn't mean that you're ineligible. In category two, you may be able to to win a selection in category two. If you don't Meet every specification.

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Nick Kacsandi, TechConnect Ventures 55:05

Probably have time for a handful more. So I think we can we can push through a couple of these as well. So one question here. So for challenge category one specifically, does the storage unit need to be transferred between vehicles? Or can the sample be transferred between multiple storage units where each vehicle has its own?

C

Chad Hammons, NASA 55:28

I'll make sure I understand the question. So it's you're basically asking, "do we need like a single container that's going to be transferred", or okay, yeah, I would say using both good.

N

Nick Kacsandi, TechConnect Ventures 55:43

No, a single unit across all or multiple units, one for each view,

C

Chad Hammons, NASA 55:49

I would say both approaches are equally valid. It's why we didn't specify it. And I forgive me, if I'm overusing this, this phrase, but the solution space that we're dealing with is very complex. And the more prescriptive we are, I feel like the less innovative people can be with their solutions. So we know, we've got a sample that needs to get across those vehicles. But if you've got one unit that is transferred itself across all the vehicles, that you know, still meets all their specifications, then that's, that's fine. If you need to have one copy of your unit that goes up with the lander and one copy of a unit that's in Orion. And some either copy the unit or a different conditioning unit, because you'll find our specifications and gateway actions, slightly different specifications than HLS. And Orion, you've got the capability there to condition samples. So you could, I'm just going to throw out an example, you could have some sort of passive cooling up for the ride from the lunar surface to Gateway, do some serious conditioning on the samples at Gateway, and then put them in a passive container and bring them back on Orion. Any combination of those active passive solutions, either the entire unit moving itself or moving the sample from unit to unit across the vehicles. As long as you can meet the specifications, which are

written from the samples perspective, as it just goes along for the ride through your solution space, then I think that, that either one of those approaches would be considered valid. Hopefully that answers the question if I understood correctly.

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Nick Kacsandi, TechConnect Ventures 57:30

So for either of the challenges, is there a preference between if the cooling mechanism is active or passive?

C

Chad Hammons, NASA 57:39

Um, I would not say that there's a clear preference we're looking for. I think we've we've talked about the kind of difference between the two challenges enough, but we're not saying you have to be active, you have to be passive or preference between the two. When it comes to meeting the specifications, there are some things that are going to be a little bit easier to meet with passive cooling, like for example, passive cooling, beneficent doesn't require power. So it's gonna be easier for you to meet the low power requirement using passive. But if it requires so much mass, that your total solution ends up being more than an active cooling cooling solution, which uses some amount of power but as lower mass. That's there's more of a trade off there. So I would not say we are we're not specifying a preference for one or the other. The the more your solution is kind of optimized in this bucket of low mass, low power, low volume, the better you're going to be. But how you get there, that is completely up to you.

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Nick Kacsandi, TechConnect Ventures 58:37

Awesome. And then we've got time for one more question. So we'll go ahead and throw this out there. On the challenge web page, can you explain what air cooled, air cooled only means for an active cooling system?

C

Chad Hammons, NASA 58:53

Yeah, that gets into kind of, I'm trying to pick a starting point here. What we mean by that is, if you look at ISS, if you can go and search for what we use for cooling and ISS, we have a lot of water cool technologies, that is we have a thermal system that is circulating water inside the vehicle can be at very low temperatures and your the freezers we have there can actually plug in and circulate the water through their devices. So it's a way to keep their electronics cool to dump heat from whatever they're using onto the thermal system of the vehicle. For Artemis, across all three vehicles, that's not going to be an option, we're not going to have the ability to to siphon that cooling liquid into your payload. So

whatever heat you generate, we think about an active cooling solution you're using power that power is going to turn into heat inside an enclosed environment. You need to get rid of that. The only way to do that is on these vehicles is going to be to dump it out into the air. So you know whether it be passive cooling radiating heat, whether it be using and to kind of push the the heat the excess heat you're generating out into the cabin, it can then be dealt with by the equipment in the vehicle. But you're not going to have the ability to, again, kind of plumb a cooling line directly into the vehicle or anything like that. Hopefully, that's a good enough explanation, I'm sure we can come up with a something to put on the FAQ that helped explain a little bit better if we need to. But I think we I know we have a heat specification, how many watts of heat you can reject into the atmosphere. But it just again has to get there via air cooling, not not water cooling.

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Nick Kacsandi, TechConnect Ventures 1:00:40

Great. So we are up on time. It's been a great hour here. So we'll go ahead and jump to the last couple pieces of information here. Plenty of questions still coming in, obviously, feel free to send them through the last couple of minutes here. If we haven't answered anything, we will do our best to get back to you as soon as possible. The recording and transcript of the webinar will be up on a web page within a couple of days, all the answers to the FAQs will be cycled back to the website as well. So you'll certainly want to check back.

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Nick Kacsandi, TechConnect Ventures 1:01:14

Next steps. Obviously, we're just about halfway through the challenge. Most of you probably have been tracking it for the last month or so. Going forward, the biggest things that we want to recommend, obviously confirm your eligibility to participate. Make sure that you understand all of the requirements and specifications everything in the legal rules and guidelines. by submitting to this challenge, you're you are actively agreeing to everything in those rules. So we really encourage you to understand those questions come back, let us know.

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Nick Kacsandi, TechConnect Ventures 1:01:49

Stay up to date on everything that's going on. There'll be changes to the website with the the postings that are coming up after this webinar. But you can subscribe for updates the links on the page, it's very easy to find. Very easy to find, once you get there, definitely feel free to follow TechConnect Ventures on our social media accounts, Twitter and LinkedIn, the links are right there. Again, we're easy to find and submit your entries. You've got until November 12 at 7:59pm Eastern, that gives everybody the full business day plus a little bit

if you're on the east coast to get the solutions in we will have a hard cutoff at that time. I am going to re-stress that will be the end of the submissions. We're not going to offer any extensions, we will not be offering any opportunities to email us your submission after the fact or in any other capacity. You've got to go through the website, it's got to be within the timeframe. And we're not going to we're not going to be broaching the competitive nature of this challenge by by kind of offering anything outside of that.

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Nick Kacsandi, TechConnect Ventures 1:02:53

So that's really it. We're really excited to see what you guys are able to come back with. Please stay engaged. Please add please ask questions as we go forward. Chad and his team are stoked to see what comes back through this. We're we've got some great participation today. Chad, thank you so much for taking the time out of your day to weigh in on all of this. I don't think that we would. There's no way that I would have been able to articulate this even though we've been sitting together on the problem for a while. So thanks a lot for joining us.

C

Chad Hammons, NASA 1:03:22

No problem. Thanks for hosting. And I'm going to just echo what you said - I have trouble expressing how excited we are to see some of these ideas to see those of us who have worked with this kind of solution space for a while now trying to characterize and figure out how we're going to do this. Seeing your ideas that are going to be so different from anything we've conceptualized I think or it's got a lot of us very excited. So we're looking forward to kind of looking through that stack of submissions when we get to November and seeing what we've got. So thanks a lot!