

# NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

## EDITED ORAL HISTORY TRANSCRIPT

FRANCIS E. "FRANK" HUGHES  
INTERVIEWED BY REBECCA WRIGHT  
HOUSTON, TEXAS – NOVEMBER 21, 2013

*The following interview was conducted with Francis E. "Frank" Hughes for the Johnson Space Center Oral History Project on November 21, 2013 in Houston, Texas. The interviewer was Rebecca Wright.*

HUGHES: Okay, let's pick it up. When we talked last, the Space Station Operations Team started to come together. This is in late '86, after [Space Shuttle] *Challenger* [accident, STS-51L] occurred. In my organization, I was a branch chief, and so during that time, in the division, we were just pedaling. It's like a stationary bike, you just keeping on grinding sausage. New people were assigned to different flights because some people didn't want to go anymore, quit, got reassigned. A funny thing—remember I talked about Michele [A.] Brekke—she was named as a flight director just before that accident, and then never [worked] as a flight director, for that reason. She just was reassigned and went on to do other things as the time went by, the year and a half before we started flying again.

They gave me this opportunity. Carl [B.] Shelley contacted me and we wanted to go to Washington [DC] and do this project. It was all based on Space Station *Freedom*, this is '86, and then we worked through that to '87. It was called the Space Station Operations Panel.

Then during '87-'88, I was assigned to create what would be called a Space Station Training Office when I came back. That is, other people took over my old branch, and life went

on because we weren't flying again, we weren't doing anything. It took until '88, I guess, before we started flying again with [STS-26].

That was a good flight and they got it all back together. People trained very, very well. They had to train on all the new things, this is all the different procedures that resulted because of *Challenger*. So that the simulator was busy adapting procedures, changing the hardware to match up with the new vehicle changes, and so on. We trained in Building 9, too. That's where you did the training for egress, using the firemen's pole, escape through bailing out. Before that time, we never thought about bailing out—we thought about it, but nobody wanted to do that. The big problem was if you bailed out, if you opened the hatch, or you could always blow the hatch for an emergency egress, but if you jumped out the hatch, the wind would take you right into the wing. It's a big, thick wing, and so say there's a 300-mile-an-hour wind that's going by outside that hatch, then it would smack you against the wing, and that's why nobody was really willing to jump out there.

What the pole did when you extended it, it was inside the mid-deck, and then when you blew the hatch away you could pull a lanyard and it would extend. It tripled its length. Its length inside then became twice that much outside. Everybody had a lanyard on the front of their suit, the exposure suits, the launch-entry suit. You would grab one of these things connectors, and there were eight rings, even though there were only seven people—in case one screwed up or something—so the astronaut who sits near the hatch would then grab the first, the second, the third people, each one, made sure they were attached to the pole with this lanyard, so they'd just snap in. There's a ring already around the pole, there's a thing hook hanging down, and you snap that into this connector on the front of your suit. That astronaut would just throw them out the door. What would happen then is they would go down and the pole stretched down below

the wing, so when you came off the pole, you were under the wing. It gives you a chance to survive.

Then, this is all supposed to be at about 10,000 feet, and supposedly the airplane's not going ass over teakettle, that it's in a steady state. If it was in auto, the idea is that the commander would then come down and get out, too. If it's not in auto, it's in manual, then there's no chance, probably, for that guy to get out. When they did all this testing, it worked really well. People tested it; they put one of these poles in a B-52 [aircraft] and people jumped out. Some [Navy] SEALs [Sea, Air, Land, special operations force] tested all this stuff. Of course, those people will do anything. It worked very well. They were not going up against the big wing that we had, but just that the rig worked, and they survived. The big thing is you get blasted by the slipstream, the air is going by, so they put the airplane at the right altitude and they put it at the right speed, and these guys jumped out. I think only three or four went, but it was the idea. They all landed successfully.

That was the kind of thing that was going on. But, I got more distanced from that because now I was starting to put together the training for Space Station. It's the same thing again—doing training flows, working with the systems people. We were over in the Eagle Building now, when we finally got a place to set up our new shop. We started in Building 13 at JSC, we were in Building 13 for a little bit of time, and then finally they rented space and we went over to the Eagle. There were actually three new offices over there. There was a planning office, there's a flight control office, so it's planning, training, and flying, the three things inside MOD [Mission Operations Directorate]. All oriented to Station. New people, but old people as leaders like Chuck [Charles R.] Lewis. Flight Director Lewis was the head of all this, and then Ted [A.] Guillory was the Head of the Flight Planning Group. I was the head of the training

group. Somebody else, I can't think the flight control one. It'll come back to me, but anyway, that was the deal. It was a very new organization, putting it together, and as time went on, then they created a really good training regimen. [Eugene F.] Kranz would come over periodically—we were all working for Kranz, still, but it's in this new organization—and we were hiring people fast.

Shuttle's going on, so we didn't touch any of those people, although you could snag once in a while somebody who wanted to work on Space Station, instead of what they were doing. That was good so they'd give us some experience. We had drafted a whole lot of new people. I went to one recruiting event and hired three new [Texas] A&M [University, College Station Texas] graduates and one Purdue [University, West Lafayette, Indiana] and one [University of] Notre Dame [South Bend, Indiana]. We were able to just hire new people. These were contractors, they're not NASA. I got some good people that day, it was just one of those things where you get the bright eyes and bushy tails, and you know right away that's a yes. It's funny, during that one, it was more women than men in that time period. There was a real representation of women through this new crowd because now, we're talking late '80s, the engineering schools were really cranking out women that are good at what they're doing.

I didn't do the hiring itself, but I had good people under me. It was the beginning of Station and the first line supervisors were then hiring these people. The crowd that we assembled was really good. Some of them are still there and others are running other organizations in Houston. There was so many good people in that organization, they've really done very well for themselves. Almost all of them transitioned later into NASA. They were good enough that, later, somebody was able to pick them up and get them into NASA. We talked about before that I would sometimes hire people with that idea, but none of these people at

that time because they were all destined to be contractor. They were able to shine enough that somebody else decided it was a good time to get them into NASA.

WRIGHT: That's great.

HUGHES: Yes, it was really good. At the same time, back in the Shuttle, we decided to do Mir [Shuttle-Mir Program]. Two things happened. One was strange—[George H.W.] Bush was President until '92, and there had only been a decent relationship between the Russians in the biomedical world. That started from back in '75. It actually started sooner than that. There's two groups, our research group here, and then in Russia, there was an [Institute for Medical and Biological Problems] IMBP. Working with people over here, it was all kind of folks putting it together. I go back and think of names, but the fact is it was coming together, now they decided to do putting Americans on Mir.

Mir was up there, it was launched in '86, same year that we had *Challenger* occur. It was assembled like everything else. It's one piece and then they put a second piece together in orbit, and so on. All of the Russian vehicles were actual spacecraft in itself, it was able to fly up by itself after it was dumped off, launched by the third stage rocket. Or it was the third stage itself, that goes on to fly, dock, and become a part of Mir. They were going to build this new Mir module, and we started talking about it and decided we would outfit the Spektr module. The Russians were having trouble funding the outfitting of the modules, Spektr, we were going to put biomedical experiments in it. That then immediately reflected back on a lot of training that was going to have to get done.

I believe that Spektr was just a spy module. That was a whole deal, it was built to spy on the U.S., on everybody, and it was such a grief-stricken thing for the Russians, for them to let us go in their module, and all the cameras and everything like that. Strange business.

Back in the Shuttle now, this new Shuttle/Mir program is getting ready to happen. The first crew, which was Norm [Norman E.] Thagard, went over with—Bonnie was his backup, Bonnie [J.] Dunbar—and of course, that was a big thing. They had to sign up to stay in Russia, they had to learn to speak Russian, because it was going on a Russian spacecraft. They just had to fit in. Then, they had to go through testing, and testing is a big thing. I wanted tests when we started Shuttle, and there was a big revolt between John [W.] Young and I. He said, "Nobody's going to take tests in the Astronaut Office." It wasn't that we were going to flunk anybody; there's formative tests, which are in the sense they're tests to see if you understood the material, and then we were never talking about what we'd call a summative test, in school. That's if you get a grade, like an A, B, C, in college, that'd be a summative test. At the top and the end of the thing, it'd say it's a test across all the material.

These formative tests were really important because that would let us know if the material we were putting out was good. It was as much of a test for us as anything else. When we tried to start talking about that, well, that was the end of that. It was just not going to happen. That was back in '78, so there was no tests given to any astronauts. We devised a way to do it. A lot of people didn't care, but John was the head of the Astronaut Office so it didn't happen. One of the few times we were on different sides of a given issue.

We start getting ready and it took about nine months or something in the Mir training to get ready to go. Then, the crews assigned had these tests that they had to face in Russia, and it was a go or no-go—it was a deal-breaker. These were summative tests. If you couldn't speak

enough Russian and you couldn't understand these systems, you would not fly. The problem was, and we fought this a lot, there was no pre-arrange of what they're going to test you about. In other words, they could go in and sink your ship, if they wanted to. The cadre of people who do it—it's a committee—anything is fair game. It's always that kind of thing. If you had pissed off anybody, they could fix it so you weren't going to fly because they could demonstrate you didn't know X, Y, Z—which hardly anybody knew and nobody would ask it normally, but in order to make you look bad. That was one of our [mottos] in the training office. We said, "We can make anybody look bad." One of those mottos that you don't publish.

However, they didn't pull the trigger on any of those things. Everybody that went through did a decent job. They at least knew that they had worked their butt off to try to get ready, and so, Norm flew and it went on like that through the whole group of them. Shannon [W. Lucid] was the [second]. Interesting, though, at that time, we started also doing psychological support. Before they started all this, I was in charge of all of that stuff, back in the two years we were up in the Eagle Building. Then, suddenly, I'm back in the game, owning all of this extra operations.

WRIGHT: You're over all the training?

HUGHES: Station and Shuttle.

WRIGHT: Was that something that actually made your job easier, in the sense that you were over the entire training?

HUGHES: Yes and no. It's like everything else, you get more responsibility.

WRIGHT: At least you had the opportunity to shape.

HUGHES: Yes, what was going on here, and that was important. The first thing I knew is that we knew, I've always talked about psychological support, I was always talking about astronaut mates, to try to ease them through the pain of each other's flights. How does somebody tell their kids that they're okay, they're safe? Or when they're not safe? They're never safe out there. Space is just out there, waiting to get you, outside that wall. Did you see *Gravity*?

WRIGHT: I have not yet, no.

HUGHES: I went and saw it, just a few days ago. It's like all of the worst ideas you ever thought about in space flight happens every five minutes.

WRIGHT: All in one place?

HUGHES: You have to see it. You have to see it and we'll have to discuss. We don't have to have the tape recorder around, but it's really, really cool. If nothing else, it's the closest thing to ever really being there, in terms of the view and the internal operations, but it's never boring in this particular day. And it is not a physics lesson. I'm not going to say any more until after you've seen it. My poor wife thought she was going to have a heart attack about every five minutes.



WRIGHT: You understood the dangers because you provided the training to prevent them, the best that you could, so you were talking about the psychological support. Is that one of those aspects that you helped set up?

HUGHES: Yes, I got people organized, I found some good people, and we arranged it so that on Mir, they would take a PC. They would take their own PC, it would be pre-loaded, it didn't have email and it didn't have any of the things we do now because it was coming on their spacecraft, but it had anything they wanted on it, actually. I don't remember what we sent with Thagard—it was decent stuff, it's a lot of pictures of your family—and we got more sophisticated. Like, the pictures of your family, you could look at anything, but there was a program—you were going to be up there for six months—where every day, it would give you a new picture that you could see it. They're preloaded, so the family would give all these pictures and then they were preloaded, so they were new pictures to them, even though we were taking two, three months ago, four or five or six months. Every day, there was a new picture, and they loved that. The grandkids, kids, whatever, they put that stuff in. We'd put in books to read, not online but they're loaded in the computer.

WRIGHT: The e-books?

HUGHES: Movies, stuff like that. This got to be a really big thing for the Russian crews because they didn't have anything like that. It was funny because the people themselves were interesting,

so they don't know about themselves. When [John E. Blaha] was going to go, we said, "What do you want to take? What do you want? What do you do in your spare time?"

He says, "Oh, I watch football games."

We said, "Okay." We got in contact with the NFL [National Football League], and they gave us football games we could just preload. Whole games without commercials and everything else because they were excited to do it, to be part of this deal. We loaded all these things in there and then John went up for his six months, and it was like a sentence in space because he had survived all the training and he knew what he needed to know, but he was bored to tears because he didn't watch football. He sat in the den or wherever it was and his family was around him, coming and going. It was a social event where people would come back and look at a replay and things like that, and they'd talk. What he was doing in his spare time is talking, and in a context of a game that's going on, on the corner. When it was just the game without all those interactions, it was nothing. He really made some really bad choices about what to bring. He still had his photos and stuff that we'd imposed on the system, so that was good, but when he came home, it was a really, really big eye-opener for us to say, "We've got different questions to ask these people."

There are some other things—I don't know if you know that there were two times when they had to evacuate people from space like that, and another one where the guy's mother died but they didn't tell him. He was so pissed when he got home, so then there were all these questions that we started asking then, that if this happens, what? What would you do? It's everything. Your kids could be picked up for drugs, depending on the age of their family, it was just stuff. It made sure that they had these conversations with somebody.

It was a different area of the training. Not the same training, and yet, it is critical preparation for flight. How do you get it going? We've created this whole system and it runs pretty well, now. The paper that I will send you, though, is looking at that same thing, taking it into an interstellar flight, which is how far would you have to push this system to accommodate flights that are not going to come back?

In each flight, the flight training, there's a pre-flight phase of training planning and execute that training. Then you go to the flight itself, which has its own set of problems, like fires or collisions with Progress so we would get holes in the spacecraft. Then you have the other end of the flight, where you have new problems. How do you fit back into the organization when you've been gone for not just six months of your flight, but the year before that, while you were training for it? You step out of your professional life. Sometimes you are the branch chief, or you're the something in the Astronaut Office, and now that's somebody else because you had to give it away to go fly. How do you get back in the game? And this is aside from how do you rehab just getting your body back together? Now, as we know, eyesight and all those things that change, with some other changes that are even less known. The crowd who stayed at home have moved on.

Along this time, the Mir was happening, getting ready to happen, going on, and in late '93, I was called over to a meeting—the Russians are in town. This is where [President William J. "Bill"] Clinton decided to save *Freedom* by bringing the Russians in as partners. This is separate from Mir, although it kicked Mir into high gear. I'm sitting in my office, which is in [Building] 4 South, I was on the second floor, and it's on the northwest corner. I look at the duck ponds [from] the second level. Six floors up is dehumanizing, but second floor, you can see the ducks, you can see the feathers on the ducks, and everything like that, they are not just

little specks. It's a great place to be, I think the second floor or third floor is a good place if you're going to have an office.

I'm here with a TTI [TechTrans International] translator, and General Yury Glazkov, who's the head of Star City. He's the head of all cosmonaut training at that time. I'm with this other fellow, his name was Sergei Bronnikov—he is from Energia, and he is the head of the training division in Energia. These two guys, Yury and Serge, I've spent my whole career as we were in the Cold War, and of course, now the '89, the Soviet Union collapsed. It was odd now because if I brushed hands even with one of these people or something, I'd have to report a contact, foreign contact. The guys who went back and forth to Russia during '75, during ASTP—which, by the way, I learned now it's Apollo-Soyuz Test Project here but not in Russia; it was the Soyuz-Apollo Test Project.

WRIGHT: Of course, it was Shuttle-Mir here, but there, it's Mir-Shuttle.

HUGHES: Yes, exactly, exactly. I'm sitting there with these guys, and we're about prepared to just bare our soul to them about all the training, and took them over to the simulators. We're going to get in bed together and this is where we're going to fly. It was so funny because I said, "Yury," he knew a lot of English but he didn't indicate that at the time, we're working through the translators, "have you ever been to Houston?" He said, "Oh, yes, many times," and then he leans out of his chair, looks down at the floor and goes like this [demonstrates taking a picture].

WRIGHT: He's taking pictures from above?

HUGHES: Taking pictures! I said, "Okay, yes, I got that." We had a great meeting because we knew a lot about training, and I'd been a Russophile as far as the culture over there, all the time—music, books, plays, the ballet—and so I was immediately taken up with what we were doing, and I knew so much about Russia that nobody else knew. It was a lot.

WRIGHT: You made a good connection, then?

HUGHES: I made a really good connection, and I said, "My big thing is I want to ride the Trans-Siberian Express." The years going on, they start this system, and they said, "Okay, we're going to come to Russia shortly," and turns out it was screwed around until April before we got there, the first trip; '94, in April, was my first trip over there. Along the way, we got a lot of stuff ready, we talked to them about them, had a lot of questions ready to talk, and then I took a crowd. I took about eight of my people that knew training, knew the business, and that started a series of, I think I was there at least 13 times over the next five, six years.

It was great because I was able to do almost anything. They just treated me like a prince because I would go in and we had done our homework and we knew what had to be done, and we knew what they were doing and we wanted to get it done right.

Along the way, we created something called an International Training Control Board. There was a set of things that came out of that Station Operations committee back there, back in '86, '87, where you had to have something to control the training—there was one of these for planning, one for flight control—these groups worked together with all the partner players so that there would be a delegate in the training control boards from Japan, from Europe, from Canada, and so on, that represented the training organization there. The idea being we were

trying to now put all the training together, so it's flowed smoothly, because training is not done the same in every country and it's really disruptive, even, how it goes. It worked real well.

WRIGHT: Originally, when the long duration started for these American astronauts and they had to be somewhat trained on what was going to happen when they get there, did you do anything, any kind of preliminary training here, or was all the Russian hardware and all of the Russian training done at the Russian facilities?

HUGHES: Over there. In Mir, off of Mir, it was all there. We started talking about how do we get some hardware here? I got a device from Japan and I got a device from Europe to plug into our simulator, and I was working on one from the Russians, and never got there. That was mostly because of our problem, the American side. Ultimately, that led to me to just get out because I said, "What the hell, these people are worthless." I mean the people running our side.

The worst one was in late '98, and I wanted that Russian simulator, but I wanted at least the software that I could put in our sim computers and make it look like the similar systems there. I got a lot of that from the Russians. But we had a real problem with money transfer. If you gave money to the Russians, it disappeared into the system. It never got to the guys who were doing the work. It never came down through the system; it's just somebody's new dacha, and all that sort of thing. Did you ever go there?

WRIGHT: No.

HUGHES: That's too bad. You should. It's a great place. There's really big houses around Star City, really big houses, we couldn't believe it, big "McMansions" next to a hovel. I had one really bad meeting—I'll tell you about a lot of different trips, but at this one, where I had the Russian sim guys on the ropes. I got to the point where I knew that you couldn't pay for anything but I was going to give them Silicon Graphics computers. Russians couldn't get good computers, it was just we had a—what do they call them, what we're doing here around now—you put these blockages on it so you can't buy different hardware. Here we're going on like this, and I said, "I'll get you Silicon Graphics," and there would be this thirsting hunger for this, that's a rare, powerful computer. It would become the host computer for their simulator. Then it went back and forth, and at the end of the day, when I'd leave and they were pissed, then I knew that was a good day. It's all above board, and they're not just pissed at me, they're pissed that we're putting them in this position, and yet they'd say, "Okay, fine, yes, I'll get this and this, I will pay you not with money but with as good computers that you can use." Nobody can do anything with a computer; it'll come on a pallet and they'll get it down at the working end, where the working devils are.

I went back to the hotel and I guess the Program Manager at the time, Randy [H.] Brinkley, he said somebody had complained about me there. He said, "These poor people, they were really having it tough over here, and things are tough, and they really don't have to make it so hard on them when we negotiate." At the end of that day or the next day, which was Friday, we gave them a check for \$60,000,000, and that was it. Removed any ability for me to do my computer thing, and they never got the computer and I didn't get my software. I was stepping on someone's cash flow operation. That's when I said, "I think this is not the NASA that I used to know."

WRIGHT: For years before—I remember asking you this question—how do you know that a team or a crew, and in this case, an astronaut, was ready to fly? This gave a whole different dimension of ensuring that you knew that the folks were ready to go.

HUGHES: All I knew is that we had a person in that meeting. What it turns out we did is that in '93, '94, we put two people in place. One was an astronaut called the Director of Operations, Russia (DOR), person is an astronaut from the Astronaut Office. So then the DOR is that astronaut. His deputy is one of my guys, Deputy Director of Operations-Russia (DDOR) so there's a training guy, 100 percent of the time, representing me to everything that goes on. If there's a problem with one of the astronauts, I get a call, night or day, something's happened, and that was the way it worked. I said, "You call me, doesn't matter what time," because obviously they're 8 or 9 hours off, so when we're sleeping, they're in the middle of the day, doing their things.

WRIGHT: Was that where they were called the Russian Interface Officer, or was that something else?

HUGHES: That's a different thing, but right now, even as today, the DOR is an astronaut position over there, and it's been everybody. Mike [Michael E.] Fossum did it, all the guys, over the years, before they actually flew, then. Then, my DDOR [Deputy to the DOR] was operating like that.



WRIGHT: At least it gave you some eyes and ears to see what was going on.

HUGHES: Yes, it did. It worked very well. Not that I sent people over all the time, separate from me, but they'd go over and what we did is—let's go back to the beginning, in '94, there were no pieces of paper, there were no drawings. There was a drawing—there was *a* drawing—on the Soyuz system, and they didn't make copies because it was all secret. In fact, they didn't even call it "Soyuz." The Soyuz Simulator, isn't that funny, I can't remember the names but it was a codeword, even inside there, so that they would never say, "I'm going over to the Soyuz Simulator." They just wouldn't say that. "I'm going to the X-394." Probably inside Russia, they said, "Oh, just going up—" but to us external people they used the code words.

Finally, I was going to a meeting, and here is something that clearly is the Soyuz Simulator, a kind of drawing on the wall, but it doesn't say that. In Russian, of course, it's got this code. I was just playing dumb, I said, "What is that?" Where we would go, *clunk*, here's four pounds of paper, this is how the Shuttle works. They were just pulling away. They had to respond to that. We weren't telling them how it worked—we'd tell them how to work it, procedures and drawings that were training drawings, not the details that this is how you build it. That was a big thing, a much different thing.

It got better and better and better and better as we just opened it up. It was only edging kind of things. There was one day I was back in, and like I said, I'd developed really good relationships with these folks and different people. I would go to their family and have dinner, or we'd take the family out, because at '94, it was when the ruble collapsed, so that was really bad, and many of the people that we now knew were getting their same salary, but the salaries were worthless. It was 100 times less than it had been the day before. One of my best engineers

over there, I used to consider mine, but a Russian woman, she was doing sewing to get her by. She had a five-year-old daughter, divorced or whatever, I don't know, no guy involved, but whatever it was, young women were talking to me about this stuff.

When we went, we would go over and we would bring vitamins for kids, chewable vitamins and stuff like that to get them through this time. We would bring food stock, and then we'd have parties at the hotel. We'd say, "Come over after work," and we'd have cheese and all kind of stuff that we just brought. You couldn't find it, couldn't buy it there, so we just had all this [food]. You get through three or four pieces and then said, "This would go bad, I don't have a refrigerator, take it home." That sealed the deal in a lot of other ways, they're having much deeper relationships going on. It was great in the sense that we'd go—payback was interesting because somebody'd say, "Oh, you really like ballet? Bolshoi has got this program this weekend—," whatever.

I said, "Okay, I'll give you money for tickets."

They said, "Don't need to."

"Okay, I mean, are you sure?" Turns out there was a price a tier—in other words, if you were a Russian, you paid a pittance to get in versus an American trying, or Europeans or whoever, big bucks all the way at the other end of the scale. They would buy the tickets. I went to concerts, I went to ballet, and sometimes I did pay. Sometimes it wasn't available, the other cheap ones are gone, or something. It's a hell of a thing. I had a ball.

WRIGHT: Talk about the reverse, when the Russians—Sergei Krikalev and [Vladimir] Titov—came here to train on the Shuttle systems, and the alterations to what you had to do to get your trainers ready to talk to these Russians.

HUGHES: First of all, we hired people who spoke Russian already, and they generally were immigrants who were now citizens, but we fixed it up, we turned them into our instructors. They went through all the training that other people had to do, so now they had an extra skill, to speak Russian, technical Russian. It was great. Then, they would get assigned to a crew. Whenever that crew came, that person would be there. We always knew, that same thing, we'd have close encounters and everything. They act as contact for anything they needed at the time, but our people would come over, the engineers were training people, and when they first came, they'd say, "This is our weekly schedule, this is what we're going to do, Thursday, we're going to have a party," they're staying a week, "but Tuesday and Wednesday, I've got cars available if you want to go to Wal-Mart." They would come and they would get a credit card, so they would survive by this credit card.

At first, they had money, they would give them a number of American dollars a day they would live on. They didn't do anything without us—we'd put them in some place like Residence Inn [hotel] over here, in Bay Area, and they could walk to a food store. Then, they would buy everything they needed to eat at home. They would eat in there, so just cheese and bread and vodka, and they'd survive there. The extra money, they were ready, and so they wanted to go to Wal-Mart or to somewhere like K-Mart, it was still was open at that time, and they'd go buy things to take them home. It was just the most basic things, but it was interesting.

The first time, it was like really basic stuff, and then the second time, maybe they'd get a stereo system so they could have better music at home. It just moved up became more sophisticated. Later, by the last time that some of my friends were coming over, they'd want to go to AutoZone because now they've got a car. It's a nine-year-old Mitsubishi or something like

that, and they need spare parts. They'd come with a list of spare parts for all their friends. It got that good, but in Russia, there's no such thing as an auto spare parts network, but we've got three or four around here. I don't even know—Pep Boys and AutoZone and NAPA, all those things.

WRIGHT: Lots of them.

HUGHES: We'd go around and they'd load up with these big pieces of metal sometimes or whatever it was, load up their suitcases and head back. They came from the really desperate things, and then gradually, the family because of these infusions of money made them back to something like regular people. Then, even beyond that, when they were able to make things—it's never a new car, the oligarchs would have the BMWs on the road and everything, but they got something. It worked out really, really well.

WRIGHT: At what point in the training program did you start to shift from the Shuttle-Mir phase, knowing that you were going to have these other international partners coming in, and especially the Russians, for when the [International Space] Station was going to be in mode, and we just celebrated the 15th anniversary yesterday of the first module going up. You knew it was coming, and how did you start adjusting to knowing what training you needed to do for long-duration flights?

HUGHES: That's a really good question. It's again one of those things where you had to just be able to—and I tried to hire people—put your thought process ahead. That is, you had to be able to look to the future and sense what all the problems we had so far, and then multiply it by that

10 or 20 or whatever it is. People went up in orbit and they would have trouble in the Shuttle. We knew different problems that I had known about in Apollo, things like that, or Skylab. They get sick, motion-sick, or they get just sick, regular-sick. Worst thing on Space Station even now is when new people arrive because everybody gets sick. Not the new people because they already had it, but they bring a whole new set of germs, and so it goes through the crowd. Everybody gets sick from the latest thing. Maybe not very sick, but sniffles or cold or whatever. It's because humans are just swarming with germs, and so you just come in bringing a fresh supply.

Then, there's the other things that you can get upset with people and you'd try to fix that ahead of time, to make sure they'd do, like, some people have very long hair and they don't get rid of the hair, and so then their hair is floating around all the time. Trying to talk them into cutting their hair short for the duration of the flight, and then I also sign up for letting somebody cut your hair once while we're there, or at least keep it under control in some way. You don't ever want to fly with somebody with dandruff.

WRIGHT: I know, it's all these little things that mount up, don't they?

HUGHES: Yes, they start bugging you, so we go through all that stuff. The guys that wear their hair short, we have a rig with a vacuum cleaner, so you cut, but you suck up all the hairs right away.

WRIGHT: Of course, before they moved in on the Station they had all of the—and there were a lot—assembly flights. I think they said last time maybe 42? It had a lot of training now with specialized EVA [Extravehicular Activity] training. Was all that underneath you as well?

HUGHES: Yes, at the time. EVA was an interesting kind of thing. You've flown on a 747, imagine if you were building that airplane while you were flying it, so you take off and all you've got is the cockpit and a few seats, and along the way, somebody comes along and jams another thing in the back, so add more seats. You have to solder it together, you had to connect the wires together so the power is back there, connect the wires so that the computer system works back there. Then, somebody comes along and says, "We're going to put the right wing on, and then we're going to put some engines on." That's what we did. If you think about it, we started out with a really, really small, little thing, and every time, the training was not just to go out and bolt it all together, which you had to do, then inside, they had all kinds of things. In the hatch, around the edge of the hatch, are all these connectors that you have to make with the jumpers, because when you start. You dock with this Space Station module, and you soft-dock it. Then, you activate motorized bolts all around, and that makes this module part of the deal. You go in and torque those bolts and make sure they're really good and tight.

First of all, you had to open the hatch. Hopefully the module over here's got air, but there's certainly a hard vacuum in this vestibule, they call it, between the two hatches. Then, when you're ready, you crack a valve and let air get into the vestibule, then you watch and see that the pressure is there now. Then, you can undo the hatches and throw it open. Then you sample the air, make sure the air is still good on the other side of this hatch, and the pressure's equalized, and then you can open that hatch. Now, you've got free-flow going back and forth.

The first thing you do, though, is put a jumper that takes the air duct coming over on this side, a little short thing, connects up with that air duct on this module to the other. Then open another valve and it's just like you building a room on your house.

Now, you have to jump to the new air ducts in that room, and the same thing for the electrical power, computer data, water, stuff that goes on all the time. Get all that done, now you can go in. They're probably wearing, the first time they get the hatch open, masks because now you launched, it's the worst thing because every Shuttle, first flight, you'd always find nuts and bolts coming out of places, something fell down, dirt and dust. You tried to keep it clean, but stuff happens. As soon as it comes loose, now, then gradually you sweep it all up, either with the vacuum cleaners or it goes into the air return, and then you could trust it, that you don't have something getting in your eyes all the time or breathing stuff in. That's all clean, relatively, and then they start doing these other jumpers, getting it all hooked up, and becomes legitimately a part of the Space Station. Just get that done, and here'd be another one coming. There was always something new on the way up.

Meanwhile, you had to change the software because it had to be a new load of software each one, because you can imagine you had to tell the software, "There is a new vehicle over here. There's a new room added into this house." So all of these networks of data flowing around, you'd say, "Oh, by the way, there's a gym over here." So everything happens so that alarms, fire codes, now have to include that it sensors and tests and does whatever to this new one over here. Plus, they had computers of their own, so they had to start talking on the network back to everybody. It's an enormous thing, and we did it; take your hat off to the people who did this, this is awesome.

For us, it was like, here you have to launch these people in the Shuttle. They're passengers. Other people would get them up there and get them down, then there are four or so, whatever, new people were trained to do all the assembly activities. Either EVA or IVA [Intravehicular Activity], to do all this crap, and all seven would work it, they'd have duties, but these four concentrate on getting the payload installed and operating.

In other words, the payload is sitting in the bay; the easiest thing was to lift it up and jam it on the back end, and then start working both inside and outside, to get it all humming. It's the most amazing thing. The planning that you had to do ahead of time, then the training to make sure that the crews knew how to do it, and of course, a lot of times, they didn't. That is, something would happen—you tried to get the network going, it wouldn't go, call the IT [Information Technology] guys, right? It's that kind of thing. The IT guys are sitting on the ground down there and they struggle to figure out what it is. Obviously, they made it work every time, although there were whole errors made different times, where there's been computers quitting and knocked down and we'd lose power or we'd lose attitude control of the whole vehicle because you shut down the system.

WRIGHT: During your life in the training area, the EVA had its own evolution.

HUGHES: There's a very big evolution.

WRIGHT: How did your area get impacted by the changes that they would make in the training areas itself, from the WETF [Weightless Environmental Training Facility] to the Sonny Carter Training Facility [Neutral Buoyancy Laboratory], or as they made changes in the suits, I know



there had to be a lot of communication back and forth, but you taking their changes and involving that into what you would have to do to get the astronauts ready?

HUGHES: It's an interesting thing because I had the EVA for a while and then it went away because along the way, two things, the RMS [Remote Manipulator System] and the EVA, they had positions in the Mission Control Center [MCC]. It's the only one where the flight controllers are also the trainers. It didn't start out that way, but gradually, because they had a position to staff in MCC, when it went on like that, so that's why after I left—I didn't think I would let anybody else do that—everybody says, "But I want to do a Top Gun." I had this thing with Kranz and everybody else, who said, "Top Gun says that the best pilots start to be trainers." They were trying to do the opposite, and they did, after I left.

They destroyed the whole training division—it's gone—and the best training people that I had, who were really, really good systems people, had to spend three years in order to sit at a console as an environmental control guy. They mostly left. This is a guy that has trained every astronaut and knows everything about it and has even ridden as the trainer over flight controllers, but no, they've got to go back to the beginning and be subservient to some three-year person or something like that because he's in charge of training for getting to be an environmental control guy. The system that they did with Paul [S.] Hill and everything pretty much disrupted the training system as such. What they did when I was there, as I lost the RMS and the EVA guys, and then so I'd say we had to go and do this other thing, the other way to do it. Now, it's 10:30, forgive me, but I got to go to a meeting.

WRIGHT: It's fine.

HUGHES: We have to wrap it for today.

[End of interview]