RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY

NEW BRUNSWICK

AN INTERVIEW WITH CANDY TORRES

FOR THE

RUTGERS ORAL HISTORY ARCHIVES

INTERVIEW CONDUCTED BY

KATHRYN TRACY RIZZI

BRANCHBURG, NEW JERSEY
APRIL 16, 2020

TRANSCRIPT BY

JESSE BRADDELL

Kathryn Tracy Rizzi: This begins an oral history interview with Candy Torres, on April 16, 2020, with Kate Rizzi. Thank you so much for doing this interview series with me.

Candy Torres: Thank you.

KR: Last time, we left off talking about your early career, when you were working at Princeton and then McDonnell-Douglas. What challenges do you think you faced in the early part of your career?

CT: At Princeton, the job qualifications in the ad were: "Some knowledge of Astrophysics or Astronomy, or Physics or Computers." In developing my individual major, I had satisfied all requirements with "and" instead of "or." In a sense, I had already met the challenges of my new job. The on-the-job training was awesome. The astrophysicist who hired me, Dr. Ted Snow, was easygoing and provided me with extra opportunities beyond my assigned work tasks. The first day I started, he said to me, "You're a professional." He left it up to me define it. I made sure all of my actions represented myself, my boss, and the department in the highest standards. I felt proud. I was trained in my job by the guy who was leaving, and after that, I had a friendly group coworkers to coordinate with. My interactions with Dr. Snow was to report on the status of astrophysicists' experiment data and provide the quarterly NASA reports.

I interacted with the *Copernicus* technical staff on a daily basis. I would find out when an astrophysicist's data was ready for verification. I did this in a room filled with printout books from the accumulating years of data. It was a relaxed work atmosphere with time to chat and learn from each other. None of my coworkers were astrophysicists and had probably minimal knowledge of the field. My job in no way required me to program. I just had to know what a computer was. The only reason I programmed was, as mentioned earlier, I wanted a more efficient (not boring) way to complete the quarterly reports to NASA. That was the only time I worked closely with a coworker, who was a programmer. After that, I just took off on my own trajectory.

Although I didn't work with the engineers, our offices were along the same hall. I would often go to their work area and ask them what they were working on. We played pranks on each other, and every year I made homemade pumpkin pie using pumpkins from someone's garden.

Working at McDonnell-Douglas (also referred to informally as MacDac) was really wonderful. In fact, I guess in reading some more recent history, NASA was very encouraging of diversity in the '70s-'80s, not just where I was, but in other centers. There were no challenges in any adaptation to the work or people. Learning the software and mission operations was a joyful challenge. I supported sixteen Space Shuttle missions from 1984 to 1986. [Editor's Note: The Lyndon B. Johnson Space Center (JSC) is a National Aeronautics and Space Administration (NASA) facility in Houston, Texas that conducts human spaceflight training and operations. The Christopher C. Kraft, Jr. Mission Control Center (MCC) is located at the center.]

I need to clarify the work situation. NASA (civil servants) was the customer, and McDonnell-Douglass (contractor) provided the workforce. Civil servants and contractors worked side by side with different roles. My MacDac boss was Dave Clark. He was the man who interviewed

me over the phone and hired me sight unseen. He was very supportive and encouraged my desire to take advantage of opportunities. It was arranged for me to go through the Space Shuttle simulator checklist training. It was called a high-fidelity trainer because it replicated the flight deck accurately in systems and response. I was given a specific scenario to follow, such as an emergency. I had to go through every step of the checklist exactly as written to solve the problem. In this instance, it was an electrical fault. This is where one learns from mistakes safely. My lesson was to not flip the breakers unless I knew what had made them flip off in the first place. I completed the session successfully. Since this was not part of my official job description and training schedules were tight, I got to do this once. I requested any other training materials, which were a lot of black and white videotapes with crude animations to show the flow of fluids or the activation of systems.

Since our team worked whatever hours were necessary to get the software ready for the system, I was given flexibility to visit other buildings and meet people who supported the Space Shuttle in other ways. I went to the Weightless Environment Facility (WETF) to watch the divers train the astronauts in the deep swimming pool. It had a structure resembling the exterior of the shuttle, so astronauts could practice moving and using tools in a simulated microgravity environment.

We also had a NASA boss, Bill Bates. He was the one who let us go to the park, once the shuttle launched, as well as organized our group breakfast at a local restaurant before starting the work day on site. We also went on the Texas country day trips I mentioned in a previous session.

KR: How about at Princeton? How diverse was the workforce when you were working on the OAO-3 *Copernicus* satellite project?

CT: It was diverse. We had a woman from India. There were women and men. The graduate students were mostly male. I remember one female graduate student, but for the most part, I didn't really deal closely with the graduate students until I was the System Administrator for the VAX computer.

KR: You said that things changed later, and I will circle back to that as we get further into your career.

CT: Yes.

KR: I want to ask you some follow-up questions from last time, when you were talking about working at McDonnell-Douglas on Mission Control. You developed software for failure analysis and for shuttle configuration. In lay terms, what does that mean, and what did that entail?

CT: When I started in 1984, the Space Shuttle was using the same equipment as the Apollo era. What you see on TV is the main control room--the front room-- the Mission Operations Control Room (MOCR, pronounced as "moh-ker"). These people were the ultimate decision-makers. Integral to the Mission Control Room are the consoles used by the flight directors to monitor different aspects of spaceflight missions. Each console is roughly 1,200 pounds and used cathode ray tube (CRT) technology to process and display information. A system of pneumatic

tubes (vacuum tubes with cylindrical containers) were used alongside the consoles to help mission control team members communicate with one another. Each position represents a different discipline: navigation, environmental, electrical, communications, flight surgeon, flight dynamics, etcetera. The work area had monitors and rows of buttons. They each had monitors--not computers--with the data displayed from the shuttle. The monitors could only show alphanumerical information--no images or graphs.

There were also people in the back rooms, for each one of those positions in the front room that you would see on television. These were called Multi-Purpose Support Rooms (MPSR, pronounced "mipser"). There would be three or four people for each position that would do the actual data analysis. They were the ones who solved the problems and then called back on the loops to their front room person. Communication was in two forms: headsets to speak with controllers in different parts of the MOCR or with the various MPSR controllers. On the console were buttons controllers would punch to connect with several disciplines relevant to the issue at hand. The pneumatic tube was for paper information within the MOCR and between MOCR and the associated MPSR.

If the MOCR controller's screen data looked a little flukey, then he (usually male) would contact his back room people. They would see the same data on their monitor and discuss the situation. If it needed further exploration, they would open up these their dot matrix printed books with diagrams of the system and they would trace through what they saw and try to resolve the problem. They literally used their fingers to follow the diagram, and that was the task we had to replace. That was their tool, and what we did was computerize it. Midsize computers were used--the Harris computers--with real computer monitors that would help them use the software. The flight controllers logged on to the software and used FAP and SCAP. Computers were new to them. In fact, programming was a new concept, too. [Editor's Note: FAP refers to the Failure Analysis Program and SCAP to the Shuttle Configuration Analysis Program.]

Our software development was only done between missions, but during the mission, they needed someone to provide computer support to the flight controllers answering software usage questions. That was twenty-four/seven. So, we'd take shifts, and I would always volunteer for the weekend or the night shift. I'd take the pager and continue my city exploration. I could go out for twenty miles, as far as the pager could go, and still get a call, but I tried to stay close to home. Sometimes, I got a pager call in the middle of the night. It was usually someone in the front room who would say, "We're having a problem with the software. Something's not working." So, I would listen to them on the phone, and because of all my work at Princeton, I had developed good listening and visualization skills to explain. I retained that ability--what is it like to see something and not understand it?--plus I had developed the software. So, as the person spoke, I could gather where they were in the software and what did they really understand about the software. I could talk them through the problem. Now, if I was not able to do that over the phone, then the next step was for me to go to Mission Control and help them through it. However, I was always able to understand what they were talking about and resolve the problem over the phone. I took a great deal of pride in being able to do that and knowing I was helping Mission Control complete its mission.

The first time I worked in Mission Control was on January 14, 1986. I was sitting in the EECOM MPSR [Electrical, Environmental and Consumables Multi-Purpose Support Room]. [Editor's Note: Ms. Torres recorded in her journal that day: "About forty-five minutes ago, I finally got to go into the MOCR during a mission!"] We call it the cathedral. You see on television Mission Control. For someone like me who dreamed the impossible dream of working in the space program, this was incredible. I was at the heart of space exploration and I had earned that right to walk in there and help them. It was almost literally like hearing a chorus of angels sing, "Whaaa!" when I walked through the door. It was just a great feeling that I was a part of it, part of something big and important, and that not many people in the world got to do. It was a lot of fun, and the flight controllers were a lot of fun. A lot of them had worked on different Apollo missions, and they had worked the earlier missions too. One of them was Gene Kranz. Of course, he was the Flight Director for Apollo 11 and Apollo 13. He was in charge, the Mission Operations director, so he got to see our software. I was part of that history. Oh, my gosh, I'm working with this historic person, a NASA legend. Not just seeing this person, I'm helping him as a team member. I'm helping the flight controllers. I am actually helping the astronauts on the missions. It was really, really great. I had a lot of fun. [Editor's Note: Gene Kranz worked for NASA from 1960 to 1994. He served as the Flight Director for the Gemini and Apollo programs, including the first lunar landing in Apollo 11. He went on to serve as deputy director of Flight Operations and then director of Mission Operations. In popular culture, Kranz is portrayed by Ed Harris in the film *Apollo 13*, which delves into the successful efforts of NASA to return the Apollo 13 crew safely to Earth, after an oxygen tank blew in space and the crew had to abort their mission to the Moon.]

I met people from a lot of different areas. I was always talking to people on site. Of course, the astronauts were in the same building, so I got to talk to some of them too. We had mission parties afterwards, so everybody would hang out, flight controllers, astronauts, engineers, scientists, technical support. I was really right in the midst of history and historic people.

KR: What were some of those problems that you would get called about and then you would have to solve them?

CT: It was just something they didn't understand about the software. It wasn't giving them the answer they wanted, so they were confused by what they were seeing. It wasn't a problem with the software itself. There was a learning curve. In the beginning, they didn't understand the idea of computer programmers. We were a lowly bunch until we were called Software Engineers. The flight controllers could relate to "engineer." That's really all it was, helping them learn how to use the software.

An example is when a flight controller was having a problem with a *ved* file. He thought he's lost it. I saw that he had made the mistake of giving it a name with embedded blanks. I changed the name via "*mv 'eecom stat 3' eecom.stat.3*". I don't recall what a *ved* file was, but the "*mv*" means "move" the file name with blanks to one with periods. EECOM was the Electrical, Environmental, and Consumables (originally COMmunications, thus COM part) manager.

KR: What were some growing pains during these very early years of computer use in the shuttle missions?

CT: Well, getting respect for computers because they didn't understand these things at all. They just knew the old-fashioned method of seeing the data and tracing diagrams, visuals diagrams. To have a computer doing something, because it's invisible, was mysterious to them. Its machinations are invisible, unless you were the software engineer that designed it and you knew in your head what was going on. To a user, they're just entering in some information and then it somehow spits out information. They were used to manually going through the process, "I'm looking here, then I'm going there, and then I'm making this decision." That's what the software is doing, but they can't see it. That same came issue up at Princeton when they were learning. It's a mystery. I've read the computer described as a box. It does things and people can't relate to it, like they can a car engine. They understand, a car has an engine, and it needs gas, and you have to do certain things to make it go, and there's certain problems to be solved sometimes by mechanics. A computer doesn't have that same transparency. When I was at Princeton, I had learned how computers worked, not just how to program. The flight controllers didn't have understanding in either aspect of computers.

KR: You said in our last session that you witnessed as a spectator the STS-2 and STS-7 missions, the takeoffs?

CT: STS-1.

KR: Oh, you saw STS-1.

CT: The very first one.

KR: Oh, wow.

CT: Yes.

KR: Okay. Tell me about that. What do you remember?

CT: Oh, wait, I knew that there was something else that I wanted to add, because before we get to that, this week is the fiftieth anniversary of Apollo 13. I was in high school. We had a television in the room, so I remember seeing the splashdown in language lab when it occurred. Of course, I didn't get to see most of the mission because I was in school. Well, I got to meet Fred Haise, one of the Apollo 13 astronauts, in the 1990s at a book signing in Clear Lake. Lots of astronauts and NASA folks live in Clear Lake. That was one of the things that happened in the past, and you don't know you're going to meet these people. Now, I've got to remember what your question was. [Editor's Note: Fred Haise is an astronaut who served as the Lunar Module pilot in the Apollo 13 mission. On April 11, 1970, Jim Lovell, Jack Swigert and Fred Haise launched from Kennedy Space Center in the Apollo 13 mission, which intended to land on the Moon. On April 13, an oxygen tank blew in space, so the lunar landing was aborted. On April 17, tens of millions of people watched on television as the crew of Apollo 13 safely splash landed in the South Pacific Ocean.]

KR: What do you remember about being a spectator and watching STS-1 take off?

CT: Yes, there were four of us from Princeton who got together and headed straight down to Florida. It took a full day to get there. We arrived just before dawn and saw the Space Shuttle *Columbia* with spotlights on it that made it look like a jewel. We camped out for the next few days. We got on a tour bus and we didn't expect to get that close to the Space Shuttle. It was April 9th, and the shuttle was supposed to launch the next day. We couldn't believe how close we got, "My God." I have a great photograph of the shuttle, because I was on the wrong side of the bus. I was a photographer, I had a 35mm single lens reflect (SLR) camera. We were getting close to the shuttle, and I lunge across the aisle to take this picture. Of course, I have no idea how it's going to come out. Well, you see the silhouette of one guy on the left and the back of the head of the other guy on the right, with the shuttle in the middle. It was a perfectly framed shot! I showed this to a television guy several years ago, and he thought it was a great photograph. [Editor's Note: NASA conducted the Space Shuttle program, officially called the Space Transportation System (STS), from 1972 to 2011. In the first space shuttle mission, STS-1, the *Columbia* launched from Kennedy Space Center in Florida on April 12, 1981.]

The shuttle didn't launch the next day, April 10th. [Editor's Note: Ms. Torres added to the transcript later that the launch was scrubbed because *Columbia's* four primary general purpose computers (GPCs) failed to provide correct timing to the backup flight system (BFS), when the GPCs were scheduled to transition from vehicle checkout to flight configuration mode.] We were able to stick around to see it launch on April 12th. We were on a causeway with the launchpad way off in the distance. However, with my camera equipment, I was zooming in. Even from a distance, I was able to have several good photographs as it launched.

In June 1983, when Sally Ride launched, which is STS-7, I decided to go by myself and see her launch. I got in as press because I had a cable television show in South River. I didn't have an official press pass, but I had a piece of paper from the station and NASA security said, "Okay, fine, we'll let you in." I was able to hang out in the press section and a building with students who had experiments on the shuttle. I got to talk to them, meet with them. I stayed up all night, chatting with students, press, VIPs, waiting for the launch. I had a video recorder, which was big and bulky. One piece was the recorder, and the camera was the other piece. The recorder was slung in my backpack. I have actual video of the STS-7 launch, as well as photographs. It was hard to handle two cameras at the same time. I finally thought, "It's one or the other. I can't do both of these things." [laughter] I have a beautiful video of the launch, and then I have a lot of pictures, still pictures. I walked the full viewing area, hanging around, people watching, television, people covering the launch. [Editor's Note: On June 18, 1983, in STS-7, the *Challenger* launched with a crew of five, including Sally Ride, the first American woman in space.]

The shuttle was supposed to land at Kennedy Space Center. I really wanted to see that. I had a few days before that happened, so I just went off to South Florida to the Keys, before I drove back to Cape Kennedy. Again, I stayed up all night talking, because *Columbia* was to land early in the morning. [Editor's Note: Ms. Torres added to the transcript that STS-7 was scheduled to make the first shuttle landing at Kennedy Space Center's then new Shuttle Landing Facility. Bad weather forced a change, so that *Columbia* landed on Runway 15 at Edwards Air Force Base on June 24, 1983.] I never saw a shuttle landing. I've only seen shuttle launches. That was '83, and

a few months later, I was already going to be leaving Princeton. I got the job at NASA, and I was in the same building as Sally Ride and the astronauts. Who knew?

KR: Describe to me the sights and the sounds of witnessing a Space Shuttle take off.

CT: Well, they said that the Saturn V was much more majestic because it was slower in its launch. There was the big analog countdown clock on the lawn with the launchpad in the distance. When the engines lit, you'd see a lot of smoke come out. Then, the shuttle sways from the power. Then, the shuttle rose up with flames and smoke. Down at the bottom, there's puffy hot stuff that spreads out. It was just beautiful. We were quite a distance away, but there's some residue from the fuel, the solid boosters, that floats in the air towards us. We were warned of its acidity. We would have to protect ourselves from that. It wasn't a big concern because we were so far away, but they would just let us know that there might be some of this particulate coming down. [Editor's Note: The Saturn V rocket was utilized by NASA from 1967 to 1973 as a launch vehicle in the Apollo missions and for the first American space station, Skylab.]

KR: What did it mean to you to witness STS-7 and see the first woman go into space?

CT: Well, it was exciting. Then, of course, I had my television show. Our other television episodes used video from NASA, but here I had personal commentary and personal experience and video to go with it. It was exciting because all of my life I wanted to be an astronaut and I get to see the very first American woman astronaut go into space.

KR: What was it like when you met Sally Ride a little bit later?

CT: Actually, I met her at least once in New York when I attended a space conference, so that was 1983. It didn't mean anything if I had been told where my office would be. When I got there to NASA and found out that I'm in Building 4 with the flight controllers and the astronauts, the very building, and my office was in there, wow! It wasn't just Sally Ride but seeing all of the first U.S. female astronauts and the other firsts, like John Young, Bob Crippen. There was this sense of awe and wonder and excitement and like, "I can't believe this." A little girl who had this big dream and here I am, one of the privileged few to actually work there, to be part of the team. I tried not to have my jaw drop all the time, but inside I felt it. We had mission parties afterwards and I'd see astronauts from earlier periods, Alan Shepard, John Glenn, Deke Slayton. Or we'd have the chili cookoff and see them. I got to meet so many of them.

I had a friend, Bob, come visit from Virginia, someone I had met a couple of years before I left New Jersey. This is a different story, but we met in North Carolina in hang-gliding and we both loved the space program. He visited me in New Jersey, so he got to see my work at Princeton. He came down to Houston, and I showed him around. He was in awe to meet some of the people he read about. He read a book by James Oberg, a well-known author who had been a flight controller. Oberg worked at McDonnell-Douglas too. Bob and I were in a parking lot when I saw Oberg, so I called him over. Not that I was close friends with James Oberg, but still it was essentially a coworker. My friend couldn't believe it. He has his book and he's getting it autographed by Oberg. My friend was around during a mission party with all the astronauts and NASA people. He saw astronaut Gordon Fullerton just sitting by himself against a tree and went

over to talk to him. Bob was in awe that he's meeting all these people, "Oh, my God." Obviously, he was a space nut too. After all these decades, we're still in touch. He remembers all the great things we got to do. It was a lot of fun to share that with him, "Wow, us ordinary folk are part of this." [laughter] [Editor's Note: James Oberg is a retired NASA space engineer, historian and journalist. Gordon Fullerton (1936-2013) was a test pilot and NASA astronaut who served in two Space Shuttle missions, STS-3 and STS-51-F.]

KR: Who are some other astronauts that you met, and what sticks out in your mind about meeting them?

CT: At the 1984 NASA annual chili cookoff, I met Alan Shepard. Of course, I heard him on the radio in second grade. I have a great photograph I took of him. I saw Deke Slayton at a fun run, and I have some nice pictures of him. Neil Armstrong, I met in '99 and shook hands. Well, actually, I saw him in 1979 in Washington, D.C., and I have a photo of all three of Apollo 11 astronauts. I was at NASA when John Glenn returned to space in 1988. [Editor's Note: On May 5, 1961, American astronaut Alan Shepard became the first American in space, achieving suborbital flight in the Freedom 7 capsule as a part of the Mercury-Redstone 3 mission. Shepard landed on the moon in 1971 as the commander of the Apollo 14 mission. Donald "Deke" Slayton was an Air Force pilot, astronaut, aeronautical engineer and NASA administrator. Slayton served as one of the original Mercury astronauts and later as the docking module pilot on the first international space mission, the Apollo-Soyuz Test Project. On July 20, 1969, Neil Armstrong and Buzz Aldrin landed on the Moon in NASA's Apollo 11 mission. Michael Collins flew the Command Module Columbia in lunar orbit while they were on the Moon's surface. On February 20, 1962, astronaut John Glenn flew in the Friendship 7 spacecraft in the Mercury-Atlas 6 mission, becoming the first American to orbit the Earth and the fifth person and third American in space. He went on to serve as a U.S. Senator from Ohio from 1974 to 1999. Glenn returned to space on October 29, 1998, as a crewmember of STS-95 at the age of seventy-seven.]

KR: Yes, you dropped out when you started talking about going to the vending machine. Could you repeat that?

CT: Yes. I was providing software support to the flight controllers. It was around midnight, so I took a break by going down to the vending machine in Mission Control. There was Ron McNair. It was unexpected, so all I could squeak out was, "Hi." That's all I got to say to him. [laughter] He was a nice guy, but it was still the early stages, in first couple of years, I was still stunned that I was there. I also saw Judy Resnik in Building 4. It was something on the television in the lobby, and I remember seeing her there. Unfortunately, I was there for the *Challenger* accident. [Editor's Note: The Space Shuttle *Challenger* made its maiden flight in April 1983. On January 28, 1986, in STS-51-L, the *Challenger* exploded seventy-three seconds after launch, killing all seven astronauts aboard, including astronauts Ron McNair and Judy Resnik.]

I have this long list of all these astronauts that I have met over time. I've seen astronauts from every single U.S. space program, so it's just incredible. Yes, Fred Haise in the '90s. Alan Bean was on the Moon. I saw his artwork at a Houston gallery. His artwork was awesome paintings. They're large and shimmer with color. They're incredible. I saw John Young and Bob Crippen.

They were the STS-1 astronauts. I saw their launch, and then later on several times I saw them. I remember when I was working in Building 1, which was an administrative building, at one point, John Young and I were parked not far from each other. We got out, where there was a mockingbird singing. We both admired the bird that was singing in the tree. Little things like that, "Oh, my gosh, this is just so wonderful." I was there when Ellen Ochoa became the first Latina astronaut in 1993. I was happy and also wishing it was me. I also met the first Puerto Rican astronaut, Joe Acaba in 2004, Educator Mission Specialist. I had wanted to be the first Puerto Rican astronaut, but at least I got to meet one! The best is Story Musgrave, who performed the first Hubble Space Telescope repair mission. He was taking classes at UHCL, and I invited him to our SEDS meeting to give a presentation. We also took several philosophy classes together. We still keep in touch. [Editor's Note: Navy pilot and NASA astronaut Alan Bean walked on the Moon during the Apollo 12 mission and served on the Skylab 3 mission in 1973. He resigned from NASA in 1981 to pursue painting. Robert Crippen served on four Space Shuttle missions, including the first, STS-1. John Young walked on the Moon during the Apollo 16 mission in 1972 and served on STS-1 in 1981. Ms. Torres was the president and co-founder of the Students for the Exploration & Development of Space (SEDS) chapter of the University of Houston-Clear Lake (UHCL).]

KR: Give me a sense of what it was like in the couple weeks leading up to a shuttle launch.

CT: Oh, busy, busy, busy, writing the code, having it tested, because you'd spend hours on it and you'd have to have one of your fellow coworkers test it out. Ben would always find something amiss. I would work so hard and test every way I could think of. Then, he would, within minutes, find some little flaw with it. It was just intense but always good. We'd work pretty late, but it was a lot of fun. Once the shuttle launched, then we'd go off. We did not mind working all those hours. Mission-ready completed code would be uploaded into the MOCR computers.

KR: When a shuttle would take off, would you be working? Would you be at Mission Control?

CT: I wouldn't always be at Mission Control because we were not needed there for the launches. We might sit in a MPSR. There were more flight controller disciplines than programmers, so it wasn't possible for us to be on the spot for a problem. It would be a distraction for the MOCR flight controllers. They really needed to focus on making sure all the systems were ready--"Go for flight." Our FAP and SCAP software had already been tested and installed with all the updates. We could just sit and watch. Phone access was quick enough. Usually, there were televisions in different rooms in all the buildings, so we might hang around and watch the launch. We worked during the mission as software support but not usually in Mission Control. We might go there to observe and learn flight controller operations, but not everything they did required our software or our presence. If we got a call, it was because they had problem or a question about the software. It wasn't constant. We usually were in our offices doing other work.

KR: I want to ask you about the *Challenger* launch in 1986 and the disaster. I was wondering if you could recreate that day for me and what it was like for you.

CT: I have to go back a few days in order to set the scene. The previous mission STS-61-C was really less than two weeks before, January 12-18, 1986. It experienced four unsuccessful launch attempts and five landing attempts. These delays created a lot of negative press discussion and pushed back the launch of STS-51-L, which was the first Teacher in Space mission. For several days, numerous problems changed the launch date, weather overseas for emergency landing sites, launch processing issues, Kennedy Space Center weather problems, and others. [Editor's Note: Ms. Torres wrote in her journal on the 27th: "T-9 min and holding … High winds and a stuck hatch bolt are a problem. I think the latter has been taken care of. Correction: they're still awaiting the tool to remove the handle. It may be a half hour to an hour before it comes." (By noon, the launch was called off for the day.) "Oh, well. Another blow to NASA's public image. The press will again leap about asking questions about all these delays."]

I was in the Life Sciences Building 37 involved in a non-work related project when the *Challenger* launched. I stepped away from it to go into the conference room to watch with other people from the building. I was standing in the back looking up at the TV above. The launch was normal for about a minute. Then, when it split into that ugly Y shape, we all knew something was wrong. We were in our own minds looking in hope for the Space Shuttle to emerge safely. It was announced that there was a problem, and there was really nothing more to look for on the screen. People scattered. I could've gone home, but I felt lost so I went to my office building. There was a crowd in the lobby taking in everything on the TV. Mission Control was locked down to preserve all data and start the investigation. If I had been there--and I had originally planned to be--I would've been locked in, even though I wouldn't have had any direct part in the investigation. Instead, I needed a sense of stability and security, so I just stayed for hours with everyone else trying to comprehend what had happened. At home that evening, it was all on the news, and the world was watching and grieving together.

[Editor's Note: The following is from Candy Torres' journal, written the day of the *Challenger* accident. "11:00am JSC Bldg 37 28 Jan. Oh my God! It's finally happened! Several minutes ago we watched the shuttle explode. No one can really believe it. We just watch mostly dry eyed. It's a very bad nightmare. I feel shaky inside. Everything was looking good for launch. The weather was clear. I guess icicles were gone. I thought the lift-off was a bit slow but what do I know. We saw what looked like a premature SRB with an explosion. We all knew something was wrong, but we hoped so fervently that we'd see the orbiter cruising away from disaster. A big explosion with a couple of large pieces left & right which I presumed were the SRBs. There were fragments flying from the middle but didn't look big enough to be the bird. There's nothing on TV except the water and the sky. Silence. Nothing to say. Nothing useful to do. They're gone. Moments of silence. Someone mentioned that yesterday was another sad anniversary. Was it eighteen or nineteen years ago that three Apollo astronauts died on the pad? People behind me are talking about the school kids watching. I think at the pad and on TV. Are family at KSC? What hell & agony they must be going through! I hope the press are not acting maggoty. Nothing has changed on the TV. Nothing. Someone said: 'There's going to be such a public outcry.' A voice--recapping for anyone who may have missed it. His voice sounds shaky. 'No anomalous conditions were noted at the time … Contingency procedures are in effect … Data is being secured at MCC for later analysis.' A return to a numb nothingness. That feeling (or lack thereof) will remain for a very long time. Another voice: 'I can't stand sitting here. This is sick.' Yet you hope by watching that something good will show up. The camera scans for

something. Nothing to see. No, there's a helicopter; just a speck in a lovely sad sky. 'The debris fell for an hour.'"]

Around noon, I left Building 37 to go to Building 4 to be with my coworkers, flight controllers, and others from my office area. We waited for hours in the lobby staring at the TV for an official word. I have pages of comments and I was encouraged by someone to keep writing.

[Editor's Note: The following is from Candy Torres' journal, written the day of the *Challenger* accident. "2:50pm. Comments: 'People thought it was static data. People who weren't watching. Everything went static' (referring to what flight controllers saw on their monitors). Speculation about an SRB burned through the casing and punched into the ET. Other voices: 'Everything looked nominal. No one knew anything was wrong … Crew answered for full throttle up … Just thought it was static data.' Voices: 'One bad day … Could never imagine … So damned helpless …'"]

There was nothing more to gain from staying at work. It was after four PM when people finally left JSC. We had needed the camaraderie of fellow space workers to get through the day. There was a traffic jam leaving JSC. Everything would be on broadcast TV. The entire country was in shock and grieving.

The next day people went to work. Debate began about how to proceed. Questions were abundant with no answers for a long time. Our team had a meeting at four PM to "learn what our public posture should be." Everyone represented NASA, so we had to speak about only what was known. We couldn't risk passing on personal opinions or speculations, which the press and public would interpret as fact.

I was going to start my master's degree, so I was part time. I talked my boss into letting me work part time. The rest of the time I was in another building on site, trying to start my own business in software. I had found a UHCL professor who was starting a research project for the future space station. This was 1986. He had obtained an exercycle for the Life Sciences group, and he wanted software for this device. It was a stationary bike, where you put your hands on the handles to record the heartrate as you exercised. My coworker and friend Doug and I were the ones that created the software that would take that data and send it to an Amiga computer. There was no training. We were both engineers and artists, so we were good at figuring out to make things work. We started off with graphs so we could understand how to gather and organize the data--heart rate, workload, speed, resistance--and write the software interface. The medical community wanted to see that kind of data and encourage the astronauts to exercise.

We created a way to display it, instead of just graphs. What Doug and I did was create a little character that would run along the screen. This is where our artistic skills came in. I created the background and Doug designed the little guy. The astronaut using the exercycle was supposed to be challenged by running along with him. So, the speed of this little character would encourage the astronaut to pick up the speed or keep up. We were in the early stages of that.

I don't know if they ever used any of that, but, actually, the project went on for a few years afterwards. The psychologist who started it was not appreciative of a woman who had her own

ideas or would speak her mind, even though it was perfectly appropriate. He would ask us a question and I'd answer. You'd get asked a question, you'd answer it. He would ignore me and I didn't like that, so I repeated my answer. He was a control freak, and I got squeezed out after six months. Doug and I were doing it for free because we were told there wasn't any money. Later, I found out, he was getting paid, so the entire time he cheated us.

I did that, and then I started my master's degree. After *Challenger,* I could've kept working, there was work to do, but I thought it was a good time move on. In fact, I could've started training to be a flight controller and I would've been one of the few women and first Puerto Rican, but I wanted an advanced degree. I had already been taking some classes in computers at UHCL, but then I realized working forty hours a week on computers and then taking these heavy-duty classes wasn't what I wanted to do. So, I managed to find another major; Studies of the Future sounded perfect. I did that while the shuttle system was being evaluated. NASA worked to solve the structural problems and work culture to make everything safe.

Towards the end of my studies, I was able to get a paid internship at Lockheed in the Human Factors Department. As part of my "Life Planning" course, I had to do informational interviews, so Lockheed was one of those I selected. An informational interview is just to learn what the company does, get advice on potential careers, understand the industry. When I approached the woman in charge of Human Factors at Lockheed, she said, "There's no job openings." I said, "No, this is not a job interview. This is an informational interview." Then, she was open to setting up a time, so I could do the information interview.

During the process, she said, "Well, I'm having a problem here with this project and I think you'd really be great to help work out," because I had the experience working at in Mission Control. There were a number of things. One was to update the human factors manual that NASA used. It turns out I had one class in human factors and ergonomics, so I had some understanding of that field. The other part was to develop a database, which now sounds straightforward. Well, databases were still something new, and I didn't really have a background in it. What they wanted was a database collecting data from different missions, from all past space missions, and to pull out text, so they wanted to create an anecdotal database of lessons learned. We would have to digitize thousands of documents, parse them, and design a user interface. Our team of less than ten people had to try to figure this out. It sounds really simple now, but, believe me, it was not something that had been done then. The documents were not in any single place. The sources would be NASA libraries, universities, research institutes and many other places.

We might have to travel, not far, but to Rice University, which was in town. Laptops were thirty-five pounds at that point, and we didn't have any experience with them, so we never bought one. The OCR [optical character recognition] scanners were just starting to come out, and not everything was digitized. We didn't have the Internet and all that. I did a lot of research and found some really good data of environments that were very similar to space, such as submarines, Antarctica, and isolation studies. For example, living on a submarine and how life inside this container like a submarine was similar to space because of the confined living environment and psychological effects. So, anything that was similar to space was in there, so they can do these comparisons. This was for long-term planning of space exploration.

I also trained people on Mission Control flight plans and working in the Mission Evaluation Room (MER). I developed a questionnaire or a datasheet, so we could collect incidents during a mission. Anyway, it's a special part of Mission Control, where they deal with the experiments and problems. We were able to talk to the flight controllers when a problem came up and record what the problem was and how they went about resolving it. The questionnaires would be entered into the database, as well as the other research material. So, I did all that work. I had a team of people that developed it, but I was the one that had all the ideas on how to get this done and how to read flight plans and train people on various protocols.

KR: Why was that work important, Candy?

CT: How do we learn from the past? Preserving lessons learned prevents mistakes from being repeated and providing a better understanding of how to live in space long-term. It was all scattered knowledge. It had never been done before. People pass on knowledge individually, but we were trying to develop one place where we could put that information. For example, if something happened on a Gemini mission, it might provide insight into a future mission. We had produced a tool--a database--for NASA to plan what they might need in the future for long-term space habitation. This bit of technology was not really there yet, but we were trying to figure out all these different problems and issues. [Editor's Note: Project Gemini was NASA's second human spaceflight program, after Project Mercury. The missions took place between 1961 and 1966 to test human spaceflight operations in preparation for the Apollo program's goal of landing on the Moon.]

KR: How long was that database used for?

CT: It was never completed as a computer program. We were still in the process of developing it. I had drawers of documents, but we couldn't do anything with it, let alone the thousands out in the world. We never got to the point where we created the database because taking anecdotal data is not the same as numerical data, and the software, the technology, the applications were not there. It's not like we have on the Internet, where you put in the key word and it brings up the information. We didn't have the skills or resources to pull it off. After two-and-a-half years, the database was hardcopy based in the filing cabinets filled with the data I had collected and the MER questionnaires.

There were a lot of things I did on my own, such as attending space conferences as an activist. When NASA wanted a conference on psychology of space exploration, I headed up the Lockheed team. I talked to a friend about running a conference and I incorporated all the lessons she had learned and I was able to provide speakers' names. I was able to help set up different sessions because I had been out there on my own meeting people, and some of these people were not connected to NASA. They were across the country doing their own work. Some of them were so honored that they got invited, but it was because I had heard them speak. I just made sure I got the right coworkers in the right places to run the conference. I didn't run the whole thing, but I ran a good portion of it. I received a really nice letter and certificate of commendation from Lockheed with details of what I did and how much I contributed to that conference.

My team was asked to do a videotape series on human factors and I was asked to write a script. I had never written a script and they knew that, but I wrote a script and we did the video. They were interviewing those of us who worked in human factors. That was also part of the work that I did.

KR: This human factors work, how was it used in the shuttle program or in the International Space Station? [Editor's Note: Maintained by space agencies in the United States, Russia, European Union and Japan, the International Space Station (ISS) is a modular space station that resides in Earth's orbit and can accommodate as many as six crewmembers. In 1998, assembly of the modules began in space. Astronauts and cosmonauts have inhabited the ISS continuously since 2000.]

CT: The Human Factors manual existed already for years. My group was not experts in the field. We obtained the information from a lot of different NASA medical and life science sources to update the manual on the computer. Part of human factors requires knowledge of the human body to determine how far to reach equipment, tools, buttons, switches, etc. There were diagrams with dimensions and formulas for different sized people. You had to know how the human body works. For instance, the neutral position in space of the body is slightly curled in, as opposed to on Earth, we're much more rigid. That difference affects your ability to reach objects, to slip switches, and to be able to get to different equipment. So, there was a lot of measurements. We didn't make the measurements, but received them to be entered when NASA learned something new about how to live and work in space. All of that all went into the manual, which then was used by NASA. Human Factors researches all parts of space exploration's programs. I only know about the work I did with Lockheed.

KR: I want to go back a little bit and talk about the *Challenger* disaster.

CT: Yes.

KR: You were alluding to the problems leading up to the day of the launch. There was an industry engineer who brought up the problem with the O-ring.

CT: Yes.

KR: Was that something that you were aware of?

CT: No, what I was referring to were the various delays mentioned earlier that were resolved. I was not a flight controller intimately familiar Space Shuttle systems. Each controller was connected with just one of many shuttle elements. As programmers, my team really only understood basic space operations that were common for us to develop FAP and SCAP. Our perspective and training were only big picture. There may have been discussions in flight controller meetings, but I knew nothing about every issue after a flight. If my group heard anything about O-ring wear, it didn't mean anything because missions kept flying. However, after *Challenger*, we heard about incidents that there were warning signs in previous shuttle flights, such as evidence of minor SRB [solid rocket booster] burn through. At the time, no one imagined how serious they could be. [Editor's Note: After the *Challenger* explosion in 1986, a

presidential commission chaired by William P. Rogers investigated disaster, concluding that cold weather degraded the seal on the solid rocket boosters, and recommended changes that NASA incorporate for improvements in safety, communications and management. In 1988, the shuttle program resumed. In STS-26, the "Return to Flight" mission, the shuttle *Discovery* launched on September 29, 1988 and landed at Edwards Air Force base on October 3.]

KR: How did you feel, having worked on shuttle missions, witnessed the *Challenger* taking off in STS-7, and having met astronauts like Resnik and McNair, how did you feel that day? [Editor's Note: The crew of the *Challenger* included the Teacher in Space Participant Sharon "Christa" McAuliffe. The astronauts lost were Gregory Jarvis, Judy Resnik, Commander Dick Scobee, Ronald McNair, Michael Smith and Ellison Onizuka.]

CT: For a long time, it traumatized us even after we had returned to flight in '88. Every time I watch a launch, I never felt the same. My whole body would tense up in terror, afraid until the astronauts got into space. That went on for years, for a lot of people. There were some people who could no longer do their job. There were flight controllers who could no longer do their jobs. A lot of people had to go to psychiatrists. But I felt the feeling as well, for the longest time. We couldn't take launches for granted. They lost their fun, so to speak, their excitement. There was all this stress while you watched it. Now, we know it as post-traumatic stress.

KR: What was the next shuttle launch like in '88?

CT: I started working at Lockheed at the very end of August 1988. Through the fall, I was completing coursework for my MS in Studies of the Future. I also was in charge of the SEDS national conference, so I was very occupied with all of that. My first recorded Human Factors operations database meeting was September 8, where we began to set out the concepts and goals. It wasn't until after STS-26 [September 29-October 3, 1988] that we began work. My new team watched the launch at Lockheed. [Editor's Note: Ms. Torres added to the transcript her journal entry from the launch of STS-26: "I'm not excited as I normally would be. Wish I were at Bldg 4. My family is here now. I'm a bit scared. I suppose we all are. … GREEN FOR GO! AND IT WENT! … I held my breath and clutched my quartz pyramid necklace. I wore my Launch Fever t-shirt from STS-1. Subdued cheers came from other parts of the building when SRBs separated. I thought I saw a flare towards the top of the plume. I wished the SRBs away. This launch was not fun to watch. My perspective is different in many ways. There was a sense of whew! but no great elation. Celebrations will be after the mission."]

On August 31, I met John Denver. [laughter] I was a big John Denver fan growing up. I knew John Denver had been trying to get a flight on the Space Shuttle, but I thought that was all passed. I was working with a couple of friends on a video in the Space Station mockup. A small cluster of people came and I was surprised to see John Denver. I have historic pictures of John Denver, and my journal has articles about his visit. [laughter] John and his son Zack and a couple of astronauts were there. One of them actually is now director of the Lone Star Flight Museum, Bonnie Dunbar. I couldn't believe this had happened. [Editor's Note: John Denver was a songwriter and singer who lived from 1943 to 1997. On October 12, 1997, the experimental plane Denver was piloting crashed into the Pacific Ocean off the coast of

California. Bonnie Dunbar is a retired astronaut who served as a crewmember in five Space Shuttle missions.]

KR: Now, you talked about this a little bit, but how did the industry change after the *Challenger* disaster?

CT: Oh, everybody was much more cautious. It was more of an underlying tension--people being aware of all their decisions and trying not to make mistakes. Everyone was being afraid of making a decision that might lead to some sort of problem or disaster. Many people were concerned that the culture became risk averse--overly cautious and afraid to make decisions. Communication had to be improved since not all of the vital information about *Challenger's* status was passed up the chain of decision. The rapid rate of launches was unsustainable. A lot of work was done to design escape options for the astronauts in case of an emergency.

KR: What …

CT: Go ahead.

KR: Oh, no, please go ahead.

CT: From 1986 through 1988, I worked on my master's degree. From 1988 through 1990, I was at Lockheed. We had budget cuts, so I had to find some other work [1991-1998]. There were budget cuts and it was a tough time, where I could only find little bits of work, a sociology project at NASA through the University of Houston-Clear Lake. I taught in an alternative high school; I worked at a museum; I received grant money for a community project--I was an ESL tutor.

Finally, in July 1998, I found a job with a small company at NASA supporting the International Space Station. The ISS was just getting started, and my work was configuration management. It was software to help the engineers plan payload manifest, schedule what goes up to the ISS, items returning, and on what shuttle. It was a sophisticated database, and I was responsible for the user interface using RoboHelp and SQL. I did that for a couple years. There were only four of us in the company. It was really a lot of fun. [Editor's Note: SQL refers to Structured Query Language, a language used for programming and designed for managing data held in a relational database management system.]

KR: Which company was that, Candy?

CT: It was Ron Croston and Associates. He was very informal. We were a subcontractor to a larger group in the Life Sciences group. Funding cuts happen a lot, and in 2001, I had to find another job.

I was hired by Barrios in April as part of Operations Planning, which schedules the activities for the crew on ISS. The positions were: Real-Time Planning Engineer Support (RPE Support, pronounced "rip-ee"), Orbiter Communications Adapter (OCA), and Real-Time Planning Engineer (RPE). Remember, I talked about Mission Control, the front room people--Front

Control Room (FCR, pronounced "fick-er"). Now, I actually was one of the back room people, MPSR. I was not supporting them; I was one of them. I was going to train to be a flight controller and eventually work in the front room. I had had that opportunity once before, so I would have been one of the early women to do that. It was after the *Challenger* accident, but I had already planned to start working on my master's degree. So, I didn't pursue that because then my first mission would have been return to flight, but I had gone a different route. I now had another opportunity to pursue it.

Now, we're computerized. [laughter] We had different kinds of computers all over the place. I remember thinking, "It wasn't like this when I came here." My office was in the original Building 4, where I worked on training documentation and updating my flight planning skills from the Space Shuttle days. ISS had sophisticated software to produce the plans for ISS, which were longer term. Space Shuttle was one to two weeks of activities. ISS was several months for each astronaut/cosmonaut team. These were called Expeditions rather than missions. We also had to coordinate with the Space Shuttle folks. I could appreciate all the tools that we had access to for collecting documents and modifying plans to reflect crew activity changes. In the office, we worked our position tasks and attended meetings to discuss the details of the current expedition's plans and status: what was completed, what was delayed, what needed to be added or removed, how does this impact the timeline. Our weeks and days varied depending on when we were scheduled to work on console in the MCC. We were required to do shift work. We might have a week or two in the office with normal hours. On console, we rotated between day, evening and night shifts, including weekends.

My first certification was Real-Time Planning Engineer Support. One of the jobs I had was the Daily Report, where I collect heads up or status material from different disciplines and put it into a two-page summary, and that would be sent up to the crew to read. We would have a quote of the day. We'd have a cartoon in there.

The Space Shuttle was not always in space. I remember one time when the Space Shuttle had completed its time at the ISS. Well, the shuttle was leaving station, and their orbit was overhead in Houston. Here we are at Mission Control, everybody's working and we got the go ahead for most of us to leave our posts to go outside to witness this event, because you could see the shuttle and the station in the sky. They were little tiny stars, and you could see the shuttle moving away. I remember NASA security was all upset. They're concerned because all of a sudden, a bunch of people from Mission Control are going outside, what's the problem? We went out to observe this event. Once we were back inside, it was time for me to generate the Daily Summary. I wrote a rather poetic paragraph about what we did. That was something that went up because I knew it was going up to the crew to read. The crew was reading what I wrote, and I was organizing this document.

KR: When you were talking about being able to see the shuttle and the International Space Station, which shuttle was that? Do you remember?

CT: It was *Atlantis* [STS-110, April 8-19, 2002] on Wednesday, April 17, just after ten PM. The Space Shuttle people on the other side of our shared MPSR left to go outside see the two vehicles separate overhead. Then, ISS people asked to go. The security guard wondered about

the non-standard departure of flight controllers. It was a wonderful sight to see the two streak across the sky majestically and right above the MCC from our vantage points. We lost sight just above the building, when the two vehicles lost the sunlight gleaming on them that made them visible. Back inside, I was asked to enter a second paragraph of "happy words" to the Alpha crew. [Editor's Note: Ms. Torres added to the transcript a paragraph that she wrote in the USOS Daily Summary, GMT 108, on Thursday, April 18, 2002. "Alpha Crew, We enjoyed a glorious view this evening--*Atlantis* and ISS as two stars racing across the sky. A crowd of us watched in awe outside the MCC to see the beauty of the space program at work above the Earth. We wished we could have your view of humanity down below on our lovely sphere and share it with the rest of the world."]

I supported nine Space Shuttle missions and ten ISS expeditions during my time in Operations Planning. Even though I worked only ISS, we did have to coordinate with STS MPSR teams.

KR: You had started to talk about the *Columbia* disaster in February 2003. How involved were you with operations? What was that like for you?

CT: Well, I was not working that weekend. Number one, I was not Space Shuttle. I was Space Station, and I had the weekend off. I was far away. I had returned to fencing in 1998 and I was traveling across the country. I was getting ready for a fencing competition in Central Texas on Saturday morning. I got up, I ate, and then I relaxed before I went over to the venue. I had the television on, when I saw that there was a problem with the shuttle. We were waiting for the reentry of the *Columbia*. They were showing Mission Control and showing this delay and concern. They were sensing something was not right, so I never went to the fencing competition. I stayed in the motel for hours watching the events before I finally drove home. I had the radio on the whole time, and then I'm looking in the sky because they were saying pieces were falling. Of course, I was farther north, but at that point, I didn't know where it was. So, I went home and then to Johnson Space Center because it was just down the street from where I lived. I walked there and saw people gathering around the NASA-JSC sign to put flowers on the ground and on the fence. That was traumatizing.

I was at work on console on Monday, and the shuttle people were not. I remember the difference when I had been working shuttle and we had the *Challenger* accident, but now I still had a job. A lot of the other people lost their jobs while the STS program went through investigation and changes.

The tragedy changed a lot of things for ISS. It changed the number of crew onboard. Without the shuttle, we had to start working with the Russians and using their spacecraft to transport people up to ISS and back. People were experiencing trauma from the explosion and learning about what had happened. I was one of the people there that could tell others in my group what it was like and how long it took for us to get back to flight. I let them know what it was like at that time, so I was the historian of the experience. We were provided opportunities to meet and discuss our feelings about the tragedy. There were psychological sessions to deal with the emotional impact. [Editor's Note: On February 1, 2003, the *Columbia* disintegrated as the shuttle reentered the Earth's atmosphere, killing the seven crew members aboard. As a result, Space Shuttle missions stopped for two years, during which time the ISS relied on Russia for resupply

missions. The "Return to Flight" mission following the *Columbia* disaster occurred when the *Discovery* launched in STS-114 on July 26, 2005.]

KR: That must have been something, dealing with the emotional impact, but then also the *Columbia* disaster did impact the International Space Station. You mentioned working with the Russians. What was that impact like?

CT: Right. Well, it just changed everything because we were building up to six people onboard the station, and now we could only have three. We had seven people onboard the shuttle, and the Soyuz was there as your backup. However, it could only fit three crew. Soyuz returned on land, which is jarring. The seats protected the occupant's back. Each of the seats were designed for a specific person, literally molded for a hard landing. If it wasn't designed for that person, he/she could experience a serious back injury or break it in half. So, these seats were designed, each one, for a particular astronaut or cosmonaut. Crew couldn't just pop into one up there, "Okay, here's your lifeboat." [Editor's Note: Developed in the 1960s, the Soyuz is a Russian spacecraft that can carry three crew members. There is always a Soyuz spacecraft on the ISS as an escape vehicle to return to Earth. Between the end of the Space Shuttle program in 2011 and the successful first mission of the SpaceX Dragon 2 Crew in 2020, NASA relied on Roscosmos, the Russian space agency, to transport astronauts on Soyuz spacecraft and payloads on Progress spacecraft to and from the ISS.]

Now, all of a sudden, we didn't have shuttles, so NASA and Russia had to take care of that kind of issue. I don't remember exactly all the details that were going on, but I just remember it was hard on the crew and on us to figure out. We had to change everything in our planning. We couldn't plan forward on the larger crew and what the activities were going to be. It was not part of my job, but we were aware of all these different changes that had to be done and concern about the crew. How long would we be able to do this? I was telling people it took two-and-a-half years for return to flight. I was just telling my coworker on that issue because there were other people who make the bigger decisions. So, it impacted our flight plans. Everything that we planned for, we planned far ahead. We had to plan for fewer crew without knowing for how long, plus nothing would be brought up or down. It took a lot of work, a lot of redesigning and a lot of planning.

KR: In general, what was it like working with the Russians and with other countries that were involved in the International Space Station?

CT: We didn't have people from other countries. They had their own centers in Europe, Japan and Russia. I worked with mostly Operation Planning coworkers and the Russian translator, who was not always Russian. Many were Americans who were proficient in Russian. They were part of the team because the ISS crew was always astronauts and cosmonauts. Most of the time, there were Russian documents that had English and Russian, even though the cosmonauts and astronauts spoke both languages. New documents had to be translated. I had to work with translators to make sure translations were correct or the wording might better. [laughter] Occasionally, they would have questions due to funny translations. If they tried to translate it into Russian or Russian into English, it came out very bizarre. So, they would make sure they'd check with me. [laughter] I would see some of the other people from different countries on site,

but, really, for the most part, I was working with my team. Russian translators were part of that team. For the Real-Time Planning Engineer, there was the opportunity to travel to Russia to work in Moscow Control Center for a few months. I didn't get to that position, though it was my goal.

KR: Was it cooperative between the Americans and the Russians? I am just struck by the initial space race was between the Soviet Union and America, but, now, we are decades later and the International Space Station was a cooperative effort. What was it like?

CT: Well, it wasn't the first time. We had Apollo-Soyuz in the '70s, so that was a start. We had astronauts on Mir in the '90s. So, this had been developing for a while. But the real change was when we had to depend on the Russians for their spacecraft. That involved very extensive negotiations, a lot of money, and a lot of other issues that are outside my boundary. It really changed a lot for the United States not to have any way of getting people up and back on our own spacecraft. [Editor's Note: On July 17, 1975, an American Apollo spacecraft docked with a Soviet Soyuz spacecraft while in orbit in the Apollo-Soyuz Test Project. The Mir Space Station was operated by the Soviet Union/Russia in low Earth orbit from 1986 to 2001. The U.S. and Russia partnered in the Shuttle-Mir Program. In 1995, astronaut Norman Thagard became the first American aboard the Mir, where he spent 115 days. Later that year, STS-71 became the first shuttle to dock with Mir.]

KR: You mentioned before language. What language or languages are spoken on the International Space Station?

CT: Oh, several different languages, but English and Russian were mandatory for astronauts and cosmonauts. They trained in both countries. NASA had language classes. In fact, I took Russian classes because I was planning to go to Moscow. I also studied Japanese in the hopes of an opportunity with them. I already spoke German, so Europe was another dream. It was optional and free but on my own time. It was hard fitting it in between the work schedule. Whether I was working missions or in the office, I made the time to go over to the language lab by choice because I wanted to eventually work in Moscow and elsewhere. That would have been really cool, but it didn't work out.

KR: How come that did not work out?

CT: That's a whole other problem. We're running out of battery time.

KR: All right.

CT: That was a time when I was in a group that was not very fun to work with. There were a lot of different issues. It was the 21st century, and the makeup of the group was not diverse, mostly young, professionally inexperienced, and negative personality issues. I also had to be a caregiver for my mother when I started the Ops Plan job. There was no on-site psychological support system for that until after she died. Within the group, it was miserable. It was a hostile work environment, which was psychologically devastating and, unnecessarily, ended my career. So, that's a whole different set of issues we can talk about later.

KR: Sure, yes. How much time do you have for today?

CT: Well, it's not in the red yet.

KR: I will ask you maybe one or two more questions about the International Space Station and your work. What are some of the highlights from your time working on the International Space Station with your work with the crew?

CT: Well, let me back up before I forget. When I started working with this group, I had to go through, even though I had experience, I had already gone through training on the Space Shuttle a long time before, and we actually had to go through training on the Space Shuttle and Space Station. This was several weeks. Before we started working, we had to learn every system, how things operated, the structure, working on console, tours of JSC. We had tests, and I felt the pressure because I was one of the older ones by twenty years. They had a lot of younger people just out of college. I wanted to make sure I worked hard and really did well on the tests. At the same time, I had care-giving issues with my mother. So, it was a lot of pressure on me. We called it Starfleet Academy. That's what it was like. You had to learn everything about the systems, the engineering and software and operations and using the headsets and all things like that. When you worked on console, you wear headsets to plug into different people and different disciplines. There were buttons for each discipline that you punched to hear them. You could be listening to up to fifteen people. All these voices were in your ears and you had to learn how to tell who was talking and if they were talking about something that was of importance. You want to block out the others and maybe either participate in the conversation or just listen. We had to learn everything in United Space Alliance Training Academy. We had to take the test and received certifications for both programs. I had to know it all, how it all was designed and why.

There was a major event worth mentioning. On September 11, I was at home when the World Trade Center was hit. I saw a bit on TV, but the magnitude of the event wasn't apparent yet. I went to my Russian language class at JSC. Around ten AM, the word came that everyone on site was to evacuate. We now knew it was a huge serious event. Since we were a government facility, we didn't know if we might be a target. As I drove home, I kept looking up in the sky. I filled my car with gas and got two hundred dollars cash. Then, I called my sister in California to let her know I was all right. It was early for her, and she didn't know what had happened. There was no way I could tell her, so I just insisted that she turn on the TV.

KR: Going through the Starfleet Academy, that enabled you to work in the back room?

CT: Yes, everybody had to do that. I already had a lot of experience from all my other work. It was all put together in a real program, situational awareness, space resources. There was lots of information that was fascinating that we had to learn.

KR: Were there many women going through that training?

CT: Yes, yes, it was mixed. It was diverse. There was not as much diversity in age, so it was a lot of young people just out of college and not so many older. It was a different composition than I had worked with before.

KR: Are there any other anecdotes you have from that training?

CT: I can't think right off the top of my head, anecdotes. It was just very intense and very exciting. I just loved it. It was a lot of work, and I loved it. I joined this new group while dealing with family issues; it was a lot of stress and trauma.

KR: Candy, when was that? When was that time period roughly?

CT: Well, in early 2001, my stepfather was experiencing breathing problems, which was diagnosed as lung cancer. In fact, I was dealing with what was going on there, getting some homecare, finding another job, and going through job interviews. Once I got a job offer, the next day I was up in New Jersey to spend a few days to take care of some things with my stepfather. He died when I was up there, which was totally unexpected. Fortunately, other family members took over, so I could come back and begin my new job.

KR: Was that when you started working at Ron Croston?

CT: No, Ron Croston was '98. That was only for two-and-a-half years. I had lost that job in 2001 because of funding.

KR: I understand.

CT: I had to find another job, and that's when I got the one working on the Space Station in Operations Planning to plan all the activities. I was working for a different company, Barrios Technology, Ltd., then at that point.

KR: I think, for today, I will finish with one question that is maybe on a lighter note.

CT: Yes.

KR: You spent the early portion of your life in New Jersey, and then for your career, you lived in Texas. What was it like? Compare living in Texas to New Jersey.

CT: Well, I love traveling. I grew up traveling with our vacations. Because I had lived at home until I was thirty, I had never lived on my own, but I had no problem picking up and going sixteen hundred miles away. It was all an adventure, and of course I had a great job. I had great people to work with. It was just exciting and lots of fun. I loved the area, still do. It was just really nice. So, it was a great experience. I'm sure traveling to Europe alone helped. I would "wing it," go places without a hotel reservation, make last-minute changes to my destination, figure out how to get around, and I didn't always speak the language. I love solving problems.

KR: Where did you live initially when you moved and started working at Johnson Space Center?

CT: I'm still in the Clear Lake since '84, so thirty-six years. Yes, I haven't moved very far, stayed within a two-mile radius, because it's right next to Johnson Space Center. It's residential. It's far away from downtown Houston, right on the southernmost edge by the water. It doesn't have tall buildings here. It has nice parks, and it's just a really comfortable atmosphere. I still love it. There's always places to explore, places to bike, boats to sail, beaches, and more. I still love Clear Lake. I just can't think of moving anyplace else. Even though I'm not working at NASA, the Space Center Houston, the visitor's center to tour NASA-JSC, is right down the road. I'm a member, so I can still go there and hang out. They have different events and programs with a variety of speakers, so I go do that. The 50th Anniversary of Apollo 11 was a major marvelous event that I could just walk down to without traffic and parking complications. It's a great neighborhood. Now, we're in the red.

KR: Okay, all right. Let us continue with a fourth session.

CT: Okay.

KR: I will email you.

CT: All right.

KR: I want to thank you so much. Today has been so fascinating. I have learned so much. It has just been really enjoyable for me to talk with you and to learn all of this from you.

CT: Oh, I'm glad because it's so hard sometimes. How do I express this? How do I express this exactly, so it makes sense to somebody else?

KR: I would love to see some of your photographs. If you have anything digitized that could send to me, I would love it.

CT: Oh, yes, well, if you've got my book, there's some of them in there. [Editor's Note: Ms. Torres is the author of *Born on the Moon: Living in the Space Age*, published in 2020.]

KR: Yes.

CT: You'll see a lot of astronaut pictures in there. I'm on Facebook. There's stuff on there. I have a website. It's "Technorican." It's on WordPress, "Technorican." I have some things written up there and there's different articles. I've been interviewed by different people over the years and different articles. So, it's all over the place.

KR: Okay, good. I've seen "Technorican," and I've read some of the articles that you have done over the years, that you have been interviewed in. I will friend request you on Facebook.

CT: Okay, yes, I just posted my Fred Haise picture up there.

KR: Oh, great. All right, well, Candy, thank you so much.

CT: All right, well, thank you, I appreciate it.

KR: I will be in touch.

CT: All right, take care.

KR: You too, bye.

----------END OF TRANSCRIPT----------

Transcribed by Jesse Braddell 4/29/2020
Reviewed by Kathryn Tracy Rizzi 7/15/2020
Reviewed by Candy Torres 9/10/2020
Reviewed by Kathryn Tracy Rizzi 10/13/2020