

**NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT**  
**EDITED ORAL HISTORY TRANSCRIPT**

ELLEN OCHOA  
INTERVIEWED BY JENNIFER ROSS-NAZZAL  
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ROSS-NAZZAL: Today is June 13<sup>th</sup>, 2017. This interview with Dr. Ellen Ochoa is being conducted at the Johnson Space Center for the JSC Oral History Project. The interviewer is Jennifer Ross-Nazzal, assisted by Sandra Johnson. Thanks again for inviting us up. We appreciate it.

OCHOA: You're welcome.

ROSS-NAZZAL: I wanted to ask you about being named Center Director. Who approached you with that opportunity?

OCHOA: Robert [M.] Lightfoot [Jr.]. He, at the time was the Associate Administrator, the person that all the Center Directors directly report to. It was really mostly his decision. Obviously he would need to get the concurrence of [NASA Administrator Charles F.] Charlie Bolden in terms of a Center Director, but I think he was really the key person in thinking through who the options might be for that.

ROSS-NAZZAL: When you were selected as Deputy did you have a feeling that when Mike [Michael L. Coats] stepped down you would be selected?

OCHOA: There wasn't any particular understanding one way or the other. If you look at histories of Center Directors, in some cases the Deputy has become the Center Director, but in many cases not. It's definitely not a given. But it certainly gives you a lot of great experience and the ability to really understand the job.

ROSS-NAZZAL: When you were thinking about this decision, was it an automatic, "Of course," or was it, "Let me have some time to think about it."?

OCHOA: I knew for probably a year before Mike left that he was leaving. I knew he had talked to [NASA] Headquarters [Washington, DC]. I had already thought through if it was offered to me I would take it. What I didn't know for a while was whether or not it would be offered to me.

ROSS-NAZZAL: What were some of the discussions that you and Mr. Coats had about accepting the position and about becoming Center Director?

OCHOA: I don't know that Mike and I talked a lot about that in particular. To me it was really more the whole time, the five years that I was his Deputy—one of the things he really tried to do was to ensure that I saw all aspects of the position, so that at some point if I was interested and if I was offered the job, I would be very well prepared for it and not have some part of the job that I thought, "I wish I had learned more about that."

It was just one of those things in our yearly performance appraisals. We might talk about "Is there some aspect that you'd like to think about or focus on a little bit more this year that you

haven't done in the past as part of professional development?" Because of the positions we were in, that was really focused on the Center Director job.

ROSS-NAZZAL: I understand that Mike Coats was really a mentor to you in terms of management and leadership.

OCHOA: Yes, absolutely.

ROSS-NAZZAL: Would you talk about what you learned from him and how you applied that to your role as Center Director?

OCHOA: Sure. One of the things that he was very well known for was his focus on taking care of the people at the Center. He's a very people-oriented person. People talk about the fact that they would get a note from him on their birthdays, a signed card. That was a big focus of his.

Also making sure that people had time with their families. He's a big family person himself. He has a wonderful family. He wanted to make sure he maintained time for his family, and so he really brought that to this [job] as well—that that's an important aspect of everybody. You should be able to have a family life and have time for your family even if you're working hard for NASA. I would say those are a couple things that really stood out.

Also I think he was good at delegating. There were certain things he delegated to me as Deputy Center Director, and never once did he second-guess any decision that I had made. If he had said I've got it, I can't recall that he ever came back later and said, "Well, I've thought about

it; I'd like to do something different." I think he really did that with other people here at the Center too.

ROSS-NAZZAL: What were your goals when you accepted the position?

OCHOA: I knew overall that the Agency was really looking at moving forward into the future, and looking at what we need to change as an Agency. How do we make ourselves an Agency that will be stronger in the future? It was clear to me that they wanted the Centers to be thinking about that as well. That was probably foremost in my mind. What does JSC need? Not just looking at what are we doing in the next couple years, but what will make us a strong organization 5 years, 10 years, 20 years down the line, where we still play this very vital role in the Agency of leading human space exploration. What should we be doing now to set ourselves up for that.

ROSS-NAZZAL: Talk about those first couple of months and weeks as Center Director. You're credited with the idea of JSC 2.0. Where did the idea come from?

OCHOA: It was really thinking about [the need for change]. That was probably overall the most important, more strategic job that I needed to be doing. People here at the Center really know how to do their day-to-day job. I didn't feel like I had to shore that up. I had to continue to nurture it maybe, but I didn't have to get in the middle of that. All the programs and all of the offices and directorates, they know how to do their job, and do it very very well. It was really more that strategic look of what should we be doing more as a Center to make sure that we're

stronger. That's really what I felt I needed to concentrate on, and that would be how I could bring the most value to the Center.

ROSS-NAZZAL: You mentioned that JSC needed to change. Can you give a couple of examples of things that you saw that needed to be changed that were part of the "old space," and what you saw as "new space"?

OCHOA: I just felt we were still doing things in a mode that we'd been doing them for quite a long time. If you looked at almost any process that we had at the Center and you asked yourself are we doing it differently than we were doing it five years ago, the answer almost definitely was no. In some cases, you could [insert] 20 years ago, and the answer might still have been no.

We were building on our previous successes of how we did things without consciously stepping back and saying, "How's the world changing? How's the environment changing, and what does that mean for us?" Clearly a lot of things are changing. Obviously new technology comes in. Are we taking full advantage of that?

We were already in the midst of the Commercial Cargo Program. We also had the beginnings of the Commercial Crew Program. Clearly the model of how we did spaceflight, particularly in low-Earth orbit [LEO], was already changing. But were we really fully taking advantage of how that was changing, and what that meant for what we needed to do?

An example that we ended up working, it took a couple years, [was] really looking at the procedures for equipment that we send into space. We have a set of procedures that involve all different organizations around the Center. It involves procurement, logistics, transportation, safety, and all kinds of control boards that you have to go through. We would use that no matter

if it was a critical piece of life support hardware, or if it was a piece of equipment you bought at Home Depot to try some task on orbit that was not critical to either the survival of the crew or the integrity of the spacecraft.

We put everything under one process. That process makes things take a long time, and it costs a lot of money. So we really need to step back and say, “There are a lot of things we either need to send into space or want to send into space that are not critical to the safety of the crew, and we need to pare down the procedures.”

I would hear a project manager can always tailor the procedures based on whatever it is that they’re doing. But when you really looked at it, the stack of procedures is inches high, and it’s unrealistic for a project manager, particularly somebody who’s a GS-13, to go fight those battles with each of those organizations who feel they’re the keeper of the processes, and tell me why you want to tailor these or deviate from them. We really had to do more of a top-down approach.

When Kirk [A.] Shireman was my Deputy—he was my second Deputy—he had already done some similar kinds of things within the ISS [International Space Station] Program. He was definitely very enthusiastic about taking this on as the process champion and working with people around the Center to say, “Okay, let’s develop the minimum set of procedures that somebody needs to meet our safety requirements and ensure there’s no adverse impacts to the crew.”

Then if a customer developing a piece of equipment wants to add more because they want to have a higher level of assurance that their equipment will work the way it’s intended, they can always add back in. Now we have a minimum that’s been agreed to by all of these other process owners.

That's just an example. We just really hadn't stepped back and asked that question. We were not getting things into space that we should be because we didn't have the money. It just took too long. People were too discouraged. Everybody just had this feeling of "takes too long, costs too much money to get into space; I'm not even going to ask. I'm not even going to think about it." Yet we have this laboratory in space, and the lab is where you want to try things out. You want to test things. You want to have the opportunity to test two or three different versions perhaps, and our process wasn't allowing that to happen.

ROSS-NAZZAL: I'm imagining it's fairly hard to change culture here at JSC, because it's such a large ship [to turn]. Was there any [pushback], "No, we can't change," [because they were] thinking about some of the accidents that we've had and other [concerns]? Was it a challenge to change some of these things?

OCHOA: We talked about this as a senior staff in the very first senior staff retreat I had, which was in March. I took over in January of 2013, and this was in March. Honestly, all of the directorate heads and the program managers felt that we needed to focus on this, that we did need to change.

It's just human nature that it was easy for them to look at another organization and say, "And they especially need to change," because sometimes you can see it more in other [orgs]. [When] you're dealing with an organization, you're like, "Why are they making me go through all of this?" It's a little bit easier sometimes to see it in a different organization than your own. So there was a little bit of that, but I wouldn't say there was a lot of pushback in general to the idea that this is something that we needed to tackle.

People definitely wanted to be cognizant of the fact that a lot of what we've put in place are from lessons learned from tragedies, serious accidents, or just equipment that didn't work the way that you wanted to that caused a problem. That's one of the reasons we've built up the way that we work. You had to separate that out and say, "We are still very concerned about the health and safety of the crew. We're very concerned about the continued integrity of the Space Station or whatever it is that we're developing." But when you step back there's a long way between that and not changing at all.

Part of it is trying to get people to understand that you can make changes without turning your back on that history, that you do still value that history very much, and yet there's a big value to looking at doing some things differently as well.

ROSS-NAZZAL: Were there changes that you made to personnel when you came on board?

OCHOA: Of course I had to pick a Deputy, so that's always the first thing. I ended up selecting Steve [Stephen J.] Altemus, who was our Director of Engineering at the time. There were probably two big reasons. One is Steve is known as a change agent; he's always been one that pushed in that direction. My own natural state is not so much to be a change agent. In fact, if you take those surveys I always end up more on the conservator side as opposed to the originator side. Yet I was convinced we needed to [change]. I felt it would be helpful to me to have somebody that was more naturally like that. He could help push me, and I could help dampen him a little bit, because he can sometimes be out in front of people. I thought the coupling would be a good pairing.

[His selection as Deputy also gave] me a chance to name a new Director of Engineering. Steve had been in that position for a number of years, and I think there are advantages [to getting a fresh perspective]. Different people are going to have a different focus when they get in that job, and [Director of Engineering] is a very important job here at Johnson Space Center. It's our largest organization. Giving people here new roles, I thought it would challenge Steve in that new role [of Deputy Director], and then we would have a fresh look in Engineering also. I selected Lauri [N.] Hansen for that position.

Also within the first two or three weeks I was in the position, Brent [W.] Jett retired. He was the Deputy for the Commercial Crew Program. While the Program Manager is at KSC [Kennedy Space Center, Florida], the Deputy is from JSC. That was another position that I filled almost immediately, not because I just decided to change him out, but because there was an opening due to retirement. But it was one I wanted to make sure that the Program Manager, the KSC Center Director, and the head of HEO [Human Exploration and Operations] at Headquarters all had a stake in that person and that position. It was a little bit different than some of the other positions here where I wanted to make sure I was coordinating with all those people as I looked at the candidates.

ROSS-NAZZAL: Who did you end up selecting?

OCHOA: Kathy [Kathryn L.] Lueders was the person that I selected. Of course she later became the Program Manager after she'd been the Deputy.

ROSS-NAZZAL: I think she was the first female Program Manager.

OCHOA: Yes. I guess I'll add a little bit more to [the thoughts on personnel].

My idea going in wasn't necessarily, "Oh, I need to make a bunch of personnel changes or org changes," but it was in my brain that that might be needed a little bit down the line. I wanted a chance to do it more deliberately with my senior staff helping me understand what kind of changes might be helpful.

After the retreat in March, I put together a Center Director's Action Team. It was five people on senior staff, either directors or deputies; I think in one case there was an associate director. [Their task was] to come back and give me recommendations of how could we move forward with JSC 2.0. What's really needed to get that off the ground.

They came back with a number of suggestions. One of them was we should do a reorganization here at JSC and I should proceed with at the very least putting a team together to look at that, which I did. By that time Kirk Shireman was my Deputy. Steve was probably in the job for about six months, and then he left NASA for an outside opportunity. Kirk Shireman was my Deputy at that time, and so I asked him and then three other members of senior staff to spend some time talking to other senior leaders and others and bring to me some options for reorganization.

Some of the other suggestions were that my Deputy and I should be meeting periodically with people other than my senior staff. So the first idea was to have coffee with division chiefs—that's like a skip level meeting—and over probably the next year or so met 10 or 12 of them at a time and just had the opportunity to talk to them about [JSC] 2.0 and what I wanted to do, then get their perspective of what it's like to be a division chief, and if we really wanted to do change what that might take.

Then after I met with all the division chiefs I started doing it with employees. So approximately every month or so, and this is still going on, my Deputy, who's now Mark [S.] Geyer, and I meet with a group of usually about 10 folks who are mostly civil servants, but we include at least one contractor, sometimes two. We also try to include a Pathways intern as well, to get a whole range of people from different organizations, people who've been here 30 years, people who've been here sometimes six months, actually even less sometimes for the interns, and civil servants as well as contractors.

It's given me a good feel over the years of what things are going on in the organizations that are helping us change. What people have heard. Helps me gauge how my communications are working or not working. It's interesting because almost every single time we meet there are people in there who hear something that somebody else says about something they're doing in their org and they say, "Hey, let's get together afterwards because that sounds like something I want to hear more about because I think it would be helpful in my organization." So it's not just helpful to me, it's actually a way for different people to get together and talk.

The Center Director's Action Team had a number of other suggestions. They had some specific activities that they felt were duplicated in more than one organization, and so we had some actions associated with delving into those a little bit more and seeing if we could consolidate or not duplicate. It was a variety of things but I would say those were the ones that were more personnel-related.

In the summer of 2014, I'd been in the position about a year and a half, I did do a reorganization here at JSC and that did provide the opportunity to change out some of the leadership roles. It reduced the number of organizations that we had that were directly reporting

to me by five. I had a little bit leaner senior staff, which was easier to work with, but then I did need to pick a couple of new directors for the two new organizations that we formed out of that.

ROSS-NAZZAL: Can you talk about those two new orgs and what offices were eliminated?

OCHOA: One of the big changes was to take our two operations groups and make them into one operations group, which seems to make sense. Of course in JSC's history we did used to have one operations organization, Flight Operations. Then about 30 years ago or so it had split into two with Mission Ops and Flight Crew Ops.

I did want to put them back together, but I wanted to do it in a different way. In other words, when we had it before there was a head of Flight Operations and then right under that it bifurcated into the two groups of Mission Ops and Flight Crew Ops. That wasn't at all what I was interested in doing, because with us already having these two separate orgs, if that was what I was doing, all I was doing was adding one layer of management but I wasn't really changing anything else about the organization. I really wanted it to be much more of an integrated organization.

[Now] when you look the next level down—it's about six divisions that report directly to Flight Operations. One of them is still the Flight Crew but not everything associated with Flight Crew is under that. So—this change was made more recently—all of the training and also support of new vehicle development is now in one organization, rather than some of it being under Flight Crew and some of it being under Mission Ops.

We have a lot of support engineers. We had dedicated support engineers that supported the Astronaut Office. We had dedicated engineers that supported the Flight Director Office.

Those two groups really didn't talk. Yet they were really in essence trying to do the same thing. Obviously they're trying to keep the people who sit at the boards informed and the people who are either flying or running the missions informed about all of the issues, and helping to formulate positions when you had to vote at various boards. Yet they were, I think, unnecessarily bifurcating themselves into either "we support mission control" or "we support the astronauts," and yet the goal was to have successful missions.

We finally have those combined. It took a second step after forming the org, but that was the genesis of where we wanted to head. They really run it with a board of directors, so the heads of all of the orgs that report directly to them really talk over all the issues as a larger group. I think it makes us stronger as an organization. We can do it with fewer people as well, so stronger and leaner. That was one big change.

Then the other big change was [to form an organization focused on exploration.] We have a Program Manager for ISS, we have a Program Manager for Orion. Orion is a vehicle, not an actual exploration program. Because of the cancelation of Constellation and the way things were going in Washington, we don't really—and to this day we still don't—have a program that is in charge of [human] exploration [beyond LEO]. But I wanted an organization here at Johnson Space Center whose primary focus was exploration.

We do exploration activities in many different directorates. Both Orion and ISS support exploration. It wasn't like we were taking away what they were doing. We were trying to have an organization that would look out across JSC, understand what was going on in exploration, help integrate that, and help work with Headquarters as they had different types of exploration activities, and be the one place you could go where you knew where all the right contacts were even if they were in different organizations.

Also my tagline for JSC 2.0 was, “Advance human exploration by being lean, agile, and adaptive to change.” I wanted an organization that could mirror what was actually going on at a higher level in the Agency in exploration. For example, we were working on the Asteroid Redirect Mission. I figured there will also be other future activities like that. A lot of times they start out as studies, and you have to work through concepts. Sometimes the main person would be in Engineering, sometimes the main person would be somewhere else. You would find somebody to be the JSC lead on something, and then whatever org they happened to be in, that’s who was watching out for that. I wanted to have a little bit more order and structure to it.

I wanted to set this organization up where our prime point of contact for the Asteroid Redirect Mission would be in that organization, and if there was another concept that came up, that prime liaison would be in that organization even though many of the people who worked it may not be in that organization. They’re more likely to be in Engineering. There’d probably be some people from Flight Ops, maybe from Safety, Human Health and Performance. But there’s still the key interface, knowing who all was supporting here at JSC, and the key interface working with Headquarters would be in that organization. That was another key.

So I put people in there who were already supporting the Exploration Systems Division at Headquarters, which is the one that is overall coordinating Orion, SLS [Space Launch System], and ground ops. I put people in there who were doing exploration architectures work. I put a few other orgs which could have gone a variety of places, but I ended up putting them in here. One of them was our EVA [Extravehicular] organization. That surprised people a little bit, but we had two parts to EVA. One was the ongoing operations of EVA; the other one was what do we need for EVA in the future, particularly exploration. What kind of suit do we need? How do we work out some of the issues that we know are going to be bigger in the future--

maintainability of suits and mobility? Because of that focus, that one-half of their org that was more focused on strategy for future, that was one reason I ended up putting them in there. They're about a 50-person organization, 50 civil servants; they really didn't compare in size to our other technical orgs. You're always trying to figure out do we keep them in their separate org or not. I ended up putting them in there so that as they looked toward what they needed to do for a suit for exploration they were very closely tied to all the people who were looking at exploration architectures and what we might be doing in exploration in the future.

Then I also put in that group our planetary science org, Astromaterials Research and Exploration Science, ARES, group. Again ARES has had a history here at JSC where they've been moved around a little bit. In some incarnations they've been their own separate org reporting directly to the Center Director. Again they're a fairly small group compared to our other technical groups. Then at other times they've been part of a group that was called both Space and Life Sciences, so their group was tied with our human research people and then split off again. I put them in this [exploration organization].

Sure, they're doing science right now on Mars with Curiosity and they do curation and that's an ongoing job, but I really wanted to tie our planetary science folks closer with our human exploration folks. As an Agency we'll be much stronger when we can understand how do you get information from science missions that will help us plan human missions, and for the human missions what science should we be thinking about doing and should we be planning for. So I very deliberately put that in that group so there would be a closer tie to those.

I also added our Strategic Partnerships Office and also our Performance Management and Integration. Again they support a lot of different groups, and so I used this new organization which we called Exploration Integration and Science [Directorate, EISD] to be the place where if

you support many different organizations in a technical way, then you're part of that organization.

ROSS-NAZZAL: Sounds like quite a bit of change was going on at that point.

OCHOA: Yes.

ROSS-NAZZAL: Do you work a lot with those orgs up at Headquarters like Planetary Science Division?

OCHOA: I don't work a lot directly with Planetary Science. The head of ARES did work with them directly, and in this new organization we have gotten the head of Exploration Integration and Science, EISD, to also become more integrated.

One of the benefits was a couple of years ago or so when they had the very first workshop to look at potential landing sites for humans on Mars. It was happening right off site at LPI, the Lunar and Planetary Institute. I said, "Okay, this is going to be a bunch of planetary scientists showing up. As they pick that spot for science, we can bring what makes the spot good or bad for being a human landing site." That is the title of this workshop, Human Landing Sites on Mars, so some of our Flight Ops folks attended and even presented about what makes a good or bad site for supporting humans and needing to consider that as you also look at what are good sites sciencewise as well as the safety of landing.

ROSS-NAZZAL: Right after you became Center Director sequestration went into effect, which I'm sure was a massive challenge for you. What impact did that have on the Center's budget and what you could do?

OCHOA: Absolutely had an impact from which we really have never recovered, particularly in terms of our Center maintenance and ops budget. Of course it happened more than halfway through the year. They take a percentage of your budget away, which at the moment I won't remember exactly what that percentage is.

If you know it at the beginning of the year you can plan for it better. When you get it more than halfway through the year, it actually feels like a percentage that's really more than twice that, because you've already spent money in a certain way assuming you were going to have so much for the year. It makes it much more difficult.

The employees saw this as, "There's no money for bonuses." [We were not] able to do the maintenance on the buildings that we were planning to do that year. There were a lot of things we just had to pull back that are normal expected things of running a Center. Of course it affected the programs as well. But I think one of the things is that we've really never recovered in the Center maintenance and operations area.

Of course we always want money to go to the programs, that's what we're about, but it's very difficult to run an entire Center when every year your facilities get older. There's in general more maintenance required, not less, and it actually becomes more [expensive] when you can't spend the money on maintenance. Then of course there's lots of new requirements that we have to meet now. Over the last five years the IT security requirements have, I would say, just ballooned. No new money that comes with it. Adding to that, I think, is just a real challenge for

all of our mission support areas to continue to do their jobs. But they're resilient; they're resourceful, and they've figured out different ways of doing things.

I think 2.0 has helped. In some ways it helps put a little bit more of a positive spin on it than just, "Hey, we're responding to budget cuts." Clearly one of the reasons we need to change is we've got to respond to the budget that we're getting and we can't do things the same way that we were doing them.

But I think there's another reason even if we hadn't had sequestration, even if we hadn't seen that, which is we'll get left behind. We will get left behind if we don't change, because there are other organizations out there. There's new companies. They use new technology. They think differently. We will become irrelevant if we don't change, regardless of the budget issue. So it was really a bit more of a call to arms of, "Do you want to be leading human spaceflight 10 years from now?" Then that requires that we look at things differently.

ROSS-NAZZAL: Would you talk about some of the partnerships with SpaceX, some of these other organizations that JSC works with?

OCHOA: Sure. We have hundreds of partnerships. They're of all different types. It's hard to give a full picture in just a few minutes.

Clearly one of the ones that the Agency itself was pushing were these partnerships in order to start up the Commercial Cargo and Commercial Crew Programs. Those started as Space Act agreements, which is a specific authority that NASA has through the original [National Aeronautics and] Space Act of 1958. You can call it a contract, because it is, but it's different than the FAR, the Federal Acquisition Requirements, contracts that we do with companies. We

need to show that there's some benefit to NASA, but you actually can't receive goods or services through that. If you're going to receive goods or services, you have to have an actual FAR contract.

So you do it for other reasons. A lot of times there's a technology that you and another company are both interested in and by joining forces you can make more progress on that technology than you could on your own. A good example of that is when we joined with General Motors [Company, GM] and were developing Robonaut. They were looking at using robots next to humans on factory floors. We were looking at humanoid robots as astronaut assistants. We had some of the same requirements, just a little bit different end goal. GM sent money, they actually sent some of their engineers who lived in Houston for two, three years as we were doing that development. That's one example of using a Space Act agreement.

In some cases, we give money to a company or an organization. In some cases, they give us money. In other cases, there's no transfer of any kind of funds. It's more of a technical interchange that is set up through these Space Act agreements. So we have many different kinds, reimbursable and nonreimbursable.

For commercial cargo and commercial crew, it was set up where we would give money to companies so that they could be developing services that didn't exist in the United States. A company's own ability to first of all send a supply ship to and from the International Space Station, of course now we're in the midst of doing the same with crew. When you actually want a contract for services you've got to have an actual contract, so we did transition. We've transitioned both of those to actual contracts, but they started out as Space Act agreements.

It was interesting and tricky, and I think it really challenged our procurement, our legal, our CFO [Chief Financial Officer] organizations, because we were using Space Act agreements

there in I would say a different way than we had previously been using them, really as a precursor to an actual contract. We wanted the company to do certain things, and yet we couldn't impose requirements. We could only tell them, "Eventually this is what we're going to be looking for. This is what we want you to look at developing." But you couldn't impose requirements in the same way as you can with an actual contract.

It required technical and mission support people to work differently with companies. We had to think about imposing much higher level requirements, telling them what we wanted but not how to do it; whereas in general [when] we've worked with companies [in the past], we've been very prescriptive about this is exactly how we want this to happen.

ROSS-NAZZAL: Did you face any challenges with employees who thought these companies are taking over what we do or what we used to do with Space Shuttle? How did you manage that?

OCHOA: Yes, absolutely. I think we're still working through that somewhat. Obviously we're many years into that and so I don't think people think of it in quite the same way.

[Employees have told me] but, "This is what I came to NASA to do." This is being a victim of your own success in a way. We want to move on and really focus on exploration beyond low-Earth orbit, and we want there to be a viable commercial capability for companies to provide these services.

I think a key part of getting people beyond that thinking is to have an exploration program, which is why I think it was very difficult when Constellation was canceled, because we were already in that mode of starting to move to this different model in low-Earth orbit. When you think about exploration beyond low-Earth orbit, whether it's in the lunar vicinity, and

eventually on to Mars, there's plenty of challenges. That's what I kept trying to tell our people. "We've got plenty of challenges. It's not like we're giving away all the challenges. We have plenty of challenges." We are also challenging industry to operate in a way that they haven't done before.

Of course we have many many lessons learned. We have people who have so much expertise and experience. We obviously still need those people to be weighing in. We're still a ways from certification of a commercial crew capability. We're very much dependent on the people who have that expertise to help us as we work through that and as we head towards certification, ensuring that the services that these companies are developing will meet our requirements and will allow us to certify them.

ROSS-NAZZAL: I wanted to ask you about EFT [Exploration Flight Test]-1 and your memories of that event and your ties with the Orion Program.

OCHOA: It was hugely exciting. It wasn't a given after Constellation was canceled first of all that Orion would continue and that we would do an EFT-1.

EFT-1 wasn't originally on the plan earlier on in the Constellation Program, but there are a lot of benefits technically to doing that mission before you get too far along in the full development of Orion because it was designed to test a lot of the risks that are most directly associated with crew survival. The heat shield, of course, is a big one. The parachute system, which is a system of 11 parachutes—a lot of people don't realize how many—they think of just the three mains. It's actually a series of 11 parachutes, and it's all got to happen in order. Of course an opportunity to check the avionics that we had developed so far and all the separation

events, even though we weren't flying on the actual rocket that we would eventually be flying on with people. So there was a lot of technical benefits where you buy down risk at that point. Then there's also the benefit of you get something flying. That inspires our workforce, but it also inspires people around the country.

I was actually really really happy with how much attention it did get from people, not just even around the country but around the world. It can be a little bit difficult to generate that when there aren't people on board, even though it's a human-rated spacecraft. It's a test flight; it's not on SLS yet. I think we did a really good job of explaining why it was such an important flight for us.

Of course it was going to go higher and farther than any human-rated spacecraft had gone since Apollo 17. I think we did a good job of explaining, "Hey, this is actually a very challenging mission. Here's why it's challenging. It's the temperatures and the speed at which it's coming in at and the fact that it's going to see a different radiation environment." It really got picked up in the regular media. Social media was starting to become a big part of how we get the word out on things. It was a big part of that as well. Generated just a huge amount of excitement. It was really fun to see.

I was, of course, at KSC for the launch. I was in the actual control room for the mission down at Hangar AE at KSC. Obviously we had a control team here in Houston that was actually in charge of the spacecraft once it got through the launch phase. The mission management team [MMT] was really there for all the issues that came up prior to launch, and making sure that we were ready to go for launch and had connections with all of the partners that were involved, including ULA [United Launch Alliance], which was providing the Delta IV Heavy launch vehicle. You had all those people involved in this particular room at KSC.

We were inside up until just a few minutes before launch. Then at least some of us—those of us that could afford to—went outside to actually view the launch and then came back in for the rest of the mission. It was just a very exciting day.

ROSS-NAZZAL: I imagine. Were you there when they were bringing the vehicle back?

OCHOA: It landed off the coast of San Diego [California]. We were [at KSC] when the landing happened, but it happened on the other side of the country. We were watching it on the monitors and getting word about how it was doing.

ROSS-NAZZAL: Kind of a great day for JSC, a lot of pride.

OCHOA: Yes, it was.

ROSS-NAZZAL: Do you remember the feeling in the room?

OCHOA: Oh yes. Everybody was just incredibly excited.

ROSS-NAZZAL: Who else was there in the MMT with you?

OCHOA: We can get the list. Obviously Charlie Bolden was there, [Associate Administrator for Human Exploration and Operations, William H.] Bill Gerstenmaier, and [KSC Director, Robert

D.] Bob Cabana and I. Mark Geyer, who was the [Orion] Program Manager then. Several Lockheed managers were there, but I can't remember everybody.

ROSS-NAZZAL: Quite a few folks.

OCHOA: We all were sitting at consoles.

ROSS-NAZZAL: I'm wondering if this might be a good place for us to stop. Thank you very much, this was all very interesting.

OCHOA: You're welcome.

[End of interview]