

NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

EDITED ORAL HISTORY TRANSCRIPT 6

WILLIAM S. MCARTHUR, JR.
INTERVIEWED BY JENNIFER ROSS-NAZZAL
HOUSTON, TX – 26 MARCH 2018

ROSS-NAZZAL: Today is March 26, 2018. This interview with Bill McArthur is being conducted at the Johnson Space Center for the JSC Oral History Project. The interviewer is Jennifer Ross-Nazzal. Thanks again for taking time out of your busy biking day. We appreciate it.

MCARTHUR: Jennifer, it's always nice to come back and spend a little time with you.

ROSS-NAZZAL: Yes, we always look forward to it. It's been a while since we've done one of these, but I was thinking back on all the interviews that we've done. We haven't touched on the [Space Shuttle] *Columbia* [STS-107] accident. So I wondered if you would share your thoughts and your memories of that day and its impact on you.

MCARTHUR: Sure. I was training for [International Space Station (ISS)] Expedition 8 at that time. It was a Saturday, and we were in our cottage in Star City [Russia]. There are three duplexes that NASA rents from the Russians, and they are sort of townhome-style apartments, three-bedroom/two-bath apartments. We were following the mission as it was ongoing. We had, fortunately, pretty good television service in the cottages.

We picked up very quickly via the news that something catastrophic had happened, and of course we were at a loss. Of course, we Americans gathered together pretty quickly. Almost

immediately, cosmonauts started coming dropping by. Our Russian colleagues started dropping by to offer their condolences.

Expedition 8—we sat down. I think we had about a week of training left, and NASA offered to bring us back immediately. So we met and had a conversation and recognized that because we were so far along in our Space Station training, we were uncertain at that point what was going to happen with the flight manifest. It was obvious that the Shuttle fleet would be grounded, but we just didn't know what else might happen. I was pretty confident that by the time we got back to the U.S. people would be engaged in doing all the immediate postmishap activities.

We sat down, and we discussed it. We were pretty confident there wasn't anything we could do immediately to support the families or with the mishap investigation, so we agreed that the best way for us to honor the *Columbia* crew would be for us to complete our training. That way we would be better prepared for whatever plans were implemented, because it was obvious that it would be important to keep crews on board the ISS. And so, again, we agreed that that was probably the best thing for us to do. I think in retrospect it was, because we came back and we stayed in training.

Now, the crews themselves were shuffled. Expedition 6 was onboard ISS. From the U.S., Don [Donald R.] Pettit and Ken [Kenneth D.] Bowersox [and cosmonaut Nikolai M. Budarin]. They were obviously going to come back on a Soyuz.

Then the Expedition 7 crew, which was supposed to be Ed [Edward T.] Lu, Yuri [I.] Malenchenko, and [cosmonaut Aleksandr Y. "Sasha" Kaleri]. ... They shuffled the crews. Ed and Yuri stayed on Expedition 7. The plan very quickly evolved into only putting two people on board Space Station for the long-duration assignments, and then the crews would rotate on Soyuz.

I went from being the flight engineer on Expedition 8 to being the commander for Expedition 8 backup with Valery [I.] Tokarev. Mike [C. Michael] Foale stayed on Expedition 8, and then Valery and I moved to Expedition 9. In the interim, we were Expedition 8 backup crew. So that's really the sequence of events that transpired after *Columbia*.

We came back, and the training did change. We stayed in the U.S. for the next training cycle, [which] was extended, made a little bit longer. When I went back to Russia, I was going to fly on the right seat of Soyuz, so I now I had to move to the left seat and that just involved significantly more training in Russia. [To clarify, according to the original plan, I would have flown in the right seat of Soyuz, with minimal responsibilities for operating the spacecraft. But on the Expedition 8 backup crew and subsequent missions I was assigned to the left seat with a significantly greater role in flying our Soyuz.]

ROSS-NAZZAL: I didn't realize it had such a dramatic impact immediately.

MCARTHUR: You alluded to something else [before we started]. The best-laid plans—Expedition 8 flew in the fall of that year, and what we thought is that Valery and I were going to be Expedition 9 along with André Kuipers, a Dutch astronaut. During some EVA [extravehicular activity] training in Star City the Russians detected a heart arrhythmia in me, and so the doctors of course were concerned about it.

This is when we were doing Expedition 8 backup training, so we continued as Expedition 8 backup. I'm not sure what they would have done if Mike [Foale] had not been able to fly, because as soon as Expedition 8 flew it was obvious the Russians were very uncomfortable with my flying with this heart arrhythmia.

Rick Senter was the flight surgeon who was there when the Russians first saw this. It was tachycardia, a rapid heart rate. He explained to me what it was, and it was not a life-threatening issue. Expedition 8 launches. I get back to Russia to start training for Expedition 9, and it's obvious that the Russians are very reluctant. NASA is going to be hard-pressed to convince the Russians that this is a medical condition that they'll accept.

I came back, and they sent me down to St. Luke's [hospital] to an electrophysiologist, a cardiologist who deals with arrhythmias. The Russians have a test that they perform on all their cosmonauts, and that's to put in an esophageal catheter. It's a little wire that they actually run through your nose, and it goes down your esophagus, so it sits in close proximity to your heart. Then they apply an electrical impulse, and they try to trigger an arrhythmia. It's not a test that's common in the U.S. anymore.

Even before that, NASA brought in an Air Force cardiology specialist; he looked at all my data. He said, "If you were an F-16 pilot I would put you back on flight status immediately, but I don't have experience with how people's hearts respond in microgravity, so I really don't know. However, I would consider it unethical to say that your options are to have a heart catheterization or be grounded. If they're going to require you to have a procedure to allow you to fly, then I think the only ethical decision is that you don't fly."

Of course, I'm not buying that. At St. Luke's, they agreed to do the test that the Russians do. I'm in their cath lab [catheterization laboratory], and we're getting ready to do this. They're looking at this catheter, kind of looking at it, and they go, "We've never seen these before. We're not sure how to hook them up." So they do a little checking, read the instructions. "Okay, we got it down now."

They insert the catheter. It was interesting. Like I said, it goes in through your nose, and the first time they did it it then came back out through my mouth. It's like, "Okay, it's not quite going in the right place." They worked on it, and they got it in. So they started applying this electrical impulse, "Do you feel that?"

I said, "Yes, I feel that."

"Is it comfortable?"

I said, "Yes, it's not too bad."

"Okay, it hasn't actually captured your heart rhythm yet, so we're going to have to increase the voltage."

As it goes up I said, "Okay, now it's reached the point where it's not very comfortable."

"Okay, we'll give you a little something for that."

So they gave me a little something to deaden the sensation. Then they captured the heart rate, removed the signal, and the heart rate went back to normal. The deal was if the U.S. gave me the test that the Russians felt was their standard and I passed, then I'd be cleared. Then they started pacing my heart again, removed the signal, and this time it didn't return to a normal rhythm.

What I had was something called AV [atrioventricular] node reentry tachycardia, and it's caused by an area of additional electrical conductivity between the right atrium and the right ventricle. It's something you're born with. It generally doesn't manifest itself until a little bit later in life. At this point, the NASA docs go, "You're positive for this condition. What do you want to do?"

I said, "If we've gone this far, why don't we just fix it?"

ROSS-NAZZAL: What does that entail?

MCARTHUR: The NASA docs said, “Well, you’ll be grounded for six months if you do that.” We were four months from our launch date. “You’ll be grounded for six months.”

I said, “Well, we don’t have any”—I apologize—“we don’t have any balls if we don’t challenge that grounding.”

Then it was kind of ironic. The doctor was Dr. Ali Massumi, the cardiologist. Sadly, he’s passed away. Dr. Massumi said, “The way we would treat it is, we’d put in a catheter into your heart through the femoral vein. We’ll map the electrical areas in your heart. We’ll identify this abnormal area of activity. Then we’ll use a microwave tip to heat it to fifty degrees C [Celsius], which will kill the nerve tissue in that area, and it will remove that conductive path.”

I’m already in the cath lab, so it was just a matter of taking that catheter out and then doing the other ones. Then somebody said, “Oh, but we’ve given him a sedative. That means he can’t sign a consent form.”

But I was still alert enough to say, “Then it’s a good thing I signed the consent form this morning before you started.” This was actually on New Year’s Eve, I think in 2003.

ROSS-NAZZAL: Way to celebrate the new year.

MCARTHUR: It was. They performed the procedure. This was day surgery, so they put me in a recovery room. They really were concerned most about the catheter insertion site, the incision there, bleeding, because it’s a pretty large blood vessel.

I think maybe even before I got into the recovery room Dr. Massumi had told my wife, “He’s cured.” Dr. Massumi was pretty confident that that would correct the issue. Now we did

catch grief from my daughters because we did not tell them that Dad was going into the hospital for some cardiac procedure.

ROSS-NAZZAL: It's kind of a big deal, major organ.

MCARTHUR: The most uncomfortable part of the procedure was after the catheters were removed, the huge nurse—we've seen these people with these physiques from the South Pacific, Samoan-type physique. It's a male nurse, nice guy, but he's putting his full body weight down on the incision site to make sure that the incision closes. He's a big guy.

We failed in challenging the six-month grounding. In part, it was they wanted some time to ensure that the issue had been resolved. They initially just replaced me on the crew with Leroy Chiao, and then unfortunately they decided that they would bump Valery. So I became the Expedition 10 backup, and they were going to have Leroy and Valery fly with André.

But then they decided for a number of [reasons]—I think they just thought that Valery and I were psychologically so compatible, maybe they didn't think they could find somebody else that would put up with me. They just thought we paired up so well together, unfortunately for Valery—worked out okay in the long run, but they bumped him back as well.

So they left Leroy and Salizhan [S.] Sharipov on Expedition 10. We became the Expedition 10 backup, and they moved Mike [E. Michael] Fincke and Gennady [I.] Padalka up to Expedition 9. Valery and I trained as the Expedition 10 backup, and then ultimately were prime for Expedition 12.

ROSS-NAZZAL: You mentioned Valery, so I have to ask, because in another interview with us you called him your “space brother.” I wondered if you could elaborate on what you meant by that.

MCARTHUR: We met each other first in the late '90s when he was here training for STS-96. He was a Russian Air Force colonel, test pilot. We didn't get to know each other well at that time because he was training for one mission. I was training for STS-92, so we didn't have really a lot of time to get to know each other.

When I became the DOR in Star City (the director of operations-Russia)—which is really a very grandiose title which really doesn't describe the job very accurately, because the DOR is really just responsible for what goes on in Star City and not all of NASA's efforts in Russia. We had an inkling then that we were—it wasn't official, but we were pretty confident we were about to be assigned to Expedition 8 together.

Somewhere, I think in maybe April of that year, I had a chance to go with the Russian delegation to some international symposium on space exploration being held in Berlin [Germany]. Valery was also on the Russian delegation, and because his English was quite good he became the translator for me and my wife. Neither of us spoke Russian very well at the time.

We stayed in the Russia House [Russian House of Science and Culture] in Berlin. This is essentially a conference facility that was either owned by Russia or certainly controlled by Russia. They provided all our meals there in their own dining room, and they had their own chefs. So we really were eating Russian food there. They brought in German beer, but it was Russian food. There'd be a lot of chitchat and a lot of things like that.

Valery would be translating those things for us, and I think some of the language became colorful. He would be sitting beside my wife, and so when Valery would translate he would say,

“Well, this person said this, this, and this, and now some Russian slang,” so that was the colorful language. We started bonding then, and then in I think August—I’m trying to remember when the crew assignment was actually announced. Maybe it was in August of 2001.

The crew assignment was announced, and from that point forward we were together almost constantly. Generally, we’d spend a month here in the States training and then a month in Russia training. We were going to classes together constantly, training in the NBL [Neutral Buoyancy Laboratory] together, doing sims [simulations] together. We would socialize, whoever was in whatever country.

When Valery and I became paired as a two-person crew, then we would socialize just the two of us. He would generally arrive in the States for training on a Friday or Saturday—Saturday I think—so the next morning we would always meet at Perry’s [Steakhouse and Grille], when it was over on Bay Area Blvd. for brunch. In Russia I would periodically go to Valery’s house for dinner, or whatever. Of course I got to know his wife and children, and he got to know my family quite well. We did some interesting things.

He and Suni [Sunita P.] Williams went with me to a West Point [United States Military Academy, West Point, New York] banquet one year. Suni is a Naval Academy graduate, so it was kind of fun having a Navy guest at our big banquet where the interest we all shared most was a hatred for Navy. I guess maybe not so much hatred, but a keen rivalry.

ROSS-NAZZAL: Yes, I was going to say you probably razzed her a little bit there.

MCARTHUR: Absolutely. I remember he took André and me elk hunting one time. We say elk, I think they really were moose. This was quite an adventure. It was early December before I had

my cardiac intervention. We went to Valery's hometown and went and got together with a hunting collective. These were a bunch of men from Valery's hometown.

Some of the collective would drive the animals toward a line of hunters. It was probably one hundred kilometers north of Moscow. Rostov Veliky was the name of the town. It was cold, snow on the ground. We're driving around in this—looks like a little four-wheel-drive minivan, a military-style vehicle that the Russians had a lot of. Eating this sort of ground-up meat that's kind of congealed, and drinking vodka, and shooting at things. It's like, "What could go wrong here."

Fortunately, nothing went wrong and they actually did get a couple of animals. Then we went back and they had cooked up a stew with animals—not from the kill that day, but from previous hunts. That's really what they did is they would shoot these animals and then distribute them in the town, so these were folks were actually getting meat for sustenance.

Golly, I remember one night, and maybe it was that night. We stayed in a hotel right on the river locally, and I remember looking at it. It was just really strange because the name of the hotel was Riverside. Not in Russian, in English, "Riverside." And it was like a Bavarian hotel or something, so it's kind of interesting to be in relatively remote Russia.

Then there was one time Valery had been invited to speak for some holiday of some town east of Star City, so he invited me to go along. I get there and they ask me to speak. I did the best I could.

ROSS-NAZZAL: How good was your Russian at that point?

MCARTHUR: I think I could speak Russian well enough that I could demonstrate to them a respect for their culture. One lesson I learned at some point. That is you don't have to speak another

language well to be able to demonstrate that you have respect for other people, because you are trying to learn the language. So that's part of how Valery and I bonded.

ROSS-NAZZAL: You mentioned that things changed as a result of *Columbia*, especially because you weren't going to be a three-member crew, you were going to be a two-member crew. How did that shift the training? You mentioned things changed, I know your mission changed.

MCARTHUR: Our responsibilities became much broader. Now if there was going to be an EVA, Valery and I were going to do the EVA. Before, when there was a third person in the mix, it might have been, for example, Mike and Valery might have done a Russian EVA, or Mike and I would have done U.S. EVAs. Now Valery and I had to do all of those things.

At some point we actually did think—because STS-114 [post-*Columbia* Shuttle Return to Flight] flew in July of 2005, and we were scheduled to launch in the fall of 2005. We actually thought when we got there that there would be a third crewmember there, Thomas [A.] Reiter would go up. I think he would have gone up on STS-121 and he would have been there when we arrived. Then, sometime during our mission, the next Shuttle would have come up and Suni Williams would have come up and replaced Thomas.

It was only after 114 flew, and there were more foam shedding problems that the plan changed. Not only were we not going to have a third crewmember, a lot of the experiments we had trained to do were not going to be present. The specific EMU [extravehicular mobility unit] components that Valery and I would have used were going to go up on STS-121, so they had to change the actual suit configuration—with the components that were currently on-orbit—to achieve a suit fit that would be acceptable for Valery and me.

They did launch our prime EMU gloves, so we had our prime gloves, and then they had designated gloves on orbit which they thought would be acceptable as backups for us. That didn't go so well.

ROSS-NAZZAL: Do you want to elaborate on that?

MCARTHUR: I sure do. Getting into Expedition 12, we had a U.S. EVA. We thought we might get to do two U.S. EVAs. We had the first EVA maybe late October, early November. [If you] recall, there had never been an EVA from the U.S. segment out of the U.S. airlock, wearing the U.S. EMU, with only a two-person crew on board ISS.

There had been Russian segment EVAs in the Orlan [spacesuit]. Leroy and Salizhan did at least one, but no one had done [with the EMU]. When I say a two-person EVA, of course most EVAs are two people. But for the U.S. suit there had always been at least one other crewmember to help the EVA crew don and doff the suit.

So the concern was, without a third person present, how would those tasks be done? Not only how would you do those tasks, but we had to worry about the contingency of an incapacitated crewmember. What would you do if one of the two crewmembers loses consciousness during the EVA? Assuming you can get both people in the airlock, that the conscious crewmember can close the hatch and can repressurize the airlock, but can [they] get both people inside the larger part of the airlock, the equipment lock portion? If you're by yourself, how do you get out of the suit?

Previous crews had worked on techniques, so one week before we did the EVA we went through a true full-up dress rehearsal where we completely suited up. I think the only thing we didn't do was an in-suit prebreathe. The suit pressure is much lower than ambient pressure. To

avoid getting the bends, you have to, at full ambient pressure, breathe pure oxygen in the suit for four hours. So we skipped the four-hour prebreathe during the dress rehearsal.

We went through everything, and there were some interesting techniques. We put handrails in the floor that you could wedge your foot in between so you could anchor yourself, and then we took a series of straps, tethers. You could get the gloves off; you could get the helmet off. You could disconnect the body seal closure between the lower torso assembly, the pants of the suit, and the hard upper torso. But how do you get out of the hard upper torso? Because you've got these arms here [demonstrates] and the shell itself is fiberglass. You need something to react against.

If you have a third crewmember there is this EVA don and doff assembly, this rack against the wall, that you clip the suit into. If you have a third crewmember, that person can do that. Or, if you have two conscious crewmembers, one of you can do that for the other, and then once that person gets out of the suit you can then take the second crewmember and do the same for them.

But if you're by yourself you can't get into this rack; you can't clip the suit into the rack. We've got the handrails on the floor, put your feet in it, and then we take these tethers and attach them to overhead locations and then slip them around the rings. Now you're sort of spread [out], almost like you're being crucified. Then what you have to do is see if you can work yourself out [of the suit]. Valery and I had to demonstrate the ability to self-don as a prerequisite to being cleared to actually do the EVA.

After we'd done that, Valery was worried about his glove fit. Even though these were his prime gloves, he didn't find them comfortable. So we said, "We'll go find your backup gloves, and you can try those on." I look in the inventory management system. Valery's backup gloves, serial number 12345, "They are in this location." Needless to say, it's a location that had things blocking it, and they were in a bag with a lot of other gloves. So I'm looking through every glove

looking for Valery's backup pair. I go through every glove that's in the location that the inventory management system says. No backup gloves. Okay, fine. I call the ground, "Can't find the backup gloves. You have any suggestions?"

"Go look in this location."

"Already looked there."

"Well go look in this location."

I go look there, "No, they're not there."

"Try this location."

"No, they're not there."

I go back in the inventory management system. I read in the notes that these gloves were originally scheduled to be brought down on STS-114, so I call the ground. I said, "Have you checked to see if you have them on the ground?"

"What?"

"Why don't you check and see if they're over at Boeing or United Space Alliance?"

Next day. "Yes, they're on the ground."

"Okay. So how about our wrist mirrors? We can't find our wrist mirrors."

"They're on the ground."

"Okay." So we used Russian wrist mirrors and that worked okay, but Valery had to use his original gloves.

As I'm rambling about stowage, that was something I found very frustrating on Space Station, the inability to find [items]. I think it had a lot to do with the chaos that occurred when [the Orbiter was grounded again]. So STS-114 went up, and it was thought that that would be the beginning of regular logistics operations with ISS. And then of course while [Space Shuttle]

Discovery was docked, the decision was made to ground the fleet until they did additional modifications of the external tank.

There was a rush to do whatever was possible to leave the Station in the best logistical configuration in the absence of the resumption of normally scheduled Shuttle missions. A lot of things were transferred from *Discovery* to ISS, and they didn't have bar codes to interface with the inventory management system, so there wasn't a convenient way to document where all these things went. I'm sure a stowage plan was uplinked to the crew, but I suspect they were so overwhelmed with the amount of material they were trying to transfer that at some point they just started sticking things in lockers and bags and that sort of thing.

So I continually encountered two things. One is things weren't where the ground thought they were, if they even were on orbit at all. There were things that I did find that were useless. There were power cables for example, laptop power cables that were transferred from *Discovery* to ISS, which weren't compatible with ISS. There was a lot of that stuff. At some point I spent some amount of time transferring those things to a Progress to be thrown away, just to be dumped. Or I would open up a storage area, a locker or bag, and it would be complete chaos. Things just randomly put in there, and you open it up—you know what you want is in there, but you have to take virtually everything out to find it. I tried to be really meticulous; once I went into a location, to try to make it a little more orderly than I found it. I'm sure I failed miserably at times, because it's hard.

In the absence of gravity to hold things in place, it's the second law of thermodynamics, that entropy increases. That without adding energy to a system things become more and more chaotic over time. And ISS is very much that way.

ROSS-NAZZAL: I was reading actually for about a month you guys couldn't do any contingency spacewalks if necessary, because you couldn't find the air scrubbers and [had] problems with the handrails.

MCARTHUR: We couldn't find the Russian LiOH [lithium hydroxide] canisters. I remember I eventually found them.

ROSS-NAZZAL: Must have been challenging.

MCARTHUR: I suspect had we really needed to do an EVA we just would have dropped everything until we found them. It was also interesting the way the Russian—in the FGB [Functional Cargo Block], some of the lockers were very isolated. There were mods [modification] to a lot of their panels. If you opened the panels, they had sent up mod kits where they would put little storage areas in.

There were some areas in the FGB, if you opened one panel it was actually a free passage to other—it was just empty behind several panels, and there was nothing isolating them. If you put something behind one panel, it could migrate over time. I think that's what had happened to the lithium hydroxide canisters. They had just drifted from where they were originally and gone to another location.

There was another experiment. It was called PromISS [Protein Crystal Growth Monitoring by Digital Holographic Microscope for the ISS]. I believe it may have been ESA [European Space Agency] hardware, I'd never seen the [experiment], and it went into the Microgravity Science Glovebox.

We got a call from the ground, “See if you can find—.” We got samples that were supposed to be processed in PromISS. We’d gotten samples on our Progress in December. The ground said, “We’d like to start processing some of these samples. Go get the PromISS hardware out, it’s located here.” I go there; it’s not there.

“It’s not there. Any other ideas where we might look?” Turns out one of the samples expired before we processed it. I was a little disappointed that they didn’t tell us that the samples had expiration dates, because maybe I would have put even more effort into finding PromISS. But I spent hours, I did, I spent hours looking for this stuff.

And then, I don’t know why but I said, “Where have I not looked?” Where I had not looked was under the floor of the FGB. Because the deck of the FGB was completely blocked with stuff. They had these rendezvous units that came out of Progress vehicles. What the Russians really liked doing with the Shuttle there is they had these just huge—they’re not rendezvous radar, they’re actually rendezvous radio systems. They use them for determining distance and direction between a Soyuz or a Progress and the Space Station.

The Progress gets destroyed when it returns to Earth, so the Russians would lose two Kurs [radio telemetry] sets every time a Progress would come in. Well when the Shuttles were flying, lo and behold, we could remove the sets; we could remove this equipment. I think we also may have removed some docking hardware as well. We would remove that from the Progress because you didn’t need it. Once the Progress was docked you could take it off, you could take the stuff out. You didn’t need it for undocking and to be burned up in the atmosphere. Then the Shuttle could bring it back, ship it back to Russia for any refurbishment that was necessary, and it would save them the cost of building and buying additional hardware.

The deck of the FGB was just covered with this stuff, big components. Getting underneath the deck was a big deal, but I finally said, “That’s the only place I haven’t looked.” I started, and fortunately under maybe the second deck panel I found the PromISS hardware. I got a little annoyed with the ground shortly thereafter.

I found the hardware. This is when they’re in a hurry to get the remaining viable samples processed. Late one afternoon they send me some—my recollection is—a procedure with eighty or ninety steps, and they want me to set up this hardware in the Microgravity Science Glovebox. I think I was annoyed that they would send me a procedure with so many steps and schedule thirty minutes to do it. It’s almost nine o’clock, so it’s bedtime. So the ground refused to continue to talk to me about how to do this procedure, because they wanted to force me to stop and go to bed. Of course, you know what I did.

ROSS-NAZZAL: You continued, I’m guessing.

MCARTHUR: I just stayed at it till it was done.

ROSS-NAZZAL: I had read that you were only allocated—because there were just two of you and you had all these housekeeping and maintenance issues, and obviously issues with storage—only nine hours a week to actually work on experiments.

MCARTHUR: That’s probably right, because it did take every bit of the rest of the time just to operate and maintain Space Station. There was always some maintenance task we had to do.

In addition to the U.S. EVA, the latter half of the mission we did a Russian-segment EVA, and doing an EVA takes a huge amount of time. For the U.S. EVA, we devoted a week getting ready for and doing the dress rehearsal, and it took another week getting ready for and doing the actual EVA itself.

We relocated our Soyuz twice, and that would take a significant chunk out of a week because that essentially was a continuous twenty-four-hour operation. Then the Progress coming up. We only had one, but you have to train. You do a computer-based training for it to come up, then when it comes up you have to deal with that, and you have to unpack it. When you're getting ready to get rid of a Progress, you then have to spend all the time packing it.

Those things really do—you hate to say that the science is optional, but keeping the Station running and healthy, those are must-do tasks. The science, it's the reason we have a Space Station. A lot of that, you can fit that in where it's convenient. That's why having a six-person crew, and hopefully in the future a seven-person crew, is so important, because that's really how ultimately you justify the investment in the Space Station.

ROSS-NAZZAL: Had you trained on a lot of the repairs and maintenance that you devoted much of your time to on orbit?

MCARTHUR: We had done a lot of generic training. Fortunately, for the core hardware of the Station itself, a lot of it has very generic interfaces. The bolts are all the same size. Particularly, EVAs are seven-sixteenths [inch] extended-height bolts. A lot of the interfaces for the hardware, interfaces are common, so a lot of the boxes mount the same way. If you've trained on one, you're

sufficiently familiar that you can take a different component, and if you want to uninstall or install a new one you can do that. It's the same for EVA.

On the Russian segment, a lot of the hardware in the Russian mockup at Star City was built right alongside, at the same time as the flight units were built. The quality and the attention to detail on our flight units is so high, when we have a mockup unit, instead of paying the same I want to say really high price as the flight unit, we'll have a training unit which might actually be slightly lower in fidelity. For the Russians, they're very much identical, so the fidelity is outstanding.

Now, the danger is they'll cannibalize their simulator if they need it. Good for them, but for some of the Russian hardware the training is very realistic. Our training is as well, but there's some things that you'll work on—I remember one that was called a volatile organics analyzer. It was built in the UK [United Kingdom]. There was a problem with some of the fuses inside, so the unit failed as soon as it got on orbit. We couldn't fly a replacement unit, but what we did fly is a repair kit.

I spent one weekend having to open this box, and my recollection is it had seventy-two tiny little screws holding the cover in. They needed to be there because the cover formed a part of what's called a Faraday cage, and what that prevents is electromagnetism from affecting what's inside the box. These seventy-two, they were like two- or two-and-a-half-millimeter screws. They were teeny-tiny little things. The box was never meant to be opened on orbit, so that meant these screws, the fasteners, weren't captive. They were really small. I had to take seventy-two of them out and not lose any, and then at the end put seventy-two back in. I had an excellent procedure from the ground, I'd never seen this box before.

That's an ability I think is very important for people who are on the Space Station, or who are going to fly to Mars. That is that you have people who are good with their hands, who like to tinker with things and take them apart, put them back together. Hopefully you don't have any pieces left over.

One good thing about Space Station is your timeline is rarely critical. It may be very, very important, but there aren't many things on Space Station that are time-critical. So you have the ability to work at a pace which allows you normally to be careful, and even working with things or doing a procedure with which you're not completely familiar. Again, it's rarely a time crunch from the standpoint of, "If you don't get this done Space Station is going to fail."

Now there are things that are very time-critical. You've got a vehicle coming up, or you're getting ready to undock—there are things that are very, very time-critical. But most of those are things for which your training has been very rigorous.

ROSS-NAZZAL: You talked a bit about preparing for the Progress and then getting rid of one. I wonder if you would talk about moving the Soyuz. That sounded like a pretty big effort on your part.

MCARTHUR: Oh, it was cool. So why do you move a Soyuz around? When we were there, there were three places to which a Soyuz could be docked, and we ultimately docked to all of them. We initially docked to the docking compartment, and the disadvantage of being there is that is your airlock.

If you do an EVA out of that airlock and it's depressurized, you can't get back into the core of the Space Station. There is a secondary airlock in the *perekhodnoi otsek* [Soyuz compartment],

which is the little transfer ball between the service module and the FGB. It's actually part of the service module. The docking compartment was attached to that, so that's where the Russian airlock is. If you come back in and for some reason the hatch is damaged and you can't repressurize the docking compartment, you can actually go into the transfer compartment and use it as an airlock. Now the problem is when it's time to go home, you now have an evacuated compartment between you and your return vehicle.

When we arrived, the Expedition 11 Soyuz was docked to the FGB, so we docked to the docking compartment. They left, and then we later relocated from the docking compartment to the FGB *germetichny apparat* (hermetic apparatus). Now we're going to do this thing called a Soyuz relocate.

Most of the Soyuz operations, if they're nominal, they are computer-controlled. So it's a pretty good, reliable system. Moving a Soyuz is purely manual flying. So for Russian Air Force Test Pilot Colonel Valery Ivanovich Tokarev, this is a good deal. He gets to manually fly his spaceship, so this is a good thing.

What happens if you redock, and you can't open the hatch? You have to prepare the Space Station as if you're not going to be back, as if you're leaving it. Because if you can't get back in, that's exactly what you have to do. You have to then undock. If you can't dock, eventually you have to deorbit and come home. Even worse is what if you dock and something has floated against the hatch handle and you can't open the hatch. That'd be really bad.

You start doing some preparation work, and then on undock day, I think I remember they said, "Okay, you're going to get up at six in the morning as normal. You do these things. You're going to go to bed at one in the afternoon, sleep for eight hours. Then you're going to get up and start the Soyuz relocate procedure."

It involves eventually closing all the hatches, working your way back toward your Soyuz. It involves closing all the hatches. To close the hatches, if you have cables or ducts strung across hatches—and we had computer network cables that had to be strung across hatches. Fortunately, they've integrated the network cabling now so they don't have to do that. You have to disconnect all of these things. You have to shut the computers down, start closing hatches. Eventually, you get to your Soyuz and start doing pressure checks to make sure that neither the Space Station hatch nor the Soyuz hatch is leaking. Then you have to put on your Sokol [space]suits, and then eventually get into the seats in the Soyuz.

Soyuz is fired up, and then at some point, at the right time, I'd push a button that says open the hooks. Eventually the hooks would open and we would be pushed away from the Space Station. Valery would back away and then would slide over to whatever was the next docking location. In this case it was the FGB.

This takes hours and hours, not the relocation, relocation just takes a few minutes. You've redocked, and now you have to go through the same things. You have to make sure that your hooks are all fully engaged, and then you do leak checks to make sure that the process of docking hasn't introduced a leak somewhere. You, of course, want to make sure that there is no leak between the interface of the Soyuz and the Space Station.

Then you get back in. It's been a long day, so what they normally want you to do is absolute minimal reconfiguring the Station for normal ops and get to bed pretty quickly. But I couldn't stand having the computer network down too long, so even though the schedule would say reconfigure or restore the computer network the next day, I'd make sure we had the ability to call home before we went to bed that night.

ROSS-NAZZAL: What are your hours like on board Station, at least when you were there?

MCARTHUR: We operate on [Coordinated] Universal Time or Greenwich Mean Time, which is a nice compromise between the time in Moscow and the time here in Houston.

You ostensibly wake up, get up at six in the morning. Then there were just normal personal hygiene stuff, look at messages to see if there was anything that you might need to take a look at very quickly. Get dressed, [eat] breakfast. Then after breakfast you'd have a daily planning conference, a morning conference with both Houston and Moscow. Then generally start work around eight.

In the latter part of the morning, normally latter part, I'd have my first exercise period. I liked exercising twice a day. I think, if I remember correctly, there was maybe fifteen minutes—there was a little bit of time just to change clothes and to clean up afterwards. And that may have been built into the exercise, this hour. I'd have an hour which I would try to do resistive exercise using the IRED, Interim Resistive Exercise Device, weight lifting. Then in the afternoon I liked to have my aerobic exercise, and I have an hour and a half to do that. My preference was to run on the treadmill.

I had a little personal digital assistant, sort of like a PalmPilot, but this was an HP iPAQ I think is what they called it. Originally it was by Compaq, but then HP bought Compaq. I had this personal digital assistant and I was able to put video files on it, like movies. So I would have that affixed somewhere with earphones in, earbuds, and I would watch some movie while I was running along.

My younger daughter was a big fan of the TV series *Lost*. She mentioned that to the psych [psychological] support people, and so they started uplinking episodes of *Lost*. So I would play

those on one of the laptops when I was exercising. I was also a big fan, still am, of a radio program that comes on Saturday morning, *Pe-Te's Cajun Bandstand*.

ROSS-NAZZAL: Never heard of that.

MCARTHUR: How long have you lived in this area?

ROSS-NAZZAL: Officially since 2001.

MCARTHUR: Pe-Te's Cajun Barbecue was still open in 2001. I think he sold it in—well, he sold it to his son in maybe 2004, 2005, and they finally sold it. It closed sometime after I came back. It was a restaurant right across from the main entrance to Ellington Field [Houston, Texas]. I don't know if you ever saw it there.

ROSS-NAZZAL: I've seen it there, and I noticed it was closed. I actually wanted to go at one point.

MCARTHUR: I've been friends with Pe-Te for quite a number of years, and he's got a radio program on every Saturday morning from six to nine. He is from Louisiana. He's from Eunice, Louisiana, which is further north, and they call themselves "prairie Cajuns." His actual name is really Les [Lester] Johnson. He's a small wiry guy, so when he was a kid, because he was a small fellow, they nicknamed him Pe-Te. Cajun *petit*, from the French *petit*. So it's Pe-Te.

ROSS-NAZZAL: I didn't know that.

MCARTHUR: One of my favorite places to go on Saturdays was over to Pe-Te's for beans and rice on Saturday, and then I'd listen to his program Saturday morning. When I was on Station they would record it, and they would uplink it to me. I think maybe Monday night they would uplink it. I think they would manage the file on Monday and then they would uplink it overnight going into Tuesday, so I'd listen to *Pe-Te's Cajun Bandstand* while I was up there.

As I'm rambling, here's another story. *Pe-Te's Cajun Bandstand* is on a public radio station. They don't have advertising, so they depend on donations of course, and they have two fund drives a year. I'm exercising one day and I hear that they've got their, I think, probably spring fund drive going on.

The next Saturday I call down—I use the IP [internet protocol] phone—so I call while Pe-Te is on the air and charge a contribution to one of my credit cards. So I did use my American Express card while I was on orbit.

ROSS-NAZZAL: They're going to put you on a commercial now, you realize.

MCARTHUR: Pe-Te came on the air, and we chatted just a little bit. Now the next week when I'm listening to it, I hear the recording when Pe-Te comes back on and goes, "Yes, that was Bill McArthur on the Space Station," this, that, and the other. Then he says, "And I have a poster of Bill and 'Valerie'"—Valerie, Valery, it's close enough—"a poster of Bill and Valerie, and I'll send it to anyone who donates \$250."

I'm going, "Okay well, I didn't give Pe-Te the poster." He might have gotten it from George [W. S.] Abbey, but I don't know. "I didn't give Pe-Te the poster. So I don't think I'll get into any problem with the lawyers on that one."

Then the station manager gets on and he says, "If you up your pledge to \$1 a day, \$365, Bill and Valerie will sign it."

I'm going, "Okay, now that goes over the line."

The next Saturday I called down and I say, "Hey, Pe-Te, if you give that poster away that is okay. I don't have anything to do with that, but please don't say for more money I'll sign it." I said, "You know I'm going to come by the restaurant on Saturdays as soon as I get back, and if I'm there and somebody happens to ask me to sign something, you know I'll be happy to do it. But just please don't tell anyone that paying is a precondition to getting something autographed."

ROSS-NAZZAL: You had mentioned last time—just speaking of entertainment—that you watched *Harry Potter* on the Station.

MCARTHUR: I did, it was [*Harry Potter and the*] *Goblet of Fire*. It came out around Thanksgiving of 2005 and my daughters and I—they were Harry Potter fans so they got me to start reading the books. I'm a Harry Potter fan. I enjoyed the books; I enjoyed the movies. They said, "We went to see *Goblet of Fire*, it's a really good movie."

I made some comment like if NASA really was held in high esteem they'd be able to uplink me a copy. So a few days later I'm looking at the files that have been uplinked from the ground and I see *Happy Days 1*, *Happy Days [2]*, *Happy Days 3*, on through I think 7. I'm going, "What in the world are these?" I can see they're video files.

I click on the first one, and what they had done is two astronauts had flown to California, and whatever studio did it at the time—I don't know if it's Universal or who it was—but they had coordinated with the studio that released the movie. So they flew there, they landed somewhere in California, T-38 somewhere in California.

There were a couple of people from the studio there, and I think one was dressed as a witch and I'm not sure what the other one was dressed as. They had a prerelease copy of the DVD [digital versatile disc]. The studio would not ship it; it had to be hand-carried. It came back, and I'm sure it's folks in Building 8 transferred it to files that they could uplink. Then another requirement was that NASA had to destroy the DVD disk after they had uplinked it. So I got to watch *Goblet of Fire*.

ROSS-NAZZAL: That's pretty cool.

MCARTHUR: Yes, I felt pretty good about that.

Another thing, we may have discussed this—again, the psych support people will try to find celebrities or people that you might find interesting, and they'll try to coordinate a radio hookup, a space-to-ground loop connection to a telephone call. They'll try to coordinate something like that. They were able to get a linkup for me with J. K. [Joanne "Jo"] Rowling, the author of the Harry Potters. She was very charming. It was a nice thing.

I talked to the Army football head coach. Unfortunately, Army did very badly that year against Navy. I think I talked to the secretary of the Army once. Going back to *Lost*, my daughter and I would watch the episodes and we'd chat about what was going on. One of the people they linked me up with was an actor named Terry [Terrance] O'Quinn who played this slightly older,

bald—one of the castaways, John Locke. I happened to mention that Meg, my younger daughter, was a big fan and she was the one that had gotten them to start sending the episodes to me. He goes, “Oh, really? Give me her phone number, and I’ll call her.” So I did, and he did, so that was a neat thing.

ROSS-NAZZAL: I understand you had a conversation with the Russian Santa Claus, I can’t recall his name.

MCARTHUR: Not the Santa Claus, the patriarch.

ROSS-NAZZAL: Is that it? Okay.

MCARTHUR: The patriarch, who’s the head of the Russian Orthodox Church. He’s the Russian Orthodox counterpart to the [Roman catholic] pope.

ROSS-NAZZAL: I also had read that you linked up with Paul McCartney. Kind of a big name.

MCARTHUR: We did. Same younger daughter, she was a next-generation Beatles fan, and she was pretty interested in capitalizing on this ability of Dad to connect with celebrities. They told the psych support folks that “Oh yes, Bill would just love to talk to Paul McCartney” and this, that, and the other.

So I get an e-mail. It’s like “Hey, we understand you’re a big Paul McCartney fan.”

I'm going, "Well, everyone in my generation. I was a Beatles fan. I like his music." I don't swoon over him but still.

"Could you write a letter talking about what a big fan you are?"

I said, "Well no, not really. I don't think we want to go that far, but I'd love to chat with him if it's something he's interested in doing."

I think one of his songs was played as wake-up music for STS-114. Evidently, he was pleased with that and that received some publicity. The counterproposal—and most of these conversations, like the one with Jo Rowling, other celebrities, they are privatized. So that radio transmission is not open for anyone in Mission Control or the public to hear.

The McCartney group asked if we were willing to make an exception to that and do something a little more public. "Sure." So what we actually did is we actually had a live hookup with his concert in I think it was Anaheim, California. They actually had I think some round TV screens, or round TV projections, behind McCartney on the stage, where the audience could see me and Valery.

ROSS-NAZZAL: That's really cool. You mentioned your younger daughter was really interested in these kind of things. How old was she at that time?

MCARTHUR: She had just graduated from college. No, she had just finished two years of grad [graduate] school, so she was like twenty-three, twenty-four.

ROSS-NAZZAL: We've talked about talking with celebrities and well-known people. How did you stay in contact with your wife and your daughters?

MCARTHUR: I phoned home almost every day. We had two IP phone channels at the time. Last I heard they had increased it to four. I have an aviation headset with a boom microphone that you can connect to your laptop. You call up a virtual telephone, and if you have the right satellite bands, if you have Ku-band available, you can make a phone call.

I would call at least one of them virtually every day. This was before high-speed internet was truly ubiquitous. They put in a couple of dedicated high-speed internet lines to the house. I think they also were concerned—they wanted dedicated lines just for security purposes. So we would have a videoconference generally every Sunday.

ROSS-NAZZAL: That's nice. I'm thinking about the folks who flew on Apollo and Skylab. They had those squawk boxes in their houses.

MCARTHUR: Oh, yes. As far as your emotional and psychological health, these are wonderful things. You're not going to be able to do those things going to Mars, just [because of] the time lag. I think we may be able to send messages or send videos, but you won't be able to have this interactive communication.

ROSS-NAZZAL: It's kind of a big deal, being able to stay in touch with somebody else.

MCARTHUR: That's why I think the crewmembers who do that—they're going to have an extraordinary opportunity, they're going to have to be extraordinary people. I think the folks who make those decisions are going to have to put a lot of thought into the right crew complement.

People that really will be able to provide each other the emotional support and can either avoid conflict or manage conflict really well.

ROSS-NAZZAL: We have about ten minutes. I don't want to eat into your time, especially if you're going to go have lunch with your wife.

MCARTHUR: Probably not. I suspect she doesn't have time for me in her schedule. But we are leaving for Scotland on Wednesday, so I do plan to start packing today.

ROSS-NAZZAL: I noticed one of the experiments on board was very unusual. It was onboard crew journaling.

MCARTHUR: Journals.

ROSS-NAZZAL: Someone was actually looking at crew journals. I was curious, was there a format or was it just free writing?

MCARTHUR: No, it was really free. I tried to get clever, and I would say—I guess I typed it in, “Star date,” and then just put the real date. Don Pettit actually came up with a star dating, a way to express chronological points in time in an orbital sort of way. But no, I just used day date.

ROSS-NAZZAL: Would they get downloaded on a regular basis, or was it at the end of your increment?

MCARTHUR: My guess is just to ensure that the data was all [there]. I'm sure they downloaded it just about every day, just to make sure they archived it on the ground to avoid the risk of losing the data. I don't know where it is. It's got to be in my memorabilia somewhere, but I got a copy of everything.

ROSS-NAZZAL: Did you feel at all self-conscious sharing that information with an outsider? Were there certain things that you didn't include in your journals?

MCARTHUR: I don't think so.

ROSS-NAZZAL: I just thought that was a very interesting experiment. It wasn't something that I was expecting to see. Is that something that's still ongoing now on Station?

MCARTHUR: I don't know.

ROSS-NAZZAL: One of the other experiments that I noticed that you did—and they're actually available—are a series of videos. They were educational videos that you did of Station.

MCARTHUR: Right, the head of the Education Projects Office at the time was my wife.

ROSS-NAZZAL: Convenient.

MCARTHUR: So for most of those she was the principal investigator. One of the things that folks on the ground would do is they had something called "Saturday Science." So these education videos, they were considered a payload. Part of what identifies something as a payload is that it may be something the crew does on orbit that isn't involved specifically in keeping the Space Station in space.

What the ground would do is they would very often offer a couple of things. "These are two experiments, would you be willing to work on one of them Saturday afternoon?" They discovered very quickly that if they were education-related then I could not refuse. I struck a bargain with them. I said, "I will do these education things." If they happened at one in the afternoon, that wasn't that early in Houston, but it was early enough. And then if somebody's going to come in to support it, they're going to have to be in a little bit earlier.

I said I would agree to it as long as the principal investigator didn't happen to be on console when I was doing it. I try not to bring my wife into work. One time she was in Huntsville [Alabama], and she was at the Payload Operations [and Integration] Center there [Marshall Space Flight Center]. They let her on the radio as a guest payload controller.

ROSS-NAZZAL: Since there were only two of you, was Valery behind you recording or were there cameras inside the Station?

MCARTHUR: I would set cameras up and mount them on these brackets. Mount them on, and do it that way.

ROSS-NAZZAL: How long were the pieces?

MCARTHUR: Minutes.

ROSS-NAZZAL: I was looking at some of the titles. Education has them listed by increment, so you can go out and take a look at different aspects of the Space Station, that's kind of nice.

MCARTHUR: In retrospect, there were a couple of things that are unfortunate, but just the way they are. That was Valery and I generally—we did some things together, but a lot of our activities were separate. So if you were going to document with either video or still photography something you were doing, you had to set the camera up. You had to operate the cameras, as well as do whatever the other activity was. So I think we just don't have quite the depth of photo and video documentation that crews get now.

Plus, we didn't have high-definition cameras. Some of the external cameras now I guess are high definition. Some of the video we have, like video of EVAs—it reminds me of Apollo video, you know it's grainy. One of the cameras that was used got some really good footage of our Russian segment EVA, was nicknamed "Pinky" because the video has a pink cast to it.

When the ground processed it for us to use postflight, they were able to convert it to black-and-white, which isn't great. A lot better than pink, but it's—I've got pink shirts at home. Clothes, pink is good, some of the women I ride with have pink bicycles or at least pink accents on their bicycles. Pink's a good color, not a good color for EVAs.

ROSS-NAZZAL: I think this might be a good place for us to stop.

MCARTHUR: Sure.

[End of interview]