

**Oral History Interview of
Steven Lindsay**

**Interviewed by: David Marshall
January 31, 2018
Lubbock, Texas**

**Part of the:
*NASA Interviews***

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Transcript Overview:

This interview features Steven Lindsay an American astronaut as he recounts his experiences at NASA and in space. In this interview, Lindsey describes his interest to become a piolet at a young age, his training, and then his space flights at NASA.

Length of Interview: 02:03:13

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David Marshall (DM):

The date is January 31, 2018. This is David Marshall interviewing Steven Lindsey at the Southwest Collection, Texas Tech, Lubbock, Texas. Hey Steve, can you give me your full name?

Steven Lindsey (SL):

Yeah. Steven Wayne Lindsey, and I was born August 24, 1960.

DM:

Yeah, in Arcadia?

SL:

Arcadia, California.

DM:

But you claim as your hometown—I guess where you grew up?

SL:

Yeah, because I grew up in the county. I went to Temple City schools, so I kind of consider Temple City as my hometown.

DM:

Class of '78?

SL:

Class of '78.

DM:

My class also.

SL:

Old guys.

DM:

Okay, yeah, that's right. [Laughter] Feeling older every day.

SL:

Oh yeah. Yep.

DM:

Well let's talk a little bit about family influences, if you don't mind. And maybe you could mention the names of your parents as well.

SL:

My parents, Arden and Lois Lindsey. My mom still lives in the same house I grew up in, and my father passed away in 2009.

DM:

I'm sorry. Okay. When you were a child, was there anything that you can point to that indicated that you were going to be an aviator, a pilot, a fighter pilot, first of all, and then an astronaut?

SL:

So, that's an interesting question. I think from a very young age I was always fascinated with airplanes. I loved airplanes. I think all of us that grew up in the era of, you know, *Mercury*, *Gemini*, *Apollo*, particularly with *Apollo*, is what I remember most vividly, I think probably at some point we all wanted to be astronauts. But, for me, it was really airplanes, for whatever reason. I've just always been fascinated. I mean, here I am a gazillion years later, I'm still fascinated with airplanes. But I always loved airplanes, and then probably the other biggest influence is I had decided at a young age that I wanted to be an engineer. My father was an engineer and I wanted to be an engineer.

DM:

Aeronautical, in particular, or any kind of engineer?

SL:

I probably didn't know enough to specify at the time, but I wanted to—I knew when I graduated high school, for sure I wanted to be an engineer. I wanted to go engineering school. Probably at the time I didn't know enough about it to decide which direction I wanted to go. But I wanted to do that. So I wanted to do those two things. And quite frankly I was looking for a—how could I combine those two things?

DM:

Oh yeah.

SL:

I've always been searching for: How do I combine engineering science and flying? So—but again, the idea of being astronaut was never really—I thought about it, but not seriously. Because I—and I don't know why—I probably thought it wasn't achievable.

DM:

I think we probably all thought it was a long shot.

SL:

Oh yeah, I knew it was a long shot. But it was never really a goal of mine. Again, the goal of mine was I wanted to fly airplanes and I wanted to be engineering, and eventually I wanted to be able to combine those two. That was always my goal.

DM:

Were you a model airplane builder when you were a kid?

SL:

Yeah, I would go to the—we had a store called Pick ‘N Save where you could get stuff really cheap, models usually missing pieces. I would usually build models just to blow them up with firecrackers. [Laughter] But I wasn’t really necessarily a model airplane guy. I knew airplanes, I studied airplanes. I never really got a flying airplane. I had an opportunity, I think, in high school to fly with somebody in a little Cessna, but never really got to fly at all. Flew commercial airliner once or twice, is all. Then till really—till I got to the Air Force Academy.

DM:

Well somewhere along the way you developed an interest in the military, because from what I see you went straight from high school.

SL:

Well, okay, so I was in high school, trying to decide what I wanted to do with my life, and I was also—one of the extracurricular activities I was involved in, I was in the band in high school. And we would take a concert tour every year. And when I was a sophomore we took a concert tour to Colorado. My band director, who was also happened to be a pilot, he was the one guy I actually got a flight with when I was in high school, as part of that concert tour we were going to stop and tour the Air Force Academy. I’d never heard of the Air Force Academy. Had no idea what it was. So I went and my band director told me, “Hey Steve, pay attention to this, because this may be something you’re interested in.” And so we took this tour of the Air Force Academy and I learned about it and said, Well okay, it’s a full ride if you get in, if you get selected. It’s an engineering school, so you can get an engineering degree. And if you survive it and you’re medically qualified, you get a chance to go to pilot training. And I said, “Ding, ding, ding.” It would combine engineering—get an engineering degree and I get to fly airplanes. And if I get to fly airplanes I get to fly some of the coolest airplanes there are, if I can survive it. And so that’s what sold me on it.

DM:

Ah, you get to live in Colorado, too. [Laughter]

SL:

That was really not a consideration. I wasn't even thinking about—at the time I wasn't even thinking about where I was going to live. I was thinking about what I wanted to do. Of course, in hindsight I live in Colorado now, so I obviously love that too. But at the time I didn't know any better. And so those two things is what influenced me. And so I went home and said, "I want to apply to this." So I decided to apply, and go through all of the interview process and everything. My parents, obviously, fully supported me and helped me. And so then I got in. So that's how I ended up—and it just happened basic training started like five days after I graduated from high school. So I—seventeen year old kid, my parents put me on an airplane in LA, landed in Colorado Springs, and next day they shaved my head and started running me. [Laughter]

DM:

Now what about a congressional appointment? Didn't you need one to get in?

SL:

So you have to have a congressional appointment, and I had to meet an interview board with our congressman. Met the interview board, and I actually didn't get selected. I was an alternate. But then about, probably less than six weeks before the class was due to start they called me and said, "You're in." And so I got in on an alternate slot.

DM:

That's amazing.

SL:

Yeah.

DM:

So life would have taken a very different track?

SL:

Yeah. I mean I was already accepted to a couple of colleges, you know, like UCLA and Cal State. Cal Poly, Pomona near my house. So I was going to go there. I already had a job lined up as a life guard. I mean I was—I had a different—I was still going to do the engineering, but it was going to be a completely different life, I think. And then I got this call and I went in. So that's how I ended up there. It was not—you know my father was in the military. He fought in the Korean War, and he was probably one of the biggest influences. I was talking to Monte about this the other day, or on the way here, I guess. Kind of reflecting on my background. He asked

me about my father, and my father was an electrical engineer. But the way my father became an electrical engineer was interesting because he grew up in Nebraska in the Depression. Family was very, very poor. They never owned any of their own land. Their sharecropped or rented land. Moved around every year. He had nothing. His mom died, I think, probably when he was in about eighth or ninth grade. He decided—most kids didn't stay in school, in those days, but he decided to stay in school and graduate high school, because he knew his mom would have wanted him to. His dad kind of checked out, so he lived with relatives and things like that. And then he was a farm worker and a truck driver. He was working in a factory in Oregon. He got called up in the Korean War, went and fought the war. Came back and he was back working in Oregon and—this is a really interesting story, since we're Texas Tech here—he was walking across the campus in Corvallis at Oregon State University, and he started—he met some older gentleman and was talking to him. This older guy told him, said, "You need to come here to this school, and you need to come in and get a degree in electrical engineering." My dad graduated from a one room schoolhouse. He didn't know anything about this. And my dad said, "Okay, I'll do that." Well it turns out the guy he was talking to was like the dean in the engineering school.

DM:

Wow.

SL:

And he—my dad told me, he said, "I don't ever remember giving them a transcript or anything." Now what he told me, he said he went there and the first semester they put him in bonehead math and bonehead English, as they called it back then. Went through all of that. But he managed to graduate in four years with an electrical engineering degree, and ended up working for utility in southern California, and that's how I ended up in Southern California. But when I look at what my dad did to get where he ended up and I compare it to where I am today from where I started. By comparison, I've done nothing compared to him. And so I think he was—you talked about influences in your life—I think he was one of the—and my mom too—were probably the greatest influences in my life.

DM:

What year did your dad die?

SL:

2009.

DM:

Okay, okay. So he did see where your career went?

SL:

Yeah.

DM:

It must have been great satisfaction in that.

SL:

Yes, he went to—he got to see four of my five shuttle flights and all of that other stuff. So yeah, he did. He did.

DM:

How about Temple City High School. Was that good preparation? Did they have some kind of pre-engineering—

SL:

No.

DM:

—courses? Anything that was good preparation for you?

SL:

No. We had—when I got to the—and I don't want to diss my old school, because it's a good school, and it's actually a really excellent school now. And it's not that it wasn't an excellent school when I went to it, because it was. The teachers were great, and everything. But the resources and what they could do were limited. We had some science classes. What I learned at the Academy is that the vast majority of the kids that were there with me knew far more than I did. Had much more advanced classes. Now I managed to catch up in about six months, but I could tell in a lot of areas. The one area where I was prepared was math. We had a good math department. My senior year they put a calculus class in, so I got to do a good calculus class and that really helped. We had a really good math department. The teachers were great, but in terms of having a whole bunch of—like they do now with all these college prep and all that. None of that.

DM:

Right.

SL:

As you know, none of that existed. And we had probably even less than most. We were a middle-class school. We just didn't have that much.

DM:

Right, okay. Tell me about Scouts?

SL:

Scouts?

DM:

Yeah.

SL:

So here's my favorite story about Scouts. So I was in the Scouts, and I became an Eagle Scout. I have a great story about it, because I tell it whenever I talk to Scout groups I can tell this story, because it's absolutely true. When I applied to NASA to be an astronaut and I got selected for an interview, I walk in for the interview. There's about fourteen people on the interview board. For my interview the chair was John Young, who was—flew the first *Gemini* mission. Flew two *Gemini* missions, flew two *Apollo* missions, went to the moon twice, walked on the moon, commanded the very first space shuttle mission, and then he commanded another shuttle mission. You know, he's the astronaut's astronaut. If you talk to any astronaut, who's the one astronaut that they will say? It's going to be John Young. So he was the chair of the board, and I walked in, and it was an hour long—about hour, hour and a half long interview. It was actually a week long interview, but this particular formal part of it was an hour long. I walked in and basically the interview was, "Tell me about yourself. Start at high school." And so I start talking about high school, and talking about what I did in high school. "Water polo, and swimming, and band, and all that stuff. And then I was in the Scouts." The very first question I got in that interview was from John Young. He stopped me right there and he said, "Did you make Eagle?" And I was able to say I did. And I tell that story to Scouts whenever I speak to them, or whenever anyone asks me a question about Scouts. Because I tell those kids, "If you think it doesn't make a difference, I'm here to tell you it does. I was thirty-four years old when I got that question, and it made a difference." And when I was able to answer, "Yes," I knew that the rest of the interview was probably going to go okay.

DM:

That's amazing.

SL:

Isn't it? That's incredible.

DM:

I remember hearing when I was in Scouts, "You know all the astronauts are Eagle Scouts." That wasn't exactly true.

SL:

Well they're not. That's not true.

DM:

It wasn't exactly true, but a lot of them were in Scouts.

SL:

And I don't—if I hadn't of made Eagle, I don't know if it would have made any difference. But clearly if somebody on an astronaut selection board asked that question, it matters to a lot of people.

DM:

But when you mentioned you were looking at being a lifeguard, I thought, Boy Scouts. Because you have so much aquatic training in Boy Scouts, especially going to Eagle.

SL:

Yeah, well I swam competitively in high school.

DM:

Oh did you?

SL:

On water polo, so that was—

DM:

Oh, okay.

SL:

Yeah, so it was kind of fit for me.

DM:

Yeah, all right.

SL:

But I never got to do that job. [Laughter]

DM:

It's not too late.

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SL:

Maybe not.

DM:

Can you tell me anything—just generally—about the Air Force Academy? You got a BS in Engineering Sciences. Graduated in '82, it appears.

SL:

Yeah.

DM:

But what focus did you have, as a general curriculum?

SL:

Well, like you said, I got to the Air Force Academy, and it was a shock. [Laughter] Because they—coming out of high school in the late seventies and going into a military institution. The biggest shock—you know we all had long hair back then, they shave your head and then kick open the door and you're doing morning runs at seventy-five hundred foot elevation, which I wasn't used to. But it was—I mean it was a difficult experience. The first two years for me were the hardest. First year is hard because you're what's called a "doolie." You're eating at attention, and walking at attention, and a lot of hazing that would never happen today. Things like that. Second year was hard for me, mostly because I had to decide did I really want to be here or not? Because it's different. But then I started getting into it. Particularly when I got into more of my major courses, I liked it a lot better. But what I majored in there was something called Engineering Sciences. What I recognized pretty early on is in engineering is that at the undergrad level, you can't really get super in depth in a particular area. And I didn't really know for sure which engineering discipline I was most interested in. So I wanted to try them all. Well with Engineering Science degree, we actually took upper level—basically took out—they used to call them the "weed out" courses—in every engineering discipline. So we got to do a lot of electrical engineering, aeronautical engineering, mechanical engineering, you know, materials. As well as astronaut—astro engineering as well.

DM:

Golly.

SL:

And so did all of that, and then I kind of specialized more in the astro track than the aero track. So I came out with a really well-rounded, I think, engineering education. Not a huge amount of depth in any one area, but it was an accredited degree—but it was probably two or three courses different than an aeronautical engineering degree, so it was pretty close to that. And then—But

then later on when I—before I went to test pilot school the Air Force sent me to grad school, and that's when I got an aeronautical engineering degree. But I was able to—I could have jumped into aeronautically doubly, just about any graduate degree out of that degree.

DM:

Sounds like real great preparation, too, for your later closer specialization in graduate work.

SL:

It was. It was. It was.

DM:

I'll just interject here that the mission control people that were the engineers for *Mercury*, *Gemini*, and *Apollo* tell me that they were hiring people that were versatile back then. They were coming, often, from small schools.

SL:

Yeah.

DM:

Small engineering schools with just a general approach, and they wanted—NASA wanted to pretty much mold them to what they wanted in them.

SL:

Yeah, they were creating—in those days they were creating something completely new. You had some of the early leaders, Gene Kranz and some of them, they came out of a military background. There wasn't—mission control didn't exist, and so they created after a certain model. But even to this day I have a large organization. We hire people from all over the country. The school you go to, besides your own performance at that school, but the school name itself helps you get your first job, but after that it's up to you. I don't find that engineers or people coming from one school that has a bigger name than another school to necessarily be any better. It really depends on the individual and their drive, what they want to do.

DM:

That's interesting. You graduated in '82 from the Air Force Academy and went straight; it sounds like, to Reese.

SL:

Straight to Reese. So I think I graduated in June, and I started pilot training here in July.

DM:
Really?

SL:
Yeah.

DM:
Wow.

SL:
So I think I had a week or two off, and came here and spent a year here at Reese going through pilot training. Graduated. So Reese was a—when once I knew I was pilot qualified, and you're still at the Academy, they actually let us put down our choices of pilot training bases we wanted to go. Not that they would actually look at those, but I did put Reese as my first choice. And the reason I did was I knew nothing about Lubbock. I knew nothing about Texas. Not sure I'd ever even been to Texas. But I knew that Reese had a reputation for putting out good pilots, because Reese, as it happens, is a difficult place to learn how to fly. You've probably heard this before. But somebody, in their infinite wisdom, built those runways at Reese into a direct crosswind. So we had weather here, we had crosswinds here, and I knew it wasn't going to be—everything I'd heard is, "If you really want to learn how to fly right from the outset, go to a place like Reese." There were other more glamorous bases to go to, like Willy. Willy is in Phoenix, where the weather's always beautiful, so they never got any weather training and they never got any crosswinds. In fact, one of the rides we would do is a solo out-and-back in T-38s, where you'd go solo to some out base and then come back. And I think when we did ours we went to Willy. But what I was told was that the Willy students were not allowed to come to Reese on a solo out-and-back, because of the crosswinds, because they were—And I can tell you later on as an F-4 instructor, I could tell where somebody went to pilot training, based on how they flew.

DM:
Really?

SL:
Yeah. And so it made a difference. Anyway, so I came here. Like I said, it was a harder place to learn how to fly. I think we probably washed out more pilots here than most other bases, but it gave me the foundation, the flying foundation, I needed for everything else I did.

DM:
Who was the base commander while you were?

SL:

Oh God, I don't remember.

DM:

Okay.

SL:

Yeah, I don't know.

DM:

So you got your wings here, I guess?

SL:

Um-hm.

DM:

And then went straight to Bergstrom?

SL:

So I got my wings, I went straight to Bergstrom Air Force Base, which was—it was R-4 base. It had four squadrons. Two squadrons were training squadrons, RTUs; they were called replacement training units. Two squadrons were operational squadrons. So I went through F-4 training there, in the training squadron. And then I became operational in one of the other squadrons. And so I spent four years at Bergstrom, after going through training, first as an operational pilot and then later on I became an instructor pilot. I actually flew with the operational squadron and I flew with students as an instructor pilot. And I was also an academic instructor. I taught academics as well.

DM:

What did you teach in academics?

SL:

Aircraft systems, mostly. How to fly, and then flight techniques. How to fly the airplane. So I taught pretty much everything. That's typically what we did. And then obviously we flew with the students. We taught them as well.

DM:

Well that is brave. [Laughs]

SL:

Yeah, it was some—being an instructor's very interesting. [DM laughs] Particularly in an F-4, because you're in the backseat. You don't have gear controls, you don't have afterburner in the backseat. You have rudder pedal, and stick, and throttles, and most importantly you have zero visibility.

DM:

Oh no.

SL:

You can see a little bit out of one side. Like about this much. Just learning the land from the backseat is really challenging. But then keep an eye on the student and keeping yourself safe and teaching them how to air fuel. Later on I was an instructor as a test pilot. Take them to the range. Teach them how to drop bombs, and strafe and things like that. It was interesting.

DM:

Are there any stories that pop up in your mind?

SL:

So the scariest instructor flights I think I had were really when I was a test pilot. So fast-forward. I was at Eglin and I was working as a test pilot.

DM:

And this was right after Bergstrom, was it not? You went to test pilot school?

SL:

I went to grad school then test pilot school. Then I was at Eglin. We would—a lot of time test pilot schools would—Like when I was in test pilot school, we took our whole class went over to England and flew with the British test pilot school. Flew all the British stuff. But then we'd have the Navy test pilot school come to us or the Air Force test pilot school, or sometimes an overseas test pilot schools would come to Eglin, while I was stationed there. We'd fly them. So I can remember on more than one occasion getting a foreign student who was a qualified pilot, but let's say a student pilot who could barely speak English. And they'd put them in the front seat of an F-4 with me in the back, and we'd be take them out to the range. He'd be strafing at four hundred and fifty knots, a hundred feet off the ground, in a dive. I can't really see, I can't really communicate. Or I'd get somebody who, maybe, was not a fighter experienced person. Somebody who flew a transporter, a tanker. Put them in the front seat of an F-4, which is kind of an unforgiving airplane. Those flights were scary sometimes.

DM:

Have they remedied that? That problem of backseat sight? With monitors, or anything? Gosh that just sounds—

SL:

Well I mean they're not flying F-4s any more. I think modern aircraft are, depending on what they are, are probably a little bit better. But even in test pilot school, a lot of our flights, all they had were single-seater planes. So your first flight's solo. And then you'd have an instructor—instead of having an instructor in the airplane with you, you'd have an instructor in another airplane flying formation with you to keep an eye on you and help you out when you're in trouble. But anyway, those are some of my scarier flights, I think.

DM:

Well, here you are to talk about it, though.

SL:

I'm here to talk about it, so I was very careful. A few of those flights I felt like crawling down the ladder and kissing the ground. [Laughter] But not too many. For the most part they were all pretty good, but there were some frightening moments.

DM:

Where were you—You did test piloting in different parts of the US, didn't you? You were at Edwards at one time?

SL:

Well I was—when I finished at Bergstrom I applied for and got selected to go to test pilot school. But the Air Force has this program where they would send one pilot and one engineer through what was called Joint AFIT TPS. And so instead of going straight to test pilot school we would go up to grad school. The name of the school is Air Force Institute of Technology. Probably heard of it. Up the right path.

DM:

It's in Ohio?

SL:

Yeah. Dayton. So I was the pilot that year selected to go to AFIT first. So what I did was I went to AFIT, and normally a master's program is like six quarters. A year and a half. They brought me in one quarter late, so I was only—I did five quarters up there, and basically the way the program was designed is I would work all the way through the—and every program was thesis required—but I would work all the way through the analytical portion of my thesis while I was

there, and then I would go from there straight to test pilot school. Do a year at a test pilot school. And then the last phase of test pilot school you do what was called a systems management project, where you take an airplane and you do a big project. Well my project that I was supposed to do—I had to flight test my thesis on an airplane.

DM:

[Laughs] Really?

SL:

And then when I finished test pilot school and graduated, then I had to go back and defend my thesis to get my master's, so it was—

DM:

Golly, that was quite an exam.

SL:

Yeah, it was like—I think they should have called it a PhD, because it was painful. It was a lot. But it was very interesting because I got to—when I got to test pilot school I got to take my thesis and I got a couple other pilots and a couple of engineers, and I got to run a test program to go prove whether my thesis was going to work or not. And I was able to prove that it did. So it was a very painful way to get a master's, but I sure learned a lot doing it.

DM:

I have never quite heard of an exam like that. Especially for a master's.

SL:

No, they only do, like I said, they only do one pilot and one engineer a year. I think they're still doing it.

DM:

Well I have here that you were Outstanding Test Pilot in your class of 1989. So that's something. How did that—I mean how many people were in your class?

SL:

We had twenty-five in my class. And so I was fortunate. I think it helped that I—two things: the disadvantage I had is I was the youngest pilot in my class. I had the least amount of experience going into test pilot school, probably because I'd been plucked up to go to grad school first. In fact, when I went there I—When I got there, when I was first selected, I kind of looked at it because I applied as soon as I was able, to test pilot school. Kind of looked at the requirements, and it said you've got to have a thousand hours of flight time if you're a fighter pilot. They

selected me, I said, I don't understand why they selected me because I only have 750 hours. They did anyway. And so I was the youngest pilot, so I was kind of disadvantaged. And the fact that I had been at grad school for a year and half right before going there, I was a little less current than everyone else. I did a little bit of flying at Wright-Patt. They let me fly. They had a Sabreliner airplane that they let me fly up there, but it wasn't the same as flying a fighter. So I was a little disadvantaged there. But I think I was advantaged in that I'd just come out of grad school. And so as part of test pilot school you have probably twenty-one different academic courses, all in engineering, aeronautical engineering stuff. I was obviously very up to speed on all of that stuff. They were pretty easy for me. They do—you know we had to write probably fifty, sixty reports over that one year. They had me fly—probably end up flying thirty-five different airplanes. Probably took ten check rides. I mean just all kinds of crazy stuff. So think I came into test pilot school with a little bit an advantage academically, but I also knew that it was pretty important and I enjoyed what I was doing. It was very hard work. It was sixteen hours a day, seven days a week, for a year. It was tough. But I learned a lot and I was fortunate enough to do pretty well.

DM:

Did you have any issues with fear when you were going through all of this and as you were a test pilot? I mean did you have to cope with this or was this just not a problem for you?

SL:

You know we—that's an interesting question. You know I'd got in some bad situations in an airplane that I managed to get out of that you kind of that the adrenaline hits you afterwards.

DM:

Yeah, okay.

SL:

I think I'm born very fortunate. The only time—fear going into things. If I was going off on a very, very complex test mission I would sometimes wake up in the middle of the night worried about it. But once you get into it—just like flying in space—once you get into it and you're actually doing it and you're focused on doing your job, and more often than not you're praying the Test Pilot's Prayer. Do you know what the Test Pilot's Prayer is? "Please God, don't let me screw this up." [Laughter] And so that was probably—it was more fear of the complexity about what I was going to do. Make sure I do it all right. I think one of the best remedies for fear is preparation and managing the risk. Understanding what that risk is. Making sure you've mitigated everything you possibly can, and then you're also dependent on the team that you're working with, right? On a flight test mission you typically have a control room that's managing everything, and they're watching things that you can't. We've done the right engineering build up to this, we've done enough wind tunnel analysis. I did a lot of weapons tests. So that sort of

stuff is really important. Or if you're testing a new weapon or something. We've done enough things to protect yourself in the case of something goes wrong. Classic example was—I have a lot of stories, but this is just one. I was—we were testing a fuse for a weapon, a weapon fuse. It was a British fuse, and what was interesting about it was an electronic fuse, which means you could set it for the bomb to go off at certain altitude, or you could set the bomb to go off twenty hours after you dropped it, or anything. So as we were testing it—and at the time the way we typically did testing like this, we would fly these inert bombs. We would call them blue bombs. They were like say you're flying a Mark 82 Inert, which is a five hundred pound bomb. It's a blue bomb because it's painted blue, so it means there's no explosive in it. But the fuse goes into the nose and you can drill a hole and you watch the fuse go off and you could test it. Well at the time we had a shortage of these blue bombs, but we had a whole bunch of live ones. So we decided, Okay well since we're short of bombs and we need to go test these fuses, we'll just use live weapons. And if the bomb goes off then we'll know it worked. Because if the fuse doesn't work a bomb will not blow up. It's just designed that way. But one of the things we did on all of our—at least the Air Force and Navy and everybody—we had what are called mechanical arming delays. So when you release a weapon off the airplane you don't want it to arm immediately, right? Because then if it were to go off immediately it's going to take you out. And so we had an arming delay on these weapons so that when you'd released the weapon—and then if you did what's called a safe escape, meaning so if you're dropping it in a dive basically the safe escape maneuver—this was in a M-16 was pull five G's in two seconds until you're thirty degrees nose high. So that assures—if you do that right then you have the 90 percent probability that the bomb goes off as soon as it arms, it's not going to hit you. It's only a 90 percent probability, but it's pretty good. Anyway, so we—because this was an electronic fuse it had no—it was an electronic arming delay. Which we decided wasn't sufficient, so in our safety process—and our safety process was when everybody in the squadron came together when we were working up a new test and designing the test, you had to go through this safety board. Everybody's job that went there, was required to go, your job was to try and shoot holes in the test from a safety standpoint and a technical standpoint, which was a really important process. And in this process they said, “That electronic arming delay is not sufficient. We need a mechanical arming delay.” Which something that spins up, something that's reliable that we know works. And so we put that in, thankfully, because that saved my life. So I'm going out to fly this mission, and I'm the first one to fly it. Carrying two Mark 82s, our live weapons with this new fuse. And I'm in an F-16. The first release is I go into a—and the fuse I'm testing in this particular version of it is a proximity fuse, so it's essentially on the nose of the bomb. It has like a radar altimeter in it. When it gets three meters off the ground it's going to blow up. That's what it's designed to do. So I go on my first pass to release this live weapon. I'm out on the range and everything is go, and I roll. And basically I'm dropping in what's called a thirty degree CCIP drop, where I'm doing a thirty degree dive, going to release the bombs. So I roll in thirty degrees, get on my parameters, I release the bomb. You can feel it come off because when five hundred pounds come off the wing you can really feel it. I do my safe escape and then get nose way up,

then I of course do what every pilot does—I roll over and watch. I want to see where it hits. So I'm rolled upside down watching, waiting, and I got no spot. It never hits. I'm thinking, I felt the bomb come off. Where is the bomb? And I look behind me, about that time I saw air burst right behind me. The bomb had air burst way back here, and I can see the remnants of the air burst. So we knocked off the test, came back, I brought the other one back. Didn't release that one. What had happened was because the British five hundred pound bombs are a different shape, geometry, than ours, they're like kind of fatter and squattier, that radar altimeter that's put on the nose of our bomb, as soon as that radar altimeter went active it thought it was on the ground.

DM:
Golly.

SL:
And so when we released it, it wanted to arm immediately and blow up, but because we put this mechanical arming delay on through the safety process, it delayed for the safe escape. And that saved my life.

DM:
How far were you from it when it went off?

SL:
Oh probably two thousand feet, something like that.

DM:
Did you feel any effect?

SL:
No. No. We checked the airplane out. It didn't take any shrapnel or anything. So it was okay.
But—

DM:
It's too close for comfort.

SL:
Yeah. So that was one of those things. And I didn't—until we pieced everything together in the very end—I didn't realize how close I'd come.

DM:
So the next time you drop one, does this go through your mind?

SL:

Well we went—so we went back after that and we said, Obviously we had a problem with the system, but in reality we went back and said, “You know, why don’t we just wait until we get the practice bombs?” [Laughter] And so that ended the live weapons testing fuse for it.

DM:

[Laughs] Right, right, right. By the way, something you said was almost exactly what Al Bean said. He said, about fear, “My only fear was messing up in front of millions of people.” [Laughs]

SL:

Yes. Yes, that is the only—the biggest fear is not doing your job or if something goes wrong, please make sure it’s not my fault. [Laughter] I didn’t cause this. I don’t want to be the cause of it. So, yes.

DM:

I kind of have a blank in my records here from ’90 to ’95. I’m not sure what you were up to during that period.

SL:

So ’90 to ninety—

DM:

’95 is when you were at astronaut camp.

SL:

Yeah, so you know—Well I finished test pilot school at the end of ’89, then I went to Eglin and I was an experimental test pilot at Eglin Air Force Base, this is where that story happened. I was at Eglin from 1990 through the middle of ’93, as a test pilot. And then from the middle of ’93 to the middle of ’94, Air Force sent me to Air Command Staff College at Maxwell Air Force Base in Alabama, which is like a mid-level career, year long course. And then I came back to Eglin and was working in something called a Seek Eagle office, where we did weapons—I did weapons certification for F-16, F-117, A-10 and F1-11. So I did that, but I only did that for six months before NASA picked me up and I went off to be an astronaut.

DM:

When did you start thinking about going with NASA?

SL:

When I was at Eglin as a test pilot. I found my—So back to the test pilot thing. The reason I applied to be a test pilot was because remember I told you that I wanted to be an engineer, I

wanted to fly airplanes? When I graduated from pilot training, went into F-4s, I was flying those operationally, but I wasn't using engineering, or science, or any of that at all. And I thought, well how do I get to combine those two? And I thought, well being an experimental test pilot is the way to go, because as a test pilot your real job is you're taking new stuff that engineers have developed and you're trying to field it. You're trying to do the testing to get it to the operational, and having an understanding of both worlds is mandatory, because you have to do the translation between operational and if this thing doesn't work, you have to be able to work with the engineers, say, "Why doesn't it work?" Or you translate what the operational pilot needs into engineering speak for the designers and the engineers.

DM:

And that is a perfect melding of those disciplines.

SL:

It is. And that's why I wanted to do it. And so I was able to apply my education, and I used it, and I've used it ever since. In the flying world at the same time. So I'm at Eglin, been there for a couple years, absolutely love that job. I was flying F-4s and F-16s, doing [REDACTED] [0:41:24.3]. I had both airplanes and I just loved the job. It was awesome. But I found myself qualifying for the astronaut program, at least had the minimum qualifications. I had a bunch of friends who were applying and a lot of people talked about it because the shuttle program only took test pilots, basically. And so I got to thinking about it and decided—that was the point I decided, Yeah, maybe I should apply, because it's what I'm doing now. You know, where I get to combine engineering and science and all those things that I love with flying, just a little bit higher and faster, is all.

DM:

And you don't have to drop bombs, either.

SL:

I don't have to drop bombs. [Laughter] But it was the same melding of those two things. And so that's what made me decide to apply.

DM:

Oh, wow. Okay.

SL:

So I never really—I didn't have this goal from the outset to be an astronaut.

DM:

When you applied did you think, "Oh yeah, I'll get this."

SL:

No.

DM:

Okay.

SL:

I thought, "There's no way I'd get this."

DM:

Oh really?

SL:

Yeah. No when I applied I thought, well they probably won't even give me an interview. I probably won't make it that far, and even if I do make it to the interview process then they won't pick me. When I did make it to the interview process, I went through the interview. Walked away from that and said, "They're not going to pick me." I was convinced they wouldn't. But I figured, you know, I'll give it a shot. So I had—No, I never thought they'd pick me, actually. I was probably about the most surprised person there was when I got picked.

DM:

Really a real surprise when you look at this record is how quickly things clicked along here. You were a candidate in '95, you were an astronaut in '96, you were flying a mission—what—in '97, right? Your first one?

SL:

So when we got—

DM:

That seems quick. Is that quick?

SL:

Well as it turns out, timing has a lot to do with things. When we got there in 1995, as it turns out, they were—NASA was really short on shuttle pilots. Our class came in a year later than they planned on us coming in. They had a lot of missions going on, and when we got there they couldn't train us fast enough. So we were immediately thrown into the mix, getting through training as quickly as possible. I think the first pilot in our class flew less than two years after getting there, which is a record now. The next class that came in—only one year after we did—to give you an idea of my timing—and they were a big class. We were a class of about nineteen, they were a class of, with internationals, forty-four. They were huge. Because Space Station was

ramping up and we were going to be flying a lot of that. Just to give you an idea of how fast I flew compared to a class that was one year later than me, when I flew my fourth flight as commander, I had two rookies—and this would have been in 2006, so ten years—I had two rookies on my flight that were from that '96 class. And they were flying their first flight when I was flying my fourth.

DM:

It must have been kind of frustrating.

SL:

It was frustrating for them. They waited—some of them, they were mission specialist—a little different category—but they waited a long time to fly. So, you know, in these days astronauts come in and they don't fly for six, seven years, typically. But when we got there our timing was good. I think my class—'95 class, the '92 class right before us had really good timing too. And I think the class of '90 did, too. But then after our class everything slowed down.

DM:

After you became an astronaut, where you immediately training for this mission? Did you know that the next year you would be on this flight?

SL:

No, you get to NASA as an ASCAN, it's called "astronaut candidate," and you spend your, now it's almost two years of training. It was probably a little over a year when I went through it. So you go through all of this training, and learn how NASA works, and learning about the space shuttle and the Space Station and all that kind of stuff. Initial simulators. When you reach the end of that ASCAN period you're eligible for flight assignment, but you're not assigned to anything. And of course for us, how they do flight assignments is a big mystery. How do I get selected? And so I—but anyway—

DM:

But you've been in that process since then.

SL:

Well it's not a mystery to me now!

DM:

Okay.

SL:

But it was then.

DM:

We'll talk about that later. Okay.

SL:

And everybody does it different anyway. But the—so then I was actually down working on another mission, and I just got the call. I was assigned about a year out. But it happened pretty quick. I'd only been out of training, I don't know, a few months. So it happened fast.

DM:

In the meantime you were working with the shuttle software, is that correct?

SL:

I did. Let's see, after I finished ASCAN training I was working on—I worked in the Shuttle Avionics Integration Lab. And what that is, is that's actually a big space shuttle. It's almost like a—well we call it a flat sat or a—it's like a space shuttle on the ground. All the avionics. Real software and avionics. And we would test as they would come in and come out with new flight software loads, we would test that and run it through, you know, rendezvous docking. I did a lot of abort testing, contingency aborts, for NASA, where you lose engines and you have to abort. I did a lot of that kind of testing. I also worked on the—The shuttle was upgrading from what we'd all call the steam gauges—the old round dial gauges in the cockpit to glass cockpit. And I did a lot of work on the—it's called MEDS, "Multifunctional Electronic Display System". So I did a lot of work on that as well. But I only did that all for six months, maybe, and then I was assigned a flight.

DM:

Well tell me a little bit about your first flight, *STS-87*.

SL:

So first flight—it was a science mission. So we went up—it was on *Columbia*—we had six people on the flight, to include a Ukrainian astronaut by the name of Leonid Kadeniuk, who just passed away today.

DM:

Really?

SL:

Today. And so [clears throat] so he a—first and actually only Ukrainian astronaut to fly in the US program. But he was actually a Soviet cosmonaut before it split apart, and I think part of the end of the Cold War—There's a story I heard, and I don't know if this is true or not, but what I had heard was that when the Soviet Union ended and the Wall came down, Ukraine had a

number of the ballistic missiles, and Russia had a number of ballistic missiles, and the United States wanted Russia to have all of them. Not to have two different countries having them. So I was told, and I don't know if this is true or not, that part of the deal to get Ukraine to give the keys to all those missiles back to Russia was we fly a Ukrainian astronaut into space. So Leonid was a cosmonaut. He never flew as a cosmonaut in their program, but then came and flew with us. So also on that flight was Kalpana Chawla, who was on *Columbia*, and a classmate. So it was a sixteen day mission where we did science, we did a couple of spacewalks. Probably the neatest thing I got to do on that flight, we actually flew something called the Air Cam Sprint. The idea behind this was—this was really interesting—it was a perfect, perfect job for a test pilot. I was very fortunate to get to do this. But the idea behind this is you—let's say you have a Space Station, and we have—like today, we have cameras on the Space Station in certain locations, but we can't see all of the Space Station. But what this was is it was essentially a—it was about the size of a basketball, and it had twelve coal-gas thrusters for propellant, for propulsion, used CO₂ for thrust, and it had two cameras in it. It was—I connected to it through a laptop computer, and I had joystick that was part of one of our space suit—our space suit had a system called SAFER, which was called "Simplified Aid For EVA Rescue". It's a backpack, jet backpack, in case they get disconnected, they can fly themselves back. And so we built this thing out of spare parts from that system, and the idea was you could take this thing, you could put it out somewhere, and could fly it to wherever you wanted and get good video or photos or whatever you wanted to do, or assist somebody out spacewalking or doing robotics or anything. It was the first test of it and so they handed it to me as a rookie, which I couldn't believe they did that because this is potentially I could easily lose this thing. And I was able to—I figured out how I was going to train for it, how I was going to test it, the test plan, how was I going to evaluate it. And then on our second spacewalk Winston Scott, who was one of our EVA crew members, basically took it out of the airlock, took it out in the payload bay, hit a button, turned it on. I made sure I had control. He released it and I flew it around payload bay, and up above the shuttle for about an hour and a half, and then when I was done I flew it right back in his hands.

DM:

Wow. Incredible.

SL:

It was really cool.

DM:

Worked like a charm?

SL:

It worked like a champ. It went great. And so it was awesome.

DM:

Were you in on the design of it also? To a degree?

SL:

No, well, part of it. I was not in on the design of the system. The control system, the way they had the controls initially set up, I did change, because the way they had it, it was going to use too much propellant, because it was harder to control than it needed to be. So I did change that and fix that. The other thing that I wanted to be able to do was—I had cameras but the flying it was based on the orientation of the cameras. So if you think about flying something in space, it's six degrees of freedom, because it's not just pitch, yaw, roll like an airplane on this thing, but it's also translation, x, y and z. But you have to know when you give it a pulse which way it's going to go. And if it's a perfectly round ball with no markings, how do you know? Particularly if you lose the cameras. If you can see through the camera, you know that if I thrust it forward in x direction, it'll go in the direction of the camera. But also spinning. Can you—if it's spinning up, how do I stop it from spinning if there's a problem by looking at it? And so what we did—and they told, said, "We have three colors of paint we can use on this. That's it. And how do we paint it?" So myself and my robots instructor, we went to the supermarket. We got one of—remember those big plastic balls you get your kids?

DM:

In the bins?

SL:

In the bins. You've got one of those? We covered it with white medical tape, because the whole thing is covered in white insulation. We start looking at it and trying to figure out how to paint it so that I can have all of the cues to fly it, both in translation and rotation if I lose all camera views, and be able to control it, because I didn't want to lose it. So we came up with a paint scheme using three stripes of three different colors and some arrows, using this ball by mocking it up, imagining it, trying to figure it out. And then we put it on the computer in the virtual reality lab, and then the way we test the scheme is I would turn around or close my eyes, he would get on the computer and spin this ball up, and then he'd hand it back to me and I'd have to stop the spin or stop the translation, just by looking at it. And that's how we tested it on the ground, get it to do. But we ended up painting it that way, and people that see pictures of it look at the paint scheme but they have no idea how technical that paint scheme actually is, but it really worked.

DM:

You still have the bouncy ball? [Laughs]

SL:

No, I don't think I have the ball. I don't know what happened to the ball.

DM:

The prototype.

SL:

But it was a cool—it was a really cool experiment.

DM:

How neat. How fun to fly, it sounds like.

SL:

It was a blast. It was so much fun.

DM:

And what a great idea, too, to have something to go around and inspect the—

SL:

So the worst part of that whole thing is the day before I had to hook everything up and test it out the operating system—it was a specialized computer just for this test—and instead of like using Windows or something like that as an operating system, we used—I don't know if you remember from way back when, when they used to have one called OS/2?

DM:

Um-hm.

SL:

This thing used OS/2. It was the only thing on the space shuttle that used OS/2. Nobody knew anything about it, but I was flying this thing. I didn't know much about it either. So I go to power it up the day before a flight—and this is the heart and the brains of this thing that I'm going to do all the controlling from—I power this thing up and I get this cartoon thing that comes up with these flying ducks going across the screen. And I've never seen this in my life. I mean, we all know the Windows Blue Screen of Death. I think this is the OS/2 equivalent of that? I don't know, because I've never seen it before. So I call down—I call down to the ground, and CAPCOM's Bill McArthur—I'll never forget it—and he's a computer whiz. This guy is known for—he knows Windows and everything. And I called him up and I said, “Hey Billy Mac. I'm powering up Sprint computer and I got flying ducks.” And he goes, “What?” [Laughter] And so I said, “I got flying ducks and I don't know what to do, but it isn't working.” And so he said, “We'll get back to you. We're not sure. Give us—” So they could do all this work, but a couple hours later they call me back and they said, “Hey Steve, here's what you do. When you get to the Windows prompt, do such and such.” I remember somewhere on Windows where you can get in there. And I go, “That's a really good idea, Billy Mac, but this is not running Windows. It's

running OS/2.” And he goes, “Oh.” I never heard back from him again. [Laughter] So I figured, they have no idea what to do. I can’t remember what I did. I think I powered the thing down. I might have pulled the hard drive out, tried to reset the hard drive, beat it around a little bit, powered it up a couple times, and finally got it to work. But that was interesting.

DM:

Well that is. [Laughs]

SL:

All those guys in mission control, and they have no idea what to do with OS/2?

DM:

Right.

SL:

Anyway.

DM:

This first flight, was that the flight that John Glenn was on?

SL:

Unh-uh.

DM:

Which one was that?

SL:

That was the second flight.

DM:

Okay, let’s talk about the second. Was there anything about the first flight that you wanted to mention?

SL:

Probably the biggest challenge we had—we had a satellite deploy improperly and we had to go back and recover that EVA. So that was an interesting day.

DM:

There were—what two EVAs on that?

SL:

There were two EVAs. The first EVA was we deployed the satellite on flight day two. It didn't deploy properly. We tried to grab it and it started spinning on us, so we had to go back four days later and the way we had to grab this five thousand pound satellite—we put two EVA crew members out the door. We flew the shuttle up to it and they reached out and grabbed it.

Recovered it.

DM:

Golly. What keeps them from *jerking* like that?

SL:

Well I mean what we do, so by this time it had a slow rotation. What we did is we could actually fly the shuttle and match the rates, so you try to match it as close as you can, and then it's five thousand pounds and they reach out gingerly and move it really slow. You can move it, but you don't want to build up too much momentum. So they were able to get it under control. **Colt** [00:58:10] went in and grabbed it with the arm, and then I birthed it back—used the arm and birthed it back in. Actually, we actually flew that same satellite and then did get the mission correctly done on my next flight on STS-95. So that was interesting.

DM:

Was this one of the solar observation—

SL:

Yeah, it was called *Spartan*. It was a solar observation satellite. It was not SOHO, but it was doing the same thing. It was looking at the sun. So then I got back from that first flight, and I had just gotten back. I mean I was only—I think I'd only been on the ground a couple of weeks and then the chief of the office came up to me—went to the same church—said, “Hey, I want you to—Do you want to fly STS-95?”

DM:

That's amazing.

SL:

We all knew STS-95 was going to be the flight that John was on, and we also knew because of that it was going to get a lot of attention.

DM:

Right. Right.

SL:

I remember joking with my wife, I think that afternoon we were talking about it. Because I'd just gotten back. There's no way they're going to assign me again. And joking with my wife and said, "You know Diane, I'm glad we're not going to be on that flight, because that's going to be a lot of extra stuff,"—you know.

DM:

A media circus?

SL:

A media circus and all that kind of stuff. "And I'm sure John's a great guy," I didn't know him at the time, but you know, it's like, "I don't know." And then that night we came home after church and told Diane, "Hey, guess what." [Laughter] And it was only—and like you said, I flew the first flight in November of '97, and I flew the second flight in October of '98. So it was less than a year.

DM:

And that's just a couple of years after you became an astronaut.

SL:

Yeah.

DM:

That's just amazing.

SL:

And so that flight was also a science flight. We had quite the diverse crew. On the first flight I had a Japanese astronaut, Takao, as well. He was great. And the Ukrainian astronaut, Leonid, who was also really good. And then on this flight we had Chiaki Mukai, who was also a Japanese astronaut. We had Pedro Duque, who was the first Spanish astronaut. So he was going to be the first astronaut from Spain to fly, so we called him Juan Glenn. [Laughter] Just to mess with him. And then of course we had John. This was a science mission—we actually had a single powered space Spacehab in the back of the payload bay, like a little laboratory, with a tunnel going to it. And actually that single Spacehab became the double Spacehab that *Columbia* mission flew. And as a matter of fact, the majority of experiments that Rick and his crew did were follow on to the experiments we did on that flight.

DM:

Uh-huh, I see.

SL:

But it was, you know, the other part of it, of course, was John was going to be on the flight. And he had several experiments that he did associated with aging, osteoporosis, things like that. But he also did a number of the other experiments. We had like eighty-five experiments on that flight. Actually I was primed on—as a the pilot—I was supposed to be operating the vehicle—I was prime on about thirty-four of those experiments.

DM:

Really?

SL:

Yeah. So [simultaneously] I was heavily involved in—

DM:

Is that unprecedented?

SL:

Pilots and commanders typically got involved in science. Probably not to the extent that I did. I mean I was doing—even on my first flight—I was doing glove box fluid physics experiments, and combustion experiments, and all that kind of stuff. So to your point of flying and being able to do science and all that, they had it in spades.

DM:

They really pack that in, don't they?

SL:

So anyways, so I heard about this flight. And then they—of course there was going to be this big announcement—the press's conference. I think I was out on a west coast—working at Ames, doing some vertical motion simulator test pilot stuff with the shuttle landing and rollout group, and got called. Said, “Hey, you need to come back to Houston for this press conference.” That's when I first met John. So it was interesting. But John was—awesome guy. I don't know if you ever got a chance to meet him.

DM:

Never met him.

SL:

He was—he and Annie, they're the people you want to live next door to. He was just an outstanding individual for a—You know he was seventy-seven when he went up, and he came back into the program after being gone for thirty-six years like he never left. I flew with him in

an airplane, he was exceptional in airplane. Obviously did great on the mission. Quick story: After the mission we went up to—there was some event. Well John was going to retire from the Senate. Right after we flew he was retiring from the Senate. We went up for his first Senate retirement dinner, or something like that. Myself and Scott Parazynski, who was also on the crew, we flew up on a T-38. We got in early and John said, “Hey guys, if you get in early come by my office.” So we got in early so we went to his office, and when we got there he said, “Come with me.” So he set up a tour of the capitol with the chief architect of the capitol for us and then him. And we got to walk—you know there’s original dome underneath the dome—we got to walk in between those two domes, up the side of it, all the way to the top and outside that little rotunda thing on the very top. I mean it was a really cool tour but what I remember the most is, so we’re walking with John through this to get over there. And we’re always asking—we never have enough time to do anything—but he was walking so fast, I can’t keep up with him. And he’s running up those stairs, and I can’t keep up with him. He’s seventy-seven years old. I mean he was just incredibly good shape.

DM:

So physically he functioned well on the flight too?

SL:

Oh yeah. Oh yeah. Yeah. And he was great to work with. He’s humble, he was just great all around. Fantastic. So was Annie. Annie was a sweetheart.

DM:

What an opportunity.

SL:

Oh it was. It was awesome. Great friend.

DM:

Did he happen to talk about *Mercury* days at all?

SL:

Oh yeah. Yeah. He talked about that a lot. He talked about what they didn’t know, and all these doctors telling him he wouldn’t be able to eat, and he won’t be able to swallow, and your eyes will go out of focus and all of this kind of stuff. And he said, “I didn’t believe any of that. None of it.” I’m sure he’d been zero G enough in airplane to know better. And one of my greatest memories with John was—it was probably a different event. We were at the Smithsonian Air and Space and if you walk right in there his *Mercury* capsule’s sitting right there. And so we’re standing by his capsule, they’re doing some photo event or—we’re doing something with the vice president, I think Gore at the time—it was something. But we’re standing there by the

capsule and we're looking in the windows and he's looking in the windows and I'm standing right next to him, and he starts pointing at all the gauges. He said, "Well this did this. This did this. See I put this mark here because I was trying to monitor this, because we didn't know what was going to happen here." He's explaining to me how he flew this thing, and he was showing me all of the marks that he personally had made, like, with grease pencils that are still there. Showing how he flew this thing, and I was thinking, This is surreal. I'm standing next to John Glenn and he's telling me how he flew this thing when nobody knew how to fly it. And so, that was cool.

DM:
That is truly awesome.

SL:
Yeah. It was. It was amazing.

DM:
Did he ever talk about the lights he saw? When he was in orbit he saw some unusual sparks—what looked like sparks?

SL:
I don't know if I ever had that conversation. What it was—I think it was debris coming off the outside. That's what they figured out later. I don't remember him talking about it and I don't remember having a specific conversation about how they had that light that said his heat shield might be loose. They made him enter with his—

DM:
I was wondering if he had reflected on that at all.

SL:
He didn't. I don't remember him saying anything, but—oh—here's the other thing cool that we did. When he did first flight in *Mercury*, you know they didn't have satellite coverage for com, so they had certain com stations along. I don't know if you remember, but the city of Perth decided to light up for him when he flew over. So for our flight the city of Perth decided to do it again.

DM:
Really?

SL:
Yes.

DM:

Oh, that is so nice.

SL:

So we're—and it's going to happen early in the flight—it's only about four hours in the flight. So we just finished post insertion and we knew where it was on the flight plan, and it was going to be a night pass, and we knew Perth was going to turn all their lights on. And so Curt Brown, who was commander, and I were on the flight deck trying to find Perth. As soon as we find it—John's floating around doing something else, but we're going to drag him over to the window. And so we start looking and we're approaching Australia, pitch black, and I know where it should be and I'm looking, and it looks like the whole continent is covered in clouds. I thought, Oh we're going to miss it because it's covered in clouds. Well we're coming up, we're coming up, we're getting closer to the coast and I'm getting more and more paranoid, and finally I spot it. And the whole continent—at least that coast—was covered in clouds, except for Perth. And there's a hole in the clouds and you can see Perth. And so then I grab John, "John! Come here! Here it is." And so my memory is of—I wasn't really looking at Perth, I was looking at—I was watching John look at Perth thirty-six years later. So I just watched, I remember that, watching him look at Perth. I think he said to me, he said, "Well it's a lot bigger than the last time I saw it." [DM laughs] But that was a cool memory, is to—

DM:

Good greif. That's an amazing experience.

SL:

--yeah, watch John see that. So it was really cool.

DM:

Are you doing okay over there?

SL:

Yeah. Yeah.

DM:

Well we haven't gotten a knock on the door yet, so let's continue, if that's all right.

SL:

Yeah. I don't know what time it is.

DM:

Do you need to check that? I'll pause this. [Pause in recording] Let's go to *STS-104*.

SL:

Okay.

DM:

Was there anything else about that flight that you wanted to mention? Any more—

SL:

Let me think. *STS-95*.

DM:

You did more solar observations, I think, didn't you?

SL:

We did. We deployed then retrieved that satellite successfully. We had a whole set of experiments we were testing, actually, for the Hubble Space Telescope. Because of that we went much higher than any of my other flights. On a typical mission we'd go—like on my first flight we went a hundred and fifty nautical miles. Space Station is about two hundred and ten to two hundred and twenty nautical miles. On that flight we went to over three hundred nautical miles. And the Earth looks surprisingly smaller at that altitude. I remember one day being in the Spacehab, and we had a couple windows. We were south of Cuba flying along, and it was one of those perfectly clear days across the eastern United States, and I remember looking up north and I could see from below Cuba to north of the Great Lakes. Three thousand miles. It was incredible. And so do remember that. Let's see, what else about 95? All in all it was a great mission. The post-flight, we always have a post-flight period after the mission, typically you do debrief for about a month, and then you typically go on the road as a crew for a month to different things. Some people go visit their hometowns. I'm sure Rick did that here, and different things like that. But it's usually about a month long and then you're back in the technical job. That post-flight was four months.

DM:

Oh really?

SL:

And we actually did a trip, and we got to take our spouses, so that was really cool. We did actually a trip after that flight where we went all the way around the world. We started in DC, we spent a couple days in DC. The spouses joined us. We did a week in Spain with Pedro. We did a week in Europe. You know, Germany. Let's see Germany, Italy, France, Netherlands, I guess it was. And then we did a week in Japan and flew back. So it was around the world. Very, very long post-flight trip.

DM:

Oh that's nice. Not that you hadn't been around the world. [Laughs]

SL:

No, no. Actually a month on the road, speaking three times a day and getting no sleep—it get's old.

DM:

Oh, I bet. I bet.

SL:

It was painful.

DM:

You've done this after every flight, I'm sure.

SL:

Yeah. Yeah. But not to that extent. So that was the painful part.

DM:

Let me ask you this: Some of the *Apollo* astronauts have told me that when they did these public appearances in different countries that the people in those countries just accepted them like, "You're ours. You're not just US, you're ours." You know, it was like a—you know—"You represent us all." Did you ever get that impression?

SL:

No.

DM:

Okay.

SL:

No, I didn't.

DM:

Okay.

SL:

Maybe that was unique to *Apollo*.

DM:

Maybe. Maybe.

SL:

But—I mean the reception we got overseas was every bit as—maybe crazier than it is here. I mean very receptive. You know, depending on who you were. What I learned on the post-flight with John is, you know, the key was—first of all, it was perfect as the pilot, because I was a member of the crew so I got to go participate on all this stuff, but I wasn't the center of attention. John was the center of attention. Or when we were in Spain it was Pedro was the center of attention. Or in Japan it was Chiaki. Of course John was always the center of attention everywhere. So I learned just the key would be to make sure I duck as the cameras run by me to get on John so I don't get hit in the head. But it was—in Spain, Pedro, he was like a rock star. There were places where I thought we might get crushed by people. So he was—it was crazy.

DM:

So fun to experience that.

SL:

Oh yeah, it was. It was.

DM:

Let's go to *104*.

SL:

104 was my third flight. It was my first time as commander.

DM:

Yeah, yeah. And this was in '01, so you got a little bit of space between missions. Finally.

SL:

Yeah, it's—well in between that time I got to do a really unique project. I was—the chief of the office at the time told me later, he said, "I was debating whether I wanted you to go do what I had you go do, or have you go start training long duration to be one of the first Space Station crews." But he ended up putting me in the Advanced Development group, and basically my job was to—I led a team to redesign the orbiter cockpit. All of the displays. And so I'd done a little bit of that work before my first flight. And so I created a team and we came up with the concept and created something called a Cockpit Avionics Upgrade. And I had probably a team of about a hundred and fifty, two hundred people working on this. And we created it, which was really interesting because we took the basic displays. We put—rather than upgrading the flight computers, which would have cost us billions of dollars, we actually put powered PC computers

behind the displays, move the smarts in there. To basically upgrade us to, you know, nineties level technologies, at the times we were trying to do. Because you know the shuttle had been designed in the seventies, early seventies, and it hadn't really changed. And so that was an interesting project. That's when I first—that's where I really got to know Willie McCool really well, because he led the trajectory team. And that's where I first figured out how brilliant he really was. And in fact his display designs and what he did with trajectory, you can see remnants of that on *Orion* today.

DM:

Is that right?

SL:

People don't know that. And even the people working on *Orion* probably don't know that, but I knew where it came from because he did it. So I worked that for a few years and then I got assigned to—it was interesting because when our class first came in they said the, "You guys aren't going to fly in any Space Station assembly missions. We're going to use more experienced crews, and we need to get all that done before you get there. You'll maybe get to fly some of the later Space Station assembly missions." As it turns out, this flight I was assigned to as a rookie commander was one of the very first assembly flights. So the first phase was up through—I was actually the last flight of the first phase, and that was just to get the core Space Station up there. The Russian service module, the FGB, the US laboratory, the robotic arm, and then my piece was the airlock, which enabled the spacewalks. Enabled you to finish building the Space Station. And so the mission was to carry up the airlock, install the airlock on the Space Station, and then get it outfitted, then actually execute the first spacewalk out of the Space Station—out of that airlock. Because what we were carrying in the payload bay was so heavy, I only had a five person crew to do that. And then we had a three person crew on the Space Station at the time. And then what was unique is we—because there was no airlock on Space Station yet, we had to do what's called hatches closed DVA, where we would have to close off the space shuttle from the Space Station because our translation path to the Space Station from the space shuttle was through our airlock. So I'd close it off, use an alternate exit to do that. And then we had—to install this airlock we had to use the space shuttle arm and the Space Station arm simultaneously, to do it. And so we had what was called dual-arm ops going, with hatches closed. They were very complex EVAs. That was, by far, my most difficult mission.

DM:

What's the concern with launching with that much weight? I mean was there any thought about that, or was the weight sufficiently compensated by like the—

SL:

Yeah, I mean we have to meet a weight and center of gravity requirements. The reason we only had five people is we couldn't afford any more weight on the front of the vehicle. It would shift the center of gravity too far forward. That was the problem. And that's why we had to go light weight there.

DM:

Yeah.

SL:

To make it work.

DM:

Okay.

SL:

But it was [clears throat] it was about a thirteen day mission. We were fully successful. Got everything done. It's really—of course my first command. I'd never—I've never done a rendezvous and then here I am doing a manual docking to a Space Station I've never seen before. Same thing with landing. It was a night launch, a night landing. I'd never done either one of those before either. I remember the landing was—it was about midnight, one o'clock in the morning. It was one of those no-moon nights, pitch black, there was scud over Cocoa Beach, so you couldn't see any lights and dive-in at the runway was a black hole. Couldn't see anything except the lights. I thought, This is really cool.

DM:

It's all instrumentation and all?

SL:

Yeah, it was cool. But we—one story from that flight: So we go through this mission and then in the end we're finishing outfitting the airlock, we've got the EVA done, and we've got to leave. And we've just been working, working, working. I mean, haven't been getting a lot of sleeping. Working too hard, actually. And we undocked from the Space Station and right before we undocked I called down to the ground or I sent an email, I think, it said, "The crew is beat. Take everything off our flight plan we don't need to do between now and landing, because we're past the point of—we're just too tired." And that got a lot of concern on the ground. At the time I was just saying, "Hey, I just don't want extraneous stuff on the flight plan." But the—so we go the first time to de-orbit, the first day, and the weather's iffy. And so you through this whole process to de-orbit and reconfiguring the vehicle, and ever since we undocked we've been working, working, working, working, working. I remember thinking—you know, it's my first flight, and

in the end I've got to do a manual landing, because it's the only way you land a shuttle, so I've got to perform—we have to perform as a crew. And I remember counting down the hours. "I've just got to stay focused for another two hours. Another hour and a half." I was that tired, and the crew was too. So we get to our first attempt to de-orbit, and the weather's bad so they call off—so they wave us off. So then you have another attempt ninety minutes later, and then if we miss that attempt then we're scrubbed for a whole day. And so you back out to a certain point in the checklist and then we had about a twenty minute gap before we need to jump back into the checklist and try it again. And everybody is strapped in, in their suits and everything, the vehicle's ready to go. And I wake up about three minutes before the next de-orbit run, and I look around on the flight deck and everybody else is sound asleep. So I wake them up. And the ground hasn't called us—I mean if they would call us we'd all come—and I said, "Come on, guys. We've got to go." And then the ground—shortly after that—said, "Weather's no good. You're scrubbed." And I'm like, Thank God, we're scrubbed. And so we backed out of that and we got a few hours off, and I think everybody on the crew fell asleep where they were. But then we were able to go do it again the next day, much more rested.

DM:

Oh, glad it worked out that way.

SL:

Yeah, so that was a—

DM:

So that's happens when there are only five people and they're doing really a lot of—

SL:

With five people. And we were probably over scheduled. That's something I learned on subsequent flights to really watch that. We were pushed too hard. They were just—particularly those early assembly missions were just really difficult. They were tough missions. So flew that flight. Came back. Then I think I was—what was I assigned to? I was assigned to work the—I was in charge of the Space Station Operations branch in the office. So I was doing that, working basically as we're developing, and building, and starting to fly a Space Station. So that was interesting, because that's when I first started working a lot with the Russians, negotiating with the Russians, and different things like that. So I did that. I was in that job, and I was actually assigned, then, to a flight that was *STS-119*, which I obviously never flew when the *Columbia* accident happened. I think I mentioned to you in there that for the—you know, because I knew all the *Columbia* crew so well they picked some family escorts and I was—it was an interesting flight in that it was what's called a dual-shift flight. So you had half of the crew working—they were working twenty-four hours a day. So half of the crew was asleep, the other half was working. Rare that we ever did missions like that, but that one we had two shifts. So because we

had two shifts on that crew, and we had an Israeli astronaut on board and there was a lot of security concerns with Cape operations, instead of having the usual two family escorts per mission, we actually had four covering the two shifts. So I was the lead family escort for them and them, and then as I mentioned before, I was also the CACO, Casualty Officer, for Rick. And so for that flight I was—we took the families down for the launch and took care of the kids. And then, you know, liaison for the family during the missions. Get them in for the family conferences that they had and things like that. And then, of course, took them down to landing. And [clears throat] I think we had three of the four family escorts were there for the landing. When the—when all that happened. And so after that accident then I was—I essentially was pulled out of my Space Station job and I spent the next about nine months to a year full-time working with Evelyn and her family. Doing the CACO job and helping them with everything that they needed help with. [Clears throat].

DM:

Right, okay.

SL:

So—

DM:

Evelyn told me that there was just no news for a while. They just didn't know. They were waiting, time passed, and they were waiting, and just—or they were not—it wasn't soaking in.

SL:

Well, so, I was—I remember the morning. It was a beautiful morning. We got up, we got in. It was a reasonable landing time. It was like nine in the morning, something like that. I think. I don't remember exactly. So we're out in the stands in the middle of the field there at the SOF, and we have the com set up so you can hear mission control talking to them. [Clears throat] So we're there with the whole families, you know, everybody is happy because they're coming home. [clears throat] You know at that time nobody stressed out about entry. Everybody stressed out during ascent. Once the ascent was done everybody said, "Yay. No worries." And that obviously changed after *Columbia*. So I was standing there with them, listening to mission control. Obviously by this time I'm pretty darn experienced. I know what exactly what I'm listening to. And I knew well before they did. I knew that, based on the coms I was listening to, that something had gone very wrong. I didn't know what, but I also knew it was bad. I sensed they were lost then. I didn't know anything about what was going on. And so I probably knew, and I probably had about, I'm guessing, seven or eight minutes before one of them, probably Evelyn or the other families that were standing next to me was going turn to me and say, "Steve, what's going on?" And so for that seven or eight minutes I prayed, "What do I tell them?" And I never got a good answer. And then that came. They had the countdown clock counting down to

when they were going to touch down. I remember that thing went to zero. We heard no sonic booms. You always hear sonic booms when they hit fifty thousand feet. So that countdown clock count down and then go, you know, past zero. Start counting back up. And I remember hearing one of the family members said, "Oh they're late. They're always late." And I'm like, "We're never late." And so then [clears throat] they figured it out and [clears throat] or they said, "What's going on?" And I told the other family escorts. [Clears throat] I told all the families, "Get in the cars right now. Let's go." So we took them back and Evelyn was asking me, "What do you think is going on?" I said, "I don't know, Evelyn. But this is bad. I'm telling you, this is bad." Because I didn't want to—that's all I said. I didn't know what else to say. But I didn't want to—you don't want to mislead anybody, because they either land or they die. That's the way the trajectory works. [Clears throat] So we took them back to crew quarters. Bob Cabana, who is the—he's the center director at Kennedy now was in charge of flight crew operations. And then Kent Rominger, who Rick flew with on his first flight, Kent was the chief of the office at the time. So it was Kent, and I, and Bob, and [clears throat] Bob told us what they knew. That pieces were coming down and things like that. We talked about it before we went in to talk to the families. Bob said, "I've got to go tell them that the vehicle went down," and he said to us, "And we cannot give them any hope." And so went in and told them. And then Rommel and I walked over to the—in our contingency plan the extended families, like Willie's parents and—you know—parents and things like that that were not spouses and direct—immediately families were in crew quarters. That's where we took them. Extended families were in the NASA Theater, which is right across the parking lot from there. And so Rommel and I went over there and told them. And then—you know the rest.

DM:

You know you lost friends on this, and then you're dealing with the family. How do you hold up to that? Just have to?

SL:

What I determined—yeah. Because there is that piece of it. And like you said, a lot of my really good friends, Kalpana and Rick and Willie, in particular, those three were probably the closest ones that I had. My job was not—I had to deal with that on my own. My job in front of the families—First of all, I was never going to ever grieve in front of the families. I saw enough people grieve in front of them to the point where the families were having to comfort them. That's not my job. My job is to be strong and help them, but not grieve in front of them. And so I think we all just put all that aside and do our jobs. When I got home after a very, very long day, and in my own house, is when I can grieve. But I determined that I would never, ever, ever break down or even give the hint of breaking down in front of them. That's not my job. That doesn't help them.

DM:

This you had to maintain for a long time, too, because you continued to have this contact with Evelyn and—

SL:

Yeah. Well it was a long time. And you know, Rick would have—if the roles were in reverse Rick would have been doing this for me. So it was a—I considered it a privilege to be able to do that, as hard as it was. It was a privilege.

DM:

Was it the hardest thing that happened in your NASA career?

SL:

Yes. By far. No question. I mean I had other stuff that happened that wasn't fun, but this by far was the worst thing. For all of us. Everybody.

DM:

Does it—do you come away from something like that as an astronaut going into another flight a few years later, do you come away from that with concerns that you didn't have before for your own personal safety, or do you continue as before?

SL:

Certainly. Obviously we had to get to the bottom of the—what caused the accident, and the processes, or anything culturally that could cause other things like that to be out there that we didn't know about. So we worked really hard on that.

DM:

Well, I'm talking about emotionally.

SL:

Emotionally? Emotionally you thought about it more. Yeah, I certainly had to have some soul searching about it. What I couldn't get past though was—and we all felt this way—we weren't going to let them die in vain. So, in fact, probably within—I don't know, maybe eight or nine months after the accident once we kind of figured out where NASA was headed, they pulled me off that flight that I was on, assigned to, and asked me if I would command the second return flight test mission. The one after Eileen flew the first one. And I thought about that. I talked to my family about it. I told them. I said, "If you don't want me to do it, I won't do it." But I also told them, "I don't want them to die in vain. And they would want us to continue, and I feel like I would dishonor their sacrifice if I didn't do it." So I did it. But yeah, so you think about it. You're paying a lot closer attention to entry when you do it yourself after this accident.

DM:

How about your family? How about—I mean—[simultaneously] they were supportive of this?

SL:

It was difficult for my family. It was difficult for every family after *Columbia*, because it could've been them. They were all friends with these people too. All of these. They knew them all. We were a small community. We know each other.

DM:

How about their attitude toward you continuing in space flights? You'd been there three times.

SL:

Yeah, so that was—I learned—I knew it was hard. I remember sitting down with all of them and talking to them about it. They said, "Dad, you need to go do this." But I didn't fully recognize it, I don't think. I mean I recognized it because I'd been family escort before. I've seen how the families go through these. If you—did you ever go down to shuttle launch? I don't know if you ever saw one.

DM:

No.

SL:

If you ever saw one, the people on the causeway watching and the extended family and friends watching it. It's a big celebration when they launch. We intentionally, after *Challenger*, we keep the families separate at these launches. And so the families typically watch from the roof of the launch control center. They're separate. When you're with the families when they launch, there's no cheering. There's no yelling. There's just *silence*. And then when they—engines cut off and they're in orbit—there's relief. It's a completely different vibe, and our families went through it every time. So I saw it. But where I really recognized it was—in 2015 I was fortunate enough, I got inducted into the Astronaut Hall of Fame down in Florida. Which was a really cool event. Our whole family came down. All my kids. All three of our kids and their spouses and Diane and I. So our whole family was down there. It was the first time our whole family had been down there at Cocoa Beach where we weren't under stress. Because every other time they'd ever been there I was either launching or landing. I was in quarantine. I either didn't see the kids at all or waved across the ditch at them, kind of thing. We're always under stress. And so it was really cool to be down there with nobody under stress. They started talking about the stories. My daughter telling me how she wouldn't sleep the night before, and all the worries they had, and things like—things that they never—You know she was a teenager at the time, so she acted like a typical teenager. Like, "Oh I don't care about you." But that's not true.

DM:

Aw. I'm glad you found out about that, only later.

SL:

Yeah, but it was really good. I think it was healing for everybody to be down there together, under what we all consider to be much better circumstances. Less stressful circumstances. And to understand that. But after *Columbia*, I think for them it was hard. Ilan's kids and my kids went to school together. My oldest daughter and his oldest son were good friends in class. Then having to go through that. I think I had to spend, in the beginning, all my time with the *Columbia* families, and couldn't spend time with my own family. That was hard on them too. But it was for a season and everybody has recovered from it, so it's okay. [laughter]

DM:

And then there you were back in the cockpit?

SL:

There I was flying again, so.

DM:

Anything else you want to say about *Columbia* before we move on?

SL:

No. Although I will say that I think—and I wasn't at NASA for *Challenger*—but *Challenger*, they kind of pushed it under the rug and kept going. But they didn't do it the same way they did *Columbia*. For example, all the *Challenger* debris was basically shoved into a missile silo.

DM:

Really?

SL:

And forgotten. All the *Columbia* stuff was preserved—laid out, preserved. It's still preserved at Kennedy Space Center, in pieces, or different places. They learned from it. So I think they treated the *Columbia* accident—NASA did much different from *Challenger*, and better.

DM:

That sounds like NASA matured in that interval.

SL:

They did. I think they did. They didn't sweep anything under the rug. They actually used data from the *Columbia* accident, which told them a lot about—you know, we learned what can

survive entry without thermal protection or what can't. We learned a lot of things about that. We obviously learned from the mistakes of the external tank—we improved that. When Eileen went up they did some tank changes—they didn't work so well, which delayed us another year. Then they made changes for our flight and that pretty much fixed it.

DM:

Even on *STS-101*—or *121*—you were doing some safety tests, weren't you?

SL:

On that flight—after the *Columbia* accident, because we lost the shuttle up-mass and down-mass capability we went down to a two person crew in Space Station. So on *121* we brought the crew back up to three. We brought Thomas Reiter up, who was a German ESA astronaut. But we were—besides resupplying Space Station and doing a couple of spacewalks, we did one spacewalk, actually part of two spacewalks where we actually tested techniques for preparing both the tile, the underside tile, and the leading edges. The reinforced carbon. We did the experiments on that as well as we use the shuttle arm with a large inspection boom that we put on the shuttle to inspect the heat shield before coming back. We put EVA crew members out on the end of them. We put them all the way up on the truss on Space Station over a hundred feet away to test the stability of that system to do a repair. So all of that stuff was very successful. The purpose of our mission was to—was kind of our last chance to get the tank right and everything. If the tank had not gone right on our flight the program would have ended. Probably if these repair techniques had not gone well the program would have ended right then. So our flight—as was explained to me—was, “President has given us one last chance. If we can do this mission successfully then we go back to operations and finish building the Space Station.” So thankfully it was successful. We were able to go back to operations. So that was the purpose of the mission; to test all that stuff. But it all worked, so it was good.

DM:

Was in '06?

SL:

O-six. Um-hm.

DM:

How about your last mission? *133*?

SL:

Somebody is texting me, an 806 number. [Pause in recording]

DM:

Just moving on to *STS-133*, that was a five year gap there?

SL:

That was a five year gap, which—

DM:

You were in administration by this time, right?

SL:

I was—so after I flew that mission—*121*—I came back and tried to decide what to do with my life, and then they asked me if I would be chief of the Astronaut Office, so that's when—and I took over that job—you know, they gave me the opportunity. I decided, yeah, I've got to do this. So I became chief of the office. But I never intended to fly again. I was done. My job was to fly others, not myself.

DM:

Right, right.

SL:

And so I never intended to fly again.

DM:

Okay. Let me just clarify here; you say chief of the Astronaut Office. You were at one time chief of the Space Station component of the Astronaut Office first, is that right?

SL:

Yeah, so we had branches in the Astronaut Office, various branch. We had EVA branch, we had a Robotics branch, we had a Space Shuttle branch, Space Station branch. Actually in previous jobs I had been deputy for the Space Shuttle branch and then ran the Space Shuttle branch. And then before I flew the *STS-121* flight I was the chief of the Space Station branch until I became a CACO. Then out of the CACO I was back on a mission. And then coming off the mission then I was chief of the Astronaut Office. So I had responsibility for training and missions—Space Station, space shuttle missions—and I assigned crews and did all of that kind of stuff. But again, I went into that job thinking I was done flying. Intending to be done flying, because I wasn't going to—certainly wasn't going to assign myself to a flight. My job was to assign others to flights.

DM:

But this was quite a major step. This is senior position among the astronauts? This is—

SL:

Herding all the kitty-cats.

DM:

What? Herding all the kitty-cats? [Laughter] This is walking in the footsteps of Deke Slayton and Alan Shepard and John Young.

SL:

Um-hm. Yep. Yep. That's it.

DM:

Big decisions, isn't it?

SL:

It was a heavy responsibility. And it's much easier for me to fly missions than it is for me to send other people to fly missions. [DM laughs] Those are more scary. When I send other crews out to do that.

DM:

We were talking earlier about, you know, you didn't know how this astronaut selection occurred.

SL:

Yeah.

DM:

But now you do know. Can you spill the beans on that?

SL:

Sure! Um-hm.

DM:

Okay.

SL:

It's not a big mystery.

DM:

Or with you, at least.

SL:

Well at least in my era, the way I did it is—First of all, any crew that I picked had to get approved all the way up to the Administrator. That was a given. But generally what would happen is the mission ops folks, which also ran all the training, would send to me, “This is the mission that’s coming up for assignment. These are objectives of the mission. These are the tasks of the mission. This is when we need this,” and they give me what’s called an LCAD, Latest Crew Assignment Date. Said, “Need them assigned by this time so that we can get through the training.” So I would look at that. You know, usually I had several of those, right. I knew the next seven or eight missions coming up. I knew what crews I had. I knew everybody’s strengths and weaknesses, what their skills were. Not everybody could—for example, not everybody could do a spacewalk. Not everybody can fly the robotic arm. I have limited numbers of commanders and pilots, and various levels of training, and various levels of experience. Everybody’s different. Everybody has different level of skills. So I would look at—one of my goals when I took over the office is that I knew in 2011, the shuttle program, if we stayed on schedule, the shuttle program would end, and they would only be doing long duration missions. I also knew that the size of the office would decrease to probably a third of what it was when I had it, because I had 120 astronauts plus a bunch of internationals when I was there. What I didn’t know is who was going to stay after the shuttle program ended, and what I was really worried about was leaving the office—flying the same experienced folks over and over, and then them all walking out the door. Ended up with this inexperienced, unflown office when I left. So my goal was I wanted to get everybody through the 2004 class flown before the shuttle program ended, on shuttles, to give them that experience. So that no matter who stayed, I had an experienced office. Which was tricky, because then I had to fly a whole bunch of rookies, and I had to figure out how to do that. Based on their various skill levels and things like that. But anyway, so I would assign a crew based on kind of who made sense for the mission, with the proper mix of experience and rookies depending on the tasks, and then I would submit the flight assignment. It would go up to my boss, who was the flight crew ops, and then it’d go up to the center director—Johnson Space Center—and then the administrator. But I never had a single crew turned around on me, except for one. And the one that got turned around on me was *133*, the one that I flew. And it got turned around for only one name, and it was mine. Because this was—at the time that mission was assigned, it was going to be the final flight of the space shuttle program. Now later on it wasn’t, because they added a couple other flights and one of the flights delayed—their payload delayed and it ended up being the third to the last flight. But at the time it was going to be the final flight of *Discovery*. And so I went into this flight—and this one was special because I had to pick the right people. Because they were going to represent the last space shuttle mission. They were there to talk to all of the people that had worked on the space shuttle program over the years, because we were going to lay off a whole bunch of people at the end of the cape after that, and they had to be the right representatives. So I picked them not just for their skills, but I picked them for their personalities. Above and beyond what a typical astronaut needs in terms of their ability to relate to the public, to be humble and appreciative, and say all the right

things to all these people that have dedicated their whole lives to this program. So I picked them with that in mind. So I picked this awesome crew, including an awesome commander that was not me. And I sent it up and center director said, "I want you to fly that." And I said, "I'm chief of the Astronaut Office. My job's not to fly, it's to assign others to fly." And I went back and forth for probably—and we were working this mission pretty early—I probably went back and forth with him about nine months and finally I told him, I said—he said, "Would it help if I direct you to fly it?" [Laughter] And being a military guy I said, "If you direct me to fly it, I'll do it." And so he directed me to fly it.

DM:

Did the other commander, the one that you'd chosen, ever know?

SL:

No.

DM:

Okay. We'll just leave that name off of here, then.

SL:

You got that right. [Laughter] Never reveal that name.

DM:

Yeah.

SL:

But anyway, so that's how I ended up on that flight. Never intended to fly it.

DM:

Okay. It's an interesting flight, though.

SL:

It was!

DM:

You had your robot.

SL:

Yeah, we brought up Robonaut, and we installed—we actually officially completed assembly of the Space Station on that flight, because we brought up what's called a PMM. It was a—MPLM was the logistics carrier that we would carry cargo in. We actually converted that into a

permanent module and installed that on the Space Station, as well as a logistics carrier with the last set of spares, and so we actually physically completed the space station assembly on that flight. And like you said, it had a great crew. It was such—that was probably my easiest flight, because my crew was so good. Actually none of them were—yeah, none of them were rookies. They all knew exactly what they were doing and it's very—it was kind of a crew—you know, you go through training with a group of people, intense training over a year period, you're invariably going to have arguments sometimes, things like that. This crew? All the way through the training, flight, all the post-flight we did, I never saw anybody get upset with anybody else over anything. They were just incredible.

DM:

So nice to have a smooth ending like that.

SL:

And all I had to do was—I felt like I spent most of my time just trying to stay out of their way. [DM laughs] And they were great. It was a great crew. So that was the last flight.

DM:

One of the challenges that you must have had in that office was dealing with it seems like astronauts and cosmonauts from other countries? I mean surely there was some kind of national red tape as you're working with other countries?

SL:

Well the—so the cosmonauts. You know the Russian program was kind of independent of ours. I mean they would train with us, they would be in our office, we'd train there certainly all the time. As far as their selecting crews for flights and how they operated on Space Station, they—pretty much the Russians operated the Russian stuff, and the USOS crew members operated the US side. And just like US astronauts, they all had varying levels of skills. We had—as astronaut to cosmonaut—we got along with them great, for the most part.

DM:

Did you work with Fyodor Yurchikhin any?

SL:

Oh yeah.

DM:

Okay.

SL:
Fyodor?

DM:
Um-hm.

SL:
Yep.

DM:
What kind of a guy is he? I'm trying to get a hold of him.

SL:
Oh, Fyodor? He's a good guy. He was a nice guy. He first flew—he flew with Rick, on *STS-96*, I think.

DM:
Oh I didn't realize. I didn't make the connection, but—

SL:
I think Fyodor was on that flight. I'd have to go look it up, but I'm pretty sure he was. And he flew several more. And I don't know him real well, but I've—

DM:
He's five flights. He's a five flight cosmonaut.

SL:
Yeah, all of my interactions with him, he's was a good guy. I don't know him that well, but I thought he flew on—I think he flew on Rick's flight.

DM:
Okay. I'll have to look that one up.

SL:
I don't know. You have to look it up. But then in our office we had international astronauts from Canada, from several countries in Europe, and Japan.

DM:
Did you have problems with, "Hey we want our astronauts. We want it this way. We want this. We want them to get to do that." How about coordinating across national boundaries?

SL:

Well, so we—one of the things I did as chief is we—flight opportunities on Space Station were based on partner contributions. So you know, Canada contributed a certain part, Europe did, Japan did. And they would accrue days on orbit based on this formula based on their contribution. And then we would have these meetings usually twice a year. We'd go somewhere in the world and we'd have these meetings with all of the astronaut offices of all these countries, and figure out flight assignments. And once a partner accrued at least 50 percent of the days on orbit for their increment, then they could fly somebody on the increment. And so those were entertaining meetings. Negotiating those seats. And then as far as the individuals themselves, the qualifications were the same and they all trained—in those days—they all trained in our Astronaut Office. They were all in Houston. And they had to do the same qualifications. And I'd be lying if I didn't tell you that I got political pressure sometimes to fly certain individuals. Which didn't matter to me at all as long as they met the qualifications. The only time we got into conflicts was when I felt there was a safety issue or they didn't have the right qualifications. But generally speaking, we were able to work through all of that and come to a good place. We maintained good relationships, so it wasn't—there was some political pressures, but in a way, the international astronauts, in some ways, had it a little bit more difficult than us in that because there were so few of them, when they went to their home countries they really were rock stars. But when they came to the US and they were in our Astronaut Office, they were just like any other astronaut. And they were not superstars in my office. [Laughter] And don't get me wrong, but 99 percent of all astronauts are great people. But like any organization you have some that sometimes you have to, "You're not that special." [Laughter]

DM:

So the team concept has to be emphasized?

SL:

Teamwork's everything. And like I said, I'd be lying if I didn't say I didn't have any problems with that, but they were few and far between.

DM:

Oh okay.

SL:

They were all generally great folks. The international folks were very talented. So, good people.

DM:

After being in space five times, and especially when you were three hundred and something miles up in orbit and looking at the Earth, has it changed your perspective in general? About the Earth or about the cosmos or have you reflected or did you have time to reflect?

SL:

Well I guess what I would say is that I—you know being a Christian, the way I feel about that, when I saw the Earth and the universe, everything I saw, I was amazed at the order. And it just confirmed and backed up everything I believed. Having said that, I've flown with people that don't believe in God, and it confirms for them what they believe, too. But that's what I was struck by. I was struck by the order of the Earth. I think it turned me into more of an environmentalist than I ever was before. Seeing—and I'm not going to comment on what causes global warming or any of that kind of thing, but I did feel more of a responsibility to take care of what we have. That changed, I think. An understanding of—and after over two months of floating around, you get used to the zero G. It's interesting, but I could take it or leave it. But you never get tired of looking at the Earth. There's always something new to see on the Earth. And recognizing how amazing it is to have this planet. Everything functions, we have all this abundant life on it. You look all around, there's nothing. There's no life anywhere else. It's pretty incredible. And to give you an idea of the vastness of the universe, the vastness of the solar system. Just the little piece we're in, it's just incredible. The stars up there—most stars are galaxies. You really recognize that when you get up in space and the atmosphere is gone, because all the stars are different colors, instead of all being—they tend to all be white when we look at them—they're all different colors up there because the atmosphere is gone. Greens or reds and different things like that. They're not any bigger, because you're not any closer. You're only two hundred miles closer. That's nothing. But it's—so that's probably how it changed me. And there's just something strange about being like the only people off the planet. Everybody else is on the planet. Or one of the coolest things, I think, was the first time I docked with the Space Station. It was equalizing pressure, opening hatches, and floating from one spacecraft into another spacecraft in the middle of space. Something about that was weird. So that was cool.

DM:

It's just amazing.

SL:

Yeah.

DM:

Let me just check my stats here.

SL:

Okay.

DM:

You retired from the US Air Force in 2006 as a colonel, with over seven thousand hours and experience in over fifty aircraft. Is that right?

SL:

Yeah, probably.

DM:

Okay, this is the kind of information that floats out here.

SL:

Fifty or sixty, I don't remember. I haven't tracked—I don't track anymore.

DM:

And then from NASA in 2011 with over fifteen hundred hours.

SL:

Yeah. Fifteen hundred hours in space.

DM:

What are some of the—I know about your—I think your career since then is pretty well documented. Maybe you can say a couple of words about that, though. What you're doing now.

SL:

Yeah. Well when I hit—when I got to that last flight in 2010, NASA was retiring the space shuttle and they kicked off the Constellation program, which was going to go back to the moon. The Obama administration came in, they assessed the budget and concluded, “We can't afford to do all this stuff.” So they cancelled the Constellation program. They kept Orion going, which was the capsule part, but they cancelled Constellation, which is now morphed into Space Launch Systems, so it's never really completely died. But at the time it had died. For me, personally, I was looking at the future. The commercial space activity was heating up, but really what I was—and I wasn't that enamored with commercial—you know, the Space X and all that stuff—I wasn't that enamored with that, but I was worried that with the shuttle program going away and no exploration program at the time, when they were done flying the Space Station, which at the time was going to be 2020, I think, my fear was that the whole space program would die. And it would go away. And so I thought, Where can I go? What can I do to make the biggest difference? NASA was drawing down, and I didn't see specifically any particular job at NASA I really wanted to do. So I decided at that point that maybe I start looking for something else. My youngest daughter was graduating from high school, so if I was going to go do something else and needed to move to do that, it was the opportune time to do it. Meanwhile, while I was having all these thoughts Sierra Nevada Corporation came knocking on my door and said, “Hey we've got this really cool program. It's in Colorado. What do you think?” So I said, “Well tell me about it.” It's called the Dream Chaser Program. So I went out, talked to these guys, interviewed. But mostly what I did is I got a briefing on the Dream Chaser, which is a mini-space shuttle. I'll take

about it tomorrow. But it's a mini-space shuttle. I've always thought, despite the *Columbia* accident, that the best way in and out of lower orbit is vehicle, not a capsule, because we have runway and infrastructure all over the world. It only makes sense, as opposed to bobbing in an ocean in a capsule or something. And so I spent a couple of days picking the design apart, trying to figure out what's wrong with it. So technically I looked at every subsystem and I couldn't find anything evident. Little things I didn't like, but I couldn't find anything wrong with it. Decided, hey, this thing could work. And so they made the offer to me. Talked to my wife about it. We decided, "Let's go try to make a difference there." So went up to Sierra Nevada. Been there ever since.

DM:

Pretty satisfied with it, huh?

SL:

Yeah. It's going well. It's very difficult to build a spacecraft from scratch. Extremely difficult. It's very stressful. But like I was mentioning—I was talking—earlier. It's an opportunity to make a difference. I felt like if I stayed where I was and didn't—and this opportunity is presented and I didn't take it, then that must mean I'm done. I'm ready to retire. And I didn't feel like I was ready yet.

DM:

How about hobbies?

SL:

Hobbies? Well, I still like to fly. I fly privately. Not as much as I'd like, but I do some. Most of our hobbies these days involve the outdoors, especially living in Colorado. Hiking, backpacking, skiing, snowshoeing, mountain biking—

DM:

Boy Scouting experience is coming out again? [laughter]

SL:

Yeah, all of that stuff. So I do a lot of that stuff. I do some volunteer work. I fly with the Civil Air Patrol up there. We teach young cadets to fly. You know, junior high/high school kids how to fly. Give them introductory flights. We also do mountain search and rescue.

DM:

Oh really? Nice.

SL:

We'll go fly, like, missing hiker or downed airplane. Which rarely happens these days. But also we'll go support—like we sent a couple airplanes down to Houston for Harvey support. Aerial photography or we'll do—summertime we'll do fire watch when forest fires are a concern. Things like that. So I work for them, volunteer. I'm on the board of Wings Over the Rockies, which is the Denver museum. So we do a lot of stuff. Up there we're doing—besides the museum we're actually doing an annex museum that's going to be a flying museum where people can go fly and experience flight. So we took it upon ourselves as our goal is to fly a teacher out of every school in Colorado and Wyoming. We did—I can't know what number we're up to. Think we did eight hundred and something last year.

DM:

Really?

SL:

Yeah.

DM:

Getting toward that goal, then, I guess?

SL:

Yeah, we're getting up there. We're doing a lot of that. So we do teacher flight programs. We did Young Eagles—if you've heard of the Young Eagles program, that's where they take kids and fly them in an airplane. So we're doing a lot of that kind of stuff. So I do some volunteer work in that area.

DM:

Someone tells me you're an avid reader?

SL:

An avid reader? Usually just read when I'm on an airplane.

DM:

Okay.

SL:

I just pretend I'm not there. [Laughter] Yeah, I like to. I'll read anything. Yeah, but my problem with reader is when I get into a book then I don't do anything else. So I try to avoid it as much as possible, because it just sucks away all my time.

DM:

Yeah. Anything else you want to add today?

SL:

Nothing I can think of.

DM:

I get a copy of the press conference comments as well and we'll little supplement some of these.

SL:

Okay. Anything else you can think of?

DM:

Nothing I can think of. If anything occurs to you, you have some spare time in the morning or you just need a place to get out of the madness and check your messages, you're welcome to come in, sit at the table, I won't bother you, or whatever you need to do while you're here.

SL:

Okay. All right.

DM:

I'll go ahead and turn this off.

SL:

Very good.

End of Recording

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