

**NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
EDITED ORAL HISTORY 2 TRANSCRIPT**

PEGGY A. WHITSON
INTERVIEWED BY JENNIFER ROSS-NAZZAL
HOUSTON, TEXAS – 9 AUGUST 2012

ROSS-NAZZAL: Today is August 9th, 2012. This interview with Dr. Peggy Whitson is being conducted in Houston, Texas, for the JSC Oral History Project. The interviewer is Jennifer Ross-Nazzal, assisted by Rebecca Wright. Thanks again for taking time out of your afternoon to speak with us.

WHITSON: No problem. Happy to do that.

ROSS-NAZZAL: We appreciate it. Yesterday we were talking about Expedition 5, and there are a couple things we hadn't talked about. One of those was your EVA [Extravehicular Activity]. Can you talk about that? You were in a Russian suit, actually.

WHITSON: Yes. It's really interesting to me that I was able to do a spacewalk in the Russian spacesuit. When I was training for the spacewalk one of the Russian instructors wanted me to sign one of their pictures, and they said that this was another American woman. I'm said, "No, I'll be the first US woman to do a spacewalk in your suit. And as far as I know, I'll be the second woman ever to do a spacewalk in your suit." It was only Svetlana [Y.] Savitskaya who did the first spacewalk in a Russian spacesuit and then myself. It feels very special to have been trusted by the Russians to actually accomplish that. I think that was actually one indication of how far I had come in terms of building a respect with the Russians that they would allow me to

train and perform an EVA during the mission. It was satisfying for me to know how far I'd come over the course of 20 years or so since I had started coming to Russia.

ROSS-NAZZAL: Things had advanced quite a bit over there.

WHITSON: Yes, they weren't asking me about my sweater anymore.

ROSS-NAZZAL: That's always a good thing. Tell us about training for the EVA and then your experience when you went on that first spacewalk.

WHITSON: I'd had training as a contingency to do a spacewalk in the US spacesuit. The procedures and the training philosophies again are very different. In Russia the training sessions only last two and a half, three hours, versus in the US we run the full length of what we would consider a spacewalk to be, which is six hours minimum. So it's a lot more endurance from the US perspective of being able to perform for the six hours. The Russian suit is also at higher pressure nominally, and so even though the tasks tend to be simple by comparison to US tasks, it is still a lot of work in the Russian suit. In the Russian suit in their version of the Neutral Buoyancy Laboratory [NBL] is very difficult to position your body much out of a vertical position, whereas in the US suit, it is possible to be in pretty much any orientation relatively easily.

So the training is more flight-like in our training facility than in theirs. But it was obviously important to train on the specific task, and for the Russian Segment they had the higher fidelity training facilities. The Russian suit as compared to the US suit has a lot of

differences. The Russian suit is easier refurbish and turn around and for the next spacewalk. It's also easier to get into, by stepping in a back door. Getting into the US suit is a bit more complicated, with pants, torso, gloves and helmet to put on.

Since Expedition 5 was my first flight and I was planned to do a spacewalk, and I had some concerns based on the fact that I heard some crew members would freeze up and not be able to let go. They would have a sense of falling. So I talked to Valery [G.] Korzun, my commander, since he'd already done a previous spacewalk. I asked him how to ensure that I wouldn't feel that way. He reassured me that this would not be the case, but told me if I felt that way to focus on my hands and what where I was with my hands, as well as, not to look around if I felt as though I was falling. Fortunately, it didn't turn out to be an issue at all.

The analogy I use about the first glimpse of the Earth with nothing between me and the planet except a visor was that it was like having lived my whole life in semidarkness and seeing the Earth was like stepping outside on a sunny day. The colors are so much more vibrant, the textures, everything has so much more clarity. It's hard to explain how much more beautiful the view is.

ROSS-NAZZAL: What were you doing for your EVA?

WHITSON: For our spacewalk we were installing micrometeoroid shields on the service module. The purpose of these shields was to increase the PNP, probability of non-penetration, as a result of micrometeoroid impacts. The thickness of some portions of the Russian segment was not enough to meet the minimum standards that the US had, and so we were adding additional shielding on the external surface. So we installed six different shields during the course of our

EVA. It was a relatively simple EVA, but because the Russian spacesuit has only one torso size, it was very difficult for me to get my hands together. So I was thankful that the EVA was pretty straight forward. The EVA involved pulling shields apart, sliding them into position and then bolting them down.

One of the neatest experiences during the whole spacewalk was while we were picking the shields up from Node 1, and I was on the Russian mechanical arm. Valery was cranking the arm, extending the arm out and then rotating it 180 degrees, from the forward section of the FGB-Node 1 interface to the forward end of the Service Module. I was on the end of the arm with the shields. As he rotated me around 180 degrees to the aft, we started off in eclipse [dark]. As I watched the sunrise, I began to see the rays over the horizon of the Earth. Then the sunrise began at the zenith part of the Station, as the shadow of the Earth no longer blocked the sun's ray. The sunrise slowly lit the station from top to bottom, and then a few minutes later it was actually lighting up the Earth below. So it was pretty spectacular.

ROSS-NAZZAL: It's amazing. While you were on board this expedition [NASA Administrator] Sean O'Keefe called when he was in mission control, I understand, and informed you that you were going to be the first science officer for the ISS [International Space Station]. Had you known that that was coming?

WHITSON: No, I didn't know that it was coming. Shannon [W.] Lucid was there as well. She, at that time, was at [NASA] Headquarters [Washington, DC] as the Chief Scientist. She was actually the one who told me that I was the first Science Officer of ISS. It was special for me

because Shannon was one of those first crew members that was picked in 1978 when I graduated from high school and made becoming an astronaut my goal.

ROSS-NAZZAL: I was wondering about that when I saw your major, because she's also a biochemist, and I was curious if you had thought, "She has a degree in that, maybe I should pursue that field."

WHITSON: Yes, it was special that we were both biochemists. I think Shannon and I are the only biochemists that have ever been selected. So there was a tie there.

ROSS-NAZZAL: So did your duties change at all, or did it really make much of a difference? Because you were a flight engineer before, and now you're a science officer?

WHITSON: Well, it was an additional title. STS-111 was called Utilization Flight 5, I believe. There was a big push to get a lot of science done during that expedition as well as the assembly tasks. So, I assume, naming me science officer was one way to highlight the fact that we were starting a more intensive science phase.

ROSS-NAZZAL: Some of your friends were referring to you as Dr. Spock, is that what I read?

WHITSON: Yes. The mission control team sent me a picture. They had taken a photo of me on board the Station working on some computer or something and had graphically put Vulcan ears on me.

ROSS-NAZZAL: That's funny. [STS]-113 arrived in November. What were your thoughts as you knew that date was approaching and you were soon going to be coming home?

WHITSON: Well, it was interesting. Our first mission was supposed to be about four, four and a half months long. It ended up being nearly six months long, 184 days total. During our stay there were two times when the orbiter was grounded for different reasons. One was BSTRA [Ball Strut Tie Rod Assembly] balls. I don't remember now what the other Shuttle issue was that caused the grounding. Both of these delayed STS-112, and then STS-113 was also delayed for a problem in which the Shuttle robotic arm was bumped on the pad. The ground team called us to tell us that we had probably a two- to three-week delay in the launch of STS-113. Valery and I were thrilled to get to stay longer. Sergei [Y. Treschev], however, was wanting to come home by then, so it was a struggle for him.

ROSS-NAZZAL: True space travelers.

WHITSON: Yes. The six months felt to me like two and a half months. Time just flew by. We were having a great time, and I didn't really want to leave. My husband gave me some good advice though and said, "It's better to leave a place when you still want to stay rather than the other way around."

ROSS-NAZZAL: That's probably good advice. So when 113 came what was your role in achieving their goals or objectives for their flight?

WHITSON: On 112, we had installed the S1 Truss, and on 113, we installed the P1 Truss. So I was involved in both of those operations, since it was a mirror image of the truss elements that we were installing and then, of course, the EVA support and cargo transfer. I suited up the guys and prepped the airlock for them and cleaned up after them while they were doing their spacewalks.

ROSS-NAZZAL: What are your recollections of leaving the Station that first time? They must be pretty strong I would think.

WHITSON: Oh yes. It was hard to leave the Station. As I said, I was not really ready to go. Obviously I was looking forward to seeing family and friends, but it was hard to leave the Station. I think part of the reason it was so hard is that every day onboard the Space Station, even if I was cleaning filters or doing something mundane, I felt like I was keeping the Space Station alive. It felt like it a very direct contribution to the space program and NASA, so that was hard to give up.

ROSS-NAZZAL: I can imagine. Tell us about landing and coming back to KSC [Kennedy Space Center, Florida]. Did you have a hard time getting out of the orbiter? Did you have someone help you out?

WHITSON: The landing process actually was pretty smooth. We had to do a few S-turns, so we felt the gravity coming up as we were coming in. The pilot Paco [Paul S. Lockhart] was calling

out the G-forces. The returning expedition crew was supine, lying on our backs, as opposed to sitting up in the seats. Mike [Michael E.] L-A [Lopez-Alegria] was sitting in the seat next to me and handed me the camera at one point. I was amazed at how heavy this camera was. I had been taking pictures with that camera for six months, and I didn't remember that it was so heavy. So I handed it to Valery so he could feel the weight as well. After he handed it back to me, it was feeling like a more like camera instead of a lead weight. That adaptation process of being re-exposed to the G-forces as we were entering was pretty interesting after having six months of no gravity on my body and then just starting to feel one or one and a half times the force of gravity as we were coming in.

At the landing L-A got up pretty quickly and was helping the flight deck crew. Valery Korzun and I were able to get out of our seats. I didn't feel great. When I launched and got to orbit I didn't really feel that bad at all. I would say that it was probably two or three weeks before I was truly adapted to space, before I felt hungry when I was supposed to be hungry, but I never felt ill going uphill. After arriving back to Earth, the first 24 hours for me was really a difficult time; there was a lot of vomiting going on. Since I was participating in an experiment that wouldn't allow me to take the drugs that would keep me from vomiting, it was a challenging first day. Gravity pretty much sucked at that point.

It wasn't a fun experience, but I did walk off the Shuttle by myself. I threw up before and threw up after, but I did walk off by myself. The worst part for me was the first 24 hours, and to a lesser degree over the course of three days, when I was experiencing most of the neurovestibular symptoms. But I was amazed at how quickly I could see improvement each day. So I felt like there was hope that I could stay here on Earth.

I think I did a little bit better after my second flight, but I was able to take some drugs too, which helped a lot. Being experienced, my body did, I think, adapt back a little quicker than it did the first time.

ROSS-NAZZAL: But it only took about three days till you felt human again? You felt gravity was not an issue?

WHITSON: Yes. But obviously our investigators are looking at muscle strength and many other parameters as well. I found that I lost some of the ability to do fine motor muscle movements and things like that. For instance, I like to play basketball, and of course I didn't have that quick reaction ability immediately after flight. That took probably more like a month to feel like I had regained that capability.

ROSS-NAZZAL: So how far out did the investigators follow you and conduct medical experiments?

WHITSON: Depends. Most of the experiments are completed in six months to a year. Some look out to three years, for example, the bone studies take considerable recovery times.

ROSS-NAZZAL: Tell us about any PR [public relations] trips that you went on after your expedition. Did you travel in the US and Russia?

WHITSON: I primarily traveled in the US with one trip to Russia. I had traveled to Iowa to start doing some of my PRs and that was when the [Space Shuttle] *Columbia* accident [STS-107] occurred. I ended up returning from that trip without conducting any PRs. We delayed starting the PRs and then crowded a bunch of things together later on. Mostly I did PRs in the Midwest, primarily because I think my farm girl story resonates a little better with young people from the Midwest.

ROSS-NAZZAL: You did mention *Columbia*. What impact do you think that had on the Astronaut Office?

WHITSON: I think the *Columbia* accident had a very dramatic impact on the Astronaut Office, and on NASA as a whole. After the accident there was this big reassessment of how many future Shuttle flights were needed. That was part of the politics of the time. I was part of a Space Station team that was trying to determine exactly how many Shuttle flights we needed to complete assembly of the ISS. That led to the [George W.] Bush administration decision to put end all Shuttle flights by 2010. This HQ [NASA Headquarters, Washington, DC] team had to come up with an assembly plan, not knowing how soon we'd be flying again, because at the time we didn't understand the mechanism of what caused the accident and how we were going to be able to fix it.

Luckily, we made pretty much the complete construction as originally planned, but we just compressed the schedule and eliminated science utilization phases. We also transitioned from rotating crew members on the Shuttles to rotating crew members on the Soyuz. Obviously we initiated this process while the Shuttle fleet was grounded. After that we had to continue

crew launches on Soyuz because we needed the upmass and the volume for getting supplies and hardware up onto the Station, since we didn't have the luxury of spreading things out anymore. So all of that had obviously significant impacts from a programmatic perspective, which also then impacted how the Astronaut Office viewed that. Obviously with the loss of friends and colleagues, it was a very difficult time for us all.

ROSS-NAZZAL: Did you help at all with the recovery up in East Texas?

WHITSON: I didn't because I had just finished my mission. Numerous folks from my class of astronauts were involved in that, but I was not. I was supposed to be doing my post-flight PRs at that time. So we delayed everything by a couple weeks and then I continued the PR plan. When I finished the majority of the PRs, that was when I started working on this Space Station team at HQ, trying to figure out the minimum number of Shuttle flights to complete the Station.

ROSS-NAZZAL: That must have been quite a hard task.

WHITSON: It was, and it was at Headquarters. All different kinds of variables and factors were involved—lots of politics and international agreements. I think the international and inter-governmental agreements were basically what kept the Shuttle flying in order to uphold our commitments for building the Space Station. I think that's an important lesson that we have learned as part of the ISS, that in order to stabilize our programs as an agency, as a government, is to make international agreements and have international contributions and commitments. These agreements stabilize everyone's contribution, and the political will is a little less fluid than

if it is based on every two or four years of who gets elected when and what they might think is the right thing to do. Conducting space programs in a two- or four-year timeframe is just not feasible.

ROSS-NAZZAL: It's not good public policy, really.

WHITSON: No.

ROSS-NAZZAL: Well, fairly soon, probably year anniversary of your expedition, you were active in the NEEMO [NASA Extreme Environment Mission Operations] program. Can you talk to us about how you became involved in that?

WHITSON: Yes. It was actually six months after I returned. I was asked to command the NEEMO 5 mission, which was exciting for me. When I returned from my spaceflight, the chief of the office at that time was Kent [V. "Rommel"] Rominger, and he was asking me what I was interested in doing. I said I would do any job that would convince him that I could be the commander on the International Space Station. At the time I was also on the selection board for the 2004 [astronaut] selection. He had asked me to become the Deputy Chief of the Astronaut Office and to lead this NEEMO expedition.

So in part I think it was a way to assess or evaluate me in that commander role. I wasn't a big diver in advance of that mission, and I would not say I was totally excited about it, in advance. Although I had reservations, I wanted to demonstrate that I could do this and serve the role as a commander. Once I was involved, I was really impressed. Two of my crewmates were

rookie astronauts. Since it was just six months after the timeframe that I'd just flown, I could tell them, "Okay, this is just like spaceflight; this is not at all like spaceflight; don't worry about this. This reminds me of something that happened on Space Station, and I did this. Maybe you should think about doing this or moderating it this way." It was a great opportunity to share all those experiences, because in an office environment you don't necessarily get that level of interchange with your officemates. For me it was a really great learning experience, just being able to do that much diving. As it turned out, I really enjoyed it and I thought it was some of the best space-like environment training that we had in the sense that [it was a] relatively confined space and we couldn't go to the surface without risking death. It was a good environment to train a situation that's very similar to being in space.

I really became a big proponent of the NEEMO missions after that, because I thought it was such a good training experience not only for me but for the folks that I was training with. Coincidentally I ended up flying with both of those guys [Garrett E. Reisman and Clayton C. Anderson] on Expedition 16. It was great that we had this previous experience base in advance of actually flying in space together.

ROSS-NAZZAL: Did you train at all for the NEEMO mission, or did you just go down to Florida?

WHITSON: No, we trained. We did the science training here at the Johnson Space Center probably two or three weeks' worth, and then we did the dive training, a week's worth, down in the Florida Keys before we did the actual mission.

ROSS-NAZZAL: I think I saw several pictures of you doing what you called spacewalks, but they were dives.

WHITSON: Yes. Underwater spacewalks.

ROSS-NAZZAL: What were you doing on those EVAs?

WHITSON: We were monitoring coral reefs, taking different measurements that the scientists wanted on the coral reefs. We also practiced some assembly activities to simulate some of the things that we were doing on Station with EVAs and different aspects of how to get these tests done most efficiently. So it was a combination of both of those.

ROSS-NAZZAL: You spent two weeks underwater?

WHITSON: Yes. It was two weeks. I enjoyed seeing the wildlife, getting to know some of the wildlife. There was a large eel, probably 8 to 10 inches deep and 8 to 10 feet long, bright green, that would swim around. You could tell it was the same guy because he had a big scar on one side of his body. Then there was also a large grouper that lived near the habitat, a couple hundred pounds' worth of grouper.

During one of the engineering tests, some of the hardware that we had out there was PVC [polyvinyl chloride] pipe we were putting together and it had not fit together properly. In order to fix it, we had taken a PVC cutting tool outside. My crew mate was using the tool to cut the PVC pipe and ended up slicing his finger. It was interesting because when I first saw this green

stuff coming out of his glove, I was confused until I realized that it was blood, but that I just could not see red colors that deep. I decided, without too much consideration, that we should get back to the habitat, since there were two sharks nearby when we came out to the worksite.

ROSS-NAZZAL: You also mentioned that you were deputy for the Astronaut Office at that point. What were your job duties as deputy?

WHITSON: At the time, because the Shuttle was down and there was a lot of activity involved in the Shuttle and trying to determine the cause of the *Columbia* accident and how we needed to fix it, there was a whole group focused on that effort. Because of my ISS experience I was focused primarily on just the ISS crew and those crews in training. I had considerable responsibility in that role, which then gave Rommel, the chief at the time, the ability to focus on the Shuttle issues and concerns.

ROSS-NAZZAL: So that included focusing on things like training and assigning crews? Or how did that all work?

WHITSON: He still assigned the crews, but I would help him by making recommendations on which people had the specific qualifications for a given mission. I tried to help with that, but the chief of the office is the one who makes those decisions.

ROSS-NAZZAL: You also mentioned that you were on the 2004 Astronaut Selection Board.

WHITSON: Yes.

ROSS-NAZZAL: That must have been interesting, having been a candidate, and then looking also at the educator mission specialists.

WHITSON: Right, 2004 selection was my first selection board. I chaired the one in 2009, and I'm currently on the board for the current selection process. So it's an interesting process. After being on the board the first time, I was really impressed that I was ever able to get in at all. There's a large number of folks that come in, very qualified applicants. So it's eye-opening to see the process from "behind the scenes", because there are so many very talented people that could probably do this job. It was eye-opening from that perspective. Then I chaired the board for the 2009 selection. Brent [W.] Jett, who was the head of Flight Crew Operations at the time, assigned me to chair the board, because we knew we were selecting only long duration astronauts that year.

For the 2009 selection we changed up the process. It was divided into two interview weeks and we added some things to try and test more of the characteristics we were looking for in long duration astronauts. Obviously there was a higher medical standard. So after one week of initial screening, we narrowed it down and included a lot more medical testing than was required for previous selections. That's the format we're using for this current year selection as well. Again obviously the focus is on long duration astronauts.

ROSS-NAZZAL: What sort of characteristics were you looking for that were different for Shuttle astronauts?

WHITSON: Well, we had actually surveyed the long duration astronauts prior to the 2004 selection, trying to determine the key psychological and behavioral characteristics that make successful long duration crew members. Turns out everyone commented that the best characteristics are self-care, self-management; in other words, being able to take care of yourself so that somebody else doesn't have to worry about you. That was considered the number one characteristic. Leadership, followership capabilities were also considered very important, as well as teamwork and group living capabilities. Another big emphasis for us going to a long duration crew members compared to Shuttle crew members was that on a Shuttle crew there was the possibility to divide up various roles and responsibilities. On the Space Station crew we were looking for somebody who would be able to do everything well, whether they needed to command, conduct EVAs, robotics, experiments or fix/repair hardware. In many cases, especially when we were in three-person crew timeframe, our crew member might be the only US crew member on board. We have to have someone capable to of all these things at any point in time.

So we were looking for crew members who could be the technically capable people but also be capable of getting along with an international crew and their crewmates well. We were trying to focus a little bit on trying to draw some of that information out of the candidates who were applying.

ROSS-NAZZAL: Were there certain tasks that you had them do? You mentioned, for instance, they might have to repair something. Or just looking at their background?

WHITSON: We did. Some of it is looking at their background and talking to them about what types of things that they had done, difficult situations they had been in. How they overcame the problem and what they learned from it. Just to try to understand their own self-awareness of capabilities and limitations.

We also initiated a test in 2004 where we wanted to evaluate a new test to see if we could say if a person performed well it would be an indicator of their ability to successfully complete their training. Then after we selected a subset of those crew members, we assessed whether the data correlated well with their skills in the NBL.

Originally we didn't use this test as part of the selection criteria, but it was used as a tool to then figure out if the data correlate with how crew members did later in the training flow, because ideally you would want to pick everybody who would be successful. There are some scenarios that it's hard to know well, is this person going to be good at robotics. You don't know. In fact our robotics test was not successful. We couldn't correlate it to how folks did in the end on that skill that the robotics test did. We're continuing. This year we're modifying our robotics test a little bit to try and see if we can find something that will relate and correlate to skills or capability to learn robotics in our future crew members. So we're continuing to refine that process, but those are a couple of examples.

ROSS-NAZZAL: In 2004, when you were on the selection board, were you concerned at all about selecting more astronauts given the fact that you weren't flying Shuttles?

WHITSON: Yes. As a member of the board it wasn't necessarily my decision to say how many we needed or not needed. Later on in the next selection it became obvious to me that we needed

to know how many people do we have available, how long is our training flows, and figure out how many people will we need in a training flow at any given point in time. We based the number that we selected on what we knew at that time of the selection. Even this year we're predicting that we can go up to as high as 15, but we won't have to make that decision until next year because it'll be a little bit closer to when we do the selection so we'll have the best data possible on how many astronauts have attrited between now and then. If we have any other issues like medical requalification issues—a lot of astronauts who've flown long duration missions aren't always requalified to fly again another mission. So knowing all those numbers at some point in time next year will give us the most accurate assessment of how many people we really need to pick in the next class.

ROSS-NAZZAL: The 2009 class, it was pretty small, wasn't it?

WHITSON: Nine I believe.

ROSS-NAZZAL: Pretty small group.

WHITSON: I think that's probably about the right range of where we need to be looking. I think we should be picking more often, but smaller groups. The problem is it's a huge workload to go through that whole selection process. It's a year-and-a-half-long process. To do that more often, it's a lot of work. We have 20-some people working reviewing applications. In this particular case we had 6,400 applicants. It was the second highest number of applicants ever. Each one of those applications has to be looked at by at least two people and evaluated on whether then they

become highly qualified or not. So it just takes a lot of time and a lot of manpower when we're trying to do a selection. There's some balance between how large of a class to pick, and how often you want to try and have a selection. I think it's important for the program from a PR perspective to keep interest going. I think it's important from the Astronaut Office perspective to keep bringing new ideas and new people. So it's good to do. It's just a lot of workload.

ROSS-NAZZAL: Did you dedicate nearly all of your time then as deputy to that task? It sounds like it would eat up a good portion of time.

WHITSON: When I was chairing the board it was my primary task, and at that time that was my primary task. That was after my second flight. So it was before I became chief of the office.

ROSS-NAZZAL: After you stepped down as deputy, you were Chief of the Station Operations Branch for a while before you became a backup commander.

WHITSON: We had reorganized the branches within the Astronaut Office. I asked to step down to do a new position, which was basically what I would consider the fun parts of the job I had been doing. It needed to be divided up and separated from what the deputy was doing at the time. So I asked to do that branch chief job until I happened to be assigned.

ROSS-NAZZAL: So what did that entail? What were the fun parts?

WHITSON: That involved the astronaut training and on-orbit support for crew members. It was a real focus on the actual operations for crew members getting ready to fly and who were already on orbit.

ROSS-NAZZAL: Then you were selected as a backup commander for an expedition mission.

WHITSON: Yes.

ROSS-NAZZAL: Talk about that because that was something that NASA did for a while in the '60s, backup crews, and then they did for a short time with Shuttle. Then they eliminated them. Why the need for backup crews for expedition?

WHITSON: For the expeditions, I think it was Expedition 1 through probably about 18, we had dedicated backup crews. We always had a crew that was trained up and ready to fly in their place. Then they would fly a prime flight a year, or year and a half later. We've changed our training flow to try and shorten this process. I mentioned yesterday we had started off with like a four-year training flow or longer. In order to shorten that training flow we went with what we call single flow to launch. So the person who was assigned six months later is the backup to that crew six months prior to them. If we had to fly our backup, they are not a dedicated backup so they're not fully trained on what that first crew is doing. But we would have some time to train them and then just fly them in the place of that other crew.

It saves then on training flow duration. The training flow went down to two and a half years that way. You'd always have somebody six months behind you that would be your

backup. When it was three-person crews and during the early six-person crew timeframe we had dedicated backups. Obviously in order to support 6-person crew training if we had not changed the process would have required more instructors, and we just didn't have the facilities capability to support the additional training load. The Russians didn't have that capability either for their Soyuz training so we had to come up with an alternative way. Single flow to launch was the solution to that. At the time I was assigned to Expedition 16 I was backing up Expedition 14 at the same time. I was a dedicated backup for 14 in that particular case because that was before we went to single flow to launch.

ROSS-NAZZAL: You were finally selected as a commander. Could you explain to us why you wanted to be commander of a long duration spaceflight? What was the motivation?

WHITSON: After I had done the first mission, I felt like I could be the commander on the Space Station. So I thought that would be the next step, the next challenge. I am one of those people that likes a little additional challenge all the time. So I wanted to do that. I was honored to be selected to do that.

ROSS-NAZZAL: You were of course the first female commander of an expedition mission. Was there a lot of attention given to that fact?

WHITSON: I guess some. Interestingly the Russian training team who I'd trained with before for Expedition 5 never really expressed any concerns or issues. I did get an interesting response in Kazakhstan prior to launch. Since the Kazaki are a nomadic-horse culture, they sometimes give

the guy in charge a whip as a symbol of his leadership. I got two or three whips during the course of time before launch because I was going to be the first female commander, and they wanted to make sure I had a whip in order to keep the guys under control. I think there was some attention because of that, because of so many Russians giving me whips in public events.

ROSS-NAZZAL: Here in America it has a little different connotation.

WHITSON: I know.

ROSS-NAZZAL: That is too funny. We've heard from a lot of Shuttle commanders what their duties are, but what are the duties of a Space Station commander?

WHITSON: It's not all that different. It's to make sure that the crew as a whole is being taken care of, the crew as a whole is getting the job done. But primarily, the role as Commander is to ensure the safety of the crew and then the safety of the Station. On a day-to-day basis on a long duration mission, it's not too much telling the crew what to do since that is determined largely by the ground team. Instead the work environment is much more of a team effort, and everyone was working together to meet our objectives. I would, for instance, look at a timeline and determine if two tasks were going to conflict and whether or not conducting one task might cause a problem for another crew member. I spent some time talking to the ground and organizing and setting that up. I was the interface with the ground if we needed to make changes, and tried to keep the big picture in mind. I think that was the interesting challenge for that role as commander on board the Space Station.

ROSS-NAZZAL: You brought something up that I was going to ask. You're the commander of the Space Station. How do you work with the lead Shuttle flight director, the ISS flight director? And then you have various Shuttle commanders coming in. How does all of that work with so many different people in charge of different tasks but still trying to get to the same goal?

WHITSON: The MOD, the Mission Operations Directorate team, has a pretty defined plan. The Shuttle flight directors are in charge of Shuttle operations. The Station was in charge of Station so when the Shuttle crew is on board and doing EVAs out of the Station airlock, the Station flight control team was the lead and the Shuttle team assisted, because a lot of things involve both. For instance transfers and moving hardware that needed to be returned to the Earth, or hardware that needed to be moved to the Station was an integrated effort. They had a very well oiled team on the ground. On orbit we followed a similar breakout of responsibilities. We had the Station team and the Shuttle team. We came together, and we worked together as needed. There were things that the Shuttle team would take leads on, other things where the Station team would take the lead on. It really was based on hardware familiarity and who had the expertise to do which particular task. So I think it was pretty well choreographed, and I didn't really ever see any issues with that. It was great to have visitors come in work with a different group for a while. It was great to see them go too, because usually by the end of the visit, I was ready to have a little more solitude.

ROSS-NAZZAL: "I need my space," like the bumper sticker.

WHITSON: It was fun having visitors and sharing that time together, because it's a very intense time. One Shuttle crew member said to me, "I'll bet you'll be happy to have us go so you can relax again." I replied, "Well, there's not a lot of difference in the volume of work we're doing, but maybe some of the criticality and the complexity of what we were doing when Shuttles were docked." So it's not the volume but just the intensity level of the work that's going on that makes it a little more stressful when the Shuttle crew is there.

ROSS-NAZZAL: Shuttle crews of course practice for hours what they're going to do on orbit. Did you have a chance to work with some of the crews on some of the things that they would be doing while you were in orbit?

WHITSON: Yes. We worked a little bit with each crew. It was very important as part of our training plan to come up with some standardized ways of doing things so the communication between an arm operator and the person that was doing the spacewalk on the end of the arm was always the same. We had to standardize a lot of the com [communication]. If the Station crew needed a particular camera view from the Shuttle we had to be able to make a standardized call so that the Shuttle crew could point the camera in the right direction for the Station crew to use as a visual aid while they were running the robotic arm on the Station.

It became very apparent early on that we had to have that standardized in order to be able to interface any Shuttle, because Shuttle flights would slip and they would be in a different increment. So we didn't necessarily always train with the right people if the Shuttle flight slipped. We had to standardize these processes so that everybody had the same expectations and could communicate with any crew that they ended up with.

Yes, the answer is in reality we did try and train with each crew that we were going to be interacting with. It was to differing levels, but the only reason it was really successful was because of that standardized training, standardized communication so that the expectations were similar.

ROSS-NAZZAL: You weren't the only woman playing a leading role in this expedition. There were other women who had important roles as flight directors, for instance, or a female commander in another instance. Can you talk about that coincidence?

WHITSON: Yes, it was an interesting coincidence. I had a female flight director, Holly [E.] Ridings, during Expedition 16. Also was lucky enough to have Pam [Pamela A.] Melroy and her STS-120 crew arrive during Expedition 16. It was a complete coincidence because STS-120 was supposed to launch and be there prior to when I arrived on the Soyuz. That Shuttle launch slipped a few weeks so I arrived first and then was there while she was there. The press made a big deal about the fact that first time ever two female commanders in orbit at the same time, but it was just a coincidence. I think the neatest thing I got from that was a little cartoon. The cartoonist from *Florida Today* sent both Pam and I an original copy of his cartoon that he had put in the newspaper. It was a cartoon of a little girl getting ready for Halloween, because the STS-120 mission was just before Halloween. The cartoon mom was holding a princess costume, and a little girl was reading on the computer about two female mission commanders. The caption was the little girl saying "I don't really like the princess outfit; I want to dress up as a NASA mission commander." I thought that was pretty cool. It is hard to really imagine that my actions might inspire our youth, but I am glad for that opportunity.

ROSS-NAZZAL: Yes that is cool to have that impact on kids. Talk to us about the crew relationship. I thought this mission in particular was pretty complicated. You had a couple of crew members that were consistent, but then you had people constantly rotating in and out. Plus you had the Shuttle crews coming and going.

WHITSON: Well, I mentioned we had switched to rotating crew members on the Soyuz vehicle right after *Columbia*, and then there was a desire by the Russian side to sell seats to tourist astronauts that were arriving. So that meant the Russians needed one of the three Soyuz seats and the US needed to provide the third seat for a USOS [United States On-Orbit Segment] crew member. Since Shuttle schedules aren't always concretely defined, it was hard to know who was going to actually show up during our mission. Actually our mission patch didn't have names on it before we launched, because I was unwilling to put the names on the patch if we didn't know who was going to really be there, and also having been a deputy and having to remake patches all the time because we changed our crew members. So I decided not to have any names on our patch prior to launch, and we put them on after the fact.

So Clay Anderson was there when Yuri [I. Malenchenko] and I first arrived. He was there a little bit over a month during Expedition 16, and then Dan [Daniel M.] Tani arrived on STS-120 with Pam's flight. He was only supposed to be there a very short period of time, and he ended up being there almost four months because STS-122 slipped. Then Leo [Léopold] Eyharts from France was there for a month and a half, and then we finished up with Garrett Reisman, for about a month and a half. It was an interesting experience, interesting to see how the crew dynamic changed with that third person.

Both Yuri and I are very quiet somewhat reserved people, and so having a third crew member come in with a different personality did impact the crew dynamic quite a bit. I don't know if it would have been true if Yuri and I had been more gregarious or outspoken. Because we were the quieter two throughout the mission, the Flight Engineer 2 added a lot of the flavor. So it was interesting to observe that change in the crew dynamics.

It was fun to have over a relatively short period of time different folks and to see how different people adapted and reacted to the same stimuli.

ROSS-NAZZAL: Any initiations of the new people as they came on board?

WHITSON: No. But speaking of initiation, the opposite was the fact on April Fools' Day when Garrett Reisman was with Yuri and me. Garret is a real prankster. He convinced Yuri that they should use some blow-up swords to try to mutiny. We had it on video with the ground team when they floated into the lab for the mutiny. They also demanded the ground team have a pizza delivered and reverse the orbit of the Station.

ROSS-NAZZAL: You brought one [a whip] with you, right? You had so many.

WHITSON: No, never used the whip, but it was fun just to interact with different folks and have the different experiences throughout the mission.

ROSS-NAZZAL: Very different from your first experience I would think.

WHITSON: Well, my first experience I was up there pretty much on the US segment by myself most of the time. During Expedition 16 I was sharing the USOS space, but there was much more space to share at that point in time because we added on Node 2 with STS-120, and *Columbus* with STS-122. STS-123 brought up the JLP [Japanese Experiment Logistics Module], the first Japanese element. We increased the living volume by about 45 percent during Expedition 16, especially if you count the first ATV [Automated Transfer Vehicle] to ever arrive also arrived during Expedition 16. It was a very exciting time for us to be so actively involved in the expansion of the habitable volume of the ISS.

The timeframe between STS-120 and 122 was probably the most dynamic time for us. During STS-120 we redeployed the solar array, and in the process generated a 1 m [meter] tear. It was a very serious event. People ask me about when I was the most scared on a mission, and that was the time I was most worried. We had deployed one side of the array with no issues. However, when they had retracted that second side on a previous Shuttle mission several months earlier they had some difficulty getting it retracted. It's quite a feat to take 239 feet of solar arrays and fold up into a blanket box that's about one foot deep or so.

When we redeployed this finicky array, we generated a tear. We found it later, there was a knot or fray in one of the lines.

We stopped the deploy when we saw the tear in order not to cause further damage, but we couldn't have undocked the Shuttle with a partially deployed array and we knew we weren't going to get it back in the blanket box, so we had to figure out how to get the array fully deployed. The ground team spent days coming up with a plan for how we were going to do this. During that timeframe the Shuttle was actually unsafe to undock from the Station because that array needed to be stable. If the Shuttle needed to undock or if we couldn't fix that array it

meant we were going to have to throw that array away, which meant then the next Shuttle couldn't bring the next module, because we needed the power from that array to feed the module that we were going to attach to the Station. So it was a stressful time for the crews. We didn't know all of the details that the ground team was working on, but we knew they were working on a plan. Since it was the array all the way at the end of the truss, the station arm wouldn't reach it alone. It was going to require a nontrivial plan to fix this problem.

So that four day timeframe was a pretty nerve-racking time. After the third day, the ground team sent up the plan. They had us construct from sheet metal, wire and tape, using only items we had in our toolkit on orbit, pieces that we ended up calling cuff links. We cut pieces of metal and punched holes in them, ran a wire of very specific length, and used a high tension clamp on it. These cuff links were planned to span the integral holes of the solar array structure on either side of the tear, providing a structure that would hold a constant tension across the tear as we continued to deploy it.

I was building these cufflinks with the understanding of how important the lengths of these wires were, because if they were too long then it would allow the tear to propagate. If it were too short then the array wouldn't be able to fully extend. This importance was highlighted when ground called up and said, "We need you to change the length of that number four cuff link, and shorten it by three eighths of an inch." George [D.] Zamka, the pilot on board the Shuttle, and I were constructing these cuff links and sweating the details.

Then the next day we had to send a crew member [Scott E. Parazynski] out to fix this. He had to place each of these five cuff links into specific locations either side of the tear in the array. Even though the array was not being used to generate power, there was still power going through the array even when all of it is shunted. I taped up all the exposed metal on Scott's suit

to minimize any potential for him getting shocked, as well as using some other insulated tools. In order to reach the array we had to use the OBSS [Orbiter Boom Sensor System], the adapter arm that we had on the Shuttle post *Columbia* to do the inspections. So we grappled the OBSS with the big arm on the station and moved the arm with Scott all the way out to the end of structure. With that extension on the end of the Station arm we were able to reach the crew member just barely out to where he could reach. It happened to be Scott Parazynski who was doing the EVA. He's one of our tallest, longest-armed guys, which was lucky that he was there, because even he could barely reach. It was a tense time.

ROSS-NAZZAL: I imagine you were biting your nails.

WHITSON: Yes. As Scott threaded the first cuff link, he found it was too thick. I was thinking, "Oh no, I put too much tape on it." He flipped the cuff link around and was able to thread the other side through first. I was very relieved.

ROSS-NAZZAL: How long did that EVA take?

WHITSON: It was a six-and-a-half-, seven-hour EVA to do all that. Just to get the arm with the crew member out to the final location for the installation took 45 minutes. It was some of the sportiest robotics we've ever done. Stephanie [D.] Wilson and Dan Tani were doing that.

ROSS-NAZZAL: You must have been happy when he finally came back in the airlock.

WHITSON: Yes, it was a relief.

ROSS-NAZZAL: Didn't get electrocuted so that's good.

WHITSON: No. No, everything went great. I think it was the same day we went ahead and fully extended the array. It was generating power, and the ground team was testing it for a while, but the power generated from this array was added to the system less than a week later. It was fully up and running and ready to go. Because of all that activity, those four days, there was an EVA that Yuri and I were supposed to do during the docked timeframe that we ended up having to complete after the Shuttle undocked.

When the Shuttle undocked we were five days behind our timeline. It was 22 days or so before the next orbiter was supposed to arrive, STS-122. The ground told us that they would likely have to slip the Shuttle launch date because the crew would not be able to get all the work done before arrival of the next Shuttle. We were supposed to do three EVAs and two major robotics operations in that 22 days, and we were five days behind when we started. It was previously planned that we wouldn't have any weekends in that timeframe because there were so many activities, so they couldn't just ask us to work more. We knew it was going to be a big push. It was Dan Tani, Yuri Malenchenko and I on board at the time. I was very proud of the fact that we were able to gain back the five days, get three EVAs done, and move PMA [Pressurized Mating Adapter] off of the Lab and then onto Node 2 and then move Node 2 into the forward final position so that we could accept the next orbiter on the forward end of the station, with a new module in place. It was a really challenging time, really exciting time. And, in the end, the Shuttle launch was delayed.

ROSS-NAZZAL: To work that hard. Oh!

WHITSON: It ended up being delayed almost three months, two and a half. In the meantime then we did two more contingency EVAs that were completely unplanned. Just prior to STS-120 arrival, one of the Alpha Joints was having an unusual signature. They sent us out on the EVA to inspect this Alpha Joint. In order to rotate there on the truss, the Alpha Joint rotates along the long axis of the truss, and the Beta Joint rotates the solar array relative to that in a 90-degree angle. That way you can always maintain the optimum pointing angle towards the sun on the solar arrays.

With the Alpha Joint being questionable we weren't able to point in one of the two axes. As a result we had limited on power at that point, and we wanted to determine the problem. Dan and I went during the contingency EVA found that there was something wrong with the entire joint. This joint is about a six-meter diameter joint on the end of the truss—this whole ring was damaged. We inspected under all the different covers on the circumference of the ring, and found it was screwed up under all of them. Then the ground team had to figure out what to do. At that time it wasn't a critical concern in terms of keeping the next module from coming up, but it was going to limit how much power we could generate.

Later on [before the arrival of STS-122] we then had the Beta Joint on the same side fail on one of the two halves of the array. We had to replace the Bearing Motor Roll Ring Module, which is the size of a large garbage can, weighing around 380 pounds. We had to carry the new unit out with us and secure the array so that it wouldn't fall off while we removed the failed the BMRRM, Bearing Motor Roll Ring Module, of the Beta Gimbal Joint, and then insert the new

one. It was complicated a bit more, since all the connections had to be mated in darkness so that we wouldn't have any risk of electrocution. We got all but two connectors done in the first eclipse, and had to wait during the sunlight phase before we could go back and finish the last two connectors.

That EVA was interesting from the perspective that we had not specifically trained for this task, and hadn't practiced any of the details of it. We only had training materials provided from the ground. They sent us pictures and videos and training materials, reminding of the dos and don'ts. Shortly after we got to the work site during the spacewalk, we lost com with the ground. They could hear us, but we couldn't hear them. I was going through the checklist, trying to figure out what we could do without a lot of pre-coordination with the ground. I was telling the ground, "Okay, I'm going to go ahead and do this. We're going to start this. If we don't get the com back, understand we'll have to put this back on." I really didn't think we were going to do the EVA that day with the loss of com. It was too complicated, it required too much choreography with the ground for when they would shut power off to certain hardware, when they would enable the proper inhibits that would allow us to make or break connections. I just didn't think it was going to work with one-way com. Luckily the ground was able to get the com back up within about 15 minutes or 20 minutes.

Then STS-122 arrived, and we had the *Columbus* module added onto the ISS. All the EVAs that we'd done prior to that set up Node 2 to enable it to power and have the thermal system set up through Node 2 so that basically for *Columbus* installation we only had internal connections to perform. That was fairly straightforward.

123 arrived with Garrett and brought up the Dextre arm attachment for small fine arm. They also brought up the JLP, the first Japanese element. It carried up numerous racks within,

including scientific racks and systems racks. It was fun to be able to receive and install all these new modules, adding new rooms onto the Station.

ROSS-NAZZAL: I thought it was interesting, one, that you were a commander, and you got to do five EVAs. I think you were out there on every one for this expedition.

WHITSON: Yes.

ROSS-NAZZAL: Is that normal? For a Shuttle crew you never see the commander go out.

WHITSON: For US EVAs, the few that we've done on board the Station from the Station, when there's no Shuttle there, you can have the commander go out, because it's two of the three crew members that were able to do the EVA so it's very likely the commander would be a part of that team. So we've done that before.

ROSS-NAZZAL: I also thought it was unusual. I've read that a lot of women can't do EVAs in the US spacesuit, because they don't fit as well as men do and so women haven't done a lot of EVAs as a result. You obviously fit into the suit. Can you talk about that? Is that the case?

WHITSON: I don't fit into the suit. In the training on the ground I have to have an inch-and-a-half, two-inch back pad to force me far enough forward in the suit to keep my hands in the gloves when I'm upside down in the pool. You have to have enough strength to curl your fingers, to hold your hands in your gloves, and be able to manipulate the connectors and do all

the tasks. Basically it requires a lot of strength for someone who doesn't fit the suit well. For someone who fits the suit well, it doesn't require quite as much strength, and you can get away without having to work around the poor suit fit. For the most part anyone smaller than me is going to have a hard time—unless they're very, very strong—manipulating the suit. I think my biggest asset was that I like to weight-lift, and I happen to be strong enough to be able to handle that. Suni [Sunita L.] Williams is on orbit now. She's going to be doing two more EVAs, and I think she'll break my record. So it's great that it's not just me. We're moving ahead, hopefully.

ROSS-NAZZAL: I think on this flight you had gained the most EVA experience for a woman.

WHITSON: Yes, I took the record from Suni during Expedition 16. So it'll be neat that during this current expedition, if everything goes as expected, she should take the record back.

ROSS-NAZZAL: We had talked about STS-120. We have interviewed Pam Melroy, and she talked about going up there and that historic handshake in space and getting that photo. Can you talk about your recollections of that event?

WHITSON: Luckily Pam is the type of person who would take care of that and make sure it's organized. I don't even know if I would have ended up with a picture at all if it had been up to me, so I'm glad she was there for us to have a picture. She's the one that did all that organization and making sure it was ready.

ROSS-NAZZAL: That was an important photo.

WHITSON: Yes it was but I guess I probably wouldn't have prioritized it high enough to worry about it. I'm glad she did because in the end it's nice to have that picture now.

ROSS-NAZZAL: One of our favorite photos. Tell us about launching. We didn't talk about you launching in the Soyuz. How different is it launching from [Kazakhstan] compared to KSC?

WHITSON: The ride on the Soyuz during the launch is a lot smoother than on the Shuttle because it's all liquid fuel, and so it's a smoother ride. It's smooth enough in fact that it seemed like it was a slower start. We got down to zero, and I was wondering if we were going to go anywhere. Because that's a bad thing in the Shuttle, you want to be moving when the timer reaches zero. The staging is a little more dramatic in the Soyuz. Dropping the SRBs [Solid Rocket Boosters] off of the Shuttle was also dramatic. When the pyros exploded to release the SRBs, it felt like it was right underneath my feet. Whereas, the staging threw me forward in my harness in the seat in of the Soyuz, then a push back into the seat as it accelerates again with the next stage.

It's not any more Gs in one versus the other. I think it gets up to around three and a half, four Gs also on the ascent. On the Soyuz it's just a little bit different feel in the sense that there is less vibration without the SRBs, more staging sensation, but about the same Gs. It's always just amazing to me that eight and a half minutes later and you're up there floating.

ROSS-NAZZAL: Do a lot of people go to see launches out there? Or is it in the middle of nowhere so there's not many people out there watching?

WHITSON: There's a small group of folks. They send folks over from our programs over there. Each of the astronauts can have a certain number of guests that can be invited. Of course the guests have to pay to get there, but we can have a certain number invited. You can't logistically take care of very many folks, but that works out. A few people are there during the launch phase.

ROSS-NAZZAL: Were your parents there?

WHITSON: No. My dad doesn't travel very well. He's got MS [multiple sclerosis], and it's very difficult for him to get around so he wasn't there. But my brother and his wife came. My best friend and her husband were also there. Then there were also some extended family and friends that were able to make the trip, including people that work in the program and other areas around NASA that I had invited.

ROSS-NAZZAL: Any rituals associated with flying on a Soyuz?

WHITSON: Oh yes, there's rituals. The rituals in the US and Russia are a little different. It's interesting just to see the cultural differences. On the Shuttle launch pad, on the 195-foot level, which is the level where the crew walks into the orbiter to get into the Orbiter, there's a toilet up there for your last-minute potty check. There are also the O₂ and H₂ lines, these are 17-inch diameter lines that feed into the liquid fuel to the stack and in Florida collect a lot of condensate in the form of frost. So we wrote our initials in this two- or three-inch snowy condensate.

For the Soyuz launch one of the most notable rituals is the potty stop on the way to the

launch pad, known as the Yuri Gagarin stop. Crew members typically urinate on the tire of the crew bus there. As a female that was not possible, so I told Yuri to pee for me since I couldn't really do that.

ROSS-NAZZAL: It'd be a lot more complicated.

WHITSON: A lot more complicated.

ROSS-NAZZAL: Something that I thought was interesting is when you were launching you had a commander, and then when you got up to the Station you were commander and he was a flight engineer. Tell us about those dynamics, how that worked.

WHITSON: It was really not a problem because as I said before Yuri and I are both pretty laid-back people so it was no issue whatsoever. Obviously on a Soyuz vehicle, the commander of the vehicle has to be a Russian. All the communication to the Soyuz is from Russian mission control, and it's all in Russian. There's no dual-language anything on there. I had to become fluent enough in the Russian flight data file to be the board engineer. So I was the left seat flight engineer for Yuri during that launch.

That actually is probably the biggest contrast between launching on the Soyuz and launching on the Shuttle. On the Shuttle I launched on the middeck, and on the Soyuz I launched in the left seat with the commander seated in the center. I played much more of a role in the Soyuz, more comparable to what a pilot or mission specialist 2 would be on the Shuttle. That part was an extra exciting, challenging aspect of that phase of the mission in particular.

ROSS-NAZZAL: You were pretty cramped in there though, aren't you, compared to the Shuttle?

WHITSON: Oh yes. I always tell everyone launching in the Soyuz is like three people in the front of a VW [Volkswagen] Bug with your knees up near your chin. It's not very comfortable. Once you get launched and in space there's another—what they call a habitation compartment, which is a little more than double that same volume that you can go and spread out and straighten your legs and get out of your suit and things like that up there. There's a little toilet up there. The descent module, the part that the crew lands in, is a very small capsule, and that's the section that we launch in.

ROSS-NAZZAL: Are there any rituals once the Soyuz docks at the Station? Anything that you recall?

WHITSON: No, there's no real rituals associated with the docking of a Soyuz to the Station. When Shuttles arrived—we have a Station bell and we would ring it for an arriving crew and arriving commander. That was a US ritual started by Bill [William M.] Shepherd with his Navy SEAL background. I don't know if it has been continued with all the Soyuz dockings.

ROSS-NAZZAL: Kind of a shame.

WHITSON: Yes.

ROSS-NAZZAL: Well, this was a pretty international flight, as you talked about. You accepted so many different nodes and laboratories. Talk to us about how that changed things. Of course on your first flight you were dealing with mission control in Houston, in Moscow, and in Huntsville. Then you also added Japan. I think Toulouse in France.

WHITSON: Yes. Japan, Germany near Cologne, and Toulouse in France. France was in charge of the ATV control for the Automated Transfer Vehicle. Then in Cologne they were in charge of the *Columbus* module, the European laboratory module. Japan was in charge of the first module of the Japanese element. So we went from three control centers to six over the course of Expedition 16. It was pretty interesting to think about farm girl from Iowa, every day talking to control centers all over the world.

ROSS-NAZZAL: Did you have to know all those various languages? Or everyone else spoke English except for Moscow?

WHITSON: Except for Moscow we spoke English.

ROSS-NAZZAL: That's a relief, right?

WHITSON: Yes. If I'd been required to learn more languages I'd have never made it. Learning Russian was a big enough challenge for me.

ROSS-NAZZAL: How good was your Russian by the time you were on Expedition 16?

WHITSON: I had to be able to communicate with the ground controllers in the Soyuz in Russian, and Yuri and I in the Soyuz spoke Russian, because it was just more convenient to stay in that language during operations in the Soyuz. It becomes difficult to switch back and forth so we would stay in Russian all throughout any operations in the Soyuz. Because we were reading in Russian, seeing the displays in Russian and talking in Russian to the ground, it was easier just to stay in Russian.

In Russian language I can talk a lot better about pumps and pressures and temperatures than I can about what kind of feelings you might be having or what your concerns about your family might be. I nearly as good at the social Russian, but I managed to get by knowing the technical Russian, enough to survive on board the Soyuz.

ROSS-NAZZAL: Interesting. I would think that that would be harder than the social aspect.

WHITSON: No. Because it's a more common vocabulary, a smaller vocabulary needed for the technical part. It's a lot, but it's still more common. We also have a lot of Russian acronyms as well.

ROSS-NAZZAL: Talk to us about accepting that ATV and the importance of that first vehicle coming up to the Station.

WHITSON: The ATV was the first time they used a videometry technique for a rendezvous. They had GPS [Global Positioning System] as well, but the videometry was the main technology

that they were using, replacing the radar range and range rate system that the Russians have used in the past.

The other, I think, important thing to note on ATV is it was about five times the mass of a Progress. As you know, the only time there has ever had a depressurization of a station, the Mir space station was hit by a Progress vehicle. We obviously wanted this thing to fly very stable, to be doing very precise procedures, following the fine corridors that we had in order to reassure us that the docking would be successful. Yuri and I were tracking the vehicle as it approached ISS. It was an automated approach. We had the capability to make it stop, make it back up to the previous hold point, or to send it away permanently. It was a pretty limited capability at least compared to a Progress vehicle, in which Yuri could take over, and fly it into docking manually if the automated systems did not work. We didn't have that capability on the ATV.

Because it was the first docking of this vehicle, we weren't sure how stable it would be and how steady it would be as it was approaching. We did a practice run the day before where we brought it within 15 meters of the Station and then backed it away. The next day, the ground team commanded it all the way in, and it successfully docked to the Station. There were no issues. At one point, the ground team couldn't see something that we could see on board. So it took them a while to get comfortable with the fact that we could see this signature, and it was fine to continue. We were able to press forward because we could fine-tune our video to where we could see the distinction and say yes, we're okay. We docked with no issues, and it flew very very stable. We've since then flown another one to the Station, with the same type of approach. It's interesting when you think about why we need to worry so much about these. Because the ground team, engineers and operations folks made it look so easy. That's one of my sayings, that NASA makes everything look easy. As a result, the press doesn't really care about us, because

they assume it must be easy. It looks easy. There's a lot going on behind the scenes to make it look easy, and that's NASA's strength, making hard things look easy.

ROSS-NAZZAL: There's a lot of training that goes on to do those things.

WHITSON: Yes, to make that happen, and to ensure that if something didn't happen exactly the way we planned, that we have a plan that we're going to default to or move to in various different scenarios.

ROSS-NAZZAL: How did your crew entertain themselves on this expedition? Did you continue those Friday night videos?

WHITSON: We did. We did dinner and a movie. Not every Friday night but we did do dinner and a movie on various occasions. It was fun. Because of my experience the first time, I flew up special things, little things like drink bags full of Jell-O and then I would pre-make up Jell-O. Of course we didn't have a refrigerator so I'd have to go find the coolest [space], like either the Progress or the Soyuz and temp stow them there till they solidified. Then I'd break them out. We'd have Jell-O dessert, which was unique because we didn't have that normally. Little things like that that we'd try and make it special.

ROSS-NAZZAL: I think I've seen a picture of you and the crew celebrating Christmas.

WHITSON: Oh yes. Dan Tani, Yuri and I were there when a Progress arrived on Christmas Day, or the day before. I don't remember if it was Christmas Eve or Christmas Day, but the Progress arrived. Of course the first thing we did after opening the hatch was find the crew care packages, which had the fresh fruit and the Christmas gifts which had come up. I had gotten Christmas gifts for them. One of the things that Dan had gotten from his family was some jelly beans and so we were playing catch across the service module with jelly beans. We have some video of us doing that, which was fun. I always say I work on my basketball skills, knocking people out, hip-checking them to get them out of the way so I can get the jelly bean.

ROSS-NAZZAL: I did want to ask you, and I didn't ask earlier. Do you think that there was a difference between your command style and those of the male commanders before you on expeditions?

WHITSON: I think every commander has a different style based on their personality. I can compare Valery [G.] Korzun. He was a very gregarious outgoing person. I learned a lot from his style; his positive outlook and optimism I think is a very important aspect to a long duration crew. Maintaining that capability and being openly the one that's helping keep that optimism and positive outlook going I think was an important thing that I learned from him. I handed over with the Expedition 15 commander, and other commander on the 17, on either end. So it really varies. It's very much a personality thing on how folks do the missions.

I think in general though I would say it's very much more of a team experience. You're not effective as a directive commander for a long duration period of time. We call it situational leadership where the situation is that hey, we're this big team. Something bad goes wrong, I'm

going to start telling you what to do and you what to do. We're going to make sure everybody's safe, and then we're going to make sure the Station is safe. It's a very different style when something serious is going on. You've got concerns about something, you need to make sure something's happening, rather than the day-to-day command experience. It's much more laid-back. I think that's in general just a Station thing. I think it's a long duration thing. You couldn't be effective being overly restrictive or directive commander for a long duration period of time. You'd have a lot of unhappy people around you.

ROSS-NAZZAL: You'd have that mutiny.

WHITSON: Yes, you would.

ROSS-NAZZAL: Did you get to decide though who would do certain tasks or certain experiments? Or was that pretty much just shared responsibility?

WHITSON: The ground team typically, based on what you were trained on, and what your user level [is]: expertise, user, operator, specialist, and what the task involved, would assign the crew members based on that. Occasionally we would move some things around that didn't matter. If I had been working on an experiment and they gave it to Dan one day we would exchange tasks on our own because it would be more efficient that way. That worked out fine. No issues with that.

ROSS-NAZZAL: It sounds like you spent most of your time reassembling the Station. Did you have a lot of maintenance issues that you dealt with?

WHITSON: Internally we had what I would call standard maintenance issues. The only major one was probably the CDRA [Carbon Dioxide Removal Assembly]. My second time taking that apart happened during Expedition 16. That's probably the biggest internal one we did. Of course externally we had the SARJ [Solar Alpha Rotary Joint] and the BMRRM that we had to change out, which were pretty big deals in both cases.

ROSS-NAZZAL: Yesterday you had talked a little bit about this, but give us more details about the reentry of the Soyuz. I understand that there were a lot of complications with that reentry.

WHITSON: We had overlap with Expedition 15, handed over with them, and then they went home. Then we heard they went ballistic and landed not at their prime landing site but near the ballistic landing site, which was about 400 kilometers different than where it's supposed to be. The reason that we heard on orbit was that it had potentially been because of a kinked line in one of the descent cables. The ground team had us check to make sure our cable was not kinked. The vehicles are built in pairs, and ours was a pair with the one that had a ballistic reentry profile, so they wanted us to check.

We didn't really hear too much else about it from the Russian side. I was hearing some from the US side as they were getting parts of the story. I was a little skeptical about if there really was an understanding of what the issues had been. I think Yuri and I both thought there was a nonzero chance that we were going to go ballistic. Normally the descent module portion

of the vehicle separates from the habitation and instrument compartment sections after the deorbit burn.

After we heard the separation pyros blow I looked out the window near my seat. The MLI [multi-layer insulation], the cloth type shielding, was over the window, and it was over the other window as well. I asked Yuri, "Is that normal?" because people had sent me all the gouge of what to expect during the reentry profile and no one had ever mentioned it to me before. Yuri had been on a previous Soyuz reentry. He loosened his harness enough to lean forward and look out the windows and said, "No." Yuri is not a man of a lot of words. As we started entering the atmosphere it turned out one out of five of the bolts had not separated between the descent module and the instrument compartment.

Normally the shape of the capsule keeps the vehicle aerodynamically stable as it enters the atmosphere. Because we were not in an aerodynamically stable configuration, with this big hunk of metal flopping around attached to us, we inside the capsule were moving around a lot within the limits of our harnesses. There seemed to me to be of pitch action, but Yuri felt like there was some yaw involved. The seats are canted a little bit so it's probably some combination of that and the fact that we hadn't felt any of these types of sensations for six months.

In any case, we were shifting back and forth a lot. Then eventually we separated from the instrument compartment.

The previous crew, unbeknownst to us, had separated around 100 nautical miles. We were closer to 70 nautical miles when we separated. We were much lower in the atmosphere when this happened. Once we went ballistic maneuvering engines were firing, spinning us up to 17 degrees per second for the ballistic profile. A normal reentry profile is shallower and less Gs. Maximum Gs is around four and a half. The first G peak is around four and a half, and then the

second G peak is around two and a half. Then under the chutes and there is only the one-G sensation.

On a ballistic reentry profile, the first G-peak is a little over eight Gs because it's a steeper reentry profile. Then the second G peak is around four and a half. It's a lot of G-forces going through your chest again. It is obviously hard to breathe. However, as part of the training program for the Soyuz we experience a ballistic [reentry] profile in a centrifuge, in order to know what it feels like. How fast you get up to the eight Gs, how much the sensation drops off and then up to the four and a half Gs again, and then back off. It's in the timeframe profile that you would have during your reentry so you get to know what that feels like. It's important to do it so you know how to breathe, because you can't really take a breath. You're breathing through your diaphragm and using your stomach to actually even breathe.

After that things settled down when we were under the chutes. However, the cabin air was hazy, smoky. Yuri had me shut off a couple of instruments. I have assumed always he was worried about them, and he didn't trust those particular instruments because they were added on instruments from when he had flown previously so he had me shut them off.

As we get low enough in the atmosphere there's an equalization valve that blows and equalizes the pressure interior and exterior to the outside air. When that occurred—now in retrospect we can say—that after the air all went out, because initially it's higher pressure inside the capsule than out, and then as we were descending the atmosphere outside was higher than inside. Well, since we were smoking hot because we'd been in the wrong orientation throughout the reentry and had a lot more charring than normal, the air that was sucked in was very smoky. It filled the cabin with smoke, and looked like we had a fire. Yuri has been on a previous reentry. So he commented, "I think we have a fire; I'm going to shut off the panel." The panel

controls all the computers. The only course of action if you think you have a cabin fire is to shut off the electronics.

I agreed with him and he shut off the panel. Coincidentally, after we shut off the panel, a couple minutes later the air starts clearing, because the smoke concentrated around the capsule is getting dissipated enough, although we didn't know that was the reason. So we thought okay, we shut the panel off, and the fire went out so we had a panel fire.

Without the panel, however, we had no data. We didn't have any way to tell how high we were. Yuri asked me, "Can you see how high we are looking out the window?" Because I have one contact lens that allowed me see my display, and one contact lens that allowed me to see his display. I told him, "All I can tell is the ground is below us." I couldn't tell how far above the ground we were.

We had input. The one thing that was wired separately from the panel in the computers was the cabin pressure. We had input the altimeter setting at the landing site so we knew approximately how high we were just from the cabin pressure. So had some sense of when we would be getting close.

We did actually end up turning the display back on. We got only cabin pressure data. It didn't tell us where we were going to land or anything, because all that data had been erased once we shut the computers off, but we had a little bit of data to help judge that elevation that we were.

Of course we hit and rolled and hit and rolled some more. I ended up being on top on my side. My hands hanging down like this. [Demonstrates] Yuri said, "I'm going to wait till I'm sure we're not rolling anymore before I release the chute." All this of course is in Russian. I

told him that we had stopped rolling. And then he asked “Who’s on top?” I’m replied, “That would be me.”

My arm was hanging down. That arm weighed a lot, so it was difficult to hold it up. We shut the panel off immediately again because again we thought we’d had a fire associated with it. So Yuri opened the hatch so that we could expedite our egress. That day there was a pretty strong wind blowing away from us but in the lee of the capsule—we’d started a big grass fire because we were smoking hot. The grass fire had burned the chutes up, but in the lee of the capsule the fire was coming toward us. I’m said, “Yuri, let’s shut the hatch for a little while and wait this out.” So he held the hatch shut, with some smoke is billowing in around it. Actually I forgot to mention that as he opened the hatch he said “Opyat’ pozhar.” Which is, again, a fire! The Expedition 15 crew had also set a fire when they landed.

So we waited until the smoke dissipated and then Yuri managed to get out. Soyeon Yi, who was the South Korean tourist that was on board, I told her to get out next. She was having a little trouble getting out and eventually got her straps off. Somebody reached in and grabbed her and pulled her out. I was surprised, thinking search and rescue got there fast. Turns out they weren’t search and rescue, but I didn’t know it at the time.

I was next, but in order for me to get out we had to close the hatch back up so that I could move down in a position where I could get my head around the hatch. Since there’s just not that much room to move your head up and around with the hatch, Yuri closed the hatch. I had this whole plan of how I was going to release my five-point harness and hold myself in position by holding onto the rescue hardware with one hand, release the harness, and lower my legs. Everything was going to be fine.

When I released the five-point harness, unfortunately I immediately fell down to the bottom of the vehicle, because I weighed a whole lot more than I remembered I did six months ago. My feet are up over my head across the hatch. Yuri was outside and asking if he should open the hatch. I told him, “No, not yet. Wait a minute.” I was trying to get my heavy backside underneath me and get my head up so that I can get through the hatch. After several minutes of maneuvering, I was able to allow Yuri open the hatch up and get out.

Then the fellows that I thought were the search and rescue guys helped carry me to a position near the aft end of the capsule where the cesium altimeter is. I was surprised. In training they told us not to be this close to the cesium altimeter.

I looked around, and I start checking out these search and rescue guys. These fellows were just some guys in the field that saw the fire that we started, and they’d driven over and were checking us out. One of the Kazakh guys who knew some Russian approached Yuri and asked, “So where did this boat come from?”

Yuri responded with our story of being cosmonauts and astronauts from the International Space Station. We had an off-nominal reentry and landed here. Not quite on course. It was funny watching the guy’s face as Yuri is trying to explain what’s going on because of course it wasn’t known that we were coming down in this area. So I’m sure he was thinking, “I must not have understood all that.” Because he replied, “Nu, ladno,” which means approximately, “okay, whatever” and then he walked away.

He thought about it for a while, and then he walked back up to Yuri. He asked again, “So this came from space? You were in space?” Yuri explained again, “Yes, we were on the International Space Station.” He went through the story again. The fellow asked Yuri, “So is

that a spacesuit?" Yuri went through the story again. The guy once again said, "Nu, ladno," okay, whatever and walked away again.

He came back a third time. I think by then he was finally starting to believe what was going on. By then we'd heard the search and rescue aircraft fly over. It was about 45 minutes after we had landed or so and then another 30 minutes before the helicopter showed up to pick us up. It was an interesting landing, very interesting.

ROSS-NAZZAL: Pretty memorable. Nothing like your KSC landing at all.

WHITSON: No, no. Everyone always asks me which would I rather fly on, the Shuttle or a Soyuz, and I say, "I'd like to launch on the Soyuz and land on the Shuttle." It's the kinder, gentler, more civilized version of landing.

ROSS-NAZZAL: I think we're getting close to time, but I wanted to give Rebecca a chance to ask any questions.

WRIGHT: I just have one. It's related to what you were talking to but on the other side. You spent a lot of long duration time away from your family and friends and your home. Can you share some about that impact on them and on you about being gone? All those months of training and of course all the months in space.

WHITSON: My husband always says it was much easier for me to be in space, because he always knew where I was, and he works here at NASA, so he could see my timeline, he would know

what I was working on, and when there might be Ku pass, so he knew when I might actually try to call him. He also knew when he would get an e-mail synchronization so that we could exchange e-mails. He always felt like he knew what I was up to more when I was in space, and of course the video cameras were on so he could see me working during the day. He had it on his TV in his office. He felt very connected to me while I was on orbit. He said it was much more challenging when I would be off on a training session in a different country. When I was traveling for training, I think the hardest thing was I would call home and either I was tired or he was tired. It was the end of my day or the end of his day. It was very challenging. I think for the folks that have children trying to Skype and keep in touch with the kids and keep that connection is pretty challenging.

Even just with a spouse it was not an everyday thing. It's something you have to adapt to. I tell folks in training you have to figure out the ways to adapt to that, because that's the test for spaceflight. You have to learn along the way which things work for you and your family and which things don't work, which things you want to do to occupy your time when you don't have your family around you.

ROSS-NAZZAL: It's got to be challenging, I would think.

WRIGHT: You think about all—it's not days, years you've actually been transplanted someplace else.

WHITSON: Yes, I think I was one of the few crew members when I was assigned as backup for Expedition 3 and prime for Expedition 5. I decreased my travel time, because I'd been working

at the crew interface testing I'd done and set up a team in Russia, and I was spending 70 percent of my time on travel. Then when I got assigned it was only 50 percent. So I was thinking, "Hey, this is an improvement in my travel time."

WRIGHT: Less airplanes, less airports.

ROSS-NAZZAL: Are you hoping on flying another expedition mission?

WHITSON: Yes, I would like to fly another expedition mission. That's why I stepped down from chief of the office job. I'd like to put my name in the pool to be considered for another expedition.

ROSS-NAZZAL: We hope it all works out. So with that I think we'll end today.

[End of interview]