DISCOVERY 30TH ANNIVERSARY ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

JESSICA LOUNSBURY
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is September 13th, 2023. This interview with Jessica Lounsbury is being conducted for the Discovery 30th Anniversary Oral History Project. The interviewer is Sandra Johnson, and Ms. Lounsbury is in Edgewater, Maryland, and talking to me today over Microsoft Teams.

I appreciate you taking time out of your schedule to talk to me for the project. I'm going to start out by asking you to talk about your background, your education, and your work background. I thought it was interesting because you have a degree in physics, and you do have some coursework in astronomy, but you're a systems engineer. Talk about where that interest came from, and how you got to your position.

LOUNSBURY: Sure. Once I graduated with my degree in physics, I started working at Wallops Flight Facility [Wallops Island, Virginia], which is a branch of Goddard Space Flight Center [Greenbelt Maryland]. At Wallops, there are a number of suborbital projects. They're quick turnaround, usually technology development type projects, and they're on smaller teams. I got a lot of experience very quickly through the whole mission life cycle, through working on multiple aspects of a mission, so there were times where I was the person writing the software, wiring up the harness, building the electrical board, populating parts onto boards, integrating sensors. What was really unique about the experience at Wallops is that you're hands-on, and you're doing everything at a more rapid pace, and so actually I didn't realize I was becoming a systems engineer just by being there and by being in that environment. When the call for a systems engineering education development program came out, I applied and transferred to Greenbelt to take that opportunity.

That was about seven years into my career, so I had really been doing these smaller, quick-turnaround projects for about seven years, and really I was learning about attitude control systems, electronics, learning about software engineering, mechanical, and thermal, all in one. I was very poised in that way, and I will say that I didn't really know what I wanted to be when I grew up, and so I went for a physics degree because I loved the science, and I didn't know that I was going to end up with NASA. Ending up at NASA was an amazing kind of divine intervention for me, and what was even greater about systems engineering is that I got to marry my passion of science with engineering. At the systems engineering level you spend a lot of time interfacing with the scientists, what experiment it is that we're trying to put into space, what questions are we trying to answer, and, to me, that connection to the science is what drove me towards systems engineering.

JOHNSON: I hadn't thought about systems engineering being that connection between the science and the engineering, so I would think you were in a good position to fall into that, like you said, and get to work at NASA. Let's talk about some of those first projects you worked on when you were at NASA. I did read that you worked the MMS [Magnetospheric Multiscale mission], with Craig [R.] Tooley.

LOUNSBURY: Yes.

JOHNSON: I've interviewed several people about LRO [Lunar Rendezvous Orbiter], and they had so much to say about him and how wonderful he was to work with. Maybe talk about that first project for a few minutes.

LOUNSBURY: Sure. MMS was a family. I absolutely loved working on that project. I learned a lot about leadership, a lot about team camaraderie. Of course, I learned a lot of technical, as well. That was my second systems engineering role, and one of my greatest ones. It was an in-house team. We were a pretty large team because we were building four satellites that were identical. They were to fly in formation, and collectively it was a hundred instruments, so there was a lot of work going on, not only on the floor inside Goddard but also with partners, with different universities, with the Japanese, with other instrument providers. I didn't have as much interaction through travel, but certainly once our partners came onsite I spent a lot of time working with just everyone across the mission, and the reason being is that not only did I have the opportunity to look at some of our larger tests that were across the entire suite of observatories, things like our comprehensive performance test, where every single piece of hardware is turned on and is operating in science mode, but also I spent several years working fault management. What that entailed was really if something were to fail, or not perform as expected, what should the response of the spacecraft be to get it back to a safe state? From that perspective, you get to ask the questions of every engineer, and all the instrument teams, "Okay, well, what happens if this turns off, or this fails, or this goes into the wrong mode, or we don't see any data from this sensor?" In certain cases, it might be okay and we can live with it; in other cases, we can't, and we need to have the spacecraft respond in a certain way. I got to do a lot of work not only asking those questions, and coming up with the different fault trees, and solving the fun problems, but I also got to help write the software and make sure those responses actually performed the way we wanted, feed those into our tests, and test them before we launched. It was nice because it gave me that opportunity to work with everybody.

I had several other roles. We did a stacked vibration test, where you stacked all four spacecraft on top of each other like they would fly inside the rocket, and you shake them to make sure they can survive. As part of that test, we also did a harness separation test, because each of these had to deploy. Number four was on top, then three, two, one. Number four needed to deploy first, so if the software wasn't correct, and number two deployed, well, that would really ruin how we were going to get the formation in orbit. So that was a really fun experience, as well, because, again, I got to work with everybody, and make sure that this huge test was successful to show, hey, on launch day we're going to be in a good position.

So I had some unique opportunities on the mission, and there were more, but just to give those examples reminds me about what it was like to work with those folks, and the qualities that you would look for in someone you'd want to work for. So there were several people. Craig Tooley, absolutely fantastic project manager. He was very knowledgeable, was an engineer previously, and you knew that he knew more than you did, or at least more than I did, certainly, but he never played it that way. It was always asking questions, seeing what we thought, supporting our decisions. It was very much give the employees enough room to be accountable, and to make decisions, and own their piece. Obviously, if we're going down a really bad path he'd step in and say something. "Hey, well, hold on; have you thought about this other path?", or, "Have you thought about the impacts of the path that you're going down? This is what I see." But it was never critical. He was very guiding in his mentorship. You wanted to work for him. You wanted to wander into his office. You wanted to have a beer with him, and think about random ideas, and shoot the breeze, and then eventually come to a conclusion as to whether that was a good idea or not. He gave that open space to do that in the relationship, and I think that's something I take with me, or try to take with me, in my leadership style with my team, and I learned that directly from him.

We had our mission systems engineer, Pete [Peter] Spidaliere. Pete is a character. He uses a lot of sarcasm and humor with the team. He can be a little inappropriate at times with his humor, but he is always careful to see who he could walk that line with, because ultimately he ended up with really great relationships that were lasting relationships with people, even though there was some little off-color humor there. Joanne [L.] Baker, fantastic I&T manager, Integration and Test manager. She and Craig were kind of a tag team. They had worked LRO together. They'd moved over to MMS together. Just fabulous team. Looking back on it, I'm so grateful to have worked with them. I'm getting a little nostalgic just thinking about it, because that was Craig's last mission, and I'm glad I got to have that experience.

Joanne, though, you always wanted to work for her. I can't even ever put my finger exactly on it, but she wouldn't have to even really ask you to work extra hours; you just wanted to help her meet the schedule, and you wanted to make sure that your test got done to your satisfaction, and so those things in combination made you want to stay late, made you want to get it done that day, as opposed to trying to push for the next day and ruin the schedule for the next day. She just had this way about her of asking that wasn't really directly asking. She would say, "Well, how much do you want to get out of this test? Do we need to find another day next week, or are we in a configuration that's hard to get back into?" And she'd kind of make you think, ah, now or never for some of those tests, but she never said that. She just had a really relaxed personality, even though here she is, on the line for delivering on schedule.

It's really interesting, because both of them were managers in their own right—Craig as project manager, Joanne as I&T manager—but you never really felt the schedule pressure from them that you see on maybe other missions, under different leadership. It was just different, the way it came across from them, and maybe that's why even when we went into a furlough in 2013 while the spacecraft were in thermal vacuum at NRL, Naval Research Laboratory [Washington, DC], and we didn't want to pause for a month. I mean, typically these tests last a month or more, and we had four spacecraft at the time. Now, we were sending them through two at a time, so we didn't have to do four thermal vacuums, but we did have to do two, and to lose 16 days, it's a little debilitating for a project.

Joanne and Craig figured out that our contractors were not furloughed, so we looked at our contractor workforce and said, "Who of you can continue on and run through these tests without the rest of us?" And, lo and behold, we were able to successfully get through that 16 days and continue testing with the workforce that we had. I don't think there was any forethought put into that—I think we just had a large enough team, we were lucky—but seeing that that opportunity was there, instead of just standing down completely, was something I realized, learned from those leaders that, hey, come up with a creative solution. Then, here we are, years and years later, post-MMS, and COVID[-19 virus pandemic] comes along, and it forces you to think, how can we be creative, how can keep moving, even though most people want to work from home, or want to stay virtual, and if they come in, they don't want to stay for long, or they don't want to get sick, of course. I'm diverging from your question a little bit.

JOHNSON: No, that's all right, that's fine.

LOUNSBURY: But I think that having seen the flexibility and a creativeness from Joanne and Craig helped me with Lucy [mission to the Trojan asteroids] as we went forward and tried to figure out creative solutions to keep moving on that spacecraft.

JOHNSON: Yes, because that is my question, how these earlier experiences shape you to be prepared to join one of these missions. That's a good example. I was looking at the fact that during the same time the AO [announcement of opportunity] came out in 2014, and the Lucy team was working toward that, but you were actually on the DAVINCI [Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging] team at that point, right?

LOUNSBURY: Yes.

JOHNSON: Talk about that, and during that competition, and that process of going through that competition, since you didn't do it with Lucy, you did it with DAVINCI, which, of course, wasn't selected that time, but it was selected later.

LOUNSBURY: Yes, in hindsight it was an awesome experience to have been competing against the project that I ultimately ended up executing. DAVINCI, fantastic mission, has since been selected, as you probably know, so I'm very excited for them, as well. During that time, being on the DAVINCI mission was amazing: great team, great science. I was all in on that mission, and we knew that Lucy was our competitor at the time, but there were other competitors, as well, more so competitors to go back to Venus, and so we had a lot more of a focus at that time on VERITAS [Venus Emissivity, Radio Science, InSAR, Topography and Spectroscopy] and their uniqueness versus DAVINCI's uniqueness, and how we could maybe sell the mission. We knew Lucy was a competitor, but the science was so different, and the planet or planetary bodies were much different, and so the focus wasn't quite on Lucy. We also thought maybe they were going to select two proposals, and so at that time we thought that we might have the opportunity to be selected alongside another mission.

It was such a cool experience going through the proposal process. Going through Discovery step two is what I did with DAVINCI, and you get so invested and so embedded in the mission that you're proposing that it's probably so exhilarating when you win. I don't know that feeling, but it was so heartbreaking to lose. We really thought we were so close, and who knows what's true but we even heard rumors that they were going to select both Lucy and DAVINCI, but because both were at Goddard there was concern that we wouldn't be able to handle the workload for both missions, and that just felt like twisting the knife a little bit more if that was the real reason. Was it the real reason? Who knows? Only the TMC [Technical, Management, and Cost Evaluation] knows. Thomas Zurbuchen knows.

But we said, all right, well, we're going to get back on our horse, and we're going to go again, and we proposed a similar science-wise but different mission through New Frontiers [program] called VICI [Venus In situ Composition Investigations], and we went through step one of VICI at that time, as well. We didn't win that one, either. Then it took a whole other proposal cycle, step one, step two, before DAVINCI got selected, and they're in early phase, phase B bridge, right now, I believe.

In the end, it was amazing to contribute to such an exciting mission. You felt almost like a death in the family not winning the proposal step two. Everybody was just heartbroken, and we were so excited because we thought we have the right team at the right time and all these things.

Of course, it ends up the way it needs to go. Maybe we really weren't ready, and there were some weaknesses that we needed to address, and I think that we came back stronger in the next proposal round. Although I wasn't on the team for the final proposal round, I was consulted on a number of topics. There was a lot of reach back to figure out how can we address the weaknesses, and I think ultimately they ended up in a better place, so while it had its ups and downs for all of us emotionally invested in it, it turned out better.

What's fun is I can now be a cheerleader for DAVINCI, and what's even more hilarious is that the team that we had on Lucy that went through all of the formulation and launch, most of that team is now leading DAVINCI have already experienced how to work well with the partners that were new at that time.

JOHNSON: Like DAVINCI, Lucy didn't win the first time, but when they went through the competition again the next time, they won, and it was two asteroid missions that actually ended up getting picked, so let's talk about that [Psyche mission to a metal rich asteroid was also picked]. Since you weren't on that Lucy team until around 2018, I think I read, you joined?

LOUNSBURY: Yes.

JOHNSON: Okay, let's talk about that. How did that happen? How did that opportunity to go ahead and work on Lucy happen?

LOUNSBURY: Yes, when I had finished up the DAVINCI proposal, I turned to working on an in-house Earth-orbiting mission called PACE—Plankton, Aerosol, Cloud, ocean Ecosystem. I moved over to the PACE mission, and I was there for about six months as a deputy mission systems engineer, and I liked it. There were a lot of folks that were on MMS that were over on PACE, but there are also a lot of new faces, especially in the leadership area. And I was thrilled to be in that position, but it actually turned out that the team dynamics weren't a good fit for me. The manager at that time, who's not the manager now that will be launching it, hadn't had experience working an in-house mission, and so there was a lot of addressing the team as if we were contractors. There wasn't that sense of family and community that we had on MMS, so it was just very different. The other leaders that that manager brought along also came from more of an out-of-house mentality, working with contractors on some of our NOAA [National Oceanic and Atmospheric Administration]-type programs. Just the—I don't know—team leadership, the atmosphere just wasn't a great fit.

And initially I spent time thinking, well, I have an opportunity here, and I can start to help bring my in-house perspective, and help to gel the team, and help to bring those experiences that I saw. I spent some time doing that, and I think there was benefit, and there were a lot of people that kind of rallied around the mission, but all of a sudden an opportunity for Lucy came about. I don't know how candid to be with some of these conversations, but I'll say it this way: the PI [principal investigator], Hal [Harold F.] Levison, was not satisfied with the mission systems support on Lucy at the time, and I think he actually went through two different mission systems engineers—could've been three, I'm not even sure—well, okay, three technically, but one of them left after only being there a very, very short time to go be the mission systems engineer on another project in-house. And so one person left; he loved working with that person but they just had a different opportunity presented. The other two, there wasn't a good leadership relationship there.

The styles did not mesh. So while the person that was exiting as I was entering is a great systems engineer, they just weren't a good fit with Hal, and Cathy [Catherine Olkin].

I had never been a proven mission systems engineer, and so Hal and Cathy said, "Well, we're willing to entertain bringing her on, but we'd like to interview her first. We'd like to get to know her a little bit. We don't know anything about her. She's not proven thus far. Is there anybody that can mentor her?" Now, I'd gone through the development program for systems engineering. I had gone through working on tiers at the instrument systems level. I'd gone through MMS, doing all these wonderful things for the mission. Had done the proposal work, and had sat on PACE for a little while. I understand, they had their reservations. You don't want to bring someone on that you're concerned might not be able to do the job because they've never done it before. But to my delight, they were willing to consider it, they were willing to give me a shot, because if you never give someone a shot then you're never going to get new people infused down the line, so at some point someone's got to give you a shot.

My mentor, who had been my mentor for about 9 years at that time, Dave [David F. Everett] said he would support me through the first major preliminary design review. I joined in April of 2018. That was right after a system requirements review had concluded in February, and so we were right between reviews. PDR [preliminary design review] was coming along, less than a year away, I want to say summer timeframe. PDR might have been, I don't know, July, August.

So Dave said, "Well, I'll come on the project, sit alongside you, let you do your thing, I'll stay out of it, and let's get through PDR, and we'll talk to the PI and the project manager and we'll reassess."

I said, "Sounds good. I'm fine with that approach. It's great because I have you here, and I can ask you all the questions I want to ask, and figure out what I'm missing, or what I'm not seeing."

That was really nice, and getting to know Hal and Cathy, and at the time the project manager was Mike [Michael] Donnelly, it was a great experience. By the time we got to that PDR, it was great: everybody said, yes, cut her loose, which was nice. It was nice to hear. It was nice that they had confidence in me after just a few short months of seeing me work. Did I have confidence in me? Yes, but I always know there's so much I don't know, and I think that piece of it, coming at and approaching a role realizing you have to stay humble, and you have to rely on your experts, and you have to ask questions, that's a lot of what I learned watching the good leaders that I saw on all these other missions. Having a good bedside manner with the folks that you work with, and striving for a sense of community within your team, I recognize those pieces as really important cornerstones of my role, and so luckily whatever it is that I did or said to convince Hal and Cathy and Mike and others, it was enough to earn my spot. I was really fortunate to continue through that whole mission, to go through launch.

I don't want to say I was fortunate to go through our solar array anomaly, but in the end, I think it was an awesome experience, and I now miss that family and that team, and when I go over and visit those that are still around center working on DAVINCI, I get a little nostalgic for several reasons. That, oh, I'd love to work on DAVINCI, but I need to move on, and they need to grow as leaders; and, oh, I miss that team from Lucy, it was so great working with them, but when I was on Lucy I spent a lot of time making sure we were pulling in people who were mid-level systems engineers and letting them grow, putting them in roles where, again, they could be accountable, just like Craig and Pete did for me on MMS. I keep looking back at, well, what opportunities were given to me, and how can I give those opportunities to other engineers that want to become systems leaders going forward? To me, I always find that that is part of my sense of purpose in the role, is not only to work the actual tech authority job, of course, but also to grow the next generation, to grow those next leaders, and support them and mentor them.

JOHNSON: Let's talk about that position as the lead systems engineer. You mentioned the tech authority, and I did talk to your mentor, Dave Everett, for LRO, and he had some interesting things about what he thought this systems engineer role is. He talked about the tech authority, and also the fact that the lead systems engineer provides, as he put it, an independent reporting path all the way to the office of chief engineer. He described it as a separate thing, that even the funding comes from a separate area than other managers and everything on that mission. Talk about that for a minute, how you would explain to somebody what a lead systems engineer does for a Discovery mission.

LOUNSBURY: Sure. Yes, as the technical authority, you're responsible for the integrity of the mission, and what that really means is the science that we set out to collect needs to be supported by the launch vehicle that sends the satellite into orbit, the instruments that are going to collect the data, the systems that are going to transmit the data back, the archiving on the ground, the communication, the flight dynamics, how the mission is going to fly and get to its target. There are multiple mission elements across a project that need to work together in order to achieve that science. It's the tech authority's job to make sure that all of those elements are playing together to achieve those level one science requirements. For Lucy, the example here is the trajectory needs to get to all of the Trojan asteroid targets, so that's the flight dynamics piece. We need to be able to communicate to the satellite to ensure it's headed to the right location, that we're doing the maneuvers that need to be done to get there, that we're sending the commands we need to to operate it safely, that we're getting the telemetry and the data back, and that all has to do with where are you in the orbit, what ground stations can you talk to.

There's kind of the comm [communication] piece of it. There's the spacecraft piece of it, that the spacecraft actually has to operate the way that you intend for it to in order to collect the science. It has to support the instruments that are on board, and it needs to have all of those functions to do the communication and data collection. There's a lot of science planning that's happening on the ground as well. So as a systems engineer and a tech authority, you're looking at the full scope of the mission, from end to end, from the data bits that are coming down to how do you generate those data bits.

The tech authority role, it does stand separately from the rest of the project for good reason. The *Columbia* accident [STS-107] investigation board found that that was a lesson learned, and they instituted technical authority on all flight projects, enabling engineers, or anyone on the project, had a way to bring forward their concerns and not be shut down by a hierarchy or a structure within the team that didn't allow for a dissenting opinion. Part of the tech authority role is really to support the team independently so they can come to myself, in this case, and express where they're concerned, get an ear, and not just an ear but if there's a real risk here, I would support them in writing up the risk, talking with the project. If the project did not agree, or didn't want to fund fixing a problem, or coming up with an alternative solution, then it would be my role to go up the chain of command and seek an alternate path, independent from the project, to resolve that issue. Again, it's all in the name of technical integrity of the mission, so it's really, "Is there a risk we're not going to meet our level one science as a result of this concern, this risk?"

It actually is a lot of fun, looking at the risks across a project, and deciding which ones to address and which ones to kind of mitigate to a certain point and then call them good enough, especially in a cost-constrained program. Discovery budget is certainly not what New Frontiers budget is, and it's certainly not what a flagship budget is, and so it's fun in that you have to play inside those constraints, and decide what risks need tending to and addressing, and we end up doing a lot of risk assessments on Lucy to really think about what's the best path to go down, and "use as is" is always a path. You start any risk assessment, "use as is" could be a path, and then there's all the other host of paths that come with their own impacts. That was one really fun piece about being a tech authority, but though you're shown as independent, though you're paid outside of the project by the center, it doesn't mean that you're not part of the team and part of the community; it doesn't mean that your leadership isn't there. I was still very much a part of the team. My leadership was very much a part of how we made decisions around those types of risks, or how we did design trades and things of that nature.

Tech authority and mission systems engineering, to me, it's a really fun role. Though you're paid separately and expected to be independent, there is also a lot of team building that comes along with the role, and there's also a lot of making sure everyone's voice is heard, hearing the dissenting opinions, not always going for consensus, because that's not necessarily efficient in getting the job done at all times. But there's ways to do an assessment, look at a risk, or look at a decision, making sure everybody's voice is heard, and still meeting the integrity of the mission, even though you don't have consensus. I think that's how I would describe the role to someone who hasn't had it.

JOHNSON: That's a good description. I noticed, just since we've talked, there's a theme that keeps coming up and it's communication. In these type of PI-led missions, which are different than the flagship missions and some other types of missions, but New Frontiers and Discovery with the PI-led mission, the scientist, the PI in his team, they lead it, but there are engineers supporting them, and sometimes communications between people that are scientists and people that are engineers can be problematic, and then you have all these other things thrown in. You have lots of other institutes, or universities, or people that are involved in the same mission. How do you see your role, as far as facilitating communication, and how important is that communication and being able to bridge that gap between the way people communicate and making that feel like a family, like you were talking about? How do you make that team cohesive?

LOUNSBURY: Yes. Communication's huge on a project. It's a very important, key role for the mission systems engineer, or project systems engineer as we call it in the Discovery world. I'll give you a funny example. Hal, fantastic, fantastic PI. Absolutely enjoyed working with him. He had fantastic engineering ability. He would often say that he was more of a dynamics guy, flight dynamics, understanding how do we get to these asteroids. Because he was technically savvy in certain areas of the mission, he spent a lot of his time over the years trying to learn how to trust the engineering team and let us do the work, and not roll his sleeves all the way up and get down in there with us at every opportunity. I mean that in the most wonderful way, because he was welcome in many of the forums, and we were grateful, because there were many times where, had he not be involved to the depth that he was, we would have made mistakes. There's a blessing and a curse in there, too, because we wanted to do our jobs, and be able to report out to him.

But communication-wise, there were times where I had to talk to Hal and say, "Hey, I need you to trust me to run this to ground." He and I had plenty of blunt conversations. I'm not really a beat around the bush type of person, and he isn't, either, and that was lovely for me—and for him, I think—that we could just say frankly, "Okay, Hal, I need you to give us a little breathing room, give us some time, and I promise that I will communicate to you as we're going along in this assessment or whatever it is. I will report out to you on where we are, what we're thinking, but you have to allow us to make that sausage. Even if we're midway through and you don't like the conversations that we're having, can you just give us that time? You can hear what we're saying, and see what we're doing, but can you be that fly on the wall?"

I will tell you, he was fantastic when we went through the solar array anomaly. He stayed a fly on the wall during our technical meetings. Then, we had separate meetings where myself and my deputy systems engineer would then interface with the project management and the PIs, and then we'd have our free-flowing conversations without the engineering team there, so that he could tell us, "Well, I don't understand why you want to do it that way. I don't get it. That just sounds stupid to me." Then we'd spend some time explaining why, or trying to justify our case. Or he would bring, "Well, haven't you thought about doing it this way?" And we're like, "Well, this isn't going to work, and here's why." We could have those frank and open discussions in the right forum.

We went through a lot of learning together what type of communication in what audience, or what forum, because we didn't want to have the team think that the PI doesn't like the path we're going down. We wanted them to be able to have a free-flowing conversation of what they thought, because they are, after all, the subject matter experts. We understood Hal's position, always, of, "I want the best science I can get, flying by these asteroids," and we understood that, and we carried that on our sleeves, too, but there were times where we had to make tough trades, and talk about where the science might take some reduction if we went down the right engineering path. If we really felt that that was where we needed to go, those hard conversations fell to myself and my deputy to have with Hal and Cathy, and not hash them out in front of the engineering team. So there was a lot of understanding how do we set up the communication pathways for us to be successful as leaders, and to support the engineering team at the same time.

Many of the times where we had to kind of slap Hal's hand, and it became a joke in the end, was with our GN&C [guidance, navigation, and control] engineer, Phil [Philip] Good. Hal and Phil had worked the proposal together, and when you start a proposal in early pre-phase A formulation, the team is really small early on, and the two of them developed an awesome relationship. Going forward that was always there throughout the life of the mission, and at times it got in the way, and my deputy and I would call them a white wire. A white wire means if there's, say, a path that you need to shortcut on a circuit board to go from one pad to another pad, you need to fix something so you have to jumper it across two nodes, you put in a white wire. It's short circuiting something, essentially. We would joke and call Hal and Phil the white wire, because they would go directly to each other to talk about solutions for things, and completely cut out the systems engineering team, completely cut out the rest of the engineering team. Initially, first, we had to recognize the white wire was even there, so that took me a little getting used to in the first year.

Once we figured that out, I started figuring out, okay, well, what tactics can I use to get in there and make sure that the communication happening between them is also getting out to the rest of the team? Because we don't want them making decisions that seem like the best path for the two of them but they're not looking at the impacts to the rest of the project, the rest of the mission, all the other mission elements. We spent a lot of time where I would hold meetings with them, writing down what they're saying. I wouldn't even talk. I'd just put a meeting on the calendar, put the two of them and a few other people, but not many, in the meeting, and then they would just go off on a tangent, and I would write it all down and figure it out. Because they have amazing ideas, they were great and brilliant together, but we needed to look at the impact across the rest of the system. There were times where we definitely caught them before the white wire got out of control.

I will also say that there were many times where I had to go for beers with them in order to keep the white wire scenario from happening. It was tough because Southwest is located in Boulder, Colorado. Lockheed Martin is located in Littleton, Colorado, so they were down the street from each other. They could go for beers all the time, and they did. It was tough being out in Maryland, in Greenbelt, and not being able to get in that conversation, and to have to learn about it after the fact.

One of the things that Hal admitted to me later down the road that he learned, in terms of being a successful PI, was that that relationship, he realized, whenever they'd make a decision on something, if it didn't get communicated out to the rest of us, that was a problem. But what was even worse was they'd have a conversation over beers, and Phil would take that as direction to go do something, and Hal had to learn that when I'm speaking off the cuff, and I think this is a cool idea, I have to realize the power that I hold, and that when I think this is a cool idea, the engineer says, "Okay, I'll go off and do that at once," not in those words, of course. He didn't realize he held that power, and that can really mess up a project manager's schedule. If their engineer is running off and doing the whim of the PI and not focusing on the thing that needs to get delivered here and now, and staying on task, that really can affect our ability to meet mission success.

I think he ultimately learned that he had that power, and he needed to be careful about what he was saying to folks. I think that he also realized that the right people needed to be in the conversations to look at the impacts, because the impacts weren't just against the system and the technical integrity, but the impact could be against schedule and the workflow, because of the people going off and doing side projects. Communication is paramount, and I think those were some examples of things we learned along the way.

JOHNSON: I'm sure it's a learning curve for a lot of PIs, because they are coming out of an institute, or a university, and they've not led a mission, a NASA mission, before. I know this was his first, and he said he depended on the NASA people to help get him through it, but I think that's interesting. They don't realize the power they hold.

Well, you mentioned it a minute ago, and I thought it would be a good time to talk about in the middle of all this, in 2020, the COVID-19 pandemic, happened. There were instruments that were going on this mission, and they were at different places, and being built, or being adapted for Lucy, but as far as NASA was concerned work had to stop there for a little while. Then your team had to figure out how it was going to work toward this launch that was set for October 2021 with all of these new protocols that were in place. Let's talk about that time period, and how that affected what you were doing, and some of the instrument teams. Since you had to touch every area, talk about that time.

LOUNSBURY: Yes, it was very interesting. At first, we were all, of course, in shock, as was the nation, the world, but once we realized this wasn't going to be go home for two weeks and come back, we realized, oh, we really have to do something, because we have a planetary launch window we cannot miss. Sure, we have a backup launch opportunity a year after, but that's not what any of us wanted. We wanted to launch on time, and at the beginning of the launch window, and so we did. But we recognized that we had to come up with creative solutions.

Really, I credit Lockheed Martin. Our ATLO [Assembly, Testing and Launch Operations] manager, Chris McCaa, came up with a way to look at putting together what he called red team and blue team, and we had essentially shift schedules where if you were assigned to the red team, you were on the red team forevermore; you cannot cross over to the blue team. That way, the thinking was if someone from the red ream fell ill and it potentially spread to part of, or all of, the red team, the blue team is there, unfortunately, to work double time, or to work slightly more than regular time, at least, maybe not double time, to support until the red team was well again, potentially two weeks later.

I will say everybody took wearing your protective PPE [personal protective equipment] very, very seriously. We set up, where we could, barriers to stay six feet apart or more. Work-wise, there was rotations in terms of where people were working on the spacecraft, so there weren't ten engineers crowded into the same area working on the spacecraft for long periods of time. We had the Lucy 6-15 rule, which was 6 feet apart, and, if you were closer than that, it couldn't be for periods longer than 15 minutes, but you always had to have your PPE on. If you were working in an area, you and another engineer were side by side, working on the mission, you had to take breaks every 15 minutes, step away, rotate others in, what have you, but there needed to be separation as much as we could, but we needed to keep working, as well. We did stay in person, if you will, for the work on the floor.

Our partners adopted that on our instrument teams. When it was time to do shift work, and we weren't necessarily on the floor with the spacecraft, but we were in the control room commanding the spacecraft, then we would stay six feet apart or more. We'd have dividers, everybody would have their PPE, and, again, red team and blue team stayed separate. I happened to be on the red team, and I never sat shift with someone on blue team. We would do our shift handovers virtually. We would call each other, switch out of the room, and then the next shift would come into the room. We found ways to make it work.

I will say we never had COVID pervade through either team. Most people, when they started to feel ill, or they weren't sure, they would stay home, and they would immediately self-isolate, let the team know. We did a lot of contact tracing. We were very careful to be open with it, as much as we could, and we would report. I think NASA actually had a link where you would report if you had come in contact, or if you had been exposed. You didn't have to say who you were; you just had to say what building you were in and what rooms you were in, and you could self-report that way so that everyone who was in that room and working that day got a notification saying, "You may have been exposed if you were in this room and you were working under these conditions." Oftentimes, if folks felt that they were at risk, they would stand down for two days. The folks that had been doing that work would stand down for two days, others would come in, and they'd wait to see, am I testing positive? Okay, I'm okay. Great. I'm going to come back to work, but I was exposed, or what have you. So we went through pretty strict protocols. NASA put good systems in place to help us with that.

Kind of rewinding a little bit, at the very beginning of this, only specific projects were allowed onsite at the Greenbelt facility, and we had an in-house instrument, Ralph,[1] and we had to put together a justification package to explain why Ralph should be allowed onsite, how much

[1] The Ralph instrument was made up of two instruments: MVIC (Multispectral Visible Imaging Camera), a color visible imager, and LEISA (Linear Etalon Imaging Spectral Array), an infrared spectrometer.

work they were going to be doing, what rooms they were going to be in, who was going to be on that list, all of that. There was a very tightly controlled environment at Greenbelt across center, across projects, so that they knew who was working on what, where, and when, and that way we didn't have cross-project illnesses happening. So there was layers of this happening in different ways. It was a little taxing, but we got through it.

I will say at a certain point, one year before launch, Lucy went seven days a week all hands on deck. Now, not everyone worked seven days. It would be red team that week worked four days, blue team worked three days; the following week blue team worked four days, red team worked three days, and it switched back and forth this way. Those days were always long days. Now, Lockheed always had a shift schedule of they would work nine days a week and have every other Friday off, so they did ten-hour days to supplement that. To be honest with you, depending on where we were in the build and the test of the mission, we were working more than ten-hour days, nine-hour, ten-hour days.

It was a long year, 2020 into 2021, but we were successful. We launched right at the opening of our launch window, on the first day. We were thrilled. We were so excited, and I think we all just got used to working that way, and, I don't know, it was a creative way to do it. I think our way of doing it was a blessing and a curse, because we were able to launch in our planetary launch window, and so other projects that don't have that type of constraint certainly get that question from [NASA] Headquarters: Lucy was able to launch on time during the pandemic. Why can't you? You're an Earth-orbiter, or you're a helio mission, or you're an astro mission, and etc., etc., right?

The curse part of it is we worked many more hours and many more days, and so of course you can recoup some schedule if your team overall is working seven days a week, but that's not practical in all cases, and that's not the right answer for all cases. Were we burnt out at the end? Absolutely. Most people are, when you get to launch, pretty burnt and charred. It got worse for us because we went into an anomaly investigation for eight months, and by the time we came out of that I was so crispy fried, it's not bacon you want to eat ever. But had that not happened, I think I would have come off feeling fantastic, and taken the nice, long vacation, and all that good stuff. Anyway, hopefully that gets at your question about COVID and how we did it.

JOHNSON: Yes, and there was a lot of testing going on during that time, too, that you had to get through during that time.

LOUNSBURY: That whole year.

JOHNSON: Yes, that whole year. I have heard other people say that other missions were compared to Lucy, like you said, "If they did it, why can't you do it?"

LOUNSBURY: We don't really do that to everyone.

JOHNSON: No, you don't. It's nice to be appreciated, but please.

LOUNSBURY: Yes, but we're never going to do that again, right?

JOHNSON: Yes, hopefully the world isn't going to do that again, but you never know, and that's part of it, and you do have to plan for anomalies and that sort of thing in a space mission, but I'm sure a pandemic wasn't one of the things that you planned for ahead of time.

LOUNSBURY: Yes. You know, let me say one other thing, because one of the things we did was a lot of risk assessments, and I want to mention that because I spent a lot of time with our engineering team putting together these assessments and then presenting them back to our management and PI team, to talk about how could we be more flexible, more agile if, for example, the red team came down with COVID, and we couldn't complete a test, or we needed to shift a test, or an instrument came in late and wasn't going to make the test. We asked a lot of what-if questions, and we did a whole bunch of what-if assessments early on to look at how could we pivot if we needed to pivot. I spent a lot of time looking at: could we reorder our environmental tests? Could we do electromagnetic interference tests before we went to vibration? Could we do thermal vacuum before we did any of the others? Could we accept going into thermal vacuum without the Ralph instrument? What would that look like? What risk would we be taking? What makeup tests would we need to do if we took an option that isn't our ideal option?

I spent quite a bit of time leading the team through those assessments, and putting together a takeout menu, if you will, so that if we ran into certain situations we didn't have to stop and do the trade study and ask ourselves those questions. We already knew what we would do. As the systems engineer, I was able to run those assessments in the background while everybody else kept marching forward on the nominal path, and I think that really helped us, one, to feel comfortable going forward, that we had safety nets in place. It also got a lot of traction with our management team so that in certain cases we put safety nets in place. We spent dollars to put a safety net there that we hoped to never use, so we would parallel path buy additional hardware, or buy time for a certain contract. It also not only put us in a good position to feel like we could get through potential situations, but it also sort of taught us how to make decisions as a team, how to decide what risks are worth taking against the science, and which ones we could cut loose a little bit.

I think that when we went into the solar array anomaly, and we had already established this way of working together, which we had no idea we would need to revisit, I think that framework served us very, very well going forward into an anomalous situation that we, again, didn't expect. Did we plan for and budget for a solar array anomaly? Yes, to a degree, but not to the degree that we actually went with the investigation. Anyway, I think it served us well, though. Having to learn how to plan for a pandemic gave us that foundation.

JOHNSON: It sounds like it. It sounds like doing those risk assessments probably helped quite a bit with the solar array anomaly. Like you said, you had built that foundation on working together on those things. Let's go ahead and talk about that—we have about 30 minutes—and let's talk about the launch and when you found out about the solar array, and if you were in the control center, what you were doing.

LOUNSBURY: Yes, launch day, I was at the Cape [Canaveral, Florida]. I was in the control center, on the headset. We actually had—I'd have to go look up the exact time—maybe an hour and a half, or a little under that, where we weren't going to have any telemetry, so we ran outside, we all got to watch the launch. It was really awesome. We were all just nostalgic, standing there in the dark, watching this beautiful, bright light light up the sky, and all patting each other on the back, and congratulating each other, and just super excited. We came back, and we said, okay, let's get ready, and we're going to start getting telemetry, the [payload] fairing's going to open, we're going to separate, and then solar array deployment's going to start. So we got on the headset, and we all got back and got ourselves geared up, and we were so excited, launch fever all the way, and we sat there, and we watched, and we were back and forth with each other on the headset. "Okay, looks like both of the arrays are deploying. We're getting some telemetry." It takes about 30 minutes to fully deploy, nominally, the arrays.

We're going along, and everything's looking pretty good. We've got plots going. And I couldn't tell you how far in time we were into it, but a little into it we started realizing, hmm, power profile on one of these isn't looking quite right. The temperatures aren't making sense. Certain spots on the array are colder than they should be. Other spots are hot. What's going on here? Then we started seeing the microswitch telemetry that we would expect at different phases along the way. Things weren't showing latched, and we're all staring at the screen going, okay, all right, minus-Y is latched, but plus-Y microswitch isn't latched. Is it just the microswitch? Do we have faulty telemetry on that switch? Well, no, because the currents on the arrays and the temperature on the arrays aren't right on this array, on the plus-Y array, and uh-oh, what's going on?

We thought, all right, well, we have full protection. Full protection is supposed to autonomously continue to try the deployment up to an hour, because there are certain scenarios where it would continue. We thought, well, we're going to keep watching, and everybody start pulling your data, let's start figuring out what's going on here. We need to get those plots generated on the ground. We need to pull the right people together. We need to start having these discussions. We knew, okay, what other things are coming up in our nominal operations that we need to watch for? Can we break a few people off into a separate conversation while others continue? So we quickly organized ourselves.

Then we started making phone calls to our solar array experts, who work for Northrop Grumman. Turns out a few of them were at the launch site and had watched the launch. They were just there on vacation with their families, and we called them in to work that day. They quickly came. They, of course, were concerned. "What can I do to help?" That was a very long day, because we had all gotten up really early in the morning, and we stayed late into the evening, having these discussions, poring over what little data we had. We did realize closer to the end of those operations that we were in a safe configuration, and that we could hold where we were to assess what we needed to assess, and that was really important because you don't want to make a rash decision. You don't want to send commands off the cuff without really thinking it through and then potentially damage something further. While we were all thinking, oh, just try it again, see if we can get it latched, it's got to be close, while that was going on in our minds, the other side of us was saying, that's risky, stop and think, be careful, don't be rash.

And so we got ourselves to a position by the end of that day to say, we're not going to do anything today. It's okay. We think where we're at is okay. We can keep moving, and then what we can do going forward is assess each activity that we had initially planned and decide, is that activity safe to do? Do we have to do it? Is it time-critical, or can we put it on hold? And so we really started immediately standing up an anomaly resolution board, and we organized ourselves and said, okay, who's going to chair this? Who's going to be part of it? Who do we need? We started getting outside help.

The chief engineer at Greenbelt Goddard, Tupper Hyde, was onsite for the launch, and he came right over. "Let me sit in; let me help you guys; I'm an outside perspective," that sort of thing. So we immediately had help inside and outside the project from some brilliant people, and it took us a little bit of time but we immediately laid out a charter and said, "Okay, this anomaly board"—which we ended up calling the Anomaly Resolution Team, or ART—"the ART is going to do the following." And we wrote up a charter, and it's going to be chaired by our spacecraft systems engineer, Colby Goodloe, and it's going to have membership from all the different groups: Northrop Grumman, Lockheed Martin, Goddard Space Flight Center, and then some chief engineering support through NASA.

That was really helpful for so many reasons. We talked about communication earlier. As we went through the eight-month investigation and we did risk assessments, we did tons of ground tests to prove out what went wrong, what's the state of the spacecraft, how can we fix it safely. We went through all of this work, all of these assessments, all along the way asking ourselves for every activity that we had normally planned, can we do it, should we do it, can we delay it. Figuring all of that out, the communication was super critical, because not only were we now communicating within our team and setting ourselves up on a good course to ensure we're still going to get that science, we also had to communicate outward to stakeholders across management in all of our groups, management at Northrop Grumman; management at Lockheed; management at NASA headquarters; Planetary Science Division; AA, Associate Administrator. Folks wanted to know what are we doing. The media was calling us. We're getting requests to put out something on day one, and we didn't want to hide anything that was going on, but we also didn't want to give premature, incorrect information when we didn't know ourselves exactly what had happened. So communication became the crux of this entire investigation.

I will say I learned so much from that. One of the things that I learned that I pass on now to systems engineers is use your chief engineering path. We have chief engineers within our center.

We have chief engineers at Headquarters. We have chief engineers at our program office. We have chief engineers with our partners, at their industry and their locations. All of those folks, while it seems cumbersome to bring in folks who aren't as familiar with the design, it also brings in fresh perspectives. The team was burnt out. We had gone through seven days a week, a year of COVID, on the floor, all of this happening. We needed the fresh perspectives. And while we still were the experts on our system, it doesn't mean we were the experts in creative solutions.

When it came time to put forward here's what we're going to do to solve it, thankfully, I had learned to bring along all of those chief engineers, get them along for the ride with us, get their buy-in, so that when we went to Thomas Zurbuchen and sat down and said, "We're going to try to redeploy the array, and here's why we think it will work, and why the risk is worth taking," I already had his chief engineers nodding their heads and agreeing with my plan before I walked into that room. I also had my chief engineers at Goddard, and my chief engineers at Lockheed, and while not every single person agreed—remember, I said earlier consensus isn't required—while I didn't have full consensus, I can tell you that we had enough stakeholders willing to the take the risk.

While people's level of comfort wasn't green across the board—some people felt like this was a red risk, and some people felt like it was green, in their personal gut—we spent a lot of time, through the charter and the risk assessments, level-setting the playing field so that based on the scientific return, and the risk, we could color code it and say, look, this is a two-by-three yellow risk, and here's why, and here are all the possible outcomes that could actually happen if we try it this way. Are we comfortable with any of these possible outcomes happening? Even if some of them are yellow and some of them are green risks, can we get our arms around the fact that the return on investment here is greater than and worth taking that risk?

By coming at it in that fashion, or through that process, and bringing people along throughout, and communicating like crazy on almost a daily basis—in certain audiences, it was a daily basis; in other audiences, it was a weekly basis—we were every week giving Headquarters a report out. Then when there were major milestones, it was immediately reporting out to Headquarters. By doing all of that, it really kept everybody calmer, and able to focus on the professional aspects of getting the job done. A lot of times I will say to people, "It's professional; it's not personal." I understand people are emotionally tied into this project. We all want the same outcome. We all want this science. We're all here for this reason. If there's dissenting opinions, and we make sure that we've hashed them out, and we've laid them all on the table, and we've written them up as part of the risk assessment—and we did. Every single thought you could come across, we wrote it down and it got in front of the forum. And by keeping it out there and open and public, within the team, and within our stakeholders—not the media—by doing that, it allowed us to make decisions even in the face of not having consensus.

One of the things I'll say is when we went to Headquarters, and to Thomas, and said, "We're going to redeploy," Lockheed Martin was a dissenting opinion at that time. They understood and they were along for and part of the full assessment. They came down on a different path. Now, I don't really know what I can and can't say in an archive, so I'll just say it. Different companies have different perspectives because they're driven by different business models, and in this situation, Northrop Grumman had everything to lose because if their solar array technology doesn't work, well, they're one of the leaders in developing and producing solar arrays for many satellite missions. For them, their reputation's on the line here. For Lockheed Martin, if they're not held responsible, but Northrop is, then they don't need to take a risk. For them, they're profit-driven, and it's limiting for them to take more risk on this mission that's currently flying, where they're delivering, they believe, enough of the science to have mission success, meet some of the threshold mission, maybe not meet the full mission, but why would they take more risk? From their business standpoint, if we take more risk and then we fail, then it falls on them.

As a systems engineer, and as a NASA employee, you need to realize those perspectives. The NASA side of it, being a NASA employee, there's a beautiful aspect to civil service in that my goal isn't profit-driven, isn't to stay in business, to develop solar arrays in the future. My goal is to get the best science I can get for this mission. That's where being a systems engineer, having an independent tech authority path, and your sole goal being the integrity of the mission to further science, you're the only one wearing that hat, other than the PI, but the PI, of course they're wearing that hat. You're unbiased from a profit perspective, or from a business model perspective, and so there is a beauty in that role that I certainly cherished and really got to see come to light with the anomaly investigation. I think the CAIB [*Columbia* Accident Investigation Board] report got it right in terms of making sure tech authority is independent from the project, and also a NASA civil servant, because anyone else wearing that hat would have another agenda, potentially.

JOHNSON: How long from when you knew about the anomaly to that point where you felt comfortable going in to Thomas Zurbuchen and telling him what the decision was, how long was that time period?

LOUNSBURY: Yes. We would have loved more time, but we didn't have more time. Let me talk about a timeline a little bit, and then I'll answer your question. We realized when we looked at the operations calendar, and all the things we wanted to do, like turn on this instrument and do this calibration activity, etc., we realized we could clear the calendar, and we could just be, just fly safely, and hold our position with the array as is, and we could clear our calendar from these other activities, and we could focus on the investigation.

A little while into it we realized, okay, we think we know what happened. We think we know the state of the spacecraft, that the panel didn't quite close. It's being held by a Kevlar lanyard. It's not going anywhere unless we try to move it. If we try to run the solar array motor again then it's going to move, potentially. Other things, like turning on an instrument, have no impact on the movement of the array. We realized after a little while that we could actually safely do some of these other activities, and let the instruments start looking at how is my instrument performing and those types of things. So we started slowly letting the ops [operations] team do the safe things, and so we were immediately communicating with Thomas, saying, "Thomas, we know that we're in a safe enough state that we can go do some of these other activities, and keep moving, and not get super behind on other activities, but that we can keep investigating at the same time, and we're asking you to give us time. We think we've got probably five to six months before we have to do anything on the spacecraft."

It came down that we could wait as late as—gosh, when did we do the first activity? We waited as late as June, and we did six activities in the June/July timeframe before we came upon a time where our telemetry coverage was not good enough to do anomalous redeployment. Basically, we knew we were going to go into this low telemetry coverage period, starting in August, and that it was too risky to do anything without enough data to see what had happened if we attempted something. So we knew we had a hard cutoff, or roughly hard cutoff, there in August, and then we knew in October that we were going to come upon our first Earth gravity assist, and we didn't want to do anything during that time, either, and we realized, timeline-wise, what trade space we had, and we let Thomas know that that's where we were and what we were going to do. And so by continuously communicating upwards, they said, "Okay, sure, take the time you need."

No one threw a mishap flag on us, which was nice because when that happens there's a lot larger hoopla, and the investigation. You're essentially saying the mission's had a mishap; we're not going to meet our success. We're going to do an independent investigation at this point, and you're going to get a lot more help from outside sources than you want. And because we had already said, "Look, we're bringing along all these outside folks; we don't think we've had a mishap; we think we can recover from this; we still think there's a possibility if we do nothing we might still meet our mission criteria, as well, but we need time to actually figure out if that's true."

We ended up going down a path of really use as is versus try to redeploy, and those two became our very clear paths. There were risk assessments inside each of those, and little pieces, and many facets to each of those, but those were ultimately the two paths that we had available to us. Thomas knew that, and when it was time to decide between those two paths, because we had done enough of the legwork, enough of the analysis, enough of the testing, enough of the risk assessment on both sides, could we have done more? Sure. We could have suffered from analysis paralysis, but we laid it out ahead of time and chartered our course, and we said, "We know where our cutoff is, and if we don't have all the information, we still have to make a decision." That's the crux of being a systems engineer. You get in those situations and that's that. If we did nothing and we were wrong, and we suffered from analysis paralysis, we could have missed our opportunity, so we didn't want that to happen to us.

The meeting where we had to go to Thomas, and go downtown, and sit in front of him, and say, "Lockheed wants to go use as is; Goddard and the PI want to go with a redeployment attempt," that meeting was on April 26, 2022.

JOHNSON: Okay. That's fine. We can fix that.

LOUNSBURY: Yes, we'll fix the date later, but, as I said, when we went to that meeting, Thomas was already armed with the fact that his chief engineers were onboard. He was armed with Lockheed's dissenting opinion. He knew what that was about. And I will also say that myself and my deputy went off and had side conversations with Thomas's chief engineers to explain why Lockheed was dissenting, and why we didn't agree with their dissent, why we felt it was still worth the risk. I think the communication up and out to Thomas was critical on this, and I think the team and myself, we learned a lot through this.

In the end, we did six redeployment attempts, which I will tell you, each step of the way, as we were gathering data, we had to make sure we were informing people, we're going to go again, and we still think it's safe, and here's why. Trust me, there was a lot of handwringing through each of those six attempts, but in the end we ended up pulling the array in about 72 inches, approximately 30 degrees further than it was, and we reduced the risk of flying and going through maneuvers and moving the spacecraft, we reduced it greatly. And while we'll never get it fully latched, we believe, with great confidence, with data to back it, that we should be able to meet full mission success, meet all of our criteria going forward for the rest of the mission through 2033. It's great that in the end we went through all of this and we came out better for it. We would have liked even more success, but I think that had we done nothing, I'm not sure I'd be able to say we could meet full mission success today.

JOHNSON: Yes. Well, we're right at the time we had allotted for this, but I definitely have other questions, so, if you don't mind if we meet again and maybe finish this up?

LOUNSBURY: Sure.

JOHNSON: I'm going to go ahead and stop the recording, but I appreciate you talking to me today.

LOUNSBURY: Sure.

[End of interview]