

The oral histories placed on this Website are from a few of the many people who worked together to meet the challenges of the Shuttle-Mir Program. The words that you will read are the transcripts from the audio-recorded, personal interviews conducted with each of these individuals.

In order to preserve the integrity of their audio record, these histories are presented with limited revisions and reflect the candid conversational style of the oral history format. Brackets or an ellipsis mark will indicate if the text has been annotated or edited to provide the reader a better understanding of the content.

Enjoy “hearing” these factual accountings from these people who were among those who were involved in the day-to-day activities of this historic partnership between the United States and Russia.

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JEFFREY A. CARDENAS (Session 1)

April 24, 1998

Interviewers: Rebecca Wright, Paul Rollins

Wright: I am speaking with Jeff Cardenas. Jeff, could you start by telling us what you're currently doing with the Shuttle-Mir project.

Cardenas: My current responsibilities are co-chairman of Working Group 6, which is the Mir Operations and Integration Working Group. That's an additional duty I just picked up. It had been Rick Nygren up until the last month or so. My job before that was within Working Group 6, I was the Operations and Training IPT [Integrated Product Team] leader.

Wright: When we visited yesterday or day before on the phone, you suggested we come visit with you so we could kind of map out how all the Ops teams worked. So we're going to let you take it from here and proceed however you want.

Cardenas: I don't know how much you know about Phase 1 from a in the Working Group stand point.

Wright: Why don't you just take us back. Pretend we don't know anything.

Cardenas: Okay.

Wright: Have you ever had to do this before [give an overview], lecture people who are curious about this [process]?

Cardenas: Yes.

Wright: Was that captured on anything?

Cardenas: Not recently. Usually what's happened is because we've had a lot of people from CB [Astronaut Office - Johnson Space Center], from the office, transfer in and out, and because sometimes we've had to interface with them a lot and be the continuity across the increments, I'd had to go through this several times with several crew members.

The Phase 1 Program, under Frank Culbertson, the organization within that, within that he's got the different Working Groups. Let me see if I remember these. Working Group 1 is PAO [Public Affairs Office]. Working Group 2 is Safety; this is Gary Johnson. Do you have the names of all the Working Group chairs?

Wright: Yes, we do have that list, unless there's been some recent change.

Cardenas: I don't believe so. This is Debbie Rahn at NASA Headquarters. Working Group 3, I think officially it's Bob Castle, but you've got people like Bob Castle, Bill Reeves, Phil Engelauf, and Paul Dye -- all within that flight directors. This is actually what's called Flight Ops and System Integration, so actually you've got Bob Castle and Greg Lange or George Sandars, and now it's Bobby Brown, I think, who does some of the Hardware Integration.

Working Group 4, which is Mission Science, is John Uri. Before that it had been Nitza Cintron; John Rummel before then; I think Carolyn Huntoon before that.

Working Group 5. Was it Crew Exchange and Training? That's Charlie Brown, Tommy Capps. I'm going to come to [Working Group] 6 last. Working Group 7, which is EVA Working Group, that's Richard Fullerton. I think he's always had it. Working Group 8, which is Med Ops, the Flight Surgeon is Roger Billica and Sam Poole.

Working Group 9, which is JICR, which is Joint Institutional Communications Requirements, and that was originally set up by Gary Coen. I don't think it actually had a Working Group number when they started it. But Gary Cohen, and now it's Dan Jacobs.

Then, last, Working Group 6, MOIWG, Mir Operations and Integration Working Group, and that was originally Rick Nygren, Charlie Stegemoeller - I don't know if you have that name or not. Charlie moved on. Rick's moved up. So that leaves me. The reason I was Ops and Training, the other fellow is Don Schmalholz, who does integration, hardware integration on that. There were some other fellows in here when we first started on some other things, but they've since moved on.

The way the Working Group 6 got started is when we originally did Mir 18, the Phase 1A stuff with Norm [Norman E.] Thagard, if you look at this, this would seem to cover everything, so you've got Working Group 3 and Working Group 4. Working Group 4 defined the science requirements for all of the Phase 1A, so both for the Mir aspect and the Shuttle aspect. Then when it came to implementation, these guys [Working Group 3] were only responsible for the implementation on the Shuttle. No one was responsible for implementation on the Mir. Leave that as it may, because I said, "Who's responsible for operations?"

They said, "Working Group 3."

I said, "Who's responsible for science?"

And they said, "Working Group 4."

I said, "Now, who's responsible for science operations?"

"Uh, no one."

So originally it was a part of Working Group 4, but because it became so big --these are the requirements -- and then you had another forum for implementation. That's where Working Group 6 came from. So this actually started late in the flow of development, so originally a lot of the stuff originally was assigned to work through some of the Working Group 4 stuff for the operations.

Within the MOIWG, it's kind of split up in an AIT [Analytical Integration Team] level with IPTs under it. This IPT is assigned mission management; that's a little bit of a misnomer. What this is, is more in the traditional Shuttle mission management role where you actually support payload complement on a Shuttle flight. So these guys don't really have a role during the long duration phases; it's only interfacing during the Shuttle aspects of it.

You have integration, which is basically the hardware development and processing, so pre-mission. You have operations, which is all the mission preparation activities, timelines, documentation, procedures, and then the real-time mission execution, all the post-flight assessments, things like that, reporting. And you have training.

Wright: IPT stands for?

Cardenas: Integrated Product Team. This is Analytical Integration Team, AIT. Those were the buzzwords at the time when this was set up.

Training was the last one. Originally this dealt with both flight crew, so training of the crew members, as well as the ground control and support personnel. What we did is move this over into here, because most of these people work for operations. So we moved that over there [Operations IPT].

Now, keep in mind when we did Mir 18 we did not have a lot of this in place, so this was really more going into Phase 1B, so ramping up to that. So you just put together little tiger teams to go off and do this. So it was kind of an evolution over that period.

In May of '95--let me see. I'm trying to remember. I started working this in late '93. Thagard's flight was '95, so Shannon went up in '96. Around springtime of '95 [actually '96], we decided to put these two together, so that's kind of how I inherited it. So it combined the two, so that's why I said operations and training lead on these two.

The integration guy was originally some other guy. I'll write the other names, too. His name is Don Schmalholz. The other guy is Dick Meyer. These are all integration guys. Gary Kitmacher. So those guys have filled in the role of integration. Mission management is Mike Hendrix and Karen Morrison. So that's how it flows.

This was the structure on the NASA side, and we have counterparts on the Lockheed-Martin side,

who's the prime contractor on that. So across the board for the most part you have Lockheed-Martin. I forget the full name now. I just say Lockheed-Martin Engineering & Science. I forget what the full name is.

We also had some Krug [contractor] support, because when we did Mir 18, Krug supported not only the development of a lot of the science, but also some of the early science training, so we kept them on to support some of the training aspects out at Star City in Moscow. So there was a small Krug content on that. It's also Lockheed-Martin, but it's a different component. This was from the old Martin Marietta supporting that, and this was the actual Lockheed-Martin, and now they're all Lockheed-Martin, [referring to Mission Management] but they're two different schedules, two different parts of the contract. So this is a different house. This is under Gloria Salinas. She's the project manager. And this one is Robert Moeller.

Wright: Robert Moeller did Mission Management?

Cardenas: He supports this wing, so Robert Moeller's the Lockheed guy on that, and all the rest of this is under Gloria Salinas.

The is the structure we did and we had it kind of broken down by functions, by functional areas. In addition, we weren't very deep on the civil servants, so because we do not have the traditional team leads, enough bodies to do team leads for each individual increment, we got some more resources from MOD [Mission Operations Directorate] in here, so for each increment, we established like an Ops Director, an Ops Leads. The title was Ops Lead, because "Flight Director" on that, they objected to us using that term. So we just call them Ops Leads.

For NASA 1, for the first one for Thagard, I was the Ops Lead for that, but for NASA 2 through 7 we've had--let's see: that's three from MOD, one transferred from YA into MOD, and then the other was a Marshall [Space Flight Center] person. So I can give you all those names if you need them.

Basically what we did is when we set up the structure, Lockheed came back and said, "Okay. We're going to create increment teams." We had counterparts on this, in these functional areas, but then they also created increment teams across that, experiment teams. That's what I'll lay out. So you have a little bit of a matrix on that.

So you have within Lockheed-Martin operations, training, integration, and then across the top you had each increment. Here's increment 2, 3, 4, 5, 6, and 7. So, for example, for each of these they would create a lead for each increment, and then under that you had people assigned from what was the Ops group, assigned to do that, so you would have an Ops for that increment, a training lead for that increment,

and you still had supervisors here. So what we did is, what we really wanted to do is actually create--let me back this up. What they did is actually created three teams on this, so what you did is end up repeating it. So the guy--to try to build on the experience, because you can't create five teams at the same time or six teams, rather, at the same time to do that, because we didn't have the budget or the resources. They did it and they just rotated them back around through.

So the guy who is working 3 is working 7. The team that did 4 left, so we had to use new teams for 5 and 6. I think that's how it came out. Two is actually--he did back to back on that, so he's probably got the most experience, and that's the one that we have right now. And that is basically the way the team staggered.

As the lead, he may not always be working with the same people, depending on who's available. People come and go through attrition. So you had these team leads in these areas to make sure all the schedules were met, to make sure all the hardware deliveries, all the training schedules, everything was made on that. Within that, he was assigned complements of teams within operations.

What we found in trying to structure it as far as the rotations within operations, we were trying to come up with two complete teams. When I say complete teams, it consists of an engineer, an operations support person, a data and communications engineer. This is like a payloads system engineer, what they call that. Data and communications, mission science representative. Also assigned to us was a biomedical engineer and a flight surgeon. Then you had remote PIs [Principal Investigators].

The things that we contracted Lockheed to provide were these four positions. If you notice, this mission science is the same as the mission science that we had from John Uri. And each one of these positions is three-deep. So you've got three of all of these. So what we wanted to do is come up with two complete teams, so you're talking about 24 people, and what they would do is, to give them time off, one group would work the odds, the other would work the evens, just to break them up randomly. But we weren't that deep to do that, to come up with two complete teams. The budget wouldn't support it, because we're under-budgeted.

So in some cases, for example, we had the same three engineers who work all the missions; same with the Ops support, same three. We work all three. Data and communications engineers, again we didn't have the budget to even provide the three, so we had two who worked all the time. We didn't even have the budget to send them over to Russia. Mission science--he didn't split them up by three. I think he's actually got five, but they work every mission, but within it they have leads for each one. So when you talk to John Uri, he can give you a breakdown on that.

In addition, we do have what's called discipline within the operations group. We have discipline leads, and they're responsible for doing the operations requirements documentation. In some cases these

guys are also operations support, but they do all the preliminary documentation to establish what the operational requirements are driving the timelines, driving the flight procedures, the execution plans, things like that. So there are five of these guys, and they, again, end up supporting every increment. They're based on the science discipline, so one for human life sciences, one for microgravity, one for ISS RME [International Space Station Risk Mitigation Experiments]. At one time there were more advanced technology experiments. Now they've been lumped in with microgravity. So you have another one for advanced technology.

Actually, there were seven originally. HLS [human life sciences], microgravity, fundamental biology, which is out of Ames [Research Center], advanced technology, ISS RME. You had Earth Ops. You had Space Science. Seven. Advanced technology has gone into microgravity now. This also includes Space Medicine.

Wright: What is the ISS RME?

Cardenas: ISS is International Space Station Risk Mitigation Experiments. It originally was a part of-- I'm not sure what it originally was part of, but now it's part of OZ, within Mike Suffradini's group, and Rod Lofton is the leader. What they were doing is taking experiments or concepts, proof of concepts of ideas on station, making them like an experiment, and then putting them on board to test certain concepts and things like that. But the problem is these weren't coming in as mission science experiments through the Working Group 4. These things go directly, kind of bypass some of the gates, so it's a little bit awkward trying to understand, keep track of this after it's already been scheduled on a timeline. Same thing with some of the space medicine plans.

But anyway, these guys end up working all the missions, so if you look at who is actually assigned to a mission or assigned to go to Russia, we try to look at the functions we had to provide the things that needed to be taken care of in Russia, and then this was the first pool that we went to. If for whatever reason these guys weren't available, then we went to the discipline to see who we could send. Then the next fallback was anyone from the increment team. Because these guys had done all the mission preparation, and once the mission started, these guys worked in the facility here in the States and these guys worked in the facility in Russia. So, in the States the facility is Payload Operations Support Area [POSA]. In Russia their acronym for MCC [Mission Control Center] is TsUP, so we'll use that term a lot so they can understand what we're talking about.

Then within that it's Mir Operations Support Team [MOST]. We use this acronym because before we started with Thagard's flight we spent about a year and a half talking to people who had flown with the

Russians, who had done business in this area, in operations and training, operations primarily, because that's what I was responsible for--how do you set up things with the Russians? How is their Control Center? Because we didn't want to come in with a Shuttle mind-frame, or even a Spacelab, to a degree. So we tried to play kind of dumb and just build on that, asking the same questions and looking at the same jobs that had to be done on Shuttle or on Spacelab, how do those migrate to a Mir environment? So we spent about a year and a half talking to the Europeans, we talked to the Austrians, to the Germans, to the French, to ESA [European Space Agency]. We didn't talk to any of the Japanese or, of course, Eastern Europeans at the time.

But basically, based on that, we tried to follow their structure for some of this stuff about having this support team over there, having flight surgeons, having the traditional CAPCOM [Capsule Communicator]. We had to provide the CAPCOM function out of there, because normally the Europeans were using the backup. What they do is in the Russian system you have a prime and a backup to train [flight crews]. So whoever wasn't chosen as the prime is the backup. He was actually the CAPCOM on the ground during the mission [in the European system]. American astronauts were not interested in doing that function. So Norm Thagard's backup we could not utilize as a CAPCOM.

In the European system they also use the flight surgeon, because they were with them through all the training, they were an integral part of this team. Our flight surgeons weren't interested in that function, so we had to use the Ops Lead, basically the NASA manager for this team over in Moscow. So he also had to serve as a CAPCOM. So there are limitations to how much we could copy from the Europeans, so the Russians got used to seeing the same structure on that, so they understood how we did business.

He is backed up, though. Originally we only had one person over there for NASA 2. For NASA 1 and for NASA 2, we went to actually two leads because of the sheer workload over there. He's got to work fifty, sixty hours a week, so we have a backup and they also serve as CAPCOM. Then also occasionally we do use the flight surgeon. The flight surgeon does talk to the crew member, but that's about medical issues, but he is available to provide that. So we've kind of been able to get over there. Then also any of these people in whom we have confidence, because actually what we found is they do like some variety in who you talk to. Provided the person on the ground knows what they're talking about, they do like variety, talking to different people about different things.

So that's kind of, in a nutshell, how this is split out. With regards to the training group over there, we actually had training coordinators both in the States and in Russia, and they had schedulers, documentation experts, a team of about seven or eight people here and a team of about two or three in Russia. Basically they were assigned long-term in Russia. As I mentioned, we had a training coordinator and kind of a scheduler in Russia, and then there was also support by a hardware engineer, but that was

half time.

Over here you had kind of the same thing--training coordinator, scheduler, again a hardware engineer. You had a documentation. You actually had a manager on this side. Actually, in some cases you actually had two schedulers, because you're preparing for two increments at a time. Sometimes you would have two coordinators, depending on what was going on on some of this stuff. From this pool is where this person would come from, so also they were pulling double duty in that case. So usually it was the scheduler on that. So some of the job kind of evolved.

So I guess based on our phone discussions, what you're looking for is this, or are you looking for all these names?

Wright: It's like a can of worms. I was looking for that, but then now you've spelled it all out.

Cardenas: The function of this [MOST] is to interface with the crew member and to interface with the Russians. The function of the team back in the States is overall management of the increment. So these guys have to make sure that the requirements are documented correctly and that the right products are put in place for these guys to go off and work. So these guys are only as good as the product that these guys turn out. So if he's given garbage, you know, he's go to call people in the middle of the night, and that's what we were trying to get away from. Take all that overhead off, because it's hard enough. The cultural and language problems with the Russians, as well as talking to the crew member, take all that overhead and let them work it back here, because these are the guys who did it pre-mission, pulling that together.

We try to encourage as much of a relationship between this lead per increment and the NASA operations lead, although a lot of times this guy [Increment Lead] actually was more knowledgeable than this guy [NASA Ops Lead], because this guy also had to support the training sessions and build a rapport with the crew member pre-mission. So just talking about odds and ends, whatever, so he didn't always know the background on something, what was going on during the integration flow. I mean, we're really stretched to the limit on this as far as bodies. I think we're about 30 or 40 percent under budget.

I asked one of the guys from MOD to do an independent assessment. If we're looking at all the functions--I didn't have these out--I said, "These are all the functions we've got to cover. How many people do you think it would take?" His estimate was about 30 or 40 percent higher than what we had.

Wright: How many people does this involve per mission?

Cardenas: Per mission?

Wright: You were talking about how they overlap and some continue on and some are on every mission.

Cardenas: Our operations staffing was around--I'm trying to remember if it was loaded or not. I think it was a little under thirty, so we had thirty people to do all this on the contractor's side. Then we had about two or three civil servants, myself. I kind of had a part-time deputy, but that didn't always work out. Under ten to do the training between Lockheed and Krug. So, overall, this whole thing was a little under fifty people.

On any one increment, then, you would have--now, this would go that once the mission was launched, he would just jump to the next mission. So he didn't have a role during the mission execution phase. So do you want to look at while the mission is running or preparing for the mission?

Wright: Let's do one, then the other.

Cardenas: Okay. Pre-mission, you'd have one, two, three, four. He'd have these guys assigned, but these guys were working double duty. So if you're just looking at heads, if you're trying to do a budget thing--

Wright: Do you want to help us out so we don't have to come back and ask you again? When you say "this" and point--

Cardenas: I'm sorry. Okay.

Wright: It won't get on the recorder.

Cardenas: Sure. From the increment team you would have four. You probably have about three heads out of the discipline lead that you could support. Maybe one or two out of here.

Wright: "Out of here" which means?

Cardenas: The operations team supporting it. So I imagine around ten or eleven. From an operations perspective, let me go back and double check. Let me actually bump that more to fifteen, because you wouldn't have what they called--they also had the term "payload systems engineers" out of the integration supporting the hardware development. So, pre-mission, you'd have about fifteen people. Once the mission got started, that would drop to around ten, doing the actual day-to-day mission operations. Now, if something comes up, you could pull in more resources, someone who was working something downstream. You could free up and double bookkeep. So that made it very interesting, looking at monthly charges, what they're charging against, stuff like that, because sometimes it was splitting hairs. Three hours he had

to do one thing, the rest of the day he was covering something else.

My personal feeling is, some of the plans to do station, a little bit overkill, where you've got six or seven teams, plus one in training, accounting for other stuff, but this is the other extreme, though.

Wright: You proved it could be done with less people.

Cardenas: Yeah. Now, keep in mind, some of the requirements we had, this was going on early, starting when we had the problems on Mir, we started adding. We've added some more bodies to that. So on top of that, what we've added to this, originally to do the timelining and the planning was supposed to be a function of this guy over here. Once he got over there, he had so much overhead, what we've added to this is called the timeline engineer, and there are three of those. So starting with NASA 5, we just did some testbedding, but for NASA 6 and 7, we added a timeline engineer. Normally what we did is within this group he had an Ops Lead. That Ops Lead was responsible for doing the timeline engineering. So for NASA 5, this Ops person went to Russia to start it off on, so they counted in that mix. So if you take that figure of ten, we'll bump it up one to eleven for the timeline engineer.

We also added what's called a Mir systems engineer, because of the problems they had on Mir, to follow the actual--that was not our original responsibility, to track what's going on in the Mir systems, because we were following the payload systems from the U.S. side. So they've added MOD people, Mir systems engineer. Those are three people. Again, that was starting with NASA 5, so that moves it up to twelve. So at any one time you're looking at twelve people on console or directly responsible for what happens that day.

Now, they rotate those between the rotations to Russia, nominally anywhere between four to six weeks. We've had to adjust that a little bit because of these charter flights now we're required to take. What we did is, the way we came up with that number is when we talked to the Europeans, they had a flight in late '94, which was about a thirty-day flight, and they found out that after thirty days, people on console, basically they hit a wall. So they just happened to stretch it to the limit. They just got lucky that that's how long the mission would last. So what we did is we took that and we really didn't know how much you could use them after that, so when we set up Mir 18, we said, "You guys can go over for a four-to five-week rotations and that includes a week of handover. Go over for that period. When you come back, take some time off and then go back in the flow, supporting the POSA [Payload Operations Support Area]."

So before they go over from the POSA to the TsUP and they're required to be in the POSA two weeks before they go over there, so they can get up to speed, have them directly responsible. So if you look

at it, you've got one engineer in Moscow, one engineer in the States, and one who's either just gotten back or preparing to go. So you can kind of spread it around. The problem is for this mission, if I've got a problem on something downstream that I've got to work on, on sorting out requirements or working procedures, then I get taxed if this guy's sick or he takes vacation. So we're really thin on that.

You've added these two positions [Systems Engineer and Timelining] in there. What that did is that freed up to do actually some of the intensive timelining, because it's a very manual process in the Russia system. Also the Mir Systems Engineer who can go talk to the Russia systems, for the vehicle systems for their water production, for their attitude and control, things like that.

The other interest is that a lot of these systems, they're using the same, like their Service Module and in their FGB, so we're interested in saving this system, because they're using the same system for station. So seeing how it works now.

So all the support, strictly speaking, goes through NASA 7, which ends with STS 91. Well, NASA 7, from a flight crew standpoint, ends with this, 91, when Andy Thomas comes back. However, we'll be doing some science activities on the Mir until the Russians come back. The actual Mir 25 crew comes back in August of '98. So there's a little over a two-month gap there. We'll be bringing back--I'm not sure what the responsibilities are with these, because this actually came through YA and MOD. I'm not sure. It would not make sense to have been following these systems all this time and then drop it, so I'm not sure how this will continue, but it won't be necessarily part of the Phase 1 Ops team. Timeline engineer will be pulled back. Mission science will be pulled back. Data and communications will be pulled back. Basically we'll just have an engineering and operations support personnel over there.

So starting after 91, we'll be going with two guys for the rest of the period. I think in this case one guy has volunteered actually to stay for the full two months, and the Ops support, I think, will be rotating them in and out. So, two, maybe three rotations on that.

Because this was kind of short-handed [Data and Communication Engineer], we had people there through NASA 2, I believe, and then basically after that, this was on call. We tried to get out of the computer business and actually have Marshall through the NISN support provide these, because they had actually guys in country and that was their primary job, because we'd have to stop and send parts and things like that, go through Customs. So it would be at least a two- to three-week delay if something were to break. So basically this is a job primarily in the POSA, supporting the servers and the data transfers back here.

If you want all these names, I can get them to you. Gloria Salinas is a good one to start, and she could probably point you in the right direction, because, as I mentioned, there are supervisors in each of these areas. There are leads across all this. The only one that's left the company is the Increment 4 team.

However, these people are still available. One actually works--I think you talked to Tony Sang.

Wright: Yes.

Cardenas: One works with Tony Sang and the other one, I think, works for Boeing.

Wright: Typically where were these people's areas of expertise? When you were pulling these people, were they aerospace? Clearly some of them are medical people. Are they aerospace engineers, scheduling-type people?

Cardenas: Not at my level. They did have some here who had configuration management expertise, especially at this level, who had budgets and schedules, who were very adapt at the software programs you can use to develop schedules and things like MS Project and things like that.

For the support on here, they were primarily engineers. There was some science background. Also the majority of these people had space lab experience. Some had even worked Spacelab and, kind of like myself, were starting to get involved with station. So they had a little bit of a knowledge that way, and that's one thing that we've also tried to do, is try to be a testbed for the Phase 2 concepts, although that's always been interesting, because they're not very mature yet in all these things. So we don't mind being a guinea pig for Phase 2, but come in with a system that you've already gone through a shakedown on, and we'll try to use it. Especially in a timeline, we try to use some of the planning tools that they're going to use for Phase 2. In approaching the Russians, "You guys are going to have to use this, or you've agreed to try to use something like this for the International Space Station. Why don't we try to work together and we can help you learn some of it and we'll testbed some of this stuff out."

So we try to do that for the planning systems, for the inventory management systems, for the procedures developments systems, and for the logistics and resupply stuff. And we've only had success with one of those. When I say "success," a system that was in some kind of shape that we could use it now. All the others, it was kind of fragmented or they're too new, it's too young, or there wasn't any interest. For whatever reason, it didn't work out.

So, like I said, for the most part, in some cases we did stub our toe because where we had to get some more people in, they didn't have the experience that we needed, so we did stub our toe on a couple of things, but we made sure at least there was someone there to try to mentor them. In some cases we had to kind of throw them into the fire on some stuff, but we did the best we could to make sure they got up to speed.

Wright: They had the potential to do the job, if not the experience.

Cardenas: Right. That's what we were looking for--potential--so that if they did stumble, at least there was someone there to help them up. We weren't going to send them to Russia for six months, like a single point [of failure] kind of thing.

Wright: This is knowledge and experience and an adventure, because everybody that has moved into this has had no prior expertise.

Cardenas: Yes. See, I had worked Mir 18, and the problem was when we did Mir 18, it was assigned to this no longer exists--the Life Science Projects Division, which is SE. So we did the implementation. SD, which is the Medical Sciences Division, because on Mir 18 a lot of stuff were medical investigations, human life science investigations, there was only one or two things that were outside the scope of that, but we lumped it in. So they defined the science and the requirements, and then we did the majority of implementation.

When you moved into Phase 1B, starting with Mir 21, you had SD only for HLS [Human Life Sciences] and SMP [Space Medicine Program], so you had a whole slew of other things. You had, like I mentioned, all these other investigations--non-human life sciences, microgravity, which SD had no experience in. I mean, they were only supporting requirements in this area. So you had all these other disciplines, and now we're being managed by Working Group 4, mission science, and the implementation now, all this structure comes out of the division I'm in right now, Payload Projects Office. To be honest, I'm not even sure if that's the name, because they changed it a couple of times.

There was very little continuity as far as heads between what we did for Phase 1A and what we did for Phase 1B. Originally this was supposed to be given--I was supposed to stay in SE. Then it didn't work out with the configuration they had at the time, so me and one or two other guys transferred over to SM and picked up that job. So all these people here, during this time frame they had worked STS 71, but from a pure Spacelab. They had nothing to do with the Mir aspects of it. So when we came over, they were expecting us basically to tell them how everything was done. I said, "We just did one flight. We can help you go on flight, but we've got to work together to try to lay all this out."

So our instructions were, we don't expect the contract support to know how to--it's not just a turnkey, "I write the task and you fill in all the spaces." It's like all of us have to work together on this. All the questions, all the stuff that they got done on the Shuttle and on the Spacelab flight, you know, if you did it this way in the NASA system, how would it manifest itself in the Russian system? Some cases, maybe it didn't apply. For example, all the communications things. You don't have that many with the crew member. Our responsibility early on is to track the systems there. We just hooked up to the interface.

So a lot of the stuff didn't match over, but at least ask the question. I said, "I don't expect you to know the answers, but at least be sharp enough to ask the question and then we'll work together and figure it out." Do we need a document to do this? Do we need to bring this up and close this with the Russians? Do we need to write a letter and say this doesn't apply? That kind of stuff.

That's how a lot of this stuff has evolved. A lot of the stuff during Mir 18 we didn't have to worry about, like I said, because it was a one-time deal. Our only responsibilities were to support the crew member on orbit and the science complement that was with them. That's the same way that the Europeans did, because the Europeans didn't do any of this, the Mir systems tracking. I mean, they were interested if a thermal loop broke, how was that going to affect the crew member, how was that going to affect one of their facility class hardware that was providing a coolant or something. So it was a learning process.

Wright: You've mentioned a couple of times that Thagard was a one-shot deal. Then it wasn't too long after that, you got brought in. Did that time period between the one-shot deal and Lucid going up, was it as busy as the board looks?

Cardenas: Yes, because what you did is, he went up in January. I'm trying to think. January, February of '95. He came back in June. In June of '95, because we use--again, it's kind of skewed because you had these Working Groups split up, and even within that, integration had its own schedule; operations had its own schedule, and training had its own schedule. If I needed to develop a procedure here, I may have needed it at this training session two months before. Or the hardware for this training session may not have been documented till two months later. So it was a real mess. They were being trained on stuff that maybe didn't even look at all like what was going to fly. So trying to pull these schedules together across this, because it's different Russians and the Russians don't talk. We've explained to them. They've said, "You want us to have this here, but this guy doesn't need it. I can't get it signed for another month."

This was a mess, and we probably erroneously mirrored the problems on the Russia side. Luckily we were all together so we could try to sort this out and hammer the issues out. But he came back in June of '95, was the first training session for this increment [NASA 2], and that's only six, seven months before she launched. Like I said, we didn't put these together until like late spring, until the middle of Thagard's flight. So I was back here, to be honest with you, to try to pull these things together to make these schedules match to support this increment. Plus not only this increment, but you had to work this one and this one, and start planning for this one. Because normally within a Shuttle time frame, you're given four years. In a Spacelab you're giving four years to develop hardware. You have to get funding and then four years later you launch. This thing is about fourteen months. So by the time I get approved, by the time I

get the money to go pay the engineers to develop a piece of hardware, it's like a year before launch. I can't develop flight hardware in five or six months. I can get it certified and ready to go through this process, ready to get trained and ready to document everything.

So it's really been, in some ways, like I said, a learning process, but this concept of Express payloads for station, you've got to be careful how complex you make them and how you sell that, that's going to solve everyone's problems, because it doesn't. It doesn't. Adding more people and more dollars doesn't, depending on where the bottleneck is. If the bottleneck's on the PI and PED side, all that means is there's more people breathing down his neck. You know what I mean? Because he's got to answer to these schedules and these schedules, these schedules, etc. So it's tight. Now, actually going into NASA 6, there was some breathing room because we only had two increments coming up. So last fall wasn't bad.

Wright: Has it continued to evolve for each one, or once you get a point--

Cardenas: You mean the workload?

Wright: The whole matrix, all of this.

Cardenas: It's settled down a little bit, but now the problem is, this is the end and people see it coming up. So do I wait till the end and then hope that I can transition to something Monday morning when I come in? Or if there's something out there, why not? Like when we lost these guys [NASA 4]? They were not assigned to any other flights because we already had the other teams in place. So they actually booked-- one booked in the middle of the mission, the other one booked the minute the things landed, so we're still struggling with that to get all the documentation to close that out. Because these guys have other assignments.

Wright: I received some of the briefing reports from the program. I saw the email stacks. I'm sure we don't have all the documentation for each of these folks.

Cardenas: There's a guy under Gloria, Jim Thompson, who does the archiving, and he can even print out a list of everything he's responsible to archive. I talked to Charlie, and he said, "Yeah, go and get the debrief reports." This is the only one that's come out so far. This should be coming out next week. I'm writing the executive summaries on them, so these should be coming out also shortly. Then you've got mission reports. This is coming out. We just signed that. So they're starting to come out.

We have records from NASA 2, but maybe over the summer we'll go back and make it consistent with this, the same look and feel. But also another thing is, people are big on these lessons learned and

having debriefs. Well, by the time you debrief this, you might already be into the end of NASA 3. So anything I learned from Increment 2 I cannot always directly apply. If it's something in the Control Center that I learned that I don't do that again, I fix it right away. I take an action. I close it that day. So next time I get the report in, I don't do it the same way, or whatever it was. I have to fix it right away because if I wait till debrief, till everybody sits down and agrees how to do it, I'm already out of this increment and I'm starting this one up. Realistically, I can't put it down in black and white from a mission preparation phase till this one.

We try to tell PIs that, "If you did an experiment here, plan on your lessons from there, or your analysis that you're going to be able to do that. Skip an increment or maybe two so you can get on the ground and assess it and analyze it, and then start up again." Because even one increment in the middle makes it tight. You've got to have a really good staff in there. What's complicated is the communications with the Mir, because you don't get the data instantaneously. There may be a delay of several days. So I have a plan, but it's based on what I thought I was going to get back down. I have to give myself enough time period to do that. We do work that.

For example, when you come in with a replanning request to schedule change when you want something scheduled, you've got to give us at least a week's notice, because we've got to work it within the Russia system and the way they do their planning and scheduling for their timelines. Granted, that's maybe not directly applicable to the station, but there is sloppiness in the Russia systems and they expect it, because they don't try to schedule down to the five-minute mark.

Cardenas: On station, there's probably some middle ground that we have to shoot for, because otherwise you're going to burn people out. I mean, no matter how much they love the space business--

Wright: Your body can only take so much.

Cardenas: Yeah. And, to be honest with you, I tried to dig around and find, before we started this, from Sky Lab, how we did things and stuff like that, and it's out there, but no one really analyzed it. They just kind of documented what happened. No one really analyzed it and said for long-term flights.

The Russians, the schedule these guys work over there is they'll alternate people on different schedules depending on what's going on. The Ops Lead and the backup will usually work like one week. They'll either work a Saturday or a Sunday, and then the normal work week, they'll work all mornings, eight to five, because the first COM [Communications] pass--and these are Russian times--so you work 8 a.m. to 5 p.m., or you come in the afternoons and you work like 2 p.m. to 10 p.m. So there's always someone there when the crew's awake. There's always an American presence when the crew's awake. We

won't go to that after this period [through NASA 7]; we'll just be there during the normal eight-to-five hours over there, because that's when the main management is on the Russian side. So eight to five, then roughly two to ten for these positions.

For these positions over here, normally what we've done is we go to what's called an ABBA, which the lead for NASA 2 came up with. What you do, you come in eight to five on that day, and that would be your A shift. The next day you go to B. So then I go home and then I don't have to come in till two to ten. But then I'm there two to then, but then I have to come in the next morning again. What that does is, he found that allows them to give them some overlap and some free time and also some time off, so it's a little different schedule. So he ends up working like a morning, then he works an evening and a morning, and that makes it rough because you get off at ten and you have to be back in at eight, but that's just for one day. They try to play with different options, and it depends on what the workload is, different people. If you're not a morning person, that kind of thing. But we try to formalize that a little bit so we don't have a lot of deviation.

To be honest with you, one of the other problems we had is that this whole Working Group 6 function was mandated to Space and Life Sciences [Directorate], so it was our responsibility to make this work. When we didn't have enough civil servants to do some of these jobs that we had, like operations lead, we went out and we asked for support in doing this, because we didn't have not only the right people, but not enough of the right people to get this job done.

We had a hard time getting people interested in coming over and going to Moscow for six months. I think part of the incentive to come do this was because it would be good preparation for Phase 2 or it would look good within station. They didn't come just for love of Phase 1 or for love of space and life sciences.

So people outside the directorate, my impression is, came in with different agendas, and in some cases that caused a little bit of problems because different ways of doing business. For example, we would establish policies. You'd have one lead doing things one way, another lead doing things a different way. You won't get that in a short-duration flight, but you will get that after three or four weeks, things come out. So we've tried to be adaptable, to be flexible, and we've said, "Nothing is cast in concrete. If you've got a better way of doing business, we'll do it." But we don't like to change just to change.

Wright: Isn't that part of people's management style in general?

Cardenas: Yeah, and we try to be very careful about that.

Wright: But there are rules.

Cardenas: Yeah. Management style is one thing, but here's the process, here's the policy that we do things, and we try to stick to that, because the ones to suffer is these guys [contractors], because this guy will say, "On this flight I did it this way. On this I did it that way." So these are the guys having to adjust to the different management styles, and not the other way around. You've got to learn to work with different people on that. And the fact that it's NASA sometimes was awkward. Because you could challenge these, but you couldn't challenge that, because of that.

Wright: That's quite an accomplishment, considering you didn't have a whole lot of information when you stepped into this.

Cardenas: Yeah. You know, the way it got started like in late '93, when we were doing just the Mir 18, I was asking one of the guys who was setting it up, "Who's going to take care of this? What about this? What about that? Who's going to set up the things in the Control Center? What about the training flows? Who's going to monitor from this side? What do we do with the data products?"

He said, "That's a good question. Why don't you look into that."

What I was afraid was, because it was so tied to STS 71, they were going to come to us at the last minute. So the STS 71 was June of '95. I was afraid they were going to come back at the last minute and say, "Oh, by the way, can you add this on to your stuff?" And we would have already been down the road and we already had Shuttle documentation, which it didn't really fit into because that was only during the Docked phase. So I was afraid we were going to end up inheriting it anyway, so I'd rather at least know about it up front so I could at least plan for it. Over in this, it was just me and another guy working these issues over there, and he was tied up in the Shuttle flights and the Spacelab flights.

Wright: So what were you doing before you got this task?

Cardenas: Before I opened my mouth on the Russia stuff, I was working the Shuttle, like Spacelabs, space and life sciences, IML, a lot of the Spacelabs, because I was in SE, so any mission that had a life science complement on, we were supporting. It wasn't only some of the Spacelabs; there were some standalone Shuttle flights, and then also I was working station. So half and half. So when this came along, you know, I didn't get any help; I just had to like absorb the other. So I was split between the three. As I mentioned, there was another guy I worked with, actually for, so he was a prime on the Spacelab flights. So when this came up, he was shoving off towards me, anyway. But I had to drop a lot of the station stuff. So since this has come up, it's taken all my time. I haven't worked anything Spacelab or any of the ISS stuff.

Wright: Will you go to station now?

Cardenas: I don't know. I don't know. I have not seen any transition plan for anyone. Right now a lot of these functions are being done by OZ within station, which is Mike Suffradini. They do have, I think, a few of our contractors over there supporting them, either through SAIC or USA or Boeing, but there's no civil servants who have Phase 1 experience.

Wright: From what you were describing, it seems to be somewhat totally out of character of how NASA's done business in the past. Did these forty to fifty folks adjust well to that? It sounds like the magic word to work on was "teamship" and be flexible.

Cardenas: Yes. I think so. But because they came from a payload background. From payload background, everything is different. I mean, there are things you have to do, a process you have to go through, but every payload is different. There are some similarities in terms of the design on some of the things, and they have to meet the interfaces, but every payload is different and every Spacelab is different from the last one in the way the thing is put together, which is not always the case on the Shuttle side. Basically it's the same basic Shuttle. There are some mods and differences between each Shuttle, but basically the thing is going to operate the same way, every Shuttle flight. So these guys have been pretty flexible. The MOD support between here and here hasn't always been, because they're in the mind-set of cookie cutter. Originally some of the training concepts that we had were based on Shuttle experience, Shuttle systems training, not payload training. So we really screwed up on that one, I think, when we started down that path.

We tried to take a cookbook approach to doing the training rather than saying, "Look. We're already in a jam because we've only got ten, twelve months to prepare a training template. Let's hit what we think we can hit, the high points. What are the critical skills we need to establish?" Because it's a different mind-set when you're preparing someone for two weeks, you just do it, do it, do it almost to the last minute, and then he can almost do it in his sleep in some cases. But where he's going to forget that after a month, when the payload has been scheduled a month into his flight, what is he going to remember? What key points do I have to give him to try to help him remember here? And then what on-orbit tools also is he going to need to go forward with that?

That's what I'm saying; I think they're flexible because of that, you know. Some of the people came in and said, "On Shuttle flights, on Spacelab flights, we had this." And that's a good question. "What will we have on this flight?"

"Well, you'll need that and this is the document." Or, "That's a good idea. Let's create that document. Let's go off and do that. We think that's got some use either on orbit or for the ground team."

[End of Interview]

JEFF CARDENAS (Session 2)

May 21, 1998

Interviewers: Rebecca Wright, Carol Butler, Mark Davison

Wright: Today is May 21 [1998]. Today's interview for the Shuttle-Mir Oral History Project is with Jeff Cardenas, who is co-chair of Working Group 6 and previously served as the Operations and Training Integrated Product Team [IPT] leader. Interviewers are Rebecca Wright, Mark Davison, and Carol Butler.

Thanks again for spending time with us. We would like for you to start by explaining your role with the Shuttle-Mir Project.

Cardenas: As you mentioned, initially I started off as the Operations and Training IPT lead, and basically for all the mission preparation and execution aspects of implementing the NASA-Mir Research Program. Since that time, though, for about the last six months, I've also been the co-chair, in the sense that we have a Russian counterpart, so the co-chair for the MOIWG, which is the Mir Operations Integration Working Group, and that's been roughly since January of this year.

Wright: What was your previous role, and what helped you prepare to take on the role you have now?

Cardenas: Having done the operations and training aspects of it roughly the last six to nine months of this program, I've been involved primarily in the training and operations aspects itself, so it was a natural fit to take over the other duties, the other duties within our working group that I had not been doing before such as hardware processing and preparation, but that was very low level, and the contractor's in a good position to pick up that job and basically we provide some direction and oversight on the NASA side.

Prior to this program, I had been involved in some Space Station and some Spacelab efforts, which we believe gave us a good foundation to start off going into Phase One.

Wright: What was your first real job in the Shuttle-Mir Program?

Cardenas: The first job I had was kind of, I guess you would call it, for Mir-18, which was Dr. [Norman] Thagard's flight. Didn't really have a title. It was kind of like an operations point of contact, just with regards to preparing the timelines and procedures and ground support teams to support Dr. Thagard in Moscow. Then once the mission got started, it kind of evolved into a NASA operations lead over there. So I did about two or three tours over in Moscow during Mir-18.

Wright: Was it a natural flow for you, or was there lots of changes and challenges from your previous role in taking on this--

Cardenas: It was a natural progression. It was an evolution in the sense of what I had been doing before, because prior to that time on the Space Station programs, I was kind of an operations point of contact for those efforts. So it was a natural fit. It was a challenge in the sense of this was something we, NASA, had not done before in long-duration flights and working with the Russians, in particular. So it was a challenge in a good sense.

Wright: Could you give us some examples of some of the challenges that you had to meet?

Cardenas: We never planned on sending people to support the space flight from a ground support role for more than a couple of weeks at a time. It was always usually either at JSC or another NASA center, Marshall, usually, in particular. So we never had to send people long-term to various locations. We never had to give them all the tools and processes that they would need to work over there. Russia is basically, especially at that time, a Third World country. So it was somewhat of an eye-opening experience, trying to pick the right people for the right job and get all that stuff in place, especially with regards to the crew, getting the crew members prepared, trying to figure out what they would need two or three months down the line to do their job.

Actually, in some cases it was easier working with the Russians than with, say, the mind-set that NASA had at that time about the traditional way of doing Shuttle flights and the way Phase One was looked at early on.

Wright: Could you explain a little bit more about that?

Cardenas: I think my perception is that early on it was looked at as somewhat just a flash-in-the-pan kind of one-shot kind of deal, that Mir-18 wasn't really going to lead to anything, it was just a science research program that was off doing some common efforts with the Russians, and that was going to be the end of it. I don't think early on it was envisioned that it would grow to this and become part of the Phase One to Phase Two kinds of projects with regards to Station. So it did not get a lot of support, I think, from an operations perspective and a training perspective. We tried to put the same structure and discipline into the preparation for those flights, but that required support services and tools of processes from outside our directorate, and we weren't always getting those in a timely fashion. It wasn't given maybe the cognizance at the Center.

Wright: Do you feel like the Mir-18 went well, since all of the challenges were there and experiences that no one had had?

Cardenas: Relatively speaking, yes. Even going in, you knew you were buying into some risk, but you didn't really know downstream, because we had never had the experience of what the negative aspects would be necessarily. For example, if you didn't prepare for this or for that, you weren't really sure how it was going to hit you two months from now. You were kind of speculating, because you'd never been through this before. So I guess the thing is, when you buy into risk, make sure everyone buys into it and they understand what's there, that you're not just biting the bullet and agreeing to proceed on, that the team as a whole--and that would include the flight crews--understand what the shortcomings are going to be.

Wright: While you were the ops lead for Mir-18, I imagine your duties just kept getting added on every day. Could you give us some examples of the different areas that you had to cover or some of the questions that were asked to you, that you had to come up with the answers for?

Cardenas: Usually just a lot of things with regards to the long-duration space flight, how you were going to handle some of the products that are being returned, either on Soyuz or on the Shuttle, how those things were going to be handled. If someone should get sick or just through normal attrition, how were you going to replace people? There's a lot of the group interactions that you see. I'm sure that the Navy has studies on that, and Antarctic expeditions have run into this, of basically having a small team of people somewhat isolated for long periods of time. Luckily, we haven't seen much of that until lately--the negative aspects of the group dynamics. We haven't seen that till lately. I think what's complicated is that the more people that are over there that come from different organizations, different ways of doing business, and you throw them together in Moscow. After a certain time, their nerves get frayed and that kind of stuff. Plus, a lot of people, they've been working this three or four years. I think they're tired. They're just kind of wearing out. So it's those type of things, kinds of things you associate with people interacting with other people.

A lot of things have come up. There's always new challenges, things we can expect. A lot of times on the Russian side there's not a lot of coordination between their different houses, the group that's responsible for flight control, in comparison with the group that does integration of flight hardware, that kind of thing. So you will have coordinated things with one group and you've got to be sure the other group knows about it, because they won't always talk, because they are still so very much of a vertical hierarchy, very tied to compartments with the sense that they don't always do a lot of horizontal integration in talking with each other.

Wright: Could you walk us through a couple of yours days as ops lead over there?

Cardenas: Usually a typical example of a lead over there--and I'm sure you can get more details from the leads that have been there since me--usually first thing in the morning, try to get there before the first com pass with the crew. It's transportation from Moscow, because Korolev is about, depending on the traffic, thirty, forty-five minutes roughly northeast of Moscow. It's kind of out in the suburbs. That's where Energia is located at the Control Center. So you try to get there about an hour before the first com pass, go down and talk to the shift flight directors for that day, see what's happened overnight, any updates to any of the Mir systems, anything that's impacted negatively, the events for the day. Go over, kind of script what you're going to say, because roughly the pass--you've got a morning pass and an evening pass that are dedicated with the American crew members, so you have roughly about ten minutes on each pass. In some cases you may have to share that time with the surgeon if there's something that he needs to talk about. Kind of script, go over the day's events with the crew member, any uplink messages that he may have been sent overnight that he should be looking for. Basically you're just trying to give him a thumbnail sketch of what's coming up on the day for that first pass.

For the rest of the day, usually both following what the crew member is doing that day and also preparing for three or four days down the line. For example, if there are new messages that need to go out to tell him how actually to do this experiment, or if it's something associated with the Mir system, those have to be already in process, in work, has to be coordinated, of course, on the Russian side, both from a science and engineering standpoint. So it's shepherding a lot of these activities. There is a staff over there that's responsible for this, so it's basically making sure at the end of your shift that at the end of each day that everything is done, that the responsible party has completed the job. So depending on the shifts that you're working that day, usually you're out of there by five or six in the evening.

If you come in later on the days that you work the later shift, usually you will come in around two or three in the afternoon. You have a tag-up back with Houston around 5 p.m. These are Moscow times. Five p.m. Moscow time, which is roughly eight o'clock over here, and tag up around that time, basically talking about what's happened during the day and the things that are going on, because the majority of the people show up on the Houston side by eight o'clock, so you're filling them in as far as what's happened overnight. Then usually you're out of there, I imagine, by around eleven.

So basically you're trying to cover the day from beginning to end as far as being available to talk to the crew member. That's not only your duty as an ops leader, but also there's a backup. We instituted the backup position for NASA 3 because it's just too much of a workload to ask a single person to cover that much. Also, as I mentioned, you also have the flight surgeon's support as needed.

Wright: You mentioned you were there several times. Every time that you'd go, did you have something different to do? Or was what you did this time pretty much the same?

Cardenas: I first started going over in April of '94, so each time we went over we were preparing computers, understanding how their process works. Like I said, a normal day in the life of the things that would be required of us with the Russian side. So I was over there about three or four times in '94 setting these things up. We took a couple of trips to Europe to talk to European counterparts about how they did things, that kind of thing.

In '95, once he launched, I was going about every other month. Basically at that time it was basically to support the mission. Shortly after that time, we were told we were also going to take responsibility for what's called the Phase One-B aspects, so, NASA 2 through NASA 7. At that time it was only NASA 5 aspects. We were going over there starting to put the ground work in place just for the follow-on flights. So it was kind of a little bit of both. I would work actually from a flight support standpoint for three to four weeks, then I'd usually tack on a couple of weeks to finish the planning for the follow-on efforts.

Wright: What were your experiences like in Russia? Was that your first time to go, associated with this program?

Cardenas: Yes. Very good. I've enjoyed working with them very much. No real negative. It's a big world, you know, so just a lot of different people and different attitudes.

Wright: How long was your stay there each time? Would it vary?

Cardenas: It varied. The longest stay I ever had, I think, was about six or seven weeks.

Wright: Are you planning to go back soon?

Cardenas: I'm going the tenth of June, in about two or three weeks.

Wright: Is that part of the close-up?

Cardenas: Yes, we'll be closing some things down, also kind of doing a final push in preparation for the final few months of this flight with the cosmonauts, and then we're returning, I think, roughly mid-August.

Wright: We still have experiments?

Cardenas: Yes, about three or four experiments will be continuing on after the American crew member leaves on STS-91. They'll be docking, I think, around the eighth or ninth of June, so our plan is to get there shortly after that. Then we've got about two months. I won't be staying there two months, but the team will be in place about another two months there. A lot of the things we'll be turning over to the station guys, because they're also establishing a base over there, not in the same physical location, but in the same building. So a lot of our computers and some other things will be turned over to them either in June or in August.

Wright: What are your duties and roles as far as the science areas are concerned?

Cardenas: With regards to the science, the way it's structured within Phase One is you have basically one group, one organization responsible for managing the science requirements, and then it's our responsibility to actually go off and do feasibility assessments on the requirements and form those into some kind of implementation plan on each increment, and then also establish and process some systems across all increments so you have a way of doing business. As far as the science, strictly speaking, our responsibility lies on doing evaluations and feasibility assessments on that. Not everything that's agreed to that, yes, it's a definite requirement can be implemented, of course, so you decide, well, do you carry this thing below the line if there's an experiment of opportunity that comes up, that you can move it back over, move it above the line, rather? Or do you just roll this over to another increment, to another mission?

Wright: In the course of Phase One, was there one increment more challenging than the other regarding the science aspect?

Cardenas: The science itself, no. I would say it was the level of preparation of the payload, of the flight hardware and the associated science with it. It's not to put that in necessarily a negative light, but part of the concerns that we had with this program is because the funding has come so late for the PIs. They've had to try to do several things at the same time. A lot of times they don't actually come together [unclear] for launch, or even during the flight. They don't actually figure out how this thing would have worked, or you'll run into instances where they've never seen this before on the ground just because of the short development cycle. So the challenge or the interesting aspects of that is watching all this play together sometimes at the last minute and trying to sort that out, because strictly speaking, you set a target. You set a milestone. There's a reason for that, and if it misses the milestone, say, okay, we're going to allow one, but do you allow one experiment to do it, not two? Two, not three? Three, not four? Where do you draw the line? Because basically you're increasing the workload of what you've got to do. You've sorted this thing out and you've put

together a schedule based on what you think you can accomplish within a certain amount of time. If there are delays, you are constantly juggling against delays.

So, as I said, it's not a challenge in the sense of the science; it's a challenge in the sense of the payload that's associated, the limitation aspects of it. Overall, if you look at the increments, no two increments have been the same. We've never really had a nominal increment, if you want to call it that, because NASA 2 was extended for several weeks. That was Shannon's [Lucid] first flight. So we didn't really know what nominal was per se. A lot of the things we've learned from Thagard we fixed for Shannon, the negative aspects. So that was a step up. So we didn't really know how well they were going to work. So it was a try.

For NASA 3, with John Blaha, our ops lead resigned, plus we had a change in Russian crews, so that was awkward. For NASA 4, of course, they had the fire. For NASA 5, they had the collision. For NASA 6, they swapped crews on the American side. For NASA 7, again we swapped crews, so granted we had a few more months' preparation that we didn't for 6, but still there was some new aspects in it, some things that he had been involved in, that Dave Wolf had been involved in, rather, that Andy Thomas had not, just because he served as a backup.

Wright: At least you can say it's never been boring from one day to the next.

Cardenas: That's true. So we've probably gone down every avenue. We didn't have a lot of backup systems because of our budget. We couldn't have a lot of contingency plans in place, but the ones we did seem to have worked, and a lot of times we had to be very dynamic and very creative coming up with a solution. Rather than spending three or four months going off and analyzing them, we had to come up with an answer usually within weeks.

Wright: That had to be very challenging, to come up with a real-time system in real time, without any planning to do any--

Cardenas: Yes. Basically you want to make sure you've got the process in place to address the issue, even though you've never seen the issue before. At least you have the right people in place. You have the right processes to deal with the issue. In some cases we've been kind of fortunate because with regards to payloads, the success criteria is a little different than you would, say, a vehicle system. So there's a difference between mission criticality and mission success. So we're fortunate in that. But, of course, the budget reflected that you're only working payloads, not systems. So we've had to tack on some things later in the life of the program, like getting additional engineers to develop timelines and following the actual Mir vehicle subsystems.

Wright: Were you involved in preparing the crew for the experiments?

Cardenas: Not directly, but I oversaw it. I didn't directly sit down with the crew and explain how this experiment will operate.

Wright: It sounds like a lot of what you did was making sure everything was in place for other people to take care of.

Cardenas: Yes. Basically we had to manage and we had to make sure the process was in place, that this is the way we're going to do business and this is what people are accountable for and these are the records we're going to keep and this is how we're going to track it so we have some idea of metrics and we have some feedback mechanism to follow this stuff through, so we know what improvements need to be made and how to prepare for the debriefs with the crew members post flight.

Wright: When we talked last time, we talked about how everything was prepared for the missions and the increments. What happens when everything would come back? You've got one coming, you've got one going. Could you explain some of the processes that took place for the exchanges?

Cardenas: In finishing one increment, there are a lot of things we have to do: process the data products returning. Any hardware returning has to be inspected. If there are any problems identified in orbit, they have to be inspected from that standpoint, about closing out any problems or any fault analyses done. So that's just closing one increment. But in fact, you have to jump right into the next increment, so our ops team, for the most part, the guys who do the daily console-sitting, basically would just roll over to the next mission. The leads for those groups basically would follow the previous missions, so they would do all the close-up paperwork, the reports that had to be written, leading the debriefs with the crew members, building on those lessons learned, and then rolling into the increment going on right now. So it was very dynamic. It was very important that you had good working relationships across the different managers and different leads on that, to make sure things got done and things didn't fall through the crack. Inevitably they would, but at least try to keep those things sporadic and minor. It's when things start stacking up on top of each other that things get carried away.

Wright: I can see why you'd see yourself coming and going, trying to get the one that's up being maintained correctly and then the one that was just finished, trying to finish that work up, but you're planning for--

Cardenas: Right. When you're talking about roughly forty experiments per mission, it's hard to keep track of what's manifested on what. Was that last increment, this increment, or two downstream?

Wright: Working in a group just in the NASA environment, I'm sure lots of people have different philosophies. But then we were working, as you said, with different counterparts. Did those philosophies mesh well when you started working with the Russians, or did you have to exchange ideas so that you could find the processes that they accepted upon the Mir?

Cardenas: Between ourselves and the Russians?

Wright: Yes.

Cardenas: Usually we tried to come into the situation very open-minded, somewhat naive, maybe, in the sense that we were there to learn from their experiences. We were to ask them, because not a lot was documented. You couldn't go to something that explained why this was done this way or even how it worked necessarily. You had to go to talk to people in terms of why they did things the way they do. What other options have they looked at? Had they even thought about certain things? For the most part, they had thought about 70, 80 percent of things. A lot of it was just difference in culture, with the American culture, about the way of doing things. Just different outlooks, different technology problems. And then also just different approaches in process based on their engineering approach. So we try to go in there fairly open-minded. We try to be fairly receptive, where we thought we could make improvements. We didn't try to install something just because it was the NASA way or the American way of doing things.

We tried to look at the benefits of doing it that way and if it had some roots in the way agreements were being made for Phase Two. We tried not to get into the mind-set of, "Well, you guys are going to have to do it this way because this is the way you're going to have to do it five years from now in Phase Two." We tried to say, "The arrangements and the processes that we can agree to now, we can have a positive effect on Phase Two," and help them tweak their system to be more receptive. So, rather than imposing Phase Two on us, we try to say, "We're going to try to take the Phase One lesson, carry it over to Phase Two." Because the feeling was, within Phase One, especially on the NASA-Mir Program, that was relevant real-time experience, whereas a lot of the Phase Two concepts were based on either a Shuttle or a Spacelab mentality, which was basically two weeks. The advantage of Phase Two is that you had technology behind it in the sense that any shortcomings from the Russian experience that were based purely on technology, you could probably overcome in Phase Two. But you didn't want to get in the situation of saying, "We'll put more computers on and that will solve the problem."

Wright: Was there a resistance to all of the change, or did people want to do things for the Mir as you had done them before for the Shuttle? Did they see that there was going to be a difference?

Cardenas: On the Russian side?

Wright: And American side.

Cardenas: There wasn't much resistance on the American side. They were fairly open-minded, the group that we were then. I think overall within Phase One, there was a little bit of a challenge because you had some of the more traditional groups, like, say, mission operations or safety came to it from a very structured point of view based on NASA's approach, both regards to payloads and the things that we control, especially between our working group and John Uri's. I think they were fairly open-minded. There didn't seem to be much resistance. We were just looking at getting the job done in a way that we could build for the future. One other thing is, we didn't want to spend a lot of time putting something in place that was never going to be used again, a concept or approach. Of course, there are things like that as far as certain documentation that the Russians would require, and it would be foolhardy to try to get them to change into a station way of doing business when they weren't going to manage that anyway. But we basically tried to get as short as possible distance on getting some things done and giving stations something to build on.

Wright: Do you feel like Phase One was as successful as everyone wanted it to be when it first started?

Cardenas: Let me put it this way: the way Phase One ended, the scope and the objectives of Phase One roughly, say, in the last six months [unclear], is different than what it started out to be. So there's been some, I would say, change in direction, but some mission creep in what it was responsible to do, what it set out to do. I'm not saying that's necessarily something wrong.

Wright: Sure.

Cardenas: It's just you're measuring the success of which criteria.

Wright: Right.

Cardenas: I think given the original criteria we set for ourselves, yes, I think it was successful. Given what we've ended up with, I would say, yes, it's successful, given that those tasks were added on either after certain events or late in the flow. And they're not diametrically opposed necessarily, but there is some slant there.

Wright: It just grew and grew.

Cardenas: It just grew into something else. So you can try to go back and say [unclear] we're changing the scope and direction of this program.

Wright: The point that you were able to meet those expectations as they continued to grow is a success in itself, that the team was able to rise to the occasion over and over again to meet the changing scope.

Cardenas: Yes. You could probably say that. Even though some people griped about these additional tasks coming on and not necessarily additional bodies or budgets, I think there was this [unclear], "We'll just throw another couple of million on it and we'll take care of these other jobs." Well, that's fine, but you don't find these people just off the street. It took us a little while to prepare these people, to train them. We can't just grab somebody out of school, or we can't just grab somebody, extra bodies from the Shuttle side to do this job necessarily, because there's a learning curve.

Wright: I guess when you were mentioning about trying to find people to train, the jobs were so many, you weren't just training people for payload.

Cardenas: Right.

Wright: You were training for all these different areas, is that correct?

Cardenas: Yes, because a lot of our training up front, the training that the crew member went through was somewhat, from a payload standpoint, from our responsibilities, was Mir in terms of on the ground, in terms of what we did for the flight controllers. So a lot of them would actually go to some of the crew training sessions so they could observe the crew interactions, so they understood what the issue would be two or three months down the line. We had the same investigators when they would come to test their hardware, to train the crew. They'd also stay over extra days to train our people. Question-and-answers-type sessions also, and bring the hardware. We tried to pattern it very similar so they were all on the same page.

Wright: Looking back over the years that you've spent, is there a high point that you feel for yourself as well as for the program that you've contributed for?

Cardenas: I guess it depends how you establish priorities. I think from a professional aspect, as we mentioned briefly, it's being able to address and to meet certain challenges that have come up in a timely fashion and how you handle those things, and seeing the process work, if you will. I think from a personal aspect, I think it's more just working with people, and working with people of different cultures in that sense. So that's somewhat independent of the job at hand, necessarily; could have been anything. Could have been building a water-treatment plant somewhere or something like that. That would be more on a personal nature.

Wright: You were able to visit with the Europeans as well. Can you tell us about those experiences, going over there?

Cardenas: It was kind of interesting at first, because they take a little bit of a lower-key approach to all this. They have a smaller team working, so trying to actually corner them and get some time was a little bit difficult, because they were also very busy and their mission was kind of further along than ours. But once we sat down, they came in with the same approach. They came in somewhat with the Shuttle mind-set and a Spacelab mind-set in working with the Russians, so they wanted to use the same way they had done business with NASA, they were going to do that with the Russians. So we were able, I think, to avoid probably 30 to 40 percent of the early mistakes just by talking to them, things that we obviously knew weren't going to work or just even faux pas that you don't want to get into with the Russians.

They also suffered the kind of same thing, they were looked at as kind of a little side project by the European Space Agency, and there was no real relations between what they were doing and what the Russians in the efforts for the International Space Station. So they were kind of under the same constraints in some cases. But it was very enjoyable. We still stay in touch with those guys. I'm sure we'll run into them again on station in some of these projects. So it was very enjoyable working with them, some common lessons. We actually tried to get into some cooperative efforts on some of the things, but just the schedules and the budgets [unclear], because it would have been a new task, and they didn't have additional monies, we didn't have additional monies to go out and work it. We were just hoping our things would converge at certain times and we could get some synergy out of that. It was going to require more effort and we just didn't have the ability.

Wright: Was it just the ESA? Were there specific countries involved?

Cardenas: We worked with ESA out of Noordwijk, Holland because they had two missions with the Russians. We also had a couple of discussions with Germans, with DARA, out of Munich and also in Cologne. They had flown with the Russians prior to the Europeans and they also had one flight during the NASA-Mir Program. So we actually sent a guy to Munich for some of their debriefs. The French had two missions during ours, so we met with them in Toulouse, in southern France, and we talked about some common areas of interest with regards to science, with regards to operations and engineering. So we tried to also kind of be the glue between them. If we were doing one thing with ESA, we wanted to see if we could then the next step piggyback on with the French or the Germans, etc. So, again, that was going to take additional effort to shepherd that through, and we always had that ability.

Wright: When you say "piggyback," is that for payloads?

Cardenas: Just on some of the projects in general. There was some actual payloads that have both PIs, for example, hardwares being flown with the French and was staying over there. The investigator was still involved as part of NASA-Mir. So from an investigator standpoint, they seem much more closely aligned about things they wanted to do. From the actual implementation, because it was done through different space agencies, national space agencies, I shouldn't say--I wouldn't use the word "break down"; there was just not as much continuous coordination on that. I think in some cases--and this is somewhat of a subjective comment--if you show that you can get somebody else to do this job for you and you're just going to [unclear], that means, of course, less budget for you or less task for you. So it's probably in your best interest actually to overload your plate initially.

For example, one of the things we were looking at is on computers, laptop computers and on-board crew systems that support that, and timelines and how they better manage the crew to manage their time on orbit, because this concept was totally different than the work they do on station, so we thought if we could actually develop and improve it on Phase One, it would have some carryover on station. But the problem was, this was an additional task. You were going to need programmers and software developers on this. That was beyond our scope for what we had to do, was beyond the scope for ESA. ESA had a plan to launch a laptop and have this version. They were upgraded to one version next to us. We were going to learn from it, build on that. The next version was going to be given to the French. So each time you could do it incrementally and, from a ground standpoint, you could compare notes on what you learned and continue to improve the product.

The problem was, though, on the ESA side, they were very interested in doing that. The French side, not really too much. And on our side, the astronauts weren't interested at all. So it kind of petered out.

Wright: The communications that you personally had with the astronauts or, I guess, mostly Thagard, were there comments that came to you? Were they issues that you could handle? Were you mostly a person that went and found answers for them? Could you tell us about those?

Cardenas: It depends on the nature. If they were detailed questions about a payload operation or something like that, usually I would just have to take notes. It depends on the situation. In some cases I was kind of thrown into it as a stopgap to cover some stuff. So I'd say about 60, 70 percent of the questions I could answer, depending on what he had. That was both for Thagard and for Blaha, because we also had to go over there for Blaha for some time. Because I had a lot of things to cover, it was hard to get in-depth knowledge on any one particular area. So usually we had the team there. Most of the crew members actually prefer

talking to a different variety of people, so basically what we did is we would put different people on the [console as Cap] Com, some of the other engineers and science support people. They like the variety, talking to different people. We just want to make sure whoever is on there is knowledgeable and they can conduct themselves to be somewhat expedient in a ten-minute pass. Sometimes the crew members just wanted to chitchat about different things. It worked out.

Wright: I can certainly understand that. I can't imagine that, but I can understand that they'd like to hear different voices.

Cardenas: Right. And there's a ham radio capability on board the Mir, so they use that a lot from a diversionary standpoint.

Wright: Were you involved in making sure all that worked well?

Cardenas: No. Actually, that's being done out of the Medical Operations Group. I don't know if you've got something scheduled with those guys, but they can give you more detail about some of that. Al Holland is actually the guy who's doing that.

Wright: We'll ask him. What do you see now for yourself or for the Shuttle-Mir Program in your involvement? Will you spend the next three or four months helping to close things down?

Cardenas: Yes. As I mentioned, the real-time operations aspect is going on through August. Shortly after that we have some baseline data collection, which will be done on the cosmonauts in September out of Moscow, so we have some hardware that has to be out there to support that. Then it will be returned. So once that comes back here, we have to disposition that hardware, close some of the final reports out, some of the things. So, roughly by September-October, even though the rest of the Phase One is essentially over shortly after 91, ours will go roughly through September-October, closing some things out.

Wright: I'm sure you'll be busy up until the last very minute, if there is a last very minute.

Cardenas: That's true. That's true. I think it will come to a graceful halt, but I don't think it will be abrupt. I can see now the workload diminishing some. It's not to say problems don't keep up, but the things that would consume you day after day, eight, ten hours a day, are kind of dwindling away and now it's a little more--I'd consider it just clerical kind of stuff.

Wright: Are you adapting to the slower pace after all these years?

Cardenas: Yes and no, because I'm not used to not having to work fifty hours a week, so it's like--what do they say in Chicago? If the winds stop, people would fall down. I mean, that's kind of what you feel like, because we're not used to--a couple of guys who have left, they said, "I'm not used to sitting around and wondering where I'm going to go for lunch today." We're used to catching lunch when we can a lot of times, you know, from seven to six very easily.

Wright: It's a heck of a diet plan.

Cardenas: That's true. That's true. And also the responsibility. Because it's a small group, especially on the Civil Service side, I think we've been given a lot of responsibility and authority within a very small group. I don't think you'll find that in too many other projects. I know you won't find that in Station. So I think some of the people who have gone over there have been a little bit frustrated: "I'm used to doing all this and having this authority and getting all this stuff done, and I come over here and I'm responsible for this little box."

Wright: I guess flexibility is real important in Mir as well as real-time decision-making.

Cardenas: Yes. And very early on, I think anyone who couldn't do that we had to kind of leave behind.

Wright: That expression "hit the ground running" just hasn't stopped yet.

Cardenas: That's true. That's true.

Wright: At least now you're to a jog.

Cardenas: [Laughter] Yes. Yes, that's true.

Wright: Get up and go again. That's all that I have. I was going to ask Mark or Carol if they have anything that they'd like to ask you, if that's okay.

Cardenas: No problem.

Wright: Do you have some questions?

Davison: I wanted to ask you what you miss the most when you spent the time over in Russia and went back to the States. That's a question we've asked some of the different folks.

Cardenas: Nothing, really. Of course, family and friends and stuff like that, but you weren't able to talk to people. I think what was maybe the most frustrating is because you're in a new situation and you weren't

able--you were able to talk to other Americans and people you worked with, but you weren't able to just go out and strike up a conversation with someone on the street, because our language skills were lacking. So, that aspect. You look at it as, say, like a trip or a vacation or something, but you weren't able to fully take advantage of it because of the language. It's not like going to Canada; you can just talk to people. You could get around fairly easy in Moscow, but as far as meeting other people and things like that, sometimes it would take a while. Plus I think there was a little bit of hesitancy because of the situation over there, not being always safe in certain areas and certain restrictions. You didn't always feel maybe like you had that freedom in some cases. Some people did. Some people who had traveled extensively didn't have that problem. There were even some people who had been to Russia before, so they just kind of picked up where they left off. But I think that was it.

I think the biggest thing that helped me personally about not trying to get too homesick or something is basically going over there, especially for the longer trips, basically when you go over there, is you'll be coming home when the job is done, whether that's in two weeks or two months, because if you say, "Okay, I'm coming home on the twentieth," and the twentieth comes and goes, you know, it's almost like you go into depression, it seemed like.

I had had that experience once before. I had a job at the Cape, supposed to go down there for three or four days for a test. Well, it turned into three or four weeks because they kept having problems and it kept being delayed, delayed, delayed. That was really grueling, because you always think, "Okay, in two days I'm going home." You can't get into that, because it's really hard to snap out of it if you do that.

Wright: We always laugh, "The twentieth of what month?" Or somebody will say, "We'll have it for you in two weeks." We always want to ask them, "Two weeks from?"

Cardenas: Two weeks from when.

Wright: We've learned.

Cardenas: I think that was it. You just looked at it as an experience, as an experience. I think it would have been a little bit different if you'd gone for two years. I think maybe the guys who had been over there longer, the ops leads who had been there for four or five months, they probably had a little different perspective on that. Some of the people from the embassy go there for two years' time.

Wright: Did you have any problems adjusting because you were there for whatever point of time and then you came back? I'm sure you did hit the ground running right back when you got here. There wasn't any time for rest?

Cardenas: I think the only problem was more physical in a sense, because the climate there was dry, especially during the winter. Your skin starts flaking and stuff like that. Then if you come back here, especially in the fall, in October, if you go there in October, it's fairly cool, you come back here, it's still humid. So you come back and it's--

Wright: Kinda? [Laughter]

Cardenas: You're carrying coats and gloves and stuff like that, and you're gasping for breath when you get back here, it's so thick.

Wright: And it's not going to go away, that we know for sure.

Cardenas: Yes. That's what I told the guys, "Gee, you're missing all this wonderful weather here with the smoke and the haze and the heat."

Wright: "Welcome to the Gulf coast. We didn't know we'd have to add to the list."

Cardenas: I mean, [unclear] to go to Russia. In this case, you'd miss some horrible weather in the last month.

Wright: Yes, that's true. You have more?

Davison: I have a follow-on to that. I think you and Rebecca touched on it a little bit. Do you feel like you were a traveling salesman living out of a suitcase?

Cardenas: Sometimes, yes. Actually, you just unpack the dirty clothes, because especially in like '95, when I was going like every other month, when you're gone for five, six weeks at a time, you don't really unpack everything, so you've got everything there and you kind of figure out what works, what doesn't work, what shoes not to take, that kind of stuff. It's hard, because the first time you've been there, and when you haven't been there in a certain month, you don't really know what the weather's like and how it's changed. So you're not sure what do I need to bring. Especially in the wintertime with sweaters. You almost double just the volume of stuff you need to take, because you need to bring more undershirts and sweaters and things like that. But I think as it is now, although with all the trips I've been there in every month, I kind of know what to expect. The thing is, it's really expensive over there, so you don't want to buy anything over there, if you forgot like a sweater or something like that.

Wright: And at least when you're traveling here, if you forget your toothbrush, you can go find a local store and buy it.

Cardenas: Right.

Wright: But I guess there, that was a--

Cardenas: Well, when we first went, it was really hard, but now you can find a lot of what you'd call the luxury items. They're fairly convenient and they're reasonably priced. It's not outrageous.

Wright: So you've watched the country change as well as you've watched the program change.

Cardenas: Yes, and you kind of wonder, though, because you see the average person on the street, and for us it's not a big deal to buy average things off the shelves, because it's in line with our prices over here, but you wonder if the average person can afford these kinds of things. There's a lot of markets, there's a lot of stores. Someone can afford it. There's obviously a demand somewhere.

Wright: The people that you worked with in Russia, were they what you would consider the average people on the street?

Cardenas: I would say so, yes. They're not paid very well. They may be more receptive and open to us, but I have not seen any change in their economic status. If anything, it's the opposite. We've seen some people let go, for whatever reason, because the money isn't there in the government and so on.

No one we've worked with very, very closely, but they're not there anymore. So you kind of wonder what keeps them going, what's in it for them. Usually, though, it's the older guys, because, to them, having worked through all their early space programs, some of those guys, their first job out of school, out of technical school, in the industry was like the times that we were being born. So there's a large generation gap in that sense. I guess to them this is a natural closure, part of their career as it's winding down, working together on something like this.

Wright: Do you see a progression within the Russia folks that you've worked with, different ages, or are they very old and your age? Is there a long line of people?

Cardenas: There's a group. I think, roughly, the guys we work with are over forty-five, over fifty, and then there's a big gap. There's some younger ones. There's not really too many what you would call middle age, say thirty to forty-five. There's a few. There's some younger ones out of school, but most of them are older

and all the information is locked up in their heads. There's not a lot that's written down. So there's not this influx of fresh blood, if you will, in that sense.

Wright: Mark, do you have more?

Davison: I've got one more question. When we first went over there, they told us not to drink the water, bring bottled water, bring little snacks. I was just curious if your diet while you were over there kind of evolved from "Bring your own food" to enjoying Russian Georgian food, how that kind of transpired.

Cardenas: Early on, we ate a lot of meals in the hotel just because we didn't know what was around. Not to say that we wouldn't have gone out; we just didn't know what was around because it was a fairly small group. So as more stuff came around, we got more familiar and then we would go venture around. So it wasn't any shyness on my part away from the food; it was just not knowing what was available. But once you start walking around and you find a store you can buy some things, you can just eat in your room, eat breakfast rather than going out. The only thing is, the restaurants aren't, but in the hotel it's very expensive to eat, so breakfast is like twenty, twenty-five dollars. It's a buffet, but that's a lot of food. Then you just to take a nap or something.

So I haven't really shied away from anything from the beginning. As a matter of fact, the only bad experience I had was in the restaurant because there was some mayonnaise that was sitting out under a heat light for a long time. I pretty much ate anything. It's funny, because I've been with guys who are sitting there watching me eat this stuff. We'd go out to the canteen, where the Energia facilities are, and they're like, "You're going to die." It's okay. It's just a different way of making it. Now, some of the stuff, it's very high fat and it's like a diet. You would think from a couple of hundred years ago they're going to work in the field all day and they need those kind of nutrients. So I don't think the Russian diet is kept up with the lifestyle today, but so far as the food, though, I haven't minded too much. I'll eat pretty much of anything.

Wright: Sounds like you've had such a [unclear] experience. You have any regrets, what you wish you would have done at some point?

Cardenas: Well, in the sense that you always wish you had six months. It's like in school. "Gee, I wish I had started this paper a week earlier," or something like that. You always think, "If I had an extra two months, I could have done a better job on this," or, "I could have done that." All things considered, I think we did a decent job for what we had.

Wright: From what we've learned from all the people that we've talked to so far, and I'm sure we'll hear it confirmed again, is that it was a great group of people that worked together to get a lot done.

Cardenas: Yes, I think so. I think a lot of people kind of bit their tongue and pulled together to pull it off.

Wright: You should be very proud of what you've done.

Cardenas: You know, it needed to be done, so--

Wright: Mark, any more?

Davison: I've already said I only had one more question.

Cardenas: We'll splice that part out.

Davison: Were you ever able to go into a Russian apartment of the people you work with?

Cardenas: Yes, and that's one thing that really interested me early on, but you didn't know how to do it. You didn't know, because they're very status or image-conscious, because we wear nice clothes and their clothes sometimes are older and they can't afford new things. So you're very hesitant about just asking to see or just inviting yourself over, kind of thing. So I went to a couple. They were what we would call fairly spartan. Anything you've seen in movies or books, pretty much like that, the average Russian place. Bathrooms bordering on things we would be accustomed to seeing in a gas station, kind of thing. But one thing I found is they are very generous with what they have. They don't hold back. I think, from my understanding, it's a big commitment on their part to invite a Westerner to their apartment, especially an American, who they think is going to judge them or look down on them for what they have or don't have. But they basically share everything they have. I guess if you give them a gift, they think nothing of, in turn, giving that gift to someone else, because it's very important to them to share what they have, what little they have. So there were actually, I think, about three or four occasions.

One of the interpreters at the Control Center, who was instrumental in bringing us a lot together, because he was actually on staff. He worked for Tsnimash, which is the facility that runs the Control Center. His English was very good, so he also worked as an interpreter. He was, early on, one of our interpreters and he also supported [unclear]. I think Bill Reeves knows him. He was very good. He invited us over to his house several times for like a late lunch. Unfortunately, the last time he did that, I could not come because my manager was with me, so I could not sneak out to go to lunch. And the fellow died a month later. He had pancreatic cancer. But he was very giving, very warm.

Wright: One of the things about the language, we're so comfortable just talking back and forth. Did you ever feel awkward, having an interpreter there, that you had to wait and hear the answers? Our thought move so quickly sometimes.

Cardenas: Yes, especially when it's in a social situation, because you can't just idle chitchat or you try to make it very brief. So that's what I'm saying. That aspect would be very frustrating. I think it was more indicative of us not having a better command of Russian, which I think, all things considered, we should send people off for six months to go learn and then send them, but there was no time to do that.

Wright: No six months to do that.

Cardenas: No, and I took the initial class and I tried to take the next level, which is about a four- or five-week, and I think two or three hours a day for three or four days. I only got halfway through because I kept being pulled out and paged and this and that. It made it hard to finish. Yes, it makes you somewhat, I think-- I've seen how they live. To be honest, it's not they as opposed to us; it's probably the rest of the world as opposed to us. I mean, you look and you think if the majority of the world lives this way, or roughly the standard, we're the exceptions, yet are we the ideal? They're perfectly happy and content. They don't have all the material things. I lived in Germany a while and I saw that while in Germany, because from a material standpoint they're very well off, yet especially in the younger Germans--and I'm not trying to preach anything--but they're not overly a religious people, from what I could tell, because none of the neighbors I knew ever went to church or anything. But there seemed to be something lacking in them, whether it was religion or whether it was philosophy or something. There seemed to be something lacking, something more. I think in Germany the family is important also, but it doesn't have the same strength that it does in the Russian society and culture. So there's a balance there. I guess it's what you need.

Wright: Looking back, would you turn it down if someone offered this opportunity again?

Cardenas: No, no. No, not at all. Like I said, there's more things you would like to have a little more control over, more time or more money. I don't think there's any big goof-ups; I think a lot of them were like snowballs, things that got away from you. So, overall, I think we're happy.

Wright: That's great. You have one more?

Davison: Yes.

Wright: It's okay. [Laughter] I just didn't want to not have anything left. Is that it?

Davison: That's all.

Wright: Okay. Thank you so much.

Cardenas: Sure. Thank you.

[End of interview]