

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

LISA M. REED
INTERVIEWED BY JENNIFER ROSS-NAZZAL
HOUSTON, TEXAS – 15 MAY 2015

ROSS-NAZZAL: Today is May 15, 2015. This interview with Lisa Reed is being conducted for the JSC Oral History Project in Houston, Texas. The interviewer is Jennifer Ross-Nazzal. Thanks again for taking some time this morning to meet with me. Appreciate it.

REED: You're welcome. Happy to be here.

ROSS-NAZZAL: I thought I'd ask about your educational background and your career prior to coming to JSC.

REED: My educational background varied from what you would find with most of the training folks who came into NASA. I have a graduate degree in instructional systems design. What that is it's a degree that looks at the best ways to train people in their jobs, especially adults. It's all tied to behavioral science and a lot of research into the best way that people learn. I was actually getting that degree at the University of Texas [UT] Health Science Center here in Houston. It was a program that was offered in the UT Medical School. I saw that and thought that's what I wanted to do. So after I got out of college I went straight into that program.

As far as careers prior to that, they were just part-time jobs in the summer. I worked for my parents' company. They owned a real estate company in Houston, still do all these years

later. I just worked odd jobs while I was in college until there was an internship, which I'm sure we'll talk about later, that ultimately brought me to NASA from that graduate program.

ROSS-NAZZAL: How did you find out about that internship opportunity?

REED: Actually we went through this yearlong program, and at the end of it we were supposed to choose a place to go and intern, that was our final requirement, and then we would get our degree. Most of them, being that it was in the [Texas] Medical Center at the UT Medical School or attached to that, most of the internships they had available were with medical facilities down there, different hospitals and whatnot. Throughout the year you would go and do projects. If they needed to do some training for some of their personnel, they might send you to [Memorial] Hermann Hospital or over to [Houston] Methodist or over to MD Anderson [Cancer Center]. You would work on whatever projects, and that would be part of your school graduate work.

I went in [to talk] to my adviser in the program. That would have been about August of '86 when I entered that program, and [Space Shuttle] *Challenger* [STS-51L accident] had happened in January of '86. I had always been a space buff. Throughout that year, that was still ongoing. The Rogers Commission [Presidential Commission investigating the accident] was working, and I had just been riveted by what was going on, and just felt that I really wanted to go help, I really want to go help out at NASA. I just asked him, "Hey, I've seen all these internships that you guys have to offer, but have you all ever had any at NASA?"

He said, "Well, we talked to NASA a few years back, and they weren't really interested at the time. They weren't really interested in having any interns. But, if you want to do some research and find out about that, then I'm happy to make a phone call."

So I went to the library there, started researching, and I found the NASA—over here at JSC—Human Resources Department, called them up, so inquired what all was going on there, because I wasn't in any way, shape, or form thinking astronaut training at the time. I was just thinking that would be great to go work at NASA in any kind of training department. The lady was very kind and talked to me, and she gave me a few names or departments and numbers for those departments. So I went back to my adviser and I said, "Here you go; here's some names."

It was probably two, three, four weeks. I came out of a lab, and there in my inbox was this little white piece of paper. I'll never forget it, just a few little words in his script that said, "Charlie [William C.] Brown, Astro Training." So I'm thinking—because the Astros are a baseball team—and it has a number. And I'm not making the connection, so I knock on his door and walk in and say, "What's this?"

He goes, "Well, I did call NASA, and you need to call this guy. He's in astronaut training."

I went, "What? Really?" So I was just a nervous wreck. I called, and Charlie worked for Frank [Francis E.] Hughes, who was the Division Chief of Spaceflight Training at the time. Next thing I know, I have an interview. I head down to NASA and had a summer internship lined up not too long after that. At that time I met with Charlie, who was a section head, and then met with Frank. They had some projects, and I was for lack of a better word free labor. They had some projects in the downtime after *Challenger*. So it turned out to be one of those small little things you weren't thinking much of at the time that totally changed my life, in a good way.

ROSS-NAZZAL: So what were you working on? It was interesting when I was looking at your resume, because I thought maybe you had a degree in engineering, or maybe you had a degree in education.

REED: No. It would be a degree in education, a master's in education. In the Training Division what they were doing at the time, if you recall, they were still in the downtime. So this would have been early '87 when we made this contact, because I was in the program from August of '86 to August of '87. Probably early April is when we made contact with NASA and I was invited down for an interview, along with a person who was in the program with me, because she was interested in that as well, so they said, "We could use more." She was a good friend of mine, and they said, "Come on down," and they interviewed us separately.

The projects that they gave us when we came in, again setting the stage, they were not flying [still in the downtime before return to flight after Challenger]. They were looking at all of their training flows; they were looking at how they do training, trying to look for areas to improve and areas where there might be gaps in the training, in an effort to go forward ultimately to Return to Flight. They knew that that would happen at some point in time, they just didn't know exactly when, because it was all contingent on the Rogers Commission and the recommendations and all the things that came out of that.

There were two projects that were assigned to us that [time]. One was around technology. PCs [personal computers] were a new thing then. Part of the graduate degree plan I was in looked at some of these up-and-coming technologies. Please don't laugh, but videodiscs, precursors to what we now know as DVDs and CD-ROMs and all those other things. Using pictures to help train. Another thing on the forefront that this program was doing that I was in,

and I got some training in, was computer-based training [CBT], because PCs were becoming more portable, they're smaller, not the big mainframes, not the huge contraptions that they would use to run simulators.

They wanted to look at where we might do a study or white paper, straw man, on what were the possibilities of using CBT as a training medium for future astronaut classes coming in. Then also to develop some thoughts on inserting the instructional design process into the NASA training development piece for the courses that were training for not only astronauts—because the Training Division trained flight controllers and astronauts. When they got to doing the team training with Mission Control and the astronauts during missions, we had people that would sit in the simulation control area, monitor the flight controllers. They [flight controllers] also took a lot of the classes that we offered to astronauts as part of their training flow to get familiar with the operator's view, the operator being the astronaut, so they understood what they were seeing. So we dealt a lot not only with the astronauts but with flight controller training.

The first one on CBT, I worked in conjunction with Joy Gulde, who was the girl from my program, to put together a paper on the use of this up-and-coming [technology]. We told them, "You should do a prototype of a CBT using interactive videodisc." So the computer would drive the videodisc, pull up pictures and graphics and video. That was just new stuff; you could sit somebody down in front of a PC and possibly train them. Having an instructor in the simulator or a part-task trainer, when you look at that cost per hour, that is a lot of time and money. Why not save those people's time and the simulator costs by finding a lower-cost medium to deliver the training? This is why that was so exciting to them, because these new astronaut candidate classes that would come in, if we developed these and began to use it, they could sit in front of

the PC to learn the really basic knowledge on a Shuttle system, whether it's mechanical system or electrical power or data processing.

They wanted us to not only look near term, that would have been the CBTs with the interactive videodiscs: cost things out, here's the way you might approach it, and here's what it would best be used for. The other thing that they wanted us to do was talk about the future, because at that time in our program we were getting exposed to a lot of the technology research for training that was up-and-coming. The David Sarnoff Research Center and Philips were looking at developing these CDs, compact discs, with video and pictures on them. There were already people talking about DVDs, digital video discs. They were at that time just far in the future. The thought that you can do these big videodiscs now, but think of the future, oh, my goodness, it's going to be so great. They're going to be able to compress it down, and we're going to put it on this thing that's six inches, instead of the size of a long-playing record album.

It was pretty much a think piece on where do you want to go, long term where you want to look. That took us through about three months of an internship. We find ourselves finishing up our grad degree. We graduated from the program, and Frank said, "Hey, we don't have any NASA openings here, but we would like to offer you guys a job." There was a contractor at the time that would take us on if we were interested. That's how I got my job.

ROSS-NAZZAL: That's great, you must have really impressed Frank.

REED: I guess so. I guess we did, but also I think the skills that we brought were skills that were needed. In my early time there I actually discovered that in the early Apollo Program some of the trainers, they had developed some things using this same methodology, this instructional

systems design process. It seemed to fall by the wayside at some point in time. I view this as the time when we stepped in and did that again. Frank was very forward-thinking in seeing the benefit of having some people that had those skills in there to help guide the engineers who were putting training together and also had a beat on the technology from the learning perspective that was coming out and how we might use it to push training down to the lowest-cost, but the most effective at the time.

You don't want to pull simulator training out and put it on a PC. No, that's not it. But as any program goes, and it's a government agency, [Space] Station was beginning to be an idea at that time. There was one little office in the hallway that had Space Station group already in that one office working on I guess pre [the Space Station] program being approved, the initial ideas from the Training Division.

So they knew that with two programs budgets are going to be more difficult. Budgets are hard anyway in the government. It just made sense to use a process that was more systematic in developing it, and pull out the actual objectives, help you formulate it, where you're only teaching what you need to and not a bunch of extra stuff that maybe they don't need to know.

ROSS-NAZZAL: I have to ask. You were coming at this from an educational background, but NASA is a very scientific and technological agency. JSC is very engineering-focused. How did you get your arms around—because at some point you really did—what the astronauts were going to be trained in? I know for astronaut candidate training it was general subjects like geology and different systems like you said about the Shuttle. But how did you get that knowledge? Did you go through the training that they had previously participated in? How did all that work?

REED: Early on during that internship, number one, I was just like a kid in a candy store. I was a huge space geek and had been since I was a kid. To actually be walking the halls and you go, “Oh, there goes Sally [K.] Ride. Oh, there goes John [W.] Young.” It was just mind-blowing. For those first few months I was still very much just like, “Wow, pinch me, pinch me.”

I did not know the technical aspects, but I was eager to learn. Ironically, one of the things I had wanted to do was to be an engineer when I was younger. But at the time that I was in undergrad school, the oil boom had busted at that time. Every engineer I knew was working in the oil field, and they all lost their jobs. My parents were a little bit of an influence like “you don’t want to go into engineering.” So I was thinking there were other things that I liked to do, so that’s how I chose not to go into engineering.

When I was a kid, my mom and dad got me one of those little toy desks that had the hammer and the pegboard. My dad spent all night putting it together, and I would play with it. Then one day I just got the screwdriver and took it all apart, I was about five, because I wanted to do that. I couldn’t get it back together, but I could certainly get it apart and see all the parts.

It’s a very good question because part of this instructional systems design process—which ironically came out of the US military—it was developed by [behavioral] psychologists and training or education folks at the time, because the US got into World War II very quickly if you recall, and all of a sudden we had to staff up and train all these soldiers before sending them out to war. Looking at the research at the time, that was how they developed this very systematic process of how you bring somebody along, get them there, and ship them out in the quickest way.

Part of that is you have to partner with the people that know the technical stuff. Early on, I was assigned not only crew members in the very first thing that I did, which was to develop that CBT using an interactive videodisc. They got the funding, and we were doing the prototype. We actually did two. I was assigned an astronaut representative so they could give me the astronaut perspective, a flight controller representative, and a Training Division representative. Those were my subject matter experts.

My job was not to go out and learn all these things and then try to write them. We would sit and talk. I would put together a rough plan of here are the objectives then based on what you're saying I think you want to be in this lesson. Everybody would sign off. Then we'd go the next step. Here's the storyboard of how it's going to look. They would make inputs, we would adjust it. Then we went over to the [JSC] Photo/TV Division, actually picked out the video that we wanted to use, or photographs that were going to go on the videodisc. We had to send off the actual film raw footage that we put together in Building 8 on a one-inch videotape to—I can't even remember who was doing the pressing of videodiscs at the time, but it was a 3M videodisc, and they would write the videodisc and send it back to us. We ordered 10 copies because they were stinking expensive, and we were going to develop this CBT together, so I had help.

Now one of the benefits of being an instructional designer working in a technical field, you get immersed with these people and you do learn, it if you so desire, over time. That's a long-winded answer to how did I learn the stuff. That's where it began, working with the subject matter experts, who were either astronauts, flight controllers, other instructors at the time.

ROSS-NAZZAL: I was curious about how all of that worked. In your resume you said that this was a five-year process to put all this together.

REED: The videodisc?

ROSS-NAZZAL: The computer-based training.

REED: Yes, from start to finish, so I'll pick up where we left off with the proposals. We did the analysis and presented these in our three-month internship. At that time in that internship they took us to the simulator, they took us to Mission Control, they showed us all of the things that they do, and explained their process. That was really what happened there. When we hired on with Rockwell Space Operations Company—who hired us—then I was put in Charlie Brown's group, the Section Head, who I had interviewed with, who worked under Frank. We were assigned to develop two separate interactive computer-based training lessons, because they were about to bring in another class of ASCANS [Astronaut Candidates] in 1990. About this time it would have been '88, so yes, we were going to do that and then have that ready by the time that '90 ASCAN class came in. The '87 class was already there, so it was too late to train them on this early stuff.

If they liked these prototypes then we would have more CBTs that we would convert, because they did have some computer-based training. I won't call it interactive. They were basically black-and-white page-turners on this system called a Regency System. Imagine eight-inch floppy disks, black-and-white monochrome screen, a big system, and you would pull out the eight-inch floppy disk out of the expandable file that held them all, for whatever course they told you as an astronaut come in and take. It might be auxiliary power unit [APU], so you'd pull that

one out, and hydraulics, and you would put it in the drive and start. It was literally [clicking] next, next, next. You would read what was on the screen.

I want to say there were about 25 of those lessons that had been developed early in the Shuttle Program. They were the overview or the intro training to the different systems. They also had workbooks that you could read as well, and a lot of the same material that was in those workbooks, it was really duplication of effort. Some very rudimentary hand drawings or graphics or what the piece of equipment looked like. Our charter was to develop two of these lessons. One was on the auxiliary power unit and hydraulic system, and it was an intro overview to APU and hydraulics. We would also try a little mini-scale simulation showing some malfunctions where you could have them pick from a list based on the signatures they saw, so getting a little more advanced, getting a little more fancy.

The other one was an overview of the mechanical systems on the Orbiter. Mechanical systems are the payload bay doors, the landing gear, anything that had a power drive unit that moved something. We set about working with—I'm trying to remember—on my APU and hydraulics my CB rep [Astronaut Office representative] at the time was a new astronaut, Jim [James D.] Wetherbee. He was not so new toward the end. He went on to be the Head of the [Astronaut] Office and Deputy Director of the [Johnson Space] Center. But at the time he was a new guy. He was all in, he thought it was a great idea. I had Paul Dye, who went on to be a flight director, but at the time he was a MMACS flight controller, because they're the Mechanical, Maintenance, and Consumables Officer. So I had Paul Dye and Danielle Carelock from the Training Division who was a systems instructor. The systems instructors, the mechanical system was one of the things that they covered. So I worked with those guys to put together what the lessons would look like.

At the time people really liked it because you could sit down at the smaller PC, just insert your videodisc. You'd hit go and the computer would drive and pull things off the DVD as far as pictures and video. We actually had real footage of the payload bay doors opening and closing so that you could see how that worked. We would put rudimentary graphics on there pointing to the stripes that told them to what degree the doors were open or if there was any bending in the doors. The ASCANS that came in really thought those were pretty cool at the time.

ROSS-NAZZAL: Sounds like a lot of work.

REED: It was a lot of work. At that time the hardest thing to achieve was color graphics and having the video cards. Today it's very easy, and it's all built in, but those cards were extremely expensive. Matrox card was one of ones we wanted; the Matrox Company had put it out. It was the best at the time for video. When I think back now, it was really something that they were able to do that. The technology had just not advanced to the point that it is obviously today or even 10 years later, but it got a lot easier over time.

Ultimately in that five years we built those three lessons: the mechanical, the APU, and then that little malfunction scenario of the APU so you could see some of the signatures and begin to introduce the astronauts to that [system]. Then all of those Regency System black-and-white page-turners we had converted. That's what took over five years. We worked with a company out of Colorado Springs. I believe it was called Infotech. They got the contract. There was an RFP [request for proposal] released and they won the contract, and they worked with us to actually develop those in a PC format over time. That took me to the early '90s.

ROSS-NAZZAL: That's a lot of your time, working on those. I guess people don't realize. Nowadays you can just pull anything up on YouTube, it's so easy. The challenges of putting all that together, I'm guessing you worked with graphics and you mentioned Building 8 for instance.

REED: With the Rockwell Space Ops [Operations] contract, all these contracts at the time were bundled or there were teams. So I think the company was called Unisys which handled graphics design and videos and photographs. Being on that Rockwell team and that being part of their contract charter, they worked to manage some of that and get some of the things we needed.

What was missing was the people who knew how to program that stuff at the time that used authoring languages for computer-based [training]. Authoring languages were pretty new at the time. Today we've got things like Adobe Studio and it's so much easier. This still is a lot of coding, but a little bit simpler than if you're in C or BASIC or FORTRAN. These authoring systems were a little bit more user-friendly and didn't have so much hardcoding. But it still was very much programming.

ROSS-NAZZAL: Were you looking forward to taking lessons from the Single System Trainer [SST] and the Shuttle Mission Simulator [SMS]?

REED: At the time I didn't know that that was even going to be offered to me. At the time I would have loved to have done it. I think the environment and changes that happened in the space program is what led me to being able to do that. Because I'd been working with technical experts—and predominantly a lot of the stuff was around the systems area, but we worked in

other areas too—I had become pretty versant in a low-level understanding of all of those things from the systems level.

I don't really recall why it happened, but there was a large amount of attrition happening out of the instructor ranks in general; people were leaving. That could have been just because there's a natural ebb and flow. I won't say it was a hard life, but you're on call, and you don't get to spend a whole lot of time with your family when you're either on console or this or that. People would choose to leave.

We got to a critical mass point at a certain point in time where they were looking down the road and saying, "We might not have enough instructors to cover the teams for the Shuttle flights that are coming." Just doing the demand planning, if you will, of how many resources they needed and looking down the road. Rockwell Space Operations Company supplied instructors, there were NASA instructors and team leads too, but it was badgeless almost once you got in the simulator, because you all held a role. You would have a mix of Rockwell instructors and NASA instructors on the team. There would be a team lead that at the time was always a NASA team lead. So it was a NASA civil servant.

My Rockwell bosses came to me one day and said, "Hey, would you be interested in being an instructor?"

I said, "Oh, absolutely."

They said, "Well, you're not an engineer, and just about all of them are engineers or mathematicians or physicists, but we have a shortage. The only thing is you have to go through all of the training, we're not cutting any corners for you, you got to pass all of the evaluations, take all of the training, go through the flow. Then you'll be evaluated just the same as everyone else, and you have to get certified."

I said, "I'm game if you guys are up for it," and they said yes. So I got assigned to the Systems Section because I had the most experience in that area with some of the trainings that I had done, the development of the CBTs and different training materials. Once we got those done we were also helping them develop workbooks or revamp workbooks. People came and said, "Oh, we need to update this workbook," or, "Something on the Orbiter changed, so we got to update it because the information is no longer [valid]." They would usually assign me to work with them to help do it. By that time the first Return to Flight was in September of '88, and the tempo began to pick up, and everybody was busy, so that's what we did.

ROSS-NAZZAL: How long did it take you to become certified as an instructor?

REED: They had guidelines when they would hand you what they called a blue book at the time. It was a binder, it was blue, and it had your training flow in it. Think of it like your college catalog. To get this degree these are the things you got to do. So for systems instructor it was just all of those things that systems instructors had to do.

There were I want to say a couple hundred different either classes, observations, or self-study type things, workbooks that you would have to do. They didn't let you just go from you get certified and then you can teach anybody. It was a stairstep fashion or incremental. Most of the courses that the training instructors taught in the Training Division to astronauts or mission controllers consisted of in their discipline the system operations, so that meant how it operated normally and the systems mal [malfunction] class. You would have an APU/hydraulic operations class, APU/hydraulic mal class. You'd have an EPS [electrical power system] ops class, EPS mal.

You would get certified to teach ops [first]. Then you couldn't get certified for mal until you passed the certification for ops. To be in the Shuttle Mission Simulator where you were then eligible to be able to be assigned to a crew and work in the simulator training an actual mission, in the case of systems there were five different systems. There was mechanical systems, auxiliary power units/hydraulics, caution and warning, electrical power system, and the environmental control and life support system [ECLSS]. You needed to be ops- and mal-certified in two systems. You had to have EPS ops and ECLSS ops at least before you went over to the simulator for a cert [certification] run. Then you had to go through a cert run there to do an orbit run. Then you had to do a cert run to do an ascent or entry run. There were several wickets that you had to jump through where you were being certified by the senior instructors, more senior people. There were certified evaluators who had reached a certain level. They were the very senior members of whatever group discipline. They were the evaluators.

Maybe you had 10 classes you needed to take before you could try an APU ops Single System Trainer class and try practice-teaching it. You'd do certain practice-teaches. They would give you feedback. They would oftentimes say, "I think you're ready to go for a certification run, so make your next one a cert run." Then they'd give you feedback each time on what to work on, what to go study up on. It wasn't ever a "Let me tell you what the answer is." They made you go look it up, and you had to go study. They would help you but they knew if they told you the answer that wasn't going to help you.

ROSS-NAZZAL: Were you working at all with the systems engineers or was it just with the training folks?

REED: At the time we were in Building 4. There was no 4 North and South. It was just Building 4. It had three floors. On the bottom floor were the flight controllers, on the second floor were the training folks, and on the third floor were the astronauts. So we spent a lot of time down with the flight controllers because they knew the ins and outs of the system. They knew how to break it down and all the parts. They knew the sensors and the motors and how they worked and how they were telemetered, so what could you see and what could you not see on the screens in Mission Control, and what could you see and what could you not see on the displays in the Shuttle cockpit.

So we spent a lot of time [visiting them]. You literally could just walk downstairs, go into the office where the MMACS guys sat or where the EECOMs [Electrical, Environmental and Consumables Manager] sat, and say, “Hey, I got a question. You got a minute? Explain this to me because I really don’t understand it.”

Or, “How might this fail?” when you got into the mal classes. “Explain to me how this fails and why you get this signature.” You had to do your homework, but if you got lost, it was very open. People wanted to help each other, because it was in everyone’s best interest to share that. That’s how you get guided. If you think of them literally being up one floor and down one floor, it was very easy to just walk downstairs and go, “Well, darn it.” You’re sitting there studying some drawing, and you’re tracing the path, and you’re seeing where these sensors are, but you can see that, “Okay, this display when I was in the Single System Trainer did this. Why did it do that? I just can’t figure it out.”

They would point out, “Actually it was some little idiosyncrasy when they designed the Shuttle, and that’s why it happens that way.”

You’re like, “Oh, okay.”

They were in very close proximity. A lot of those friendships and a lot of those relationships developed, and I know this is the same way for a lot of my friends. We were just all together for a long time in that one little building moving toward this one big goal of these Shuttle flights. It didn't mean that you didn't go out[side] or maybe they sent you and said, "You know what, I don't know, but go over to the Engineering Directorate and talk to this person." Or they would just pick up the phone and put you on speakerphone. "We're talking about that."

"Oh, come on over. I've got one of these models sitting on my desk and I'll show it to you." One of the things we didn't have a lot of here was the hardware. You're working off drawings and trying to understand, and photos. The hardware was at KSC [NASA Kennedy Space Center, Florida].

ROSS-NAZZAL: I would think that they would have something that you could look at.

REED: We had some. Don't get me wrong. There were some things, but sometimes you might not have that little sensor in the location where it was where you could see why it was causing this or that. [Like] my first time down [to KSC] years later walking in an Orbiter. So many things made [sense]; it's that picture is worth a thousand words, but the real stuff is worth a million. Walked in there, and so many things became just apparent to me when they suited me up and walked me in an Orbiter for the first time. All the panels were off and you could see where everything was. You realize, "Gosh, that's really close, that's why that darn thing overheats all the time, because it's sitting right there by that really hot display unit that stays

heated up, so it's always giving false readings because it's always overheating, because it sits right there."

ROSS-NAZZAL: When did you get certified? Do you remember?

REED: My first class, yes, I do, because it was such a big event. My first one was APU operations. I probably ought to throw in, I didn't answer the first question, but there's a big list of things you got to go do, read a lot of workbooks and get passing familiarization with the whole Shuttle, all of its systems and what they do. You read a lot of workbooks and you have to take all of the ops and mal classes from the other instructors so they teach you.

For ops I had taken all those ops classes, the generic stuff, gone to the generic training, read all my workbooks, and I was ready to go into the cert flow for my first SST class, and that was APU operations. So that would have been 1990 I think. I don't have it with me, I can look that up, but it would have been probably about late '89, early '90.

By that time the '90 class was there, and so that was prime opportunity for practicing, because they all have to take the same classes. They're coming in, and they're learning about the Shuttle systems. There were a lot of opportunities to teach APU ops because everyone had to learn it in that ASCAN class.

They put me in the [APU Ops training] flow. I read all my stuff [training materials], practiced on my own. You would get instructor certification time where you'd go in by yourself in the Single System Trainer. First few times you have an instructor come in and teach you how to use it, how do you set it up so that it looks like the APU operations class, how do you put the

flight data file in the right areas where it would be located, what is the appropriate flight data file procedures that you need to pull to put in here.

Then your lesson plan, and they were standard. Here's the things that you must teach in APU operations. You'd get familiar with that and you would go in and practice it. The other thing you had to do was learn to set all the switches in the appropriate position for the flight phase. For example, when you're going in to teach an operations class, you're teaching them in compressed time every phase of the flight: prelaunch, ascent, post-insertion, orbit, deorbit prep, and entry, and then postlanding.

You're going through all of that in one class, but only for that one system. Just familiarize them with what are the procedures they're going to be seeing normally, how you operate this one system. So you'd go in and you would practice that with an instructor, and then you'd go in and you'd practice on your own, get your spiel down, because you had to do a lot of talking, because you were the instructor. Sometimes you would bring other instructors in. "Let me practice on you," because they would be going through the same thing as you. "[You] scratch my back, and I'll scratch yours" and get feedback. Then you'd go to your senior instructor and say, "I'm ready for a practice run on a real student, real astronaut." That was the thing. You had to pass muster.

I signed up for a couple in the '90 class. I did my two practice-teaches. Danielle Carelock, who was one of my senior instructors at the time, she said, "I think you did real well on the second one. The next one needs to be a cert run, go for that." I'll never forget it. I had two astronaut candidates come in for that one. It happened to be Susan [J.] Helms and Eileen [M.] Collins from the '90 class. They were just great. I taught them the class, they asked a lot of really hard questions. That's when I realized how sharp they really were.

At the end of it they leave, they've gotten their class. The instructor is back there. If you make a mistake in the class, they're going to correct you, because we don't want to teach them wrong. We made it through the class, and then you stay behind. The instructor debriefs you and then says okay, I'm ready. Then they actually have to sign on a piece of paper showing all of the steps that you've done where each time had been initialed, and you had initialed, and then they sign it.

Then you're certified, and from then on the scheduler can put you on the schedule for APU ops. Then the next one I got was APU mal. I began to work on I think EPS after that. You just begin to accumulate them, and you go through the same process for each one of those. You had to have five, like I said, before you went over to try a cert run in the Shuttle Mission Simulator. Five of those certifications under your belt before you could go there in single systems.

ROSS-NAZZAL: You had to be pretty knowledgeable about the Shuttle itself. Wow, that's a lot of work. It's almost like you went and got another engineering degree.

REED: When I look back on it, quite frankly I was having a blast. There were moments where I was terrified, because you have performance anxiety. Sometimes you're like, "Ah, am I able to do this?" But for the most part, I was just having such a good time. I was so eager to learn. Every time a student asks you something, one of the big things they—and when I refer to students, the astronauts mostly—one of the best pieces of advice was don't you ever wing it. If you don't know it, you say you don't know it and that you'll get back to them. They had these things called crew questions. You'd have to take them down if you didn't know it, and then

you'd have to research it and get back to that crew member in a certain amount of time with an answer.

It would be reviewed by your senior [instructor] and make sure it's all [correct]. So I think the best advice ever given to me was really they don't expect you to know everything, and if you don't know, don't wing it. So I stuck to that, and it proved very valuable across my career, and I learned a whole lot.

ROSS-NAZZAL: I'm sure you did, researching all that.

REED: Yes, it was a lot like getting another degree.

ROSS-NAZZAL: What were your hours like at that point when you were trying to get certified?

REED: At the time we were flying, and the simulator runs round the clock. The SSTs could be scheduled from 7:00 [a.m.] to 7:00 [p.m.], or if there was a special case they might call and say, "This crew member is only available based on training schedules or their travel or whatever, they're only available at 6:00 a.m. Can you come in?" They were truly all over the map.

At the time I didn't care. I was having a blast. I spent all my time with these people when I was away from work anyway. We were either playing softball at the Gilruth [Center] or we were going to parties on the weekend or out to eat or movies or concerts. You just moved in a pack, a really smart and fun pack. We had a lot of fun.

ROSS-NAZZAL: You weren't married at the time?

REED: I was not married. Dated lots of folks, and they did. But it was really funny, I think one of the coolest things about when I came, at least for me, and I don't know what it was like pre-*Challenger*, was in the downtime NASA had hired a lot of young people right out of college—so anywhere from 22 to 25, and I was on the higher end of that, I was 25—NASA and their contractors, because they had positions open in preparation for Return to Flight.

If you think about it also at the time a lot of the folks who were still in the program were former Apollo folks, and they had transitioned into Shuttle. They were getting on up where they were becoming the managers. They were really looking to hire more folks. I came in at a time where there were a lot of people my age, and we were all learning our system and learning about this Shuttle thing. Everybody was just totally psyched about being there. It was fun and it was exciting to be part of.

ROSS-NAZZAL: Were there a lot of women in training at that point? I'm curious about that.

REED: I have a funny story about that. The day that I came down to interview with Frank and Charlie, I get my temporary badge at the front gate, I find my way back to Building 4, and they meet me, and they walk me up the stairs to the second floor, and I'm going down the hall. All I see are men, and I remember thinking, "Oh my God, what am I doing?" For whatever reason that day I didn't see any other women.

At the time it was this typical government building, so the doors were shut. They were all doors, and you'd have four, five, six people in an office, and the desks all round. But the

doors were shut. So I was only seeing the people who were in the hall, and they were men, and that struck me.

I was very happy when I got there, and I actually felt that it was very integrated with women in the training and the flight control area. Not just all -men. The astronaut corps by that time, they were getting more and more [women]. There was probably less when I first came in. You had your original six [female astronauts], and then you got—gosh, in '87 you got two or three more I think. Then in '90 you got about four or five. It just kept getting bigger. But anyway, I saw a good representation of women, and I saw a good representation of really strong smart women.

Some of the ones who had come up even before us in Apollo, it's like, "Wow, that's Michele Brekke. Oh, that's so-and-so." You'd heard about them, they were the ones that came in and were able to sit in Mission Control. It was very cool. I never felt like women are discriminated against here. I really never did, just never had that thought, because I had plenty of women that worked around me and also had plenty of men. I saw women leading teams over at the SMS, and all men instructors, or a mix.

The crews at that time were the same way, you had women on the crews and you had men on the crews. The women were doing the same things as the men. Except for flying, and with '90 class Eileen [Collins] was the first pilot candidate who was a woman, and that was very exciting to see.

ROSS-NAZZAL: You ended up working with her.

REED: I know. It's ironic how that all came about. But yes, it was very exciting. Exciting time.

ROSS-NAZZAL: Tell me about how Shuttle training worked. You finally got certified, you're an instructor, so how does all that work? You worked on the Single System Trainer. But then also talk about working in the SMS and being assigned to an actual crew.

REED: To give you an overview, there were two types of training that you did. There was what we call generic training. That was for people who weren't assigned to a flight yet, to either train them in preparation of getting assigned to a flight, and this would be flight controllers—because flight controllers are going through their own certifications, and the crew members, it was a different process for them at the time. It got more formalized later, similar to ours. The flight controllers were having to go through their certifications as well and work their way from the back room to the front room and get orbit-certified. Same thing. It was very stairstep for the ops support people.

Generic [training] wasn't tied to a mission. That training was ongoing, because if you think about it, there was always people to be trained, or if they had had a flight and come back it was to also maintain proficiency. It was keeping people sharp when they weren't assigned to a flight, because you don't want to have to go back and train everybody from square one again. The best way to do that is to have periodic simulations and periodic SST classes or refreshers. That was one type of training.

The other type of training would be the flight-specific, which was for a particular mission, STS-1, STS-25, STS whatever on through. If you were certified, you were up. They could assign you to any of that. If you were an instructor who was not assigned to a mission, or maybe you were assigned but you were four flights out so they weren't doing any flight-specific

training [yet], you would see a lot of generic training and refresher or proficiency classes pop up on your schedule of things to train.

Maybe a crew member requested, “Hey, I’ve got this generic sim [simulation] coming up, but I want a refresher on APU/hydraulics; I want a refresher on EPS.” They would request a class and it would come down and then you’d get assigned to it. The same with the simulations.

For simulations, they had SMS teams. Team one, two, three, four, five, six, I think we even got up to seven at one time. But that would consist of a training team lead, and a DPS [Data Processing Systems], a communications, a systems, and a control prop [propulsion] instructor, so basic five-person team. Those teams, you were assigned to one once you got SMS-certified. Lisa, you’re team four, or you’re team five, you’re team six, you’re the systems person on that team.

If that team got assigned to a generic simulation, then you worked - the sim. Your week might go [like this], you’d have three or four generic sims, and you could have any number of SMS classes. The other thing is if there was an ASCAN class going [through ASCAN training] at the time, you might have to give a briefing on a system, because they would bring them in and do actual classroom briefings, two-hour briefings. “Today we’re going to teach you about the auxiliary power system, or today we’re going to talk to you about control and propulsion”. If you were certified in that area then they’d say, “You’re going to go teach this to the ASCAN class.” They usually had a couple of instructors for each ASCAN class so they just didn’t get totally overwhelmed. That was generic [training].

Once your crew was entering their flight-specific training, then if you were that assigned team to that crew. They [training division management] would assign one SMS team to a mission. Once you were assigned to that [mission], your generic training really scaled way

down, because then you had to learn about the mission; you had to become familiar with the flight plan. What were the little subtle differences that might be different from what you would normally teach them? Then your crew began to come through [their flight-specific training flow]. You would have briefings with your crew. You would attend briefings with them on various things about the flight so you can learn more. Also at that time, your crew had a particular Shuttle [vehicle or Orbiter]. The Shuttles were all basically the same but there were some subtle differences [between them]. So then you'd have to make sure, "okay, we're on *Discovery* for this flight," that you knew your system and its idiosyncrasies [on that Orbiter] based on previous flights, what you learned, or just what you knew in how it was built and that it was different [from the others].

You would train your crew. You were the only person they would see [for your particular system's training] once they were assigned. Any "systems" thing, they had to see me, unless I was sick, and you'd have a backup that you trusted. For the most part, it's to build that camaraderie, that trust. Also so you could follow them through the whole process and know what they knew, know what they needed to learn more about, and then you could exercise that with them over time to get them prepared.

Then after they went through all of their initial single system trainers and briefings and some of the Building 9 mock-ups—there was classes in there too—sometimes you would attend those. We didn't necessarily teach those, but sometimes we would attend them at the request of the instructors, because we might know things that they didn't know, about that mission.

Then you move over to the SMS. Once you started the SMS training, that really never stopped once you hit the flight-specific [training] until they flew. So you might be doing two to three sims a week, and then it would get to be where you were simming almost every day or four

days a week. The way it worked as far as hours, the SMS ran 24 hours [a day]. There were three shifts. For a while, the third shift was really reserved for the programmers who would come in and program the [simulator] models and fix things that were not working right [in the software or hardware]. We would write up if we saw software funny that was not making things work right, or the hardware was broken and they needed to fix it. But sometimes you could get one of those [third] shifts [for training sessions], if it just worked out there were so many people training. The way they prioritized who got the good hours was prime crew [next mission to launch] got the first option, first dibs. Next to prime, so the second in line, got the next, and so on and so forth. Then all the generic stuff came after.

When you were doing generics you were working a lot of nights, a lot of late afternoon [sessions]. You might go on the sim anywhere from 3:00 [pm] after, but most of them were from 5:00 to 9:00 [pm] or 8:00 [pm] to 12:00[am] because they were four-hour sims. Then you'd get off and you'd go home. You were happy when you became prime crew because you knew that while you were going to be up early, you weren't going to necessarily be staying late.

ROSS-NAZZAL: Oh my goodness. Did you have a family then as you were working those good hours?

REED: No. I never married. So I didn't. My immediate family like mom, dad, and sister and brother were here in Houston but on the other side of town. No family. Had a dog named TDRSS [Tracking and Data Relay Satellite System].

Other than that, that's how it went. You trained them until they flew. About six weeks, maybe eight weeks—it would also depend on how critical the mission was or things they wanted

to train—those sims would begin to be integrated simulations where the Mission Control Center [team] would be there. You'd have a full team of instructors in the sim control area of Mission Control who had written the scripts of the malfunctions or how the whole scenario would go for that day. The flight director and his or her whole team would be there, the crew in the simulator, and all of us down the hall in the instructor station.

We would be the ones generating the malfunctions or adjusting the numbers so that it would reflect on the [consoles]; the flight controllers would see what we wanted them to see on their displays. Failing things, and letting the team work through it. So we really took a backseat when we got into those flight-specific integrated sims. We had prepared our crew up to that point and then it was up to the flight control team and the crew to then begin to jell, and communicate, and learn how they were going to work through things. But we were still there through all that.

Prior to [integrated sims with the MCC] we [simulator instructors] played the role of Mission Control and all the voices you hear on the loops. When we'd practice prelaunch, if it was an ascent sim you would do one T-minus nine so they'd go through all the APU startup and cabin checks. Then after that you'd do T-minus two [training scripts] so you wouldn't have to go through all that again [from T-9]. But they would practice all those procedures. If it was an orbit sim you would practice their flight plan but also throw in things [malfunctions] for them to work. If it was a deorbit sim or entry you would do one deorbit burn, per session this is, and then you would do a 400K, and then after that you'd do 200Ks, which are really quick down to the ground, so they were just practicing the [last few minutes before] landings. It's a very very very dynamic time of flight. That's what we did over and over and over, but they were always different [scenarios].

You were always looking at what do they need to learn, and the team lead would take you as a team, and you would begin to script the flight-specific runs. “We’re going to do one deorbit burn, we’re going to do 400K, then we’re going to do the rest, 200K, so we need to script five runs today for the sim. We got four hours.” We’d sit there and they’d have big whiteboards that had a printer, so we would script it out as a team how it was going to go.

It was usually around, “I really want to exercise John on this today because last time he seemed a little rusty on that,” or, “We know that this is a different thing on this flight, so we really want to exercise this particular malfunction.” You’d [the instructor team] work together and play off [help with each other’s scenarios]. For example, the systems electrical power affects everybody.

The DPS instructor may say, “I really need this MDM, this multiplexer/demultiplexer, to go down hard, so it takes away this from them, can you kill a bus for me, an electrical bus?”

“Well, which one do you want?” Then you got to bargain with the control guy.

“Well, that’s going to take my engine down.”

“Well, that might be a good case, we’ll do that.”

Then he goes, “No, you can’t do that because I’ve already done that, that’d be too many things.” It was a negotiation. You just script out how it was going to run and then you would go run it.

ROSS-NAZZAL: How long did that process take, coming up with those scripts?

REED: The scripting meetings were usually two hours long. You would go in. You’d get your schedule for the next week. They would come out the Thursday before. You’d get a preliminary

on Tuesday, a preliminary look, but that meant it could change. Thursday afternoon you knew what was coming the next week, so you would go in and start scripting. The team lead would be responsible for scheduling the scripting meetings. What would happen is you would write the entire script on the whiteboard at the end you'd hit print. Then there was an actual electronic scripting tool. It was pretty archaic by today's standard, but you then would go and put it [the script from the whiteboard printout] in there, and then they'd print out a really nice copy of how it [the simulator session] was going to run.

ROSS-NAZZAL: What was the first mission that you [were] not the lead, but—

REED: As a fully certified systems instructor I guess, or SMS-certified systems instructor. That would be STS-47. Hoot [Robert L.] Gibson was the commander. Curt [Curtis L.] Brown was the pilot. It had three firsts on it. It had the first married couple in space, [N.] Jan Davis and Mark [C.] Lee, first black woman, Mae [C.] Jemison, and the first Japanese [astronaut], Mamoru Mohri.

I don't care how much you prepare, it was still scary. But I was so eager, and that crew was so fun. We just had a blast. I learned a lot on that and I made some mistakes. You do. You learn. At the time you make them early on in your career, you're mortified. But they'd been around the block enough, and so have all your other teammates usually [to help you out]. You get a good amount of ribbing and a lot of playfulness, but all in all everybody's pulling for you. That one was fun, and by the time they flew I felt pretty comfortable [as an SMS instructor]. But those first few sims, trying to teach them stuff [were tough]. Oh, and Jay [Jerome] Apt was the MS2 [Mission Specialist-2]. I forgot about Jay.

ROSS-NAZZAL: That's an interesting first flight, because that was a Spacelab mission too.

REED: It was a Spacelab.

ROSS-NAZZAL: How did you manage that? Because they were obviously at Marshall [Space Flight Center, Huntsville, Alabama] doing some work on Spacelab. Did you have to know about Spacelab systems?

REED: At that time we had a Spacelab simulator and there were Spacelab instructors. So the Spacelab instructors and the systems instructors did have to have some overlap in what they did because the Spacelab was powered by the Shuttle power. So we had to understand a little bit how each other's system worked. They were trained by another set of instructors who sat just down the hall from us just outside the Spacelab simulator. So when we did flight-specific sims for those guys, you might have Hoot, Jay, Curt, and Mark in the flight deck, and you might have Jan and Mamoru and Mae over in the Spacelab simulator, all of those connected by headsets and us listening in to all of them. I would have a Spacelab instructor sitting beside me [for some sims].

Now if it was just an ascent sim, then the Spacelab instructor wouldn't be in there. That was another thing. When you got into the orbit flight-specific simulations, depending on what that flight was, you would bring in what we would call the specialty instructors. Spacelab instructors would qualify as that. Docking instructors would qualify as that later when we had the docking system. Rendezvous instructors, PDRS [Payloads Deploy and Retrieval Console],

or the robot arm instructors. I'm trying to think who else. I know I'm probably forgetting somebody—EVA [Extravehicular Activity] instructors, that was another one—[who] weren't there for all of the sims, and they weren't necessarily part of the core team. We would get those assigned [based on the objectives of the mission]. The team lead would get those folks assigned, and they would be the one for that mission too. They would pick one and say this is the EVA instructor, this is the rendezvous instructor.

When you had those flight-specific orbit sims, because some of the sims would be dedicated to rendezvous, well, you knew the rendezvous guy was going to be there. Later when we did Shuttle-Mir there was the docking system. So if rendezvous was there, you had docking, and so on and so forth. So sometimes you'd have only five people, the team lead and four instructors. Sometimes you'd walk in and go, "There's a sea of people here," because it would get really crowded for the orbit sims.

ROSS-NAZZAL: Would the commander ever weigh in on scripts and say, "Boy, I really feel the crew was weak on this," or "This is something I really want us to focus on"?

REED: None of them were ever shy about expressing their opinions. This went pretty much across the board for all of the astronauts once they were not rookies. Rookies tended to be like, "I'm not going to rock the boat here, I've got a flight and I'm happy." As they got older they would. At the end of each of those runs we would do a debrief with the crew, because it took about 10 to 15 minutes to reset the software to do another run. So it was a perfect time. We're on headsets down there and they're in the cockpit of the simulator or in the Spacelab or in the fixed-base.

You could talk to them and say, “Okay, let’s review that run.” When I first got there it was the instructors would chime in a lot and the crew would add to it. “Okay, we went through that procedure and noticed that you seemed a little confused about that signature.” Then the crew would chime in. It was really more of a roundtable discussion.

In the mid ’90s, however, we changed our approach to implement more of what’s known as cockpit resource management in the aviation industry, and we called it spaceflight resource management. All it is is just about how well is the crew communicating [and working together]. That was always the intent when we were training before, but it became a little bit more formalized in the training flow. We’d say, “Okay, let’s debrief,” and the crew would then start us off, and we [the instructor’s] would fill in the blanks.

It was always an open conversation back and forth. We all took notes during the run if there was something we wanted to bring up in the debrief and point out. For the most part that’s how it went. Now there were occasions. So that’s where the commander could weigh in. As I became a team lead I did have a couple who would come to me and say, “Okay, I’m worried about how that went today. What were your thoughts? Because here’s what I saw.” We would sit and talk and the rest of the crew may not know. “Okay, well, then I’ll make sure that we hit a little harder on this next time and make sure we add some more cases with that.” So they did have input in that way and I would assume that other team leads had similar discussions.

Sometimes it was in private, one on one with the team lead, but most of the time they were all pretty open, because if you think about it, that’s the time where you’re teaching them to communicate well. So maybe if it’s something that the commander doesn’t want to say to them, because in some cases I know they don’t want to make the person feel they don’t have confidence in them [the commander would speak to the team lead privately]. A lot of times it

wasn't that they didn't have confidence in them, but just, "Something's not right here; what's your read, because you do this all the time. I get assigned to one flight every few years. What do you think?"

"No, that bothered me too," or, "Yes, I think we could work on that a little bit better," especially with rookies. They want to teach them, and there's a lot of teaching going on between them. Because they've [the commander has] flown. This isn't exactly right here because the simulator is only as good as it can be in one G [force of gravity].

They'll say, "Gosh, one thing you've got to remember here is that book is going to be floating at the end of the tether." We can't simulate that [micro]gravity thing in the simulator. So there was a lot of teaching that went on in that way for the rookies on the flight by the flown crew members. So there was a little bit of them talking. Mostly in the debriefs, but if they had some concern, it was not uncommon for them to come sit at your desk or call you on the phone or call you up there when everybody was gone to other training.

ROSS-NAZZAL: What was your first mission as a team lead instructor?

REED: STS-93.

ROSS-NAZZAL: Oh, Eileen's flight.

REED: Yes.

ROSS-NAZZAL: Want to talk about that? That was a pretty notable flight.

REED: Yes, it was, and it's pretty interesting because I had trained several crews in the SMS prior to that. Then I became a specialty—you never lose your certification also as a systems instructor. But then I became a docking instructor after STS-71, got certified in that. So I was a specialty instructor for docking.

Because of that, I had trained a lot of the Russian crews, and I'd taken Russian language training. At the time we were beginning to [train astronauts to] fly [Shuttle ISS build missions] and they were beginning to send people to Star City [Russia]. They asked me to do a tour of duty as—I can't even remember the title. They would send a training person over there to observe and manage the training over there, not the Russian training, but be the American rep as the training ops person.

They had asked me to do that. Now I had actually left NASA for a while because I got burned out doing the docking training because a lot of folks left, and it got down to me being the only docking instructor. So at the time we had several flights in training at a time in various stages of their training. I was literally working round the clock, because we would try to schedule the integrated sims with Russia, the joint integrated sims. Between the time zone difference, it happened that we were coming in for those sims at midnight, they would start at 1:00 [am], because you'd come in an hour before to set up and do all the comm [communication] checks. That would be a 12-hour sim. So then you debrief, you might get out at 1:00 or 2:00 [pm] the next day.

All these other Shuttle-Mir flights needed training on the docking system, from the early training briefings, payload trainer class, which was their part-task trainer, the early sims where

they were just doing the generic sim or the early flight-specific but not integrated with Mission Control. So I could literally be working round the clock. I would go catch winks when I could.

I kept saying, “We got to get somebody,” but they just didn’t have anybody to train [as docking instructor]. At the time they didn’t have a body to release. So they had asked me to go over there, and I left, because number one, I wanted to be a team lead, and I’d done all the stuff, but none of the team leads were moving away [to leave an open team lead slot]. I just didn’t see any upward mobility. So I left and I went and took another job working for Lockheed Martin.

[About 6 months later] I got a phone call because the guy I handed over to for docking system that they told, “You got to do it because we got nobody else,” he left. They called me back and said, “Would you come?” The whole reason I’m telling you this is about the Eileen 93 story. So when I came back, my first thing is, “I’ll come back, but you got to let me train people. You’ve got to find some other instructors. Because what if I get hit by a bus?”

ROSS-NAZZAL: Single-point of failure.

REED: I’m a single-point failure, exactly, that’s what I told them. “I’m a single-point failure. I could walk out and get hit by a bus. Not that I plan on it. But what happens?”

They said, “Okay, okay.”

I said, “Basically these are the terms of my return,” because I missed it [Shuttle training] terribly. I knew it was a horrible mistake when I left. I went, “Oh my God, what have I done?” Literally I was sitting there that day in my new office at Lockheed Martin, and I just thought I’m going to have to go in and tell them I can’t stay, and the phone rang. It was Hiram Baxter from

over in Building 4 South at the time. He said, “Hey, would you consider coming back as a docking instructor?”

I remember going, “Well.” Then it’s like yes! I just put the phone down. That’s when I said, “We’ll have to do some things differently [i.e. need to get more docking instructors trained to distribute the docking instructor load].”

Bottom line, I came back, but right when I came back they said, “Well, I got some people trained up [to be docking instructors. Do you want to go work in Russia? Or you’ve gone through the team lead flow.” That was another condition. I want to get certified as a team lead so that when a spot opens up [I’m an eligible candidate]. “Or you can train [be a team lead in the simulator], go do that. Train STS-93, and the commander is going to be Eileen Collins.” So hands down, I didn’t go to Russia.

I had come to know her over the years and had trained her in the docking system on STS-84, and I just thought I can’t imagine a better flight. It wasn’t so much that it was the first, it was just I just adored Eileen. She is such a fine person and such a nice lady and a good pilot. I thought it would be so wonderful to work with her, because I had enjoyed it all this time. So that was my first team lead flight.

She and I got together and the crew was named and I even felt even better about it because at that time I really wanted to train a Shuttle flight that was not a Station flight at the time, because that was all that was coming [in the flight manifest]. This was one of the few [non-ISS build missions]. It was deploying a satellite. I thought this is great, because I knew I was going to get an opportunity to train a Station flight [in the future]. It was just all right in my sweet spot. I get to train one [Shuttle deploy] flight. This is what I want.

So I got Eileen, we're deploying Chandra X-ray Observatory, and once I saw who else was on the crew I thought this is going to be really fun. They assigned me a team of instructors, many of whom I knew pretty well, some I didn't know that well, because I'd gotten older, and there were newer instructors in there. But I had a team of all men.

ROSS-NAZZAL: That's interesting.

REED: Just the way it played out because that's not how they chose it, but it was just funny. It was me and four guys. To this day that's probably one of my most memorable flight experiences because the training team jelled really well. We're still friends to this day, still stay in touch. The crew jelled well, and then the crew and the training team really jelled well. I don't know, I can talk specifics of the flights, but that one was just very fun from that perspective.

It also turned out to be challenging because that was on *Columbia* and a lot of the other Orbiters were fitted with the docking system by this point in time. *Columbia* was the only one that was not. It was big enough to fit Chandra, which took up that whole darn payload bay just about. It was huge, but it offered some challenges in the flying perspective, should there be problems. So it made for some very good malfunction simulator scripts to train this crew and the flight controllers. Because Chandra was so large, if the crew was going to have to do a return to launch site abort, which we never did in the entire program, which was very good, but it was going to mean they were going to have to try to land that thing with that extra weight and offset of the CG [center of gravity].

So it offered for the contingency procedures instructor, who trained all the really bad abort cases, some really good training cases and good flying cases for Eileen and the crew and

the flight control team once we got into the flight-specific. Because there was some concern and there were more what they call black zones, which basically meant in the ascent profile going uphill if you have to do a contingency abort, which is one where you're most likely not going to land on a runway or highly unlikely. There are contingency abort sites, but it's going to be probably the most difficult of aborts to make.

The black zones would be the areas where it's most likely you're not going to survive. So there's more opportunities of that, simply because Chandra was so big. So it made the flight control team and the flight planners, the trajectory officers, work a little harder to come up with that profile. Then it came to the training team to prepare the crew for flying some of those sims. Henry [A.] Lampazzi, who was my former team lead on STS-60 and 71, ended up being the ascent procedures, which is the contingency [abort] instructor on 93. So I got to work with him again, this time me being the team lead and him being the specialty instructor. He trained the crew really well, working in conjunction with Al [Alastair] Park, who was our control prop instructor. That was the memorable thing there. Then just the personalities and the crew. We had a lot of fun.

ROSS-NAZZAL: Steve [Steven A.] Hawley was on that crew?

REED: Steve Hawley was on there, Dr. Stevie as we all know him. Or GPC-6 [General Purpose Computer¹].

ROSS-NAZZAL: GPC-6? I don't think I've heard that.

¹ There were five General Purpose Computers on the Shuttles. Dr. Steve Hawley was known as the GPC number 6.

REED: The man had such knowledge and was so smart. He just knew things. He forgot more than we ever knew about a lot of those things. He was in the program from early on, as you know, in the class of '78. Just has a wicked wicked dry sense of humor and kept us rolling [laughing] all the time.

I really enjoyed working with him. That was my first opportunity. Of course I knew who he was. By the time I was an instructor he was already in management in the Astronaut Office then at JSC. So he came back down to do this flight. Being an astronomy PhD, he'd done Hubble [Space Telescope deployment], and then he was getting to do this one too. He was very excited. Learned a lot from him about that just in talking during debriefs and after sims. He was very excited about Chandra, getting to deploy it.

ROSS-NAZZAL: Did you and Eileen work together to create a cohesive unit with the training team and the crew? There's always stuff we learn about the crew's bonding. I'm curious if that was the case here.

REED: Yes. Because Eileen and I knew each other fairly well—again, [she was a student for] my first certification in the SST. I had known her since she came in. I had worked many a late night with her in generic sims when she'd be the pilot. They'd just pull [from the pool of unassigned astronauts], "I need a commander astronaut, I need a pilot, I need an MS-1, I need an MS-2". We'd all show up, and that was the training team.

So I'd just gotten to know her over the years. So we already had a real comfortable relationship by the time I became the team lead. I think she trusted me, and I trusted her. There

wasn't any figuring each other out or learning about each other. So I think that helped up front. Eileen, if you've ever spent any time with her, is so inclusive. She just does this by nature. She's really not looking around going, "Okay, who's feeling left out," but she's just very open and kind. If you happened to have a relative that was in town and you took them in the simulator, you'd get them badged, and they might sit there and watch, or you had one of your fellow instructors bring [a visitor], she was just always like, "Oh, come in." [She would] sign this or take pictures [with them].

With the crew for example, a real good example, we had two not so happy events happen. Our DPS instructor, Ed's wife came down with leukemia. They discovered she had leukemia and he was actually simming the day the phone call came in. So the team and the crew really rallied around donating platelets and just offering support. We had all gone to their wedding the year before. Eileen came too.

She was very much about being there for events that were our family events or personal events. She would join us. There were lots of barbecue cook-offs that would go on down here in Walter Hall Park [League City, Texas]. There was an annual one. If she knew we were out there with the cook-off team or we'd be going, she'd come out. We'd all sit around and talk and eat barbecue and have a beer or just bond, and Cady [Catherine G. Coleman] would come out. If people were available they would come.

She also included us. We had a French astronaut on that flight, Michel Tognini. There would be several ESA [European Space Agency] or French—I don't know how to call them—receptions that might be held. She would invite us to those. There was one in town one time. There was one out here at what used to be the Holiday Inn. I don't know if it's still the Holiday Inn out here. Out by the pool they had a really nice reception. It was a lot of the ESA astronauts

and the folks associated with Michel. Cheese and crackers and wine and everybody sitting around talking. Then the other one was at the French Consulate in town, so it was up near River Oaks [Houston]. She invited the entire training team to come up to that, and this was after the flight.

She just stayed in touch and was always reaching out and trying to include us where she could. That was very very nice. All that aside, I think sometimes people didn't realize just how good a pilot she really is. She was a great commander. They ended up being the flight that had the [electrical bus] short right off the pad. It could have been really bad because basically there was an AC short right off the pad, and it takes out redundancy on one of the engine controllers. Also they had a pin fly out. There were these pins in the nozzles of the engines, and right at liftoff it had flown out. It had dinged the inside of the engine, basically pierced, scraped across some of the things. So we had a leak going uphill of hydrogen.

So there were several things going on in there. It was like a bad sim case for some people sitting, I'm sure, in Mission Control. We were down at the launch watching it from outside the Launch Control Center. What I found really amazing, and this is how sharp she is—you do one last sim with the crew integrated with the Mission Control Center before they go down to the Cape [Canaveral, Florida]. The very last run you do, you'll throw in some malfunctions, but it's always known to be a good send-off confidence builder, a run that they're going to make it to MECO [Main Engine Cutoff] and on to orbit. It's a good send-off for everybody. You throw stuff in, and they work it.

We were all down there going, "Whoa, this doesn't look right," because we're hearing her calls. They lift off, and she calls, "*Columbia* is in the roll with a fuel cell pH." She didn't

say, "Roll program, Houston." "*Columbia* is in the roll with a fuel cell pH," which is a message on the caution and warning [system].

Me and the systems instructor, me being a former, know that the fuel cell pH message, that shouldn't have happened. It's usually indicative of a glitch or some electrical fail, if you get it when it's not expected. He and I are looking at each other. I was going, "I wonder what's going on."

Then we hear Mission Control per their training calling to take the AC bus sensors off so we don't trip off another AC bus. Because another one going down, you might lose an engine, or you might stick a throttle, depending on what went down. I was getting rather nervous. All of us were nervous and the mission controllers, when I go back and listen to the tape of that ascent and the flight loops, you can hear them. That's when I learned how well this training really worked. You could hear them, "I've got this, I've got that, I've got this, I've got that, what are we going to do here?" The EPS officer would tell them, and then the Booster, who's got this leak on the engines. They just handled it. When they finally made MECO John [P.] Shannon was like, "Whoo, let's not do that again."

We were without data sitting down there and it was crazy. We were just having to listen to the calls and we don't know what's going on. It was awful. She comes back to Ellington [Field, Houston] when they land. They went on, they deployed, it was beautiful. The crew did exceptionally well. They had discovered on orbit, when she got to flying around, she saw that a circuit breaker for AC1 phase A was popped.

They go through the flight and they land, and we go to the welcome ceremony at Ellington. They get up, they give their speeches and thank everybody, but at the end she runs off the stage to where I'm standing, and she runs over to me. Everybody's trying to get to her,

because there's public there and here's the first female pilot. She goes, "Lisa, I have so much to tell you." She said, "Look at my notebook." They all had these crew notebooks that they carried where they took notes. She said, "That was just like a sim." She says, "As a matter of fact, that was exactly the malfunctions you [the training team] put in on the last sim we had."

ROSS-NAZZAL: Oh, really, oh my gosh.

REED: I said, "That's just eerie." I said, "I swear we didn't do it."

She goes, "No, it was just like a sim." She said, "I just went into sim mode. The whole crew just went into sim mode."

I said, "That's great." That gave me just such confidence, because there had been problems here and there but we'd never really had an ascent problem quite like that other than the abort to orbit that they had early in the program. But after that things had been clean. The one big accident obviously, *Challenger*, there was not anything that the training could have done there. For them to come back and say the training worked, it was just like a sim. I went back and I looked in my log, and sure enough, it was exactly the things [malfunctions that had occurred during ascent]. So hydrogen leak on the same engine, it was AC1 phase A. She was like, "Did you know that?"

I'm like, "No!" What had happened is we had gotten through all of our scripts [and we had to wing it. So I just said, "Systems, off the pad give me an electrical bus, and hey, Al, control prop, put something in. We don't want to abort, just put something in; we got to make it to orbit because it's the final send-off run." And it ended up being the exact same things [the crew experienced on the real flight]. Eileen is the one that figured that out.

ROSS-NAZZAL: What are the odds? That is too funny.

REED: Oh, I know, I know, it's pretty weird. She was so excited. She came to me. "It was just like a sim! We just went into sim mode." I'm like that's good, that's what we're supposed to do.

ROSS-NAZZAL: So that's it for the crews. Once they leave Houston there's no more training at KSC?

REED: No. There's no more simulator training. They will sit—this is from them telling me and what I know—but they would sit often and go through their procedures. They would work through the flight plans. They might meet as a crew and talk through things. Later in the program they put some of the—because the computer technology had gotten such that we could do some small-scale simulations on computers, actually using some of the software taken from the simulator. They found a way to put it into a PC. There was a little mini ascent trainer that they put in the crew quarters there. They could go in and just practice the signatures and flying the ascent. Same with the RMS [Remote Manipulator System] trainer. So there was some. They could do that.

One of the things that they did do when they got down to the Cape was fly the STA, the Shuttle Training Aircraft. The pilot and commander could go and do some training runs in the Shuttle Training Aircraft. All the simulator training and the systems training stopped with that

last run. Now if they scrubbed and they had a longer turnaround than just a couple days they would come back and we'd go back to training. Got to maintain that proficiency.

ROSS-NAZZAL: Were you at KSC for all the missions that you were the team lead?

REED: All except the last one, but yes, and then I was there for many others. Over the years you become friends with some of the crew members and you get invited to the launches, so I went to many others after that. For every one that I trained I went down for, because that's what you work for and that's what you want to see. You want to be in Mission Control looking at the data in one of the back rooms, but you also want to be there to send them off and let them see that you're there supporting them. You've been with them the whole way. It was really just a personal thing.

I had a cute story about Eileen on STS-93 with that crew. We all flew down there, and they scrubbed two times before they finally launched. So the whole team had gone down and we were there in hotels at Cocoa Beach [Florida]. We had gotten the C-squared [Cape Crusaders], so the astronauts assigned as the astronaut support personnel down there had given us a wonderful tour. A lot of my guys had not seen that. I had been fortunate. My instructors, a lot of them had never seen the launch pad, they'd never seen the Orbiters, they'd never gotten to do a lot of those things down at Kennedy.

By that point in my career I really enjoyed getting to see them getting to see it the first time, because I remember what a wow that was for me, an eye-opener. So we did a really nice tour. They got to see the crawlerway and the crawler [transporter] and go in the OPF [Orbiter Processing Facility] and see Orbiters, got to go out on the pad and go up to *Columbia* while it's

on the pad. This all gets approved [beforehand]. Al and I got to fly on the STA with the crew on a couple of the training runs. So that was very nice, that was what Dr. Stevie could approve at the time. So that was a lot of fun.

I think the best part was seeing the guys get—there you are, you're next to *Columbia*, and it's a day or so before the launch, and it's almost like a living, breathing thing. It's the stack, and you're going up on the various levels. They enabled us to go out and take pictures in the White Room and the White Room crew is very nice, because we were with the C-squareds and they showed them where the [emergency egress] baskets were if they [the crew] needed to egress. Also before that some of the training team gets to go down for the crew equipment interface test, because you're there and it's a good time to learn about the Orbiter.

So third day, we were there standing inside of crew quarters behind the little rope, and they come down the elevator. We'd be standing there. They get in the Astrovan and they'd go out to the pad, and they scrub. There is a little bit of superstition, that's what I'll call it, I don't know that they would call it that. In the middle of the night Eileen had left a message on my phone in my hotel room from crew quarters saying, "Hey, Lisa, we wore these crew shirts in the breakfast [broadcast of the crew at breakfast on launch day] today when we scrubbed, so we want to wear the other shirts, the navy blue shirts, tomorrow, and we can't find Cady's down here. So do you or one of the crew members have a shirt you can bring down? And I need another one." She needed two.

We all had brought our shirts, because you show your colors when you're down there. So I go around to the team. I'm knocking on doors. I'm like, "Give me your shirt."

"Why?"

"Eileen needs it."

“Well, I haven’t washed it.”

“I’m sure crew quarters will launder it, just give me your shirt, because you look like about the size of—” I can’t remember if it was Michel or Dr. Stevie.

“Okay, yeah.”

“Then I’ll get this other one for Cady.”

So I deliver those to crew quarters, and then the next day you can see they come out for their breakfast. The one on Cady, because she’s so small, bless her heart. You see that it’s not to fit, but they were wearing the different shirts. Then they go out that night and they scrub again.

Finally the third time—and it gets to be a joke with all of us. When we show up and we’re standing there, and they turn, they see you when they come off the elevator. We decided to make some funny faces. We just got pieces of paper and we drew funny faces on them and poked holes in them [for] eyes [holes to see] and drew whatever and had our names so that when they came out [they wouldn’t see our faces]—because Dr. Stevie, it was a little play on what he used to do, where he wore the paper bag to sneak up on the [Shuttle] [after launch scrubs].

ROSS-NAZZAL: Oh, that’s right.

REED: It was also *Columbia*. So we were like we don’t know who’s the jinx but we’re not going to do that. The elevator door opens up, and we’re all standing there with these things [improvised masks]. You can see it if you look at the video—the people outside where all the cameras are getting ready to capture that walkout shot of the crew. What they can’t see is it [the crew elevator] opens up and nobody’s coming off the elevator, but this hand sticks out with this picture of the crew. It’s a crew photo. We just started laughing.

They don't hear us. First, we don't see that, and they don't see us [with masks]. So then Eileen peeks around the corner, and we've got a great shot of her peeking around the corner. Then they all just burst out laughing. It was that kind of thing. Then they launched that night and had all that trouble [right after liftoff].

ROSS-NAZZAL: Little moment of levity there.

REED: It was a moment of levity but yes, it was like, "Who's the jinx, we don't know. You better go now, we don't want you to come back. We don't want to go back into training. As much as we love you, it's tiring."

ROSS-NAZZAL: I can imagine. How long were the crews in training before they flew generally?

REED: Early on it was about a year. The IUS, the inertial upper stage, was the booster that was going to [boost Chandra to orbit] once Chandra was out of the payload bay, and it was an Air Force device. We had several slips for whatever reasons, I honestly can't even remember now. Those happen. Then an Air Force launch got up into orbit but then the IUS, when it deployed, the satellite tumbled. They ended up losing their payload. We slipped a while till they could go out and check our IUS, because it was the same basic system, because we were using that. So we slipped to make sure that there wasn't any issue once they had worked through and discovered what that problem was.

It was about a year and a half that we trained 93, start to finish. I can look up one thing. I can probably tell you when we did our first sim and when we did our last one. [Refers to logbooks]

ROSS-NAZZAL: Those are great resources, glad to see you saved them.

REED: We started in April of '98 and they launched late July of '99. So it was a year and three months. That's about how long it was. The last sim was on—let me see if I can find it. I may have another book. I think I do.

ROSS-NAZZAL: I was going to say that looks like a whole book for that mission.

REED: Yes, I ran out here. There's probably another one in here. Volume one, if I'd looked I would have known that. Anyway it would have been a week before they launched. So it would have been late July was our last sim. I don't see volume two in here.

ROSS-NAZZAL: So launch is like graduation day for the crew.

REED: Yes, it is, and for us it's the culmination of all your work as a training team member. Then when you come back you go back into generic sims. It's a little bit of a letdown after that, but you get to see how well your crew does and watch the mission. When you come back [from the launch] you go to Mission Control [to the sim control area to watch the mission activities].

One last thing I'll leave you with on the 93 mission that was just fabulous. During the entry day there's a famous shot now someone took outside JSC. We were sitting in Mission Control, and we knew they were going to fly over Houston. The conditions were going to be right that we could probably see the plasma trail. We had to run down about the time, because the flight controllers are saying when they're going to be visible, this and that, and this and that. They couldn't leave. We were hearing that, and we ran outside into the parking lot in Mission Control Center. By golly, that thing just came flying right by, really high, but this beautiful bright orange plasma trail trailing behind it. You may see this picture around, or you may have already seen it, but there's one, because someone took it, one of the photographers here at JSC, right above the Saturn V before it was encased. It was just gorgeous streak.

ROSS-NAZZAL: I think I have seen that.

REED: That's Eileen and STS-93 on entry. Once we lost sight of them, you had to get back up if you wanted to watch the landing data in Mission Control Center, because they were going to be in Florida really quickly and landing. You didn't want to miss that. When we heard they were going to fly by, that was just a special moment. "Wow, look at that." That's an Orbiter and five people that I know and I work with and care a lot about, are [they] in that moving piece of plasma.

ROSS-NAZZAL: It's amazing.

REED: That huge trail moving lickety-split across the sky.

ROSS-NAZZAL: Now I'm looking at the clock and it's actually noon. You want to stop?

REED: Yes, it'd probably be a good time to stop.

ROSS-NAZZAL: It's a good stopping place.

[End of interview]