C. MICHAEL FOALE (Session 1)
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Interviewers: Rebecca Wright, Carol Butler, Mark Davison

Wright: Today is June 16, 1998. We're speaking with Mike Foale, as part of the Shuttle-Mir Oral History Project. I'm Rebecca Wright with Carol Butler and Mark Davison.

Looking over your information, we realize that last year at this time, you were aboard the Mir.

Foale: Yes. This is like nine days before the collision. (laughter)

Wright: (laughter) How have you adjusted to being back on Earth? Been busy?

Foale: I certainly feel I have been very busy since the flight. Unfortunately, I feel I haven't taken a big enough break in terms of vacation and psychological unwinding as I should have, could have. A lot of it was because this job with Mr. Abbey, I think, needed to be filled, and I can see that Mr. Abbey needed to have someone near at hand, who had been on Mir and could apply that experience to Space Station. So I kind of was invited to take the job earlier than I think I would normally have chosen to. Because of that, I'm kind of ready to go on vacation again.

Wright: I hope you get one.

Foale: Yes, I'm going to go tomorrow for two weeks and then take another vacation in August. But getting back to Earth, I basically felt I was kind of in tune with my life, bills, payments, all the rest, by the time I had gotten past Christmas, I guess, so from October. I landed on October 7th or something, 10th or something. By the time I came back from New Year's Eve in Great Britain, where I'd been on vacation with the British part of my family in Scotland, came back here, I sort of felt that, yes, I was ready to start normal life here in Texas.

The other thing was, for me coming back from the Mir, and I think probably maybe Shannon [Lucid] has reflected this, and all the other guys before me, it's also moving back to America, you see. It's not just coming back from Mir; it's coming back from being posted overseas. My post overseas was one and a half years to Russia and then it was into a Russian environment, but in space. So it was still a posting. And even though my orders were the PCS, the transfer orders, were transferred back to the U.S. right before I launched, all kinds of things didn't really get sorted out until sometime like the beginning of this year. In fact, I was still handling paperwork for that move, tax impacts and other things like that, just a month ago. So it goes on a long time. Just like anyone coming back from deployment, say, in the military, I think I've had that to readjust to, just going, "Oh, you mean there's a new street here in Clear Lake? There's a store here?" I've gone to stores and they're gone! (laughter)

Wright: Look at the money you saved, though, right? (laughter)

Foale: So I've finally become used to the new arrangement here in Clear Lake. The only thing I hoped that would have happened while I was in Russia and then on the Mir was that they would have finished all the modifications to NASA Road One while I was gone.

Wright: Well, we're all hoping for that soon, but we've been hoping for that for years.

Foale: Since I was disappointed, I'm not going to ask to be sent to the Mir again until they finish that road. (laughter)

Wright: You were here and then, like you said, they shipped you off to Russia for your training time there. How long were you there?

Foale: Basically it was in the summer of 1995, and I had recently finished a flight on STS-63, which had been the very first approach to the Mir. We did a flyaround and a rendezvous with it, but we didn't dock because we didn't have the docking module there. That was with Jim [James D.] Weatherbee as the commander. I had learned just a little bit of Russian, maybe three hours a week for maybe six months at the most, so that wasn't all that much, so it was like fifty, sixty hours.

I was comfortably in this building, working EVA issues, when we became aware that Wendy Lawrence--well, first Scott Parazynski was too tall, Wendy Lawrence was too short to fulfill the role of a NASA flight crew member on Mir. It was about September when I became aware that Mr. Abbey and Jim Weatherbee at the time were considering me to fill that slot. This is a big change for me. I at that point had targeted STS-86 as the flight that I might be flying on. That had been hinted at to me. I wasn't really ready, with my small children, to go to Russia. I didn't want to do that at that point. I wanted to fly on station maybe five years down the road when the kids were bigger. But it looked like that was the way the wind was blowing.

I went to Russia on a business trip, actually, in October, and it was just starting to rain and be dark and grizzly there. Drizzle was falling and it was dropping to freezing. It was while I was in the office of the DOR, Director of Operations-Russia, in Star City, that one of the Russian secretaries says to me, "Oh, but Mike, we've heard that you're coming here in three weeks!" I went, "Huh? No, I'm not!" She said, "Oh, yes, you are. They just made an agreement with General [Yuri] Kargapolov and General [Yuri] Glazkov." And I was pretty angry, actually, that I hadn't had a clue that that was coming. So anyway, I

said, "Really?"

So I thought, well, I didn't even bother to call anybody here. I just called up Rhonda and said, "Hey, Rhonda, they're talking about us being here in three weeks' time. Do you mind, I'd really like you, Rhonda, and the kids to be here when I move over. I don't want to leave you in the U.S. Are you willing to do it?" And she said, "Yes. Okay."

So we went through a big, big [unclear] for three or four weeks, packing up the house, getting everything done, finding a renter for the house, and we were in Star City, living in a one-room hotel room in the Prophylactorium, my two children and my wife and I, and some meager belongings in November, the end of November. Actually, it was Thanksgiving. We got there for Thanksgiving, at which time there was snow on the ground and all the rest.

Rhonda, bless her heart, it was the first time she had ever lived abroad. She's been abroad a few times, of course, but in better conditions. She'd just been dumped in Star City. At that time you couldn't find much food in the grocery store. There weren't any grocery stores as such; you had to go and get food out from the back of trucks and things. The first thing we did, I remember, the first thing we bought after we arrived there was a sled so that Rhonda could pull the kids on the sled, going around the little kiosks and stores, to go and buy food. Now, this was a big hardship for Rhonda, to begin with.

Things got steadily better. In fact, Russia has changed incredibly in terms of services, ability to get food, etc., communications, over the two years that we have been posted there. Moscow is unrecognizable compared to the way it was two years ago. So those hardships did get better for us, and indeed we adapted. We learned how to do things, and Rhonda got better at Russian language, I got better at Russian language.

So we started off with a pretty shaky start back in November of 1995, and then lived there through two winters. If you're Russian about this, you always count seasons by the winters. (laughter) It's two winters and then moved back here.

My family moved back basically and were very excited. It was early May, late April, last year. It was always wonderful to be in America, land in America, with the conveniences, tidiness, the orderliness of life in America compared to in Russia. Whenever we landed in a Western airport, it was like being free. It has a lot to do with freedom, living in the West, compared to living in Russia. So they were very excited to move into our house again, which is on the bay here. We like it very much. Whereas I couldn't refocus on the move to here. I had to still get myself ready psychologically and be prepared to go and do my Mir flight, which I didn't expect to be much fun. I expected it to be very hard, but just something I could deal with and handle, and I would get a sufficiently positive amount out of it that I would look back on it and

say, "Yes, this was good." And that's really how it turned out.

So now after going through the five months in space and then coming back, I finally caught up with my family, who have already been back here basically a year.

Wright: How old were the children when you were in Russia?

Foale: When we went to Russia, my daughter was three. No, four. And my son was just less than one. One. Yes, he was one year old.

Wright: And they adapted well?

Foale: Pretty well. My daughter went to the children's kindergarten, called [Russian phrase], and unfortunately they had just finished teaching the Russian alphabet and basic Russian to the children, so they never made any effort, the school, to teach Genna Russian specifically. There are no English-speaking people there. So for whatever reason, Genna only really started speaking a fairly coarse, I would say, fairly rude Russian by the time we left. When I say rude, it was very demanding. She had all the demanding words down, but nothing very polite. It kind of appalled me to hear her speak Russian. That only came in after a year and a half of her going to this children's kindergarten. I was rather disappointed by that. All the Russians said, "Oh, she'll learn Russian really quickly." It didn't happen, because she just came in at the wrong point into that school. So she basically got all that she wanted and needed in that school by using gestures. Extraordinary.

My son had a Russian babysitter for about two hours every other day when Rhonda had to go into Moscow on a two-hour drive into Moscow and a two-hour drive back to get foodstuffs. Then Ian actually did respond fairly well, but he wasn't speaking English at all. He didn't speak until he left Russia, but in Russia he understood Russian commands as well as English commands.

Wright: It would be interesting to see how they've developed their language skills.

Foale: Even though Genna has such trouble with Russian, she was learning to read quite fine English at the time, just at the house with Rhonda and myself, and she's now six and reads well. Ian's now three and does not read, but is learning his alphabet well and speaks. He was starting to speak while I was in space, which was particularly poignant for me.

Wright: You said you were here and they were adjusting back at the house, but you had to gear yourself for getting ready to go. Can you talk about all those different things that you were doing, training here in

order to prepare yourself for your ride on the Mir?

Foale: Well, actually, in all honesty, the most valuable thing I did when I came back from Russia, which was like April 10th, to get ready for my flight, which was May 15th, I had basically a month, I had already received some good lessons learned from John Blaha, and he was the one who stuck in my mind the most in that early '97 time frame, and that was, he said, "Mike, take charge of your schedule. No one else will." And his point here was that so many people want to give you their last little bit of valuable information in those weeks, that they treat it like a Shuttle flight. They think if they don't tell you now, the mission's going to fail.

Well, no one here knows how to train someone for long-duration flight except those people who've been through the long-duration Mir experience. So the schedule fills up horribly with people giving you that last little bit of information, which you're going to forget anyway over a few months and, in fact, you probably don't need to know, because you'll have time to ask. It's not a Shuttle flight of ten days. So John said, "Mike, do everything you can to take control of the schedule. Don't fill up your day. Spend time with your family. Get your house in order. Get the bill payments set up. Get your will in shape. Go on vacation."

So, what I did when I came over from Russia was, I went on vacation straight away. In fact, the first thing I did was I went to Ellington {Air Field} and got myself rechecked out in the T-38. I always made a point. This is kind of an American anchor for me, was, I was still an astronaut if I could at least do what astronauts basically do here, which is fly in the T-38. So that's the first thing I ever do on a business trip, is I go straight to Ellington, I wouldn't tell anyone I was here, and I get checked out in the T-38 is the first two days.

Then I planned to go on a vacation. We disappeared with another family, not at NASA, went to Corpus Christi for a week. Then I came back and said, "I'm ready now. You can have me." And the schedulers had me, but they only had me for three weeks, and by that time they had to be pretty efficient about what they were going to give me.

So I just trained twice. Charlie [Charles J.] Precourt was my commander on the STS-84. He already had worked in Russia as a DOR. He knew about these pressures on the long-duration crew member because he'd had to represent their interests. He had to represent Shannon's and John's interests when he was Director of Operations in Russia. So, Charlie had been giving me a hard time for only doing the minimum Shuttle activities that I needed to do. So I basically spent a lot of time at home, just being with friends, wanting to talk to my parents, just trying to be as relaxed as I possibly could before that flight.

So when the flight came and I launched, it was like being on vacation. I was coming to the end of a vacation I'd had in the U.S. The U.S. is like a vacation for me. It was like a phase, an interruption between training in Russia, which was not a vacation, and then going to Mir, which is not a vacation. So I arrived on Mir in a very relaxed and resilient, I would say, psychologically resilient frame of mind. So as the surprises started to come fast and furiously, initially just because of the condition of Mir, which is not the same as the condition of the Space Shuttle--it's a place that's been lived in and worked in for twelve years. It's a bit like a frat house, but more organized and better looked after, actually, but nonetheless it has some of those characteristics. Dealing with that and then dealing with the kind of camping out, making your own spot, and then having to figure out all of these different experiment activities that you are going to be asked to do, all that I didn't rush into. My whole frame of mind was, "This is not a Shuttle flight. This is long duration. This is like being sent to Russia. So in the first two or three weeks, if I don't get all these things done, it's not a problem."

I knew that this had bothered terribly Shannon. It had bothered terribly John, trying to go, and so I wasn't going to get myself into this big personal punishment cycle where you punish yourself for not having achieved all those things they thought we could have achieved, because I just treated it as an experiment in people living in space, and I would just do my best-faith attempt in like the ten hours of the day that I was working, seriously, to try and do what I could. But once ten hours were over, I was going to go wash, I was going to exercise, and I was going to go to bed, and I was going to eat comfortably and talk to my crew members. I was not going to kill myself at the beginning of a four-and-a-half-month flight.

As a result, I was pretty comfortable with the crew. I liked the crew. I was spending time talking to them. Sometimes in the afternoon Sasha Lazutkin would find me and say, "Mike, you want to drink tea?" Because I told him I like to drink tea for a ten-minute break. "I want to talk to you guys during the day. I want to know what you're doing." So they would find me and we'd just drink tea. Then we'd go back to doing whatever we were doing. That was kind of the existence I had up to the collision.

Wright: You were explaining how you met for tea. You were all off in separate areas doing separate things, then got back together?

Foale: Yes. On the Mir, it's very easy to lose each other, where you don't know where the other people are, because it's not that the Mir is such a big space, it's because it's such a cluttered space. You're basically winding your way through, effectively, tunnels to go to one part of the station to another, so that equipment just isolates you from other parts of the station. So especially if you've done into one of the further storage areas, where there may be food boxes stored or space suits stored or just trash, if you have

to get to the back of that module for some reason, then there's a whole bunch of stuff in front of you that is floating around and you can't even be seen from the node area on Mir.

So there will be times when I would suddenly pop out of my warren, you know, out of my hole, into the node, and Vasily would say, "Mike, have you seen Sasha? I haven't seen him all morning." I'd say, "No, I haven't seen him all morning." You know, we didn't know where Sasha was. Well, we knew he had to be on station. (laughter) But we didn't know where he was. So you could easily spend a day without talking to crew members, and that we considered, the Mir-23 crew and myself, not a good thing. So we made an effort to try and tag up, especially for lunch and often just for a ten-minute tea break, basically, in the base block.

The other thing that makes you come together is the communication sessions. NASA long-duration guys had different approaches to this. Basically, again, with the Shuttle idea in mind, of trying to be terribly efficient and get as much as you can done in a day, communication, especially by Jerry Linenger, was regarded as an interference. Communication with the ground, being on the com, waiting to talk to your specialist, your American specialist Jerry found very irritating and didn't like it, and he wanted to use email to do to-and-fro traffic.

I, on the other hand, felt exactly the opposite. I felt, "This is a long-duration thing. You should be more easygoing about the whole thing. Anyway, my job here is to learn about the Russian part of the station as well." My Russian was fairly good, better, I think, than other crew members, so I would always go for every communication session. Now, most of the time it was not geared towards me; it was geared to the Russians on board with the ground, but I was always present for the communication. Because I was there, I decided to take over all of the email, all of what we called flight data file, up and down in the packet--we call it packet--transmission of flight instructions, flight data files, is American for it.

So, as a result of that, I did see the crew more and more often just because I would go for the com sessions, and the com sessions would be every nineteen minutes, for about ten, twenty minutes. So, again, that was a way to stay close to the crew. I made a big effort to go to the com sessions, even if I didn't have something to say or they didn't have something to say.

In the same way, the Russian ground controllers then got used to me being on the radio. They got used to my voice. I got used to their voices. My Russian what I would call communication language got better, because, you know, if you're an American and you hear an airline pilot talking on the radio, you don't understand what he's said if you're not a pilot. It's like any technical worker basically seems unintelligible even if it's in your own language. The same is true if you've studied Russian but you haven't been working on the radio with the controllers; you don't really understand them very well.

But over the time of a month, I got to know the controllers quite well and they got to know my voice well. I lost my inhibitions to talk to them on the radio. That kind of integrated me into the overall Russian operation of the station better.

Wright: Was it good to hear other voices as well?

Foale: Yes. I'm fairly gregarious anyway, so I like to hear other voices generally. I developed a whole picture and a whole image of these people who I'd never met before. Half of them I had never met before, and it was really strange to see them for the first time, some of them, in the TSUP when I went back about a month ago.

Wright: Do they match?

Foale: No. Voices never match your expectations.

Wright: It's okay, they were there when you needed them.

Foale: Yes. But that was kind of how the mood developed. In those days before the collision, I learned a little bit about the troubles they've had, especially with the fire. Vasily talked about it quite a bit, and Sasha. At some point Sasha explained to me--and he actually took me to where the fire occurred and showed me what he was doing and how the fire happened, and he gave me a long hour's description of everything that happened during the fire. It was very amusing. We were enjoying it. It was a good story, with serious undertones. But he wasn't making a big deal out of this; he was telling me a story, because I wanted to learn.

And other times Vasily would talk about the near miss of the Progress docking, that Jerry has since then talked about a lot in the press, as being a near miss, and it was. A very close call.

Wright: You've mentioned the collision a couple of times.

Foale: The collision demarcates everything for my flight, not because of the terribleness of the collision; because it changed the whole condition of the station and the environment in which we worked.

Wright: That's what we'd like for you to talk about, because it's been called the worst collision in the history of human space flight.

Foale: I'm sure that's true. (laughter)

Wright: And who better to know that. You've explained to us how relaxed you were when you went up there. Did it {the collision} change everything about the flight for you as well, your attitude? Did you feel differently than you had six weeks prior, when you boarded?

Foale: No, it didn't really change it for me. One of the early thoughts that went through my brain, that occurred to me in the five minutes or so after the collision, when I had just finished doing my bit of getting the Soyuz ready to leave for the emergency, and while I was waiting to see whether or not the leak really was in Spektr, I was just basically passively helping Sasha gather up cables while he was clearing cables out that pass through into Spektr, during that period of time I was thinking--or even as I was cleaning out the Soyuz, it crossed my mind, "You know, I've been here six weeks and I think we're going to be going home right now." I was actually kind of sad. I thought, "Well, you know, that's a shame. I won't finish this whole thing. I had set out here to be four and a half months, and now it's going to get cut short. This is a real emergency." And we had all the danger of getting out of there, but it was crossing my mind, "This is a shame. I've only been here six and a half weeks. What a shame I'm not getting to do the whole thing."

Then it occurred to me, "Well, you know, you'll get to see your kids and Rhonda sooner." And I thought, "Oh, but we're going to be landing in Kazakhstan. That's going to be a delay." (laughter) The thoughts that went through my mind, it was exactly like that. I thought, "You'd better focus on getting this sealed off here." (laughter) That's what went through my mind.

Then we started pulling the cables, and I got serious, pulling the cables with Sasha. There was a cable or two that burned in spots, so we had to find a way of disconnecting that one. Sure enough, we thought the way was clear from Spektr, we then tried to position this big, big hatch into it. You should remember that a node is built with six holes. It's like a dice with six faces. Each hole has a hatch. Well, since the hatches are bigger than the holes, they had to put the hatches inside the node before they built the node, and those hatches don't come out there. These hatches have been there ever since they created and built the node--six hatches--and they're somewhere.

The thing is, you have to get them out of the way in Space Station life, so they've been tied up, and they've been tied up pretty securely. The biggest hatch, the one that we wanted to put in there with a valve and all the rest, air equalizers between it, was really tied up pretty severely. I mean, we wasted about a minute trying to untie that hatch. And the pressure's falling, pressure's falling, so it's getting pretty frantic. I was worried that Vasily was not particularly ready--he was now talking to the ground, but there was no obvious movement to evacuate yet. So I was thinking, "Things are getting pretty tense now."

So we wasted some time on this one big hatch, and it was then as we moved--we gave up on that, basically. It was too tied off. We found a smaller hatch. They have two types, thin ones and fat ones. We

found a thin one, and that was pretty easy to untie. Sasha gave it to me to put in place, popped it in place, and he says, "Mike, hold it while I go and find the key to crank the latches that hold it closed." In fact, the key was present in all this space, but with all the wires, cables, and hatches, the key was not really easy to see, and we didn't see it. So he went off to another part of the station to go and get a key, a hatch lock. I held it.

Well, as the hatch pulled in because of the pressure difference, I thought, "Truly there is a leak on the other side of this," so I knew at that point we had isolated the leak, because I could feel the hatch holding in and then the pressure stopped dropping in my ears. So I thought, "Hmm. I guess I'm not going home." And I wasn't particularly pleased. In just the five minutes I was getting excited about going home. Then I thought, "Well, okay, we're here for the long haul." It's a whole matter of adaptation, and I guess that's the way my psychology works. In the space of five or ten minutes after an emergency, I will already be trying to make something positive out of what that situation has dealt me. As soon as the tables turn around, I'll try and turn the tables one more time and make something positive out of what's happening. So then I thought, "Well, hey! We just survived a pretty big emergency!" (laughter)

Then all hell started to break loose, because at that point I thought, "Well, we're kind of out of the woods," but then stuff that I hadn't any clue of started to happen, which was this whole--I had no idea how fragile the Mir guidance and control complex is so dependent on the station being in a good attitude and in good guidance and control. Believe it or not, our International Space Station, the American Space Station, is far, far worse. And because of my Mir experience, I'm now applying that in advice to Mr. Abbey into the station program.

But the Mir, having been hit by the Progress, set into a bit of a spin, and as a result, because the solar arrays weren't getting any energy and as a result of all the activities to isolate the leak, we hadn't turned off anything. We had used up all of the reserve energy in the batteries, and the batteries went flat pretty fast, and we went into a very severe power-down, so severe that in the night pass there was nothing alive. As we were on the dark side of the orbit, there was nothing on. This lasted for about thirty hours, I think. Yes, a day and a half, where when we came into sunlight occasionally would we get enough power on to a solar array that happened to be catching the sunlight at that moment, because we were still spinning, would we have enough power to talk to the ground and then try and recover.

So that was a pretty hard time, because we got very tired. And that was the hardest time I ever had on the station, was that period, because we just got so tired. Of course, the commander's morale was pretty--he was just shot, stunned.

But anyway, that was actually quite an exciting time for me, because it was the first time I was

asked to do anything to actually help the Mir, or starting with helping Sasha, I guess, isolate the leak. I had already volunteered to do some significant work on the Mir, and the specialists on the ground were sort of considering letting me do it, but, as you probably know, most NASA long-duration flights haven't been allowed to operate the systems much. They weren't relied on to do that, for a number of reasons, to do with contracts and bonus payments to cosmonauts, and whether or not you would [unclear].

But in this case, I had been offering to clean up all of the condensation that was already present on the Mir before the collision, which got a lot worse after the collision, and I was just waiting to go and get myself wet and go mop up all this water. There was a lot of water on board, many tons of it on the walls. Because I had made that effort, that proposal to the ground about a week before the collision, the ground was kind of negotiating. I don't know, for whatever reason, they were discussing whether they wanted me to do this or not, and they came back and said, "Yes, we'd like Mike to do some of this work." I couldn't stand seeing Vasily and Sasha always doing the grungy work, just getting beaten. I mean, scratches, the hair wet, the most foul places. And here I was, the pampered American poodle, just doing my experiment stuff and them having to maintain this whole place, just so that I could do my experiments without getting dirty. I couldn't--I thought that was just totally inappropriate for a small crew.

So to improve my relationship with the crew, I felt I should be doing some of the work. That was the basic goal in my proposal to the ground to do that work. I didn't want to do it, but it was work I could do. However, it opened up, after the collision, a whole bunch of things for me. Because I'd already made that proposal and they'd basically said, "Yes, let's let Mike do that," because I was speaking Russian on the radio and they could understand me, they then came and quickly started to accept what I proposed. If I hadn't done that before the collision and made that overture towards the crew and the ground--it was really to the ground, but the crew proposed it for me--I don't think they would have listened to me at all in those hours after the collision.

But in the subsequent orbit after the collision, we were spinning at about one degree a second, and the call came up on the ground, and because it was my habit to be on the com, I was on the com, the call came up, "Guys, what's the spin rate? We don't know. We've got to know how fast it's spinning." And Sasha, see, at that point, worked very fast, for whatever reason. Sasha knows how to do this. I'm not sure Vasily really had a--he wasn't quick at this. I'm a physicist who's worked on guidance and stuff, so I quickly get this. I look at the stars' wobble. So for whatever reason, I more quickly got to the window, put my thumb against the window, looked at the stars, and was able to tell the ground what the spin rate was. I called it down, and basically Sasha--I knew this was the first time I had made an operational call on the state of the Mir to the ground, and it was right after collision. They had no other choice but to accept my

word for it, because at that point Sasha says, "Well, yes." He basically said, "Yes, Mike's right." So that went down to the ground as well.

So they said, "Okay," and they then took that information and fired the engines in a blind mode to stop the spin. And it worked. They said, "Did it work?" I then looked out the window again, looked to the stars, and said, "Yes, it worked." And so they said, "Good. Well, you know, we think you're going to have to spin the station with the Soyuz."

And then we went out of contact with the ground. At that point we then lost all power. So now Vasily and Sasha--no one's been trained how to spin the station. At this point I then had some definite ideas. Because I was puffed up that they'd accepted my measurement on the rotation rate and they basically bought that, I thought, "Well, now is the time to tell these guys how I think they can spin the station." I am a physicist and I understand rotation dynamics of irregular bodies like the Mir. I said, "You know we need to use the Soyuz to fire the engines in a translation mode, not in a rotation mode," which is what I think--see, Vasily was thinking to use the Soyuz like an airplane. If he turns the Soyuz this way, he's going to turn the station. I said, "No, that's not the way you want to do this, Vasily. You need to approach it where you actually fly the Soyuz to the left or to the right, and then that effect has an effect on the station's rotation."

So we discussed this at some length. I was not totally sure of myself. I knew I could easily--what my biggest fear was, was that I would give them instructions that they, just in their desperation, would act on, but would use up fuel excessively out of the Soyuz, that we couldn't get out of the situation if we had to use the Soyuz. So the whole concern in my mind was, "They're starting to listen to you. There's a real danger here, because you may not know enough."

So I spent a lot of time, and we had a lot of time to talk. There was nothing to do. There was no sound. There were no fans. At that point we were very afraid the carbon dioxide building up around us would poison us, so we were keen to be with each other, keep waving paper like this, to keep the air moving around us, to keep the CO2 from puddling around us. It was in that time frame that we discussed how to reorient the station initially with the Soyuz and then put a spin on it.

At that time after the collision, I had no clue, really, about the moments of inertia at the station, and that specifically is those properties that determine how the station either spins like that or like that or like that. And those moments of inertia are all different for this piece of paper. For the Mir, if you look at the model of it, they're actually fairly close. They are different, and that's important, but I didn't know which axis would be different from which. That's not something anyone in the cosmo corps is taught. They just don't know it. In fact, I'm not totally sure the ground knows it. They could sort of calculate it

and think about it, but based on where you've put payloads and food boxes in the Mir, it changes what I call these moments of inertia properties in the station.

What all this comes down to is how you approach rotating the station so that the solar arrays point towards the sun is very dependent on what you think those moments of inertia are and how you think the solar arrays are going to rotate to track the sun. So there was a lot of discussion, and I really didn't know. I said, "Well, Vasily, we've got to do something." And he said, "Okay." At this point Vasily was sort of in a just--if someone would give an order, he would carry it out. I knew there was danger here. And Sasha was in the same mode. He was telling Vasily what to do, even though Vasily was the commander. So Sasha and I would basically agree. If we agreed, I would tell Vasily, I'd say, "Look. It looks like we agree," and that was good enough for Vasily. So then he would go off and act on it. Because Sasha had the real knowledge about the Mir.

So we worked out a scheme whereby in the Soyuz Vasily would fire a thruster or a jet and try and see what effect it had on the station. It was horribly complicated because the Soyuz control axes were controlled by 45 degrees to the station axes, so we had a very, very confusing technical dialogue with Vasily as to what the orientation--and Sasha and I were both confused for at least an hour as to quite how the axes of the Soyuz lined up with the rest of the station. We had no clear picture. There was no picture in our flight files. The model wasn't correct.

As you fly through the base block into the Soyuz, the node, because of the hatches, you have to do a twist around the hatches, and that twist totally throws off your orientation. You can't just move in an orientation from the Soyuz to the base block and maintain what was in the Soyuz in the base block. So we had a running argument as to what that orientation difference was. We knew it was 45 degrees out; we didn't know which way.

So anyway, I said, "Okay, let's just try it." So I went to the window. It was dark. Vasily had already turned on the Soyuz, so that was possible. That's a subtle point that probably is going to go over your head. But it turns out you can't disconnect the Soyuz from the station power bus and turn the Soyuz on if you don't already have power on the station. And for whatever reason, I think Vasily had already disconnected the Soyuz from the station while we still had power on the station, so we were able to use the Soyuz.

There was a subsequent event many weeks later, when Sasha disconnected the cable packs, that put us in a huge power-down mode, and then when we wanted to use the Soyuz, we were already powered down, had no power, and we couldn't disconnect the Soyuz. We couldn't even turn the Soyuz on. Then we just had to wait until sunlight somehow entered the station arrays.

But we were in that case after the collision, so we basically had a lot--I actually kind of enjoyed this. Vasily would say, "Okay, do three seconds." I said, "You need to do three seconds, Vasily." He was so worried about wasting fuel, terribly worried about wasting fuel, that he wasted a little blip, it turned out, but he told me he'd done a full thing, a full three seconds. I said, "You've got to count how long you hold it over." Well, I looked out the window and nothing had happened. I said, "Vasily, did you do it for real?" He said, "No, no, I didn't. I just did a blip." I said, "Vasily, we can't do this. We can't measure this thing, the effect of what your impulse is, unless you do it for the time you say, and we've got to know how long you've done it for so that we can get rid of that motion if we need to. Because we don't know that this motion is what we want." So he says, "Okay."

So we go to do it longer, and then I slowly saw the stars moving out the window, because why would he yell? He was like fifty feet from me, through two passageways. So then I come back and say, "Hey, it looks like it moved. What did you do?" He says, "Well, I did this." Okay. I said, "We don't want to do that. We want to go the opposite direction. Can you take it out?" He said, "Okay." "Just go the opposite direction, hold it over there for three seconds." He says, "Okay." "This is why it's important you know what you did."

So I went back, and it turned out he didn't take it all out. I said, "You need to do that again." "Okay." So then he kind of got the idea, and Sasha was always following. I was always making sure that Sasha knew how this conversation was going, because I didn't want to be the American telling the commander how to do things when I really didn't have the training. He didn't have the training, either, but this wasn't my station. So Sasha was always basically buying off on what I was telling Vasily, so Vasily would have some confidence in what I was saying.

So then we agreed on a specific thing to do to get the station into orientation, to where I think the sun was going to appear. Now I had to think, "Well, where is the sun going to appear?" Because that was the direction you want to move the station to get the solar arrays pointing. So we then went and found where there was some twilight coming on the dark side, but the sun was about to rise, and you could see the Earth lightning just on the horizon. I said, "Looks like we need to get the station over there."

So we started a motion to get the station over there, and within about fifteen minutes, lo and behold, the station was basically with solar arrays in that direction. So I said, "Okay, Vasily, do the opposite. Do the opposite," and he would do it, and it looked like it sort of stopped.

So then as the sun rose, and, yes, it truly was in the right direction for the solar arrays to track, I said, "Okay, now we're going to do the spin." And we agreed on what axis to spin. I had no--I just chose the axis. There's one axis the Soyuz can't control because it hasn't got what we call a roll [unclear]. And

there was nothing we could do about that, so there was one axis of the station that we couldn't control. It would have been the best axis, actually, but it turns out that's the stable axis and that's the best axis to spin about. The Soyuz can't do it. It's on that axis. And I knew that just from the geometry; we all did.

So I said, "Well, there's only one other axis we can use, and that's the vertical axis through the Command 2 and Spektr, so we're going to have to spin about that." So he says, "Okay, I'll do it." Every motion he's doing is not a pure left or right; it's an up or down, up and to the right, or down and to the left, or up and to the left, up and to the right, and down to the right. So he never does a pure movement. This is the problem. So he's not intuitive at all about what he's doing.

I said, "Okay, you need to do up and to the right." He does it, and sure enough, we started to spin. It looked like the spin was holding there towards the sun. We went through the whole orbit just pleased as punch. We had some power on the station, talked to the ground. Vasily says, "Mike and I worked out how to spin the station, and we're in a spin and we're charging."

And the guys on the ground said, "What's your charge rate?" And instantaneously we looked at it and it was charging pretty well, the batteries. They said, "Great." In the ground's mind, they thought we had solved the problem. That was it. They don't have to ever sweat this one again. And this was the biggest misconception, I think, between us and the ground, through my whole time on Mir, was that they have always felt that rotating, spinning the Mir, because we did it that first time pretty well, it was something we could always do easily. And I was never sure we could do it easy.

Sure enough, after two orbits, Sasha says, "You know, we're not charging at all well on the sunlight side." We're always dead on the dark side. And it was as we were coming into the third orbit after the collision, it was apparent that we were rotating almost edge on to the sun, and so the sun was not pointing on the arrays at all in terms of the arrays being edge on to the sun. I said, "I don't know what's going on here, Sasha." We didn't put in any thrusting that I could think of at the time that would put us into this position.

Then Sasha was brilliant. I mean, he and I worked well together. We had a little periscope that shows where the sun is, and he started to just put a piece of paper on the periscope. This periscope used to be used for tracking the Earth [unclear]. (laughter) But anyway, he's using the periscope and the sun's in the periscope, and it's a full 180-degree half-hemisphere view. And he just pointed where the sun was every five minutes, and the sun was doing this kind of thing. I said, "You know what's going on, Sasha?" It was really good that he did this. "We're processing." And not only that, these loops were getting bigger and bigger. I said, "I know what's going on. We're spinning about the unstable axis. The axis we've chosen is the unstable axis, and we're going to flip." He said, "Well, how?" In space it's really easy to do this; you

just take an object that has irregular moments of inertia and spin it.

If this didn't have so much drag--there's a book, if you span it. I need that. Pass me that box there. This thing, if you spin it like this, it spins stabley. If you spin it like this, it spins stabley. But if you spin it like this, it's not going to spin; it's going to do a flip. It tumbled. See that? I didn't put that in. It does it naturally. And that was the axis we had been forced to spin about. It was the one we'd chosen. It turns out there is no other axis we can spin about using the Soyuz that generates power.

But at the time I wasn't totally--I was trying to remember my physics. "Is there another axis that we can use?" And none of this was really clear to me in those first hours. I just knew that we were in an undesirable situation. I said, "The good news, though, is that eventually we're going to end up upside down and spinning the way we set it up." It was like saying, "Trust me. It's going to be okay." I didn't know it was going to be okay. I didn't know if we were going to have enough power. But sure enough, after another three hours, we were basically upside down and spinning and charging again at about the rate that we set up.

Over that period of time we slowly got the base block systems back on line, the CO2 scrubbers especially, which was very important, and were able to let Vasily sleep. They actually had me sleep for six hours before the other two did. It was just too much. They had to be on watch.

Vasily was just too uptight about the whole event that he wanted to have me sleep at that point, and I, realizing that someone was going to have to be awake later on when they did fall asleep, went to sleep for about six hours. They woke me up and I felt pretty good, after a thirty-hour break, to wake up after six hours, so then I just said, "Vasily, go to bed." Sasha wouldn't go to bed. So I then stayed up. Sasha had been awake for forty-eight hours, and he was just totally dead, falling asleep next to me. So finally when Vasily had about six hours, four hours, he woke up again and I said, "Vasily, Sasha's got to go to bed," so he ordered Sasha to bed, and I stayed up with Vasily and kind of watched over Vasily. I was by far the freshest one in the kind of two-day recovery period.

Then after that, we basically hunkered down and had to deal with the station that had all powered removed from all modules except for the front two, and then had to start moving batteries from the dead modules to the base block, to charge up those dead modules' batteries, and then keep a supply of charged-up batteries ready to power the base block if we went down in power again.

In that time frame, also, the ground--we established basically full continuous power to the base block after about thirty hours, and after about forty-eight hours we had power on the toilet, I think, which was terribly important, because by that time we were just bursting.

Wright: Our time that we said we would spend with you is up, and we don't want to keep you from your

schedule.

Foale: What I'd like to do is go away and review what I said. I touched a number of different areas here today. The areas that you might focus me on in the future, knowing how these things go, would be basically the recovery period; the crew activities; science activities; the change in science activities between before and after the collision; the preparation and the brainstorming of the Russian ground control with us about how to put this hatch adapter into the Spektr air lock, Spektr hatchway so that they could get the power from the Spektr solar arrays to the rest of the station. That was a very interesting development. And then the training and preparation of the EVA suits to do the EVA into the Spektr by the Mir-23 crew.

You might talk about the unfortunate medical condition that Vasily developed, which then forced me into the role of one of the EVA crew members going into the Spektr. Then the unfortunate consequence of a very tired crew pulling a cable, one of hundreds, mistakenly so that we then went out of control again, and in a very deep part. That then forced the Russian ground control management to decide to totally postpone the repair effort to get power from Spektr module back to the station until the next crew arrived. I think they were starting to feel they were jinxed with the current crew, and the current crew was starting to feel it was jinxed, too.

It then led on to, after that, then it would be the arrival of the next crew, the change in mood of the crew as a result of that, and then the extraordinary amount of activity the Mir-24 crew had with me in the first month, basically doing initially a flyaround inspection of the damaged solar array, which I did myself from the Soyuz, flying around.

And then the IVA into the Spektr, the connection of the power to the--half of the power, anyway, from the solar arrays to the Spektr module to the rest of the station. My time in the Soyuz there while they were doing the IVA, because I was kind of cloistered away in the Soyuz. And then finally after that, preparation for this EVA I did with Anatoli [Y.] Solovyev, the Mir-24 commander, to do an inspection, an excavation, of the damaged site on the Spektr module, and then the conduct of that EVA.

Then after that we can talk about some of the computer problems we started having, with the continuous loss of attitude control and this repetitive sequence that I got to know very well about spinning the station. I had to convince Anatoli all over again, you know, get him confident I knew how to do it, confident that he would listen to me. That worked out quite good.

Wright: We look forward to speaking with you again.

Foale: Who have you talked to already?

Wright: We have tried to talk to all the chairs of the working groups.

Foale: What other astronauts?

Wright: You're our first one.

Foale: Oh, I'm the first one. I'm sorry, I keep assuming you've spoken to Jerry and Shannon. It's not like the media. See, if you're like the media, you've already spoken to these people.

Wright: Well, scheduling has been quite an adventure for us, and we are scheduled to speak with Shannon Lucid tomorrow.

Foale: Okay. Good. Good. Certainly use the framework of--another thing you should remember is that my flight represents a totally off-normal flight. I didn't really experience the routine of science on orbit for more than about five weeks, and after that, there was nothing standard about my flight. Totally unexpected, unplanned for.

Shannon had a very, I think, classic stay on board an orbiting station, and I think starting with Jerry, it all started to go to rot. Then David actually basically had a pretty much standard tour of duty. At least half of it was. I think Andy [Thomas] finally has had a pretty clean flight. I just spoke to him this morning, and he believes that his increment probably was, next to Shannon's, the most benign.

Wright: That's good. Enjoy your vacation.

Foale: Thank you.

[End of interview]