NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

SARAH L. MURRAY
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is August 28th, 2012. This interview with Sarah Murray is being conducted for the Johnson Space Center Oral History Project in Houston, Texas. The interviewer is Sandra Johnson, assisted by Jennifer Ross-Nazzal. I want to thank you again for joining us today and coming over.

MURRAY: Thank you for having me.

JOHNSON: I want to start by asking you to talk briefly about your background and your education and how your interest in working for NASA first came about.

MURRAY: My education is in electrical engineering. I received my Bachelor of Science degree at the University of Texas at El Paso. Before doing that though I was in the military. I spent six years in the Army, most of that in Germany in the emergency room. I was an emergency room nurse in Germany, which was very very exciting, because the area that I worked in was called Grafenwoehr, Germany, and it was where the military sent their troops for field training. I had the opportunity to see emergencies that were more like war-type wounds. We saw crushed skulls, amputations, all sorts of things, sucking chest wounds. So I could handle any of that for you guys if you wanted me to.

JOHNSON: Good to know.

MURRAY: It was just very rewarding for me because I went into the military—I was probably 20—at a young age, and then was made a supervisor in the emergency room, and so got lots of experience leading and managing people, and in critical times at that. There was triaging that had to go on and understanding your people and who can handle this emergency, and who to send out on ambulance runs. I thoroughly, thoroughly enjoyed that experience, and also living in Germany. We were there probably about six years. My firstborn was born in Nuremberg, so he was raised by a German family there while I worked many many hours in the emergency room. It was just something I enjoyed. So, I have the Army background.

I really like math, and I like teaching, but at the time I put some thought into what could I do. I needed money, now. One of the other things that I had been interested in was medical school. At the time medical school seemed like it was just so long before you get any rewards back. Like I said, I had a family then. So I decided to go into electrical engineering because I felt I could use the math there. I proceeded to getting my degree and graduated from the University of Texas at El Paso.

JOHNSON: You went into engineering in the ’80s, and you were already a nurse, and you decided to choose this path. In the ’80s that was a time where more and more women were becoming engineers. Did anyone in particular encourage you? Or did you have people tell you’re a woman, you can’t be an engineer, or that sort of thing?

MURRAY: Both actually. My husband was very encouraging. He always encouraged me and made it his goal to make sure that I got through school. Now where I ran into I guess some issues was actually in school. There were a couple times when I would meet with a professor and have questions about something. I can tell you one example was it was an exam. I explained to him, I said, "You really didn't discuss some of these things."

He just looked at me and said, "Well, some of those questions are to weed people out." So he could have just meant he wanted to weed people out. Maybe it wasn't directed towards me. But the next time that I ran into a problem, I was a member of IEEE [Institute of Electrical and Electronics Engineers], and we would meet and study for finals together. As we studied our old exams—we use our old exams to study—we all looked at our grades. My grades were lower than everyone else's, in the 70s. They said, "Sarah, you have the same answers we have, and your grades are lower." It never would have dawned on me.

We figured out that the professor would take off just here and there because I didn't do it exactly the way he wanted, even though I got all the answers, minus two here, minus three, just for ridiculous things. I went to talk to the professor about that—and my IEEE compadres, primarily white and Hispanic, because El Paso had a lot of Hispanics, said, "Sarah, you can use our exams, if you want to show the comparison."

I went to the instructor, and he did not even defend his grading at all. All he said was women don't belong in engineering. That was the end of it. So I thought wow. But I'll tell you it didn't deter me at all. My mother was a very very strong person. I know that I've gotten some of that, and I guess the way to look at it is that the personalities that my family had and the way we were raised is that anyone trying to prevent you from doing something just makes you push that much harder to get through. So it didn't bother me.

JOHNSON: What were your expectations as far as what you wanted to do once you got this electrical engineering degree?

MURRAY: Wow. That's interesting, because I was really interested in medicine, and probably would have been a physician had the cards played out differently. It would have been interesting to go into some sort of bioengineering. However, when I graduated, I felt like I was so tired. I told my husband, "I just need to take a break. I just want to take a break. I don't want to work." I actually took a break. I graduated. He was still in the military at the time in Augusta, Georgia at Fort Gordon, so I was there. I started doing some substitute teaching while I was there. I got a call from RSOC, Rockwell Space Operations Corporation. They wanted me to come to Houston for an interview.

At the time I didn't know who they were or what they were involved in. I actually didn't really do any research. Typically when you're going to go for an interview you do some research about the company so that you're on your Ps and Qs during the interview. But my husband had orders to go to Germany, and I knew we were going to Germany. So my husband and I said, "Well, it's a free trip to Houston. You can brush up on your interviewing skills. Let's go on to do the interview." I got here, and I was taken to what they call the red brick building, and it's fondly referred to as the red brick building, and was interviewed by a few folks, still not realizing that they had something to do with space.

During the interview they kept saying that we will take you "on site" later. On site? People don't normally use that term unless you're associated with something that uses the terminology. They put a group of us on a bus and drove us over, and we were all yakking on the

bus and talking. I totally missed going through the gate. I didn't know where I was. Drove up to this building, they took us inside the building, and there were all these console positions. So the tour guide is talking to us and explaining, and my eyes start getting pretty big. "This is mission control! This is mission control." I just couldn't believe it.

Afterwards when I got to the hotel room I called my husband. I hadn't planned on taking a job because we were going to Germany. I said, "Dear, it's the Space Shuttle program." Oh my gosh. This is awesome. So we decided well, we do need the money. If they offer you a certain amount, then we'll decide. He'll go to Germany and my son and I will stay here in Houston. It tells you just how naive we were. I had no idea how much they would offer, but it was more than what we thought it was.

That's how I ended up actually here the first time around, here at JSC. So as far as my expectations were concerned, it would have been nice to go into the medical field. I still thoroughly, thoroughly enjoy the medical field. Even to this day I thought I can still go to medical school or be a physician's assistant, something like that. But going into the space industry has been just awesome for me. I think it just fell in my lap, but it's been great because there are different types of engineers. There are the engineers that have to know every little bit that's in a circuit. That's not necessarily me.

What we do, at least in Mission Operations [Directorate, MOD], mission control, is real-time operations. That was a great fit for me, because I can relate it to the emergency room. It was real-time. You needed to make decisions fast. You needed to triage. During the Space Shuttle missions you have things that are going on, you have to triage, prioritize the work, and figure out how to do it, and you didn't have a whole lot of time to get it done. Especially during

ascent, when there's just eight minutes to work any failures. So there was something about that aspect of the job that was good for me, and it fit for me.

I told my husband that there would be three things that I would love to do. If I did any of these three things I would be happy. One would either be an astronaut, another would be a flight director, or a stay-at-home mom. Any one of those would be awesome. So I didn't get any of those, but I was so close to it. It's that old adage, you shoot for the Moon and you land among the stars. It's just been great for me.

JOHNSON: Did you apply with Rockwell, or did they just call you up?

MURRAY: They called me. That happened because while I was in school I had applied for a co-op program at NASA. During the time, again, we needed money, and NASA was offering something $6 an hour. El Paso Natural Gas was offering $10 an hour, so I went to El Paso Natural Gas. But they still had the resume at NASA. So, yes, Rockwell called me.

JOHNSON: They had your information. So did you apply for the astronaut corps?

MURRAY: I did. I applied twice. I spoke to John [H.] Casper. He says, "Well, I applied six times. You need to keep on." But I think I decided to do that later in life. Probably had I started earlier then I would have continued on, but I think if I were selected now they'd really only want to do experiments on menopause or something. But yes, that would have been really cool too.

JOHNSON: You actually started at Johnson. How long were you here, because you eventually went to [NASA] Goddard [Space Flight Center, Greenbelt, Maryland], correct?

MURRAY: Right. The order is I started here at Johnson in the communications groups, it's called INCO [Instrumentation and Communications Officer]. I was here for two years. Remember, this is a time where my husband went to Germany. Well, we thought he would be back in two years, and something happened, and he had to stay longer. So I ended up having to leave after two years, and joining him in Germany. While I was in Germany I got another job.

Actually I was able to get a job, what you call on the economy, with Frankfurt International School [Oberursel, Germany]. I was able to teach school while I was there. They didn't require that you have a teacher's certificate. They just required that you had a degree in the area that you were teaching. My degree covered the areas of computer science, physics and English, which were the classes that I taught while I was in Frankfurt, Germany. That was interesting too. Teaching is really fun. It's just really rewarding to work with the kids, and Frankfurt International School had children from all over the world. A lot of the companies that were in Germany employed folks that were from all over the world. They sent their children to this one school for the most part.

One experience I had in third grade. I was actually a substitute teacher at the time. I went in, and there were two children from Vietnam that were there. I gave everyone their assignments, but they were just learning English. So they had coloring books and were coloring a cat and understanding what cat was.

When it was time to take the exams, the math exams, one of the other kids told me. She said, "They take the math exams." I will tell you the difference in how the Asians are taught is I

think huge. Those children in the third grade were able to finish their exam in about 15 minutes when everyone else took an hour. That was one of the things that I learned with the third graders, and when I went on to the high schoolers, I would just sit and have a conversation with the seniors. "So what are you going to do after you graduate?" Some kids are ready to talk about that. The Asian kids are like, "I'm going to go to college, what else." There is no other path. There just is no other path. But I do enjoy working with kids. Enjoy it a lot.

JOHNSON: So how did you end up coming back to NASA from being in Germany?

MURRAY: After my husband's tour, he was stationed at the Pentagon [Arlington, Virginia]. You're going to find this funny because it dropped in my lap again. I had just had my second child. We were living in Springfield, Virginia, and he was going to the Pentagon. I started looking through the newspapers. Okay, it's time for me to go back to work. I saw an ad from a company called Computer Sciences Corporation. I said, "Okay, let me go check this one out." I got on the road, started driving, and it was a lot further than I thought it was. I started thinking, "Sarah, why are you going, I don't like computers, it's cold."

I finally get there. There are hundreds of people there waiting to be seen. They tell you to turn your resume in, so I turned my resume in. We're in this huge cafeteria. I sit down, and I'm seated there for 10 minutes and they called my name. They didn't call my name for the job that I applied for. They looked at my resume and the guy said, "I know someone who's looking for a flight controller." I had had the flight controller experience here at JSC, and it got me right into the flight dynamics area there.

So the way we got there was my husband being at the Pentagon and us being stationed there on the east coast, and my applying for the Computer Sciences Corporation position and getting a flight controller position at Goddard in the Flight Dynamics Facility.

JOHNSON: Talk about that facility a little bit and what you did there. You became the mission coordinator and mission manager, and then the network manager, so walk us through those positions and what you did.

MURRAY: The one thing that I do remember is after my interview—and it was a couple or so months after the interview, and was hired on as a mission coordinator—the mission coordinator's job was to coordinate all the different entities that had to provide data to the ground facilities all around the world. We had ground stations all around the world, and we had satellites and antennas that would point to the Space Shuttle or ELVs, expendable launch vehicles. ELVs are unmanned.

The mission coordinator's job was to gather all of that data from everyone, from the entities there at Goddard and the different entities at the different ground stations, so that they all had the correct data—pointing data primarily—and they had the data to point to the Space Shuttle or the expendable launch vehicle.

My supervisor told me a couple months after he hired me that I did not belong in his group.

JOHNSON: Was there a reason?

MURRAY: Yes. There was a reason. He said, "You don't belong in my group. I hired you because the group that you do belong in, I don't think they would have hired you." What he meant was that the group that I should have been in was an all-white-male group at the time. He said he just knew that they wouldn't hire me. He said, "I'm getting your foot in the door." The group that I hired into were not degreed. I didn't know, didn't really care at the time, so I worked with them. In about eight to nine months I transitioned to the mission manager group, which is the group that's actually over the mission coordinators and the entire mission. They serve as—if I could compare it to our setup here at mission control—it's like the flight director in the control room during missions.

After about nine months then I moved to the mission manager job. The mission manager was the lead for each of the missions, and just pulled everything together. Like the mission coordinators, but the mission coordinators just had a smaller scope than the mission managers did, and the mission managers had to report to the program managers. I did that job for a few years I think, maybe two years with CSC. I was later hired by NASA to work as a Network Manager in the Network Control Center [NCC]. I worked as a network manager for about 1.5 years before I moved back to Johnson Space Center.

JOHNSON: How did that transition work, since they were all white males, and then you're transferring?

MURRAY: It was good. It was good. I did not—what's the right word? I don't think I gained the rapport with the supervisor that maybe we should have had. I just didn't feel as comfortable as I felt with other supervisors I should say. But as far as the actual fellows that were in the

group, no issues whatsoever. None whatsoever. I had a good time and it was great. I've learned that typically it is I would say abnormal to run into issues. There are going to be onesy-twosies that are out there, but for the most part folks are doing their best to treat everyone as equals. Also there's an element of not even being aware that you're treating someone different, and I know that's out there too. But as far as folks blatantly being unfair about it, I think that it's more abnormal, at least in my case, in the environments that I have been in. It's still there, but it's probably not as bad as it was when I first arrived at JSC.

I can remember a comment being made. This was back in '88. I was hired on, and my girlfriend and I were in the hallway and she was a black African American. Some guys walked by us talking to each other. Oh gosh. They said, "Oh it's starting to look like the ghetto around here." What's unfortunate—well, it's fortunate and unfortunate—is that you learn not to let that deter you. You don't want to totally ignore it though because you want to make sure that when it needs to be addressed it's addressed. You can't let it deter you or cause you to behave in a manner that's inappropriate or unprofessional, but it's still there and you just have to be smart and know how to handle it.

JOHNSON: Yes, you definitely have to be smart how you handle that.

MURRAY: You really do. Yes. So you were talking about the transition. I worked as a mission manager maybe a year or so. Then the network director at that time was a man by the name of Gary Morse. He heard that I had been in the INCO group at Johnson Space Center. He worked in the Network Control Center, which is called the NCC, the Network Control Center, at

Goddard, and they are responsible for the TDRSS system, Tracking and Data Relay Satellite System. He asked if I was interested in being network manager.

So I worked side by side with him, and that was interesting. It was different for me in that now I was managing folks that were in Bermuda and White Sands [New Mexico]. Again we had ground sites around the world. That was pretty interesting too. For instance when the Shuttle goes up and you have ET [external tank] separation. We have to call in the coordinates as to where that thing is going to drop and call those into Australia using our red phone. So it was an interesting job to have.

From there my husband got orders to go to Hawaii. I was all fine to go to Hawaii, yeah this is great. We had four kids by then, so I had started looking for jobs in Hawaii. They actually had network manager folks who dealt with the satellites in Hawaii. I had started looking for a job there. Then at the same time we started thinking—my husband was about three years away from retirement—if we both go to Hawaii, when you retire, we'll both be looking for jobs. We'll probably come back to the States. It'd probably be wiser if we had something established here in the States.

Not only that, I was really tired of the cold weather at Goddard. At the time a friend of mine at Goddard had come down to Johnson Space Center and applied for a job and had used me for a reference. Someone from my old group called and said, "We found you. Would you like to come back to the group?" It's like, "Yes!" All of that happened at the same time. I ended up coming back to the exact same group that I was in before I left.

The difference was I was with RSOC the first time. When I became a network manager I became a civil servant, so when I went back to the INCO group I was a civil servant. That was

the only difference, but I was doing the same job. It was great because I was already familiar with it. Some of the folks that I had known were still there.

I left them in '90 and came back to the INCO group in '96. So that's how that transition worked out. My husband went to Hawaii. He took the teenager and left me with the two-, three- and four-year-old.

JOHNSON: Lucky you. I don't know. Teenager. Little ones.

MURRAY: Yeah. The teenager was good with the kids, he was really good with the kids. He's always been good with the kids. I always brag about him, because when I had the last one, I had these three children that were all under the age of three, and he was probably 14ish at the time I had the last one. We could leave him at home with all the babies. He just took care of them and changed diapers. He's had his first here not too long ago and has been teaching his wife what to do.

JOHNSON: Many years of experience.

MURRAY: I know, I know, it's really great.

JOHNSON: That's wonderful.

MURRAY: Yes it is. Anyway, he and my son went to Hawaii. I think they were there for about two, three years. I came to Houston with the three little ones and started back, getting recertified in my communications position.

JOHNSON: For a minute if you don't mind talking about the certification and the INCO group and how you worked through those different areas to get those certifications.

MURRAY: Okay. So certification. What that consists of, is there's a lot of reading on the different systems that are within the communications realm. Within communications, at least while I was there, there were four positions. There were three back room positions and then the front room position [Mission Control] where those are the folks that you typically see on the TV in the front room. But those people in the front room have a host of people in the back room that are supporting them, so you work your way up through the back room to the front room positions.

Certification usually starts out with reading and then we have what we call the SSTs, single system trainers. They're really mockups of the Space Shuttle cockpit. Crew members' training and the flight controllers' training are different but also, in a lot of ways it's the same. Because we are on the ground and either we are commanding to the Space Shuttle or we're telling the crew members what to do, we do a lot of the same training, so that we know in our mind, "Yes they can do this," or "Yes they can reach this from where they're sitting," because we have to tell them what switch to flip.

In the single system trainers we actually either sit in the commander seat or in the pilot seat, and we go through the procedures just like the crew members would go through the procedures. We flip switches. We make mistakes so that we understand what all of that means.

After you get a certain amount of training under your belt, you are ready to actually sit in Mission Control in a training environment in a simulation, where it's integrated with all the other systems and flight controllers. Mine was communication. Then you've got your environmental specialist, which we call the EECOM [Electrical, Environmental, and Consumables Manager]. You've got your propulsions. You've got booster. So now you've received enough training under your belt where you can actually sit in the simulation with everyone else and you've got your training team. The sim [simulation] starts out nominally, things are going smoothly. Then you're watching your screens looking for any indications of problems or malfunctions as we call them.

They teach you if you see something that's abnormal, you report it. It gets reported to the flight director. We call it FIW. Failure impact work-around. What's the failure? How does it impact you? What's the work-around?

That's really what you want to learn to do. When you have malfunctions, you see issues, you understand what the failure is, you understand what the impact is to your systems and even to other folks' systems. When you talk about comm [communications] failures, you're impacting a lot of folks when the comm goes away. But then there are other pieces where there's just a piece of the com that fails. For instance the instrumentation position, which is a back room position for the INCO group, was responsible for the communication between the payloads. You may have a payload on board, and it may be connected what we call hardline, or it may be connected via an RF [radio frequency] link. So the payload signal processor—we call

it the PSP—is typically how we communicated with the payload if it was hardline. You can command to it. You could get data from the payload to make sure it's healthy. Then you have the payload interrogator. There's some payloads that would start out hardline, and then, for instance, that payload is deployed into space. It's no longer hardline, but you have an RF link. Then we turn on the payload interrogator. It's still talking to the payload and we're still getting data, and we can still command to it.

Certification required learning all of that. The fun parts are the ascent. In ascent certification, you typically learn what you can do quickly to recover, whereas when you're on orbit, depending on the failure, you may have a little time to work some issues. But during ascent you just want to recover. I don't really want to know exactly what's wrong, just recover until we get on orbit. Then we'll fix it. So that's the difference between the ascent and the on orbit piece.

I actually started—I guess they say in the middle. The back room positions were different levels. We had our recorders. That was typically an entry level position, because all they did was command into the recorders. They recorded data on board, then we dumped it when we got to a ground site or had the TDRSS satellite. It was a good entry position because you couldn't hurt anything. It got you comfortable with commanding to the Space Shuttle. You could make errors in your commanding and it wasn't detrimental to the mission. But, I didn't start there. I started in the middle with instrumentation. Instrumentation was responsible for all the telemetry coming from the Space Shuttle, to include the payload data, the PSP, and payload interrogator. I can't remember some of the other things.

One of the fun things that everyone remembers is—we call it swap PCMMUs [Pulse-code Modulation Master Unit]. Typically, if we lose data and you can't see the data, it's either a

problem with that particular instrument, and if we are on ascent, then we just want to recover. What we say is, "Flight, have the crew swap PCMMUs." The Shuttle was made up of a lot of redundancy, so we had just about two of everything.

If there was a problem we just called up to the crew. "Swap PCMMUs." They'd flip a switch from PCMMU 2 to PCMMU 1. I think we usually started out on PCMMU 2. I don't remember why.

For ascent a lot of our calls were just like that. "Swap PCMMUs," or, "Do a panel command." Doing a panel command took them from one string of communication to another string of communication. I'm trying to stay on track with my certification here.

JOHNSON: That's fine, no, this is good information.

MURRAY: I certified as instrumentation first, then ascent/entry. We call it orbit instrumentation or orbit inst. So I certified as an orbit inst. Then typically what comes after that is the ascent inst. That's a little bit easier.

The orbit inst, because you're on orbit and you really need to understand the systems well and understand the malfunctions and know how to work through them, it takes a little bit longer. But when you get to ascent inst, you already know this stuff, now you just have to learn all the quick remedies to getting through your malfunctions. It wasn't quite as difficult.

From there I went to the next position, which is RF com. I started training that; however, that was delayed because I saw another position that I was interested in. [International] Space Station had just started around 1998. There was a position called RIO, Russian—

JOHNSON: Interface Officer.

MURRAY: Interface Officer. You know that. I said, "Wow, that sounds interesting." So I applied for that. The way it was set up was that you stay in your group, so I would stay in my INCO group, but I would give 25 percent of my time to the RIO group. At the same time I went through training for the RIO position, I went through that training and started working console in the blue FCR [Flight Control Room], they called it the blue FCR then at the time. I started with the Mir [Space Station]. I think the Mir was one of my first missions that I worked on, then we went on to Space Station.

That was cool too because, like my daughter, cultures just intrigue us. On console we always had an interpreter that was sitting next to us. Just the interaction that I had with the interpreters was interesting.

At the same time I'm learning all about Space Station now. The RIO was a good job where you didn't have to know the details about every system, the CATO [Communications and Tracking Officer] position, the ODIN [Onboard Data Interfaces and Networks] position, but you had to know enough so that when there was a failure you go to the procedure, you can read the procedure, follow along, because you needed to understand what needed to be communicated to the Russians. The way it played out is because I was certified as ascent/entry inst—and then at that point I think I had also gotten my ascent/entry data comm, that's the other position for the recorders. Then there was a time where they combined them, so the ascent/entry inst also did the recording for ascent/entry. What I would do is for the mission I worked INCO. I worked the ascent/entry phase. Then during the on-orbit phase I'd run over to the blue FCR and I'd work the RIO.

Mir was in the white FCR. I believe Mir was in the white FCR, so I'd just go out front and work RIO. Then when we moved to Station I'd work my ascent/entry phase for INCO, and then I'd run over to Space Station to the blue FCR and work the RIO position. That was pretty cool.

Again, good but not so good. I didn't complete the certification because I was selected to be group lead, and my branch chief said, "No more RIO. You can't do it. We need you to focus on this group."

So I had to give it up. But I learned a lot from that and it actually helped when I was eventually moved to Space Station after I had done some work with the INCO group. I became the INCO group lead. I think one of the things they liked about me was that I enjoyed working the night shift. Many of the group leads did not work console, but I felt like I needed to work console so that I stayed in touch with what the groups were doing and understood any of the difficulties they were facing working console.

I would work the night shift as the instrumentation officer. Also it allowed me to be available during the day if I needed to be during the day to do office work as a group lead. The other thing that I liked about working the night shift is that it didn't take away from your home life. Because I'm at work at night when they're sleeping, I'm sleeping when they're in school, and then I'm up during the time that they were there. So the night shift worked out for me, and I didn't mind being up at night. That worked out.

I was the group lead for the INCO group [from 1999] until the [Space Shuttle] *Columbia* [STS-107] accident. I had handed over to the entry team, so I had been on that night shift. As a matter of fact it was a night shift. I had handed over to the team that was going to bring the *Columbia* crew in. My husband had retired by then and was also working in the training area. I

had gone home and was sleeping on the couch. My husband called; he was on a console. He said, "We don't have comm with the crew."

I looked at where they were. I said, "Well, that's typical when you get closer in. You start getting some interference." But usually we have some comm. It's a little ratty and it's got some noise. He said, "I don't know. We don't have any comm at all." Then we discovered that it had broken up.

Some interesting things happened. I am always under the belief that things happen for a reason no matter how good or how bad. We can always learn from them and something comes out of it. What I did when we got back in the office was I started remembering about not offending folks as far as religious preferences and all those sorts of things. I went to my branch chief and I said, "I'd like to have prayer but I don't know. Can I do that? Is that okay?"

He said, "No, I don't think you should do that."

I don't know what it was, but I said, "You know what, I'm going to do it." So what I did though was I sent an e-mail out. I specifically said, "I don't want to offend anyone, but I would like to have prayer. We will meet in this office. If you want to join us that's fine." I'm so glad I sent that note out. Everyone in the group was there. Everyone in the group showed up. Everyone. I thought this is awesome.

Then of course we started pulling together all the data that we needed to pull together and certifications and paperwork and all that. Then also at the same time while we were working through that, I was trying to think of something the group could do just to keep us pulled together. There was one guy in our group, Gary [C.] Horlacher, who did a lot of cycling. I thought why don't we all start cycling and practicing for the 100-mile Hotter'N Hell [Hundred]. Some of the group said, "Okay, let's do it." So we started working on that together. I was just

trying to do something to get their minds off [of the accident], because we weren't flying for a while now. I wanted to hold the group together and keep the morale up. We would have like a cycling 101 at Horlacher's house, and he'd teach us about changing flats and all of this sort of stuff. Then before you knew it, I was in the 100-mile Hotter'N Hell. Yes, it was awesome. I think that was a great accomplishment. I was looking at one of the questions. What are your great accomplishments? I rode my bike 100 miles in one day.

JOHNSON: That's an accomplishment, definitely.

MURRAY: It was great. But it was good for the group too. It was really good for the group. That's why I say something came out of that accident, that I probably would not be riding my bike today. That may be minor, and I'm sure there are lots of other things that came out of it. But I love cycling now. I ride my bike to work every chance I get. I think it keeps me healthy. Even some of the group members, they're still doing the same thing. So that was one of the things that we did right after the accident.

Also after the accident, as you know, we had different camps that were formed out all over the country looking for debris. I was first sent to Barksdale Air Force Base in Louisiana. I was sent there to help there, collecting debris. We were working with the Air Force, the Civil Air Patrol, FEMA [Federal Emergency Management Agency], forestry [US Forest Service], Army. One Army post wanted us to use a certain type of helicopter. But then another wanted us to use theirs, which had a glass bottom. We can use that. We used satellite imagery so that it could detect debris. The satellites would send us data, "Well, we think this is debris." Then

we'd send either troops or Civil Air Patrol folks to actually go out there and get the debris. A lot of times it ended up being old refrigerators and things like that, sinks that folks had thrown out.

Once again that was such a huge operation. I worked with the Navajo Indians. The Navajo Indians consider themselves their own country pretty much. They have their own FEMA point of contact that I had to work with. During the time that we were looking for debris was during the time that they said their tribesmen were going to their summer camps I guess is the way they refer to it. So what we had to do was drop flyers that had been translated telling them if you found debris here's the number to call or here are the people you contact. That was interesting too, working with the Navajo Indians.

I don't know that I would have met so many different people in so many different fields. NTSB [National Transportation Safety Board] were there too, worked very closely with everyone. I started out at Barksdale Air Force Base, then they decided to start trying to consolidate some of the camps and I ended up at Lufkin [Texas]. What MOD, Mission Operations would do was send us there for about 10 days. I was told, "Okay, Sarah, we need you to go to Barksdale for about 10 days." So I went for 10 days. Then we would rotate someone else in.

The next time it was time for someone to rotate in, the person that I was working with said, "Well, who is this person that's replacing you?" He said, "Well, I don't know that person. When they get here, we're going to send him there, and you stay here." So 10 days turned into 3 months. My poor family didn't see me for a while. My husband would bring the kids sometimes on the weekends to see me. I ended up at Lufkin and actually leading a group of folks. The work that we did there was taking a lot of phone calls from folks that thought they had found

debris. Somehow we'd either try to get them to send photos or describe it to us so we could determined whether we actually needed to go out and pick the debris up.

It was just a huge operation. We had teams in Arizona, California, Utah, Nevada, New Mexico and Florida. I would contact one of these teams depending on where we got the phone calls from to go out and take a look at the debris and determine whether we needed to send it in. A lot of the work in the search was concentrated here in Texas because that's where a lot of the debris was. The heavier pieces of the Shuttle landed in Texas and Louisiana, it was mostly concentrated in those areas.

The crew members were going out to the different camps and greeting the searchers, thanking them. I said, "We've got folks that are searching out in Nevada and Utah." In Nevada and Utah we had actually prisoners that were doing the searches. The way it was set up for them, I think it was for each day that they participated in the search, they got a day taken off of their sentence. Those guys were out there searching and some of them were getting hurt and breaking legs, because the terrain was pretty rough.

So I coordinated with the PAO [Public Affairs] Office to get a crew member. I said, "We need to send a crew member out there also." Doug [Douglas H.] Wheelock and myself flew out to Nevada. I even have pictures. We had to get on four-wheelers to make it up to where the searchers were. We went up there and talked to the prisoners, and those guys were just thrilled. They were thrilled. They had good questions that they were asking us. We also went to a school in Nevada while we were there and talked to some kids.

For me that was pretty fulfilling, because I know that after especially talking to the prisoners, they were really intrigued and interested in what we were doing and what they were

doing. I was really glad to be able to get Doug to go out there and talk to them, and Doug and I have been good friends since then also.

Then as the effort started to wind down some, we were moving the [*Columbia*] Recovery Office to JSC. John Casper and Dave [David W.] Whittle at the time were over the efforts out there at Lufkin. They said, "Sarah, we would like you to lead the rest of the effort." They were going to go off and do other things, but they still needed someone to finish out the recovery effort. They said, "We need you to lead it at JSC." I thought hmm. There was another gentleman that I felt should have led it, because he was out of Florida, and he was the first person on site at Barksdale that pulled everything together.

I said, "I think he should lead it."

They said, "Well, we need it at JSC, and he's in Florida, so you're at JSC, we need you to lead it."

I said, "Okay."

He said, "You need to find your own group of people also, because everyone else is going back to their own jobs, but we still needed a small group of folks to finish this out."

So I started just looking around Johnson Space Center for folks who were interested in working with me in the *Columbia* Recovery Office. We were located in Building 30. I found a small group of folks and we continued to work taking phone calls, getting debris. As a matter of fact, I got a letter from a little boy, may have been 10 or 11 years old. If he had not told me was 10 or 11, I would have sworn he was an engineer, because he sent a picture of the debris and he had it next to a ruler so that you could gauge the size of the object. It was just awesome. He was in Arizona. It turned out at the same time my father-in-law had passed—he lived in Arizona—

and we had driven out to Arizona with the family to attend the services. I said, "You know what, I'm going to go see this little boy."

I called up and said, "Okay, I'm going to come by and see you. We appreciate the information that you provided us." I got to the door. I didn't think about it at the time, but his dad was home. It was in the middle of the day. I said, "His dad is home. He's not at work or something." Not thinking that they're probably thinking in their mind this person is coming from NASA. I didn't think about that at all. They were dressed up; they had a camera set up and everything, so I was really glad to be able to do that. I spoke to the young man and I thanked him, and told him that we needed more people like him that were interested in the space program. I just wanted it to be a good experience for him and his family also. I love kids.

JOHNSON: That brings up a question. We talked to a lot of people that were involved in the *Columbia* recovery. That's one thing a lot of people mentioned is that dealing with the public in East Texas, and the locals, and how welcoming they were and how much that NASA logo meant in the reception that they gave you. Do you want to talk about that for a moment?

MURRAY: Yes. I can talk about that. First of all I know that my son, my oldest boy, at the time he and his fiancee were living in Nacogdoches [Texas]. She was going to Stephen F. Austin [State University] at the time. There was debris there, and what would happen was a soldier would be sent to just stand and watch the debris until someone came and categorized it and did whatever they had to do with it. My son said, "Mom, that guy must have stood out there all day long, but he was really fed." People were coming by, they would bring food, they would just do anything to help the folks that were involved in the effort.

We were in a hotel for a while, but apparently the hotel had already prebooked another conference. It had been on the books for months or a year, so they had to move us out. There were owners of cabins in the woods. They were offering up their cabins and things. It was nice. I got to go out and stay in a resort cabin for free. Everyone in the community was trying to help. They would bring food and drinks. You didn't have to ask for anything. You just didn't have to ask.

Organizations were offering up their buildings. I'll have to double-check this, but I think it was the Bank of America building that we were in in Lufkin. One night I actually had to drive home for something. My child had something in school. It was dark. It was the middle of the night. I was driving from Lufkin to Houston, and I got caught by a police officer, and he pulled me over. Oh gosh, I'm going to get a ticket. I had my *Columbia* recovery baseball cap on. He said, "Oh, are you with that team?"

I said, "Yeah."

He said, "Well, let us know if you guys need any help and blah blah blah, take care, make sure you get some rest." He shuffled me on my way.

So yes, that entire community was out to do nothing but help and assist us. That's all I saw. That is all I saw. It was just amazing. But it was encouraging too that humankind is humankind, and there are a lot of good people out there. A lot of people know that it's important to come together when there is a crisis, and you can help folks out and help them get through it. So that's my experience with the community out there.

JOHNSON: You dealt as you mentioned with a lot of different organizations and agencies and coordinating all that effort. Are there any instances or anything that comes to mind as far as

coordinating all those? Were there any surprises during this time to you, or things that you didn't expect, or any problems?

MURRAY: Actually no. Like I said, just like the community, the setup that we had in the offices, there was a central room where everyone was. The NASA folks, the FEMA folks, the military folks were all in one room. We'd have meetings at 6:00 in the morning and meetings at 6:00 in the evening every day just to figure out where everyone was, and everyone reported. I would say that it didn't seem very much different from the way we operate here just with JSC. Everyone's trying to provide whatever information they'd have and provide ideas they had for solving any of the problems that we had. I remember there was an accident with one of the search helicopters that crashed. Of course everyone came together for that because those people were out there helping NASA, so everyone felt really bad about the accident.

As far as coordinating with the different entities, I think it was just a time where it just proved that we all knew how to come together and make it work. No matter how different those entities were, they all had different resources that the others didn't have. I guess the surprising part was just what resources they had available to them. "Oh, wow, that's a good idea, we can use that." Or like I said using the satellite imagery.

NTSB helped us map out the areas that would be searched. They would receive results from satellite imagery. "Okay, we think that there's some debris here." They would give us a quadrant to search and what the square footage was. Then we'd work with Civil Air Patrol so that they could go out and fly over and determine what kind of terrain it is before we actually sent people out there. So things just fell into place, and everyone knew where they fitted in the

entire effort. It almost seemed seamless, now that I think back on it. Everyone just knew what to do and who to go to if you needed help.

It's a good thing, but if I say I'm surprised, it was because it just seemed to work so well with so many different organizations all working together.

JOHNSON: As you mentioned, you talked about the photo that the young boy took. All that debris had to be cataloged, it had to be tracked, and there had to be databases.

MURRAY: That's right.

JOHNSON: Do you want to talk about that for a second?

MURRAY: Yes. We did enter all the debris into a database. We worked with a company [Weston Solutions, Inc.]. We received calls for debris. I'd let the list get maybe four or five on the list before I'd call the company, and have them go out and pick the debris up. Then they would take it to a facility in Palestine [Texas]. The Balloon—

JOHNSON: Was it the [National Scientific] Balloon Facility [renamed Columbia Scientific Balloon Facility]?

MURRAY: Yes that's right. They would take it there and let it collect until we had a certain amount, then they would put it on a truck and drive it to Florida. So, all the debris had to be put into a database. After it was all entered into the database, what we actually did with the database

was hand the database over to a team in Florida. I flew out to Florida and handed over everything to Florida at that time. I worked with the folks, trained them on the database, trained them on the procedure for gathering the information from the callers, who they needed to call to go pick up the debris, and making sure that all the right information was entered into the database. I guess it resides somewhere. I don't know where it is now, but I can tell you that it was pretty huge. There were probably thousands of entries in that database.

I know that we probably didn't start the database until later in the effort. We were concerned about everything not being in the database, but we haven't really had to go back into the database for very much. At least I haven't, and no one's come to me. But at least the information is there if someone feels that they need it.

JOHNSON: When you were running the *Columbia* Recovery Office here, were there any instances of other interesting phone calls that you received, or anything else during that period of time?

MURRAY: Well, of course. There were probably a couple of folks that would call on just a regular basis because either they felt that some alien had destroyed the Space Shuttle and we weren't listening. Then there was the one that felt that the Space Shuttle was destroyed because we weren't meant to go into space. So yes, they were interesting phone calls.

We had to be very careful about what we did with some of those phone calls. There was a process. I'm vaguely remembering now there was a process. If they sounded as if it could be threatening or harmful in any way then we had a phone number that we were supposed to call and report them. I think we only did that for maybe one phone call.

JOHNSON: A different type of communications than you were used to dealing with on console.

MURRAY: Yes. You are absolutely right. But the team of folks that I worked with there was a smaller team. We actually became very close, and we're off doing different things now. One of the young ladies has retired. One gentleman was an SES [Senior Executive Service] at the time. I learned so much from this guy. He was so humble. He said he would be in meetings, and if something about *Columbia* recovery would come up, he would say, "Well, I'll need to talk to Sarah about that."

They said, "Well, why do you have to talk to Sarah?"

"She's my boss." He was the coolest guy. His name was Jon [M.] Smith. He's got his own business now I think too. Then Carl [N.] Martin, I just saw him. He works in the Astronaut Office now. He was a cool guy because he was just one of those very aggressive folks. He was one of those people you had to watch them and pull the reins on them a little bit. "Okay, Carl, let's not do that." But I know if I needed anything done Carl would jump on it right away. So the team that I did pull together for the effort here, the office here, we became very close. They were really really good.

JOHNSON: How long did you do that?

MURRAY: The accident was February 2003 and I handed it over to Florida in October of 2003. But we were in Barksdale in February. I think we moved to Lufkin in the March-April timeframe. Then we moved to JSC in the May-June timeframe. Then we worked here at JSC from June till Octoberish about.

What happened after that was interesting and maybe a compliment. When I got back to my group, my division chief said, "Sarah, we want you to move to Space Station." Oh. Well, what happened was that the group was able to function without me. But you know what? The way I see that is that I think it is the responsibility of the supervisor, the leader, to teach your folks to be able to function without the head. When there are wars or things like that, they figure if they attack the head, then everything else goes awry. That was my goal. You train your folks so that anyone can be leader when the leader is not there. So the group functioned just fine while I was there, which was great.

He asked me to move to another group that was struggling a little bit in the Station world. It was funny the way I was asked, because I'd come back to the group, and I probably hadn't been back more than two or three days maybe, and my division chief said, "Well, we want you to move to the PHALCON [Power, Heating, Articulation, Lighting and Control] group," which is the group that is responsible for the power on Space Station, solar arrays and batteries.

I said, "Well, when do you need a decision?"

"I'd like to make the announcement tomorrow." Okay. It was a hard decision, but what finally made me decide to say yes was that I'd been the group lead for the INCO group for probably three to four years. It's always good to move on, and then also open up opportunities for someone else. I knew that there were at least two people within the group that could run the group given that opportunity. So I said, "Okay, fine," and I moved to Station.

One of the folks who was going to be my branch chief, was trying to convince me to move over also. I said, "I know nothing about Station. I did a little bit of the RIO."

He said, "Oh that's okay. All you have to be able to do is spell I-S-S." But, I have also learned that moving can be very rewarding, because you now have different challenges. I had

forgotten how much I enjoyed challenges, and learning new things. So moving to the PHALCON group I had to learn about the solar arrays, the BGAs [Beta Gimbal Assemblies] and the SARJs [Solar Alpha Rotary Joint] and the hybrid FET [Field-Effect Transistor] failures that typically the RPCs [Remote Power Controller] would have.

I thought oh my goodness. At first I thought I was really drinking from a fire hose, but in about four months or so I was starting to get very comfortable and I was happy with where I was. The group needed some leadership. I can remember having a really candid discussion with the senior people in the group and telling them that the group has a reputation. I don't know what's true and what's not true. But you know what, we have to fix that. We're the group, we're going to fix it, and this is what I expect of you as the senior folks. It didn't take long before we were doing just fine, and we got those solar arrays up. That was before we were getting our solar arrays up with 12A, 12A.1, and all the issues that we were having with the solar arrays. But we marched right through all of that. We were working really hard with the engineering folks because we were learning things as we went.

The solar arrays, you can't park them here, you can't plume them, you can't do this, you can't shadow the other array, or it won't produce any energy. Someone had a cute joke. It was a picture of Columbus and his three ships and the sails. It says, "Yeah, these are sails, but you can't really let wind hit them, and you can't—" but we made it through all that. We got the solar arrays up and going. There's still some challenges with the solar arrays, but in general they're generating energy like they're supposed to. So that was a tough time for the PHALCON group, and I think we did a really good job in marching through all of those issues.

JOHNSON: You moved eventually from electrical systems with the ISS into a different position more in the Training Division. How did that come about?

MURRAY: Yes. I became the PHALCON group lead and then applied for the branch chief of that group, which consisted of the PHALCONs, the Geminis, who were another Station group, and a Shuttle group, the EGILs [Electrical Generation and Integrated Lighting Systems] and—I'm sorry, the PROs. The PROs were the power analysis group that supported the PHALCONs. So I got that branch chief job in 2005. At the same time we were about to put six crew members on board instead of three. Then also at the same time our budget was being reduced.

One of the USA [United Space Alliance] managers and myself had been talking about how are we going to handle this, we're going to have to find a better way for supporting 24-hour ops. That's where what we call the OSI operator/specialist/instructor concept started—you called it something else.

JOHNSON: Was it Top Gun?

MURRAY: Yes, Top Gun. So it started with this thought that he and I had. We went to the division chief, and he said, "Well, go off and figure out how you're going to do that."

I got a few folks within our division from each of the different disciplines. We went off on a three- or four-day retreat. Pulled a flight director in, and started thinking about different ways to do operations. What we really came up with was this operator is the name they use now. When we first started we called them Geminis because the Geminis were the folks that were on console during the quiescent periods, when there's not a whole lot of activity and one person can

handle two systems. Actually with the Geminis, I think we had one person handling three systems.

One of the goals also was to decrease the amount of time it took to train a flight controller to get on console so that we could start using them as soon as we could. So with this operator concept, the difference is that the way we had been training before, they just knew almost every detail about their system. For the operator concept, the concept was to teach them enough to recover. They don't have to know all the details, but teach them enough to do the routine work that happens during quiescent periods. If there is an emergency then they know enough to recover from the emergency or safe the vehicle and call in a specialist.

It reduces the amount of knowledge they have, and reduces the amount of training that they need and we can get them on console. Part of the other goal was that our Geminis were working the weekends during quiescent periods. They were our more experienced people. It didn't seem right to have our more experienced people working the bad hours. We felt the operators, we're giving them a little bit less knowledge, and they're fairly new. They're just getting out of school. They can handle those off hours more than a Gemini could, because it just didn't go with the way your lives go.

When you're right out of school typically you're not married, you don't have a family, so these off hours are okay. As you get older and have been in a discipline for a certain amount of time, you really would like for your job to work with your lifestyle. Now you have kids and you're doing things. So we were trying to make it where we kept folks in the organization versus making it even more difficult as they became more experienced and they were getting worse hours.

Operators we envisioned being the new fresh outs and working the off-duty hours. Then the specialists would be the next level where they had a little bit more training and they would either be the folks that we called in if there's a malfunction that needs to be worked, and they would work the dynamic periods, like EVAs [extravehicular activities] and reboosts and things like that. Those are the specialists, so they're not working console all the time.

Now we're getting into Top Gun and the reason it's called Top Gun is because in the military or the Air Force they use their most experienced people to do the training. The people who do the training have actually done the job. That's not the way Shuttle had been, because in the Shuttle world we hired folks in to be flight controllers, and we hired folks in to be instructors. But those instructors had never done the job. There were many times I can tell you we'd be on console doing a simulation, and the instructor would put a malfunction in, and someone on console would say, "That signature is not correct, that is not what we see in the real world." A lot of times the instructors wouldn't get the respect, because they really didn't know what you saw in the real world.

To us it made sense to at least have done the job before you start teaching it. So that's one of the goals of the Top Gun, to make sure that our instructors are the more experienced folks and they've actually done the work and can speak from experience also. That's the "I" part, that's the instructor, the Top Gun there. I don't remember what that question was you asked me, but this is where we ended up.

JOHNSON: Well, we were talking about your move into training.

MURRAY: Oh that's right. So I pulled that team together to start working on the OSI Top Gun concept. At the same time [G.] Allen Flynt had asked if I could move to training. Again it was for the same reason.

I believe I am seen as this quiet strong leader. I don't yell at people, but I do have high expectations. A lot of the way I lead is probably from the way I led when I was in the military. So he asked, "Can we use her in training?"

I know my division chief at the time wasn't too thrilled about that. He said, "Well, I don't think we really have a choice. If they want to move you, you're going to have to move."

I said, "Okay." So I moved to the training organization. The interesting story about that is that at the time my husband was working in training. Allen and Stan [Stanley J.] Schaefer, who was the division chief at the time, said, "Well, is that going to be a problem? Your husband works in training. He's a contractor. You'd sort of kind of be in charge or over him."

I said, "Well, actually it makes it better, and there's less confusion. Now I'm in charge at home and at work. So it just helps."

JOHNSON: Just simplified everything.

MURRAY: Just made things simpler, more consistent. We just laughed about that. But that was never a problem. So I moved over to the Training Integration Branch. I was probably only there for about two or three months. That was in 2007. Then MOD started moving on their plan to reorg [reorganize].

Part of the reorganization was to implement the OSI, the Top Gun concept. That meant locating the instructors in the same areas as the flight controllers so that they're all working

together. Another thing too is that we felt that it would be more efficient because some of the things that the flight controllers were learning were the same things that the instructors had to learn. Why are we teaching these things in these different areas when you can have one common? Then you teach them all the same thing at the same time. Where they need to diverge, then we start diverging. So we came up with what we called boot camp. Boot camp is for all new hires. This is all the information, all the training that you have to have whether you are a flight controller or an instructor. That way we prevented the training organization from teaching the same thing at the same time that the flight control organization is teaching it, and you're using all these resources when you don't need to do that.

That also gave us some standardization and consistency in what was being taught. Even within the flight controller disciplines, say everyone had to learn how to command, and the Station disciplines. But ODIN was teaching their folks how to command, CATO was teaching their folks how to command, the PHALCONs were teaching their folks how to command. Just have one command class rather than having eight disciplines do it. It's just one class where everybody goes to that class and they learn it. I think that was pretty huge in pulling that together, because we reduced the resources required to do that, and we made sure that the training that was given was consistent.

With the reorganization, we moved the instructors around, and we created DA7, which is the Spaceflight Training Management Office, which was totally new at the time. Before that DT, the Training Division, was just a separate division. You had DF, which was the division that had all the flight controllers in it. You had DX, which was a division that was mostly robotics and EVA. But in the reorganization, which is true, what they wanted was someone to oversee training for all of MOD, and not training just be the separate entity here.

That's where the DAs come in. I'm not sure if you're familiar with the MOD structure. But you have DA3 and 6 and 7 and 8. You have the DAs because they are more integration offices. Then you have your individual divisions that fall up under there.

They decided to create DA7 so that we had an office that managed the training across the entire directorate. Allen Flynt selected John [A.] McCullough to be the chief of that organization. Then John conducted interviews for his deputy and I was selected to be his deputy. That was maybe the July-August timeframe of 2007. Then I became the deputy chief, which is where I am today.

The cool thing about that job, first of all McCullough is just the greatest person to work with. Oh my goodness. He's a great mentor. He's a really great leader. He's got a lot of vision, and he's all about inclusion. You don't always appreciate your supervisors, but I thoroughly appreciated him. Had no issues whatsoever working with John. I learned quite a bit from him. So that was good, and we worked absolutely as a team at all times.

I've seen it done differently depending on who you work with, but with John it was a management team, period. It wasn't I'm the chief and do as I say. It was not like that at all. I really appreciated that. The other piece of the deputy job, which is another thing that has been an awesome experience for me, is being chair of the International Training Control Board [ITCB]. I didn't have a good feel for what that would be like. I did a little bit of research before the interview so that I had some sort of understanding. I went to the very first meeting to observe and introduce myself, because the chair at the time knew that she was transitioning out with the reorg and invited me to the meeting, which was in Montreal, Canada.

I met all the international partners that were a part of that board. The board has a NASA person as the chair, and the Russian GCTC [Yuri Gagarin Cosmonaut Training Center] person is

typically the cochair. Then you've got your Roscosmos-Energia, JAXA [Japan Aerospace Exploration Agency], ESA [European Space Agency] and CSA [Canadian Space Agency] representatives on the board. I think what I like most about that is the actual interaction with the different cultures. It's just learning all the different nuances and how you deal with them, because you can't really deal with them all the same way.

For the most part you want to do that because that's the fair thing to do, but you really have to understand how to work. For instance working with the Russians. If I know I have a big meeting coming up with everyone, I know I'm going to talk to the Russians first, because otherwise I'm not going to get anywhere in my meeting. So you kind of what they call "grease the skids." Talk to them, get their thoughts and ideas on it. Make sure that we're headed down the same path and there are not these big roadblocks. Then they're our biggest partners. So what I've learned to do with those guys is, for instance, the deputy of GCTC, I'm going to call him as soon as I leave here. It'll be 9:00 at night there, but we have each other's cell numbers. We've figured out how busy we are. We talk to each other on the weekends and after hours because it's the only time we can catch each other. So I called him early Monday morning at midnight because it was early in his day, 9:00. You learn to work with the different partners differently.

For JAXA, I would say the Japanese are very polite people. Oh, they're so polite. They don't get loud or arrogant or obnoxious in meetings. They're very deliberate. They're very careful about what they agree to or don't agree to. They will tell you up front, "We need to take that back and discuss it some more." I appreciate that. They also keep every document that was ever written by man. One of the issues that we had was each of the partners, each of them take turns hosting our meetings. We have face-to-face meetings twice a year, and I have a telecon once a month. In the fall we alternate either Houston or [NASA] Marshall [Space Flight Center],

because I have Marshall representatives, so either Houston or Marshall will host the meetings. Everyone will meet here at JSC or at Marshall. Then in the spring we either go to Montreal, [Canada] Cologne, [France] JAXA or GCTC in Russia.

The [ISS] Program Office led by [Michael T.] Suffredini said that it's more economical for us to have our meetings in Houston or in Moscow, because all the logistics, everything is set up to handle that. If working groups or panels or boards met anywhere else then the hosting country has to provide the interpreters. The Program Office is not going to pay for interpreters. Of course that's not a problem for Russia. CSA and ESA, they were able to provide us with interpreters. But JAXA pulled out a document from '97 or '98, and it said that all meetings will be held in English. They said, "So why should we have to provide an interpreter?"

I said, "Yeah, that document was written over a decade ago. Reality is we need Russian interpreters. That's just the reality." So we held one face-to-face at JAXA and that was when we found out their management wouldn't pay for interpreters. I said, "Well, we can't go to JAXA anymore."

The folks on my board, we've become I guess close. We're more than just coworkers. [Kotaro] Doyama-san, who is the board member from JAXA, said, "Sarah-san, I will try. I will try my very best." Sure enough he came back and said his management will only pay for our board. No one else's. Not when the crew members go over. Not any other boards or panels. So we're scheduled to go back to JAXA in the spring. Everyone's excited about that.

What I appreciate about the Japanese is that they are reasonable, and they're not obnoxious. I can't say the same about all the partners, but I thoroughly enjoy working with all of them.

Folks used to ask me, "What about the Russians? Aren't they difficult to work with?" Maybe in general they are, but then it's that old thing. After you gain some sort of rapport in a relationship with the ones that you're working with, it's easy after that. You just figure out what's important to them, what's important to you, and where you can compromise and where you can't. In the beginning there was a little tit for tat going back and forth and arguing about things. That doesn't bother me either, because I'm one of those people that like to go to the car dealership and negotiate. I just like to do that for fun, whether I'm buying a car or not. I don't have a problem with that at all. If that's something that you're uncomfortable with, then you probably won't enjoy dealing with the partners. But I'm not uncomfortable with that, so I'm perfectly fine with that.

ITCB has been very very rewarding for me, because I've had a lot of experiences. I've gone places that I probably never would have gone. I still enjoy it to this day.

ROSS-NAZZAL: One of the things I was curious about, you've worked for MOD for so long. How do you think opportunities for women and people of color have evolved over the years? Certainly you gave that example of people saying, "The ghetto has come to MCC [Mission Control Center]." But certainly things have changed quite a bit.

MURRAY: Yes they have. I would say for the good. I think there's still room for change. There is something that is typically communicated to probably 99 percent of the African American children that come up in the world. To be seen as an equal to let's say your white coworker, you have to do better. The point there is that if I perform at the same level as you perform, there are many cases where I won't be seen as your equal. To be seen as your equal I have to do better

than you. I know that many of us have told our children that for decades. You've got to do well, and you've got to do better.

I would say within MOD for the most part I have not seen any barriers, but I do know that overall just talking to other African Americans that work with NASA and even some females, there's still some room for improvement.

ROSS-NAZZAL: Do you think that's because of the history of MOD? When you look at photographs of Mission Control from the '60s for instance, you see 99 percent white males. I think the first [female] flight director didn't come around till '92 with Linda Ham. You don't see a lot of people of color. You may have been one of the first women of color to work in MCC I guess.

MURRAY: I think one of the things that I've talked to with MOD's Director is just the opportunity to even see the minorities, women and African Americans or even Hispanics. How much are we reaching out to the historically black colleges and those things? When we do our recruiting, if we're going to predominantly white schools, then that's what you're going to get. So especially in the environment that we're in today, typically when we hire, we are hiring from our pool of co-ops. So when we look at our pool of co-ops, if you don't have minorities in the pool of co-ops, then you're not going to hire minorities.

I know that's one of the concerns, just outreach to more than just the predominantly white schools. But after you get your foot in the door and you prove yourself, then your chances are pretty good that you're going to do well in MOD.

ROSS-NAZZAL: When you were talking about your management style, I thought it was very interesting. How you were talking about moving people around and the Geminis, moving them to the more experienced positions, not working on weekends, and recognizing that they had a family life. Do you think your experience as a woman, as a mother, someone who's been working for all these years, played into that style?

MURRAY: Actually it did not. Again it's because like I said, I was taught to just always work hard. Just period. I will tell you that for years—probably decades—I don't care what was going on at home, I never mentioned it at work, because I didn't want it held against me. If my kids had a doctor's appointment—because I feel like I grew up in the age where they didn't want to hire women because they'd get pregnant, or they'd get married, or they'd have to take care of their children. So I never ever mentioned that my child had an appointment or I have to go to the doctor. As a matter of fact I was pregnant four times during my careers and never ever took a day off until I went into labor, period. It was because I didn't want to fit that stereotype. I didn't want that held against me when there were opportunities to move or be promoted or something like that.

What I had to do was make myself a little bit more sensitive to the needs of our senior folks and their families. Even though I didn't apply it to myself, I knew that it was important. When I thought about in general how we were working folks, it just didn't sound right. It just wasn't right at all. These are our best people and we're shoving them off onto a night shift and the weekend shifts. We never see them. They could be working projects and things to excel us, but just the paradigm that we were in didn't allow that.

So as far as my being a wife and a mother, I would probably say that my family has probably been pretty neglected. I look back on that and I think I probably could have done a better job.

ROSS-NAZZAL: But you got to do all the things that you wanted to do. You were able to provide that balance, you think?

MURRAY: I don't know. I think I probably should have devoted more to my family.

JOHNSON: You're not alone in that.

ROSS-NAZZAL: No that's true.

JOHNSON: We've interviewed lots of people, and the majority of them were men that feel that way. So you were living that same life that they led.

MURRAY: You're just so afraid that if you miss a meeting or a conversation or a telecon, then someone else is one step ahead of you. Or someone's saying, "Well, you should know that. Where were you?" That sort of thing. So you're just trying your best to stay on top of everything. Then what's added I think for me is that I don't want to represent the black community or the female community in a negative way. I don't want someone to be able to point to me and say, "Yeah, she worked for us, and she didn't do a very good job." Or, "She was out taking care of her kids." Like I said in hindsight, I should have devoted more time to my

family. I think that being born in the time that I was born in, I understand why I thought the way I did. I absolutely understand that.

But even to this day I'm not doing what I'm supposed to do. It's hard to change. It's hard to change. I think about even doctors' appointments. I might get to the doctor every two years. Maybe. "Oh I can't take off. I can't take off." My daughter-in-law, she said something very interesting last night. I said I had a telecon this morning at 6:00. Depending upon if I'm conducting it or not, I'll either come into the office or I can just call in from the house and participate then.

I made the comment. I said, "I think I'm going to call in," not realizing that folks think of that calling in means I'm going to call in sick. My daughter-in-law says, "What? You're going to call in? I want to see that! You would never call in."

I said, "Oh no, I'm not calling in sick. I'm just going to call into [the telecom]." So even my family sees that I'm that type of person. I've never ever called in sick and just not made something.

If I'm on vacation and there's something I can tie in via phone, then I'm there. I need to stop that. I absolutely need to stop that. There were times when I just didn't take vacation. I'm one of those people that have weeks of use or lose. Weeks of use or lose.

One time it was one of our very first Station missions. Our Division Chief went on a three-week tour. I thought, "If he's expendable then I am too, and I can take vacation." It's still hard to do. But I have to think of it like that. My husband got a job in Miami [Florida] back in December. How can I get out there, I can't take off, and I'm not flying all the way out there for two days. So I haven't been there. I know now it's okay. It's just trying to get out of that mode.

Now I have three kids trying to get into school. I wasn't able to help my boys. They had trouble getting registered. They flubbed it up some sort of way and now they're not registered. I wasn't there to help them. So I think it's a little different now.

One thing that I see that's different is even with the males. I was interviewing for a job and I went to talk to some folks in one of the organizations. I asked them about their supervisor. The guy that I was talking to was an older gentleman. He said, "Oh, he's always off for something with his kids. He's always doing stuff with his kids." So I see this younger generation, especially the guys, who know it's important for them to spend time with their family. Then the older generation is like what's up with that. They're always out, the kids have a recital to go to or something.

Not only is it different I think also for the females, but I see that even the guys are coming on board with that. They see that it's okay. So it is most definitely a whole lot different than it was years ago. Most definitely.

ROSS-NAZZAL: Do you think that was your biggest challenge while working here at JSC? Or would you say there was something else that was more challenging?

MURRAY: Yes, I think that probably was the biggest challenge. In the military and at home, we were raised to speak our mind. Be vocal. Be courteous, respectful and professional, but still speak your mind. One of the things that I noticed—and it could apply to either minorities or whether it be the gender or the ethnicity—is that as a white male you can say something, and as a black female you can say the same thing, and they say, "Wow, what's wrong with her? That time of the month or what?" But as a white male you say some of the same things. "He's a

strong leader." That still happens today I'm pretty sure. That still happens today. But in general it's better.

Another thing that I think is huge is I would say just having [President Barack] Obama being elected. Not that he's the best President or the worst President, but that to me said something about the country, that people are coming around and it's okay, and that we are equal. To me that's huge. To me, I wasn't really thinking about, "Oh yes, we have a black President!" What I was thinking was how many people had to vote for him. If this country is only made up of 15 percent blacks, that means that there are a lot of people that are okay. So you know that says a lot for this country. I think that says a lot for the country.

I know that there are minorities that react differently to biases. There are some that get angry. They're just angry all their lives because they've been mistreated or there's been some sort of prejudice against them. Then there are people like me who say, "Yeah, I could be angry, but what is that going to get me?" I do see the difference when I do see that there's still room for improvement.

Where I grew up, my family is from Mississippi. I've seen my father beat by whites, when we were just little kids, and they just beat him till he was unconscious, and there's nothing you can do. My cousins killed or shot because they winked at a white girl. The body was left in our front yard.

So people react differently to their experiences. What I see is that unfortunately it's a part of life. It's how you respond to it which dictates I think how you will move forward. So you can choose to move forward or you can choose not to move forward. And I just choose to move forward. I'm glad things are changing. I'm glad things here at JSC—[Center Director Michael L.] Coats is doing an awesome job. He's looking into this disparity against the

promoting of African American males. I don't know if you've seen those statistics. It's very telling. Apparently based on the statistics African American males have not been promoted on the same order as other races. Coats has a bar chart. You need to see it. It shows promotions of black females, Asians, Hispanics, whites. They're all pretty here [gestures]. Then when you look at the African American males, these are the ones that have just been a GS [General Schedule]-13 forever and not been promoted.

Coats said that he'd like to be able to tell every young person that all you have to do is work hard and you'll succeed. But he says looking at the statistics, you can't really say that. You can't tell me all of those young men aren't working hard and they're not getting promoted. There's a reason for that.

Like I said in the beginning it's typically not a generic problem. There are some onesy-twosies here, and if you end up in an organization where there's someone that can hold you back, then they'll hold you back. Then there are also the ones that don't realize that they're doing it. There are absolutely folks that are not familiar with dealing with different races. So when we present ourselves we're just seen differently. It's not done on purpose but I think that happens sometimes also.

I thank Coats and Ellen [L. Ochoa, Deputy Director]; I really applaud them for being very open about it. He's had all hands meetings with his supervisors and talked about it, and has even given actions to go back and look at that particular group of folks within our organizations and find out is there a problem.

So that's what makes it better, when you know you have folks out there that know that there's room for improvement, and are actually acting upon it. It's good to have that at the head, at the top. If you know there's a problem down here, but your leader doesn't see a problem, then

you've got a problem. I trust Coats to make sure that every opportunity is out there for any- and everybody. That just makes a huge difference when the Center Director is on board with that.

ROSS-NAZZAL: Yes absolutely.

JOHNSON: Do you have anything?

ROSS-NAZZAL: No. I think that's it.

JOHNSON: We appreciate you coming.

ROSS-NAZZAL: Thank you so much.

[End of interview]