

The oral histories placed on this CD 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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**ANTHONY SANG**

**March 18, 1998**

Interviewers: Mark Davison, Rebecca Wright, Paul Rollins

*Davison:* Today's interview is between Tony Sang and Mark Davison. Today's date is March 18, 1998, and we're here at Space Center Houston in front of the U.S. and Russian exhibit. Today we're going to talk about Tony's job as the operations lead over in Russian when he was with NASA 4.

What background training prepared you to work on this project?

*Sang:* I started my career in Mission Operations Directorate where I spent my first six years in environmental control life support area. Then I started working in the Mir Extension Assessment Team under Dennis Webb with two other people. In 1996 I was chosen to be one of the ops leads for the long-duration missions for Phase One.

In that time frame, I kind of lived MOD's philosophy and how to get the job done, who to ask, and don't be afraid to say, "No, I don't know," and try to get the answer. I did get to sit OJT as the Russian Interface Operator during one of the Phase One joint mission, and that's probably what helped prepare me the most.

*Davison:* Tell us about the TsUP, which is the Russian Control Center similar to here at Houston's MCC. Tell us how the Shuttle-Mir operations, the relationship was there.

*Sang:* We had a team of six to eight people at time in the Control Center in Moscow, and I was the lead for the team during NASA 4. We had a payload system engineer. We also had a mission science representative and we had an ops support person who kind of did the day-to-day activities. We also had a flight surgeon. We also had a biomedical engineer who supported the flight surgeon. We had several interpreters. We had a PAO, a public affairs person. We also had a backup to me just in case something happened to me, then somebody could take over.

Our relationship to the Control Center team, we had our specific people that we talked to. I talked to mainly Victor Blagov, who was the deputy flight director, Mr. Soloviev's deputy. The flight surgeon had their person to talk to, or people, and mission science people also had certain people, and so forth.

Our relationship was pretty sometimes informal, nonformal, but we knew what we had to do as far as our jobs. We knew our day-to-day tasks, what each day we had to accomplish, the plan in order to execute the mission.

*Davison:* Who acted as the Cap Com? Who talked to the crew and what language did you use? How often did you talk to them?

*Sang:* Well, on contract we were given two ten-minute periods per day, but sometimes that worked, sometimes it didn't work. Sometimes we got more. During my flight, it was not very good communications link, so we had very poor com, in other words. Sometimes we would give up time to the Russians because they had system problems. So even though we were on paper given two ten-minute periods, sometimes we didn't get that. That was one of the frustrations about the whole job.

*Davison:* This differs quite a bit from what the Shuttle crews and the controllers are used to, but do you see that as harmful or is it good for upcoming training with the station where we don't have as good communications?

*Sang:* Well, I mean, we know in ISS that sometimes we're not going to have 100 percent com, plus we have a better system for communication. I think [unclear], we use that a lot more, rather than using the Russian ground station, even though in early stages of ISS we are relying on Russian ground station a lot more. But I think it's almost like a paradigm shift. We've got this little com and Shuttle has a lot of com and a lot of communication link. So people are starting to think we don't need that much com, they will let their crew make a lot more decisions on their own, and so forth.

*Davison:* I know that the way that they schedule the time periods for the station crew compared to how they schedule them for Shuttle crew is quite a bit different. I've read some crew reports and it seems like the crew kind of likes the Mir time lines as opposed to the Shuttle time lines. What was your opinion or what did you see when you were over there?

*Sang:* Well, I think the crew likes the fact that they are given a task and they can go off and do it. Sometimes they can go plan their day themselves. Given the number of tasks they need to accomplish per week, you say, "You need to do this, and here are your constraints for doing these activities. You need to do it within a week. Go do it," I can see where the crew's attitude is, "Yeah, let's not have a lot of communication," because it takes away from what they're doing. I mean, you get on a task and you get a certain rhythm, you don't want to get disturbed with a com pass. I understood that from the past crews we've had on the Mir.

*Davison:* What about video? How often did you get video downlink with the crew?

*Sang:* During my mission, it was very bad because we had problems with the transmitter on board. On subsequent flights, they brought up new transmitters. So we really didn't have video much to speak of on our flight. We did have some during ground sites, but that's ten minutes. So a ten-minute ground site for

video, you probably only get five minutes or so. It's not worth the trouble.

*Davison:* Did you get any kind of feeling that the crew was disturbed about not having the com that they were promised, at least the U.S. astronaut?

*Sang:* During our mission, I knew that Jerry had problems accepting the fact that we were not getting our allowed two ten-minute passes sometimes, and also they were not very good passes. He at one point in the mission decided not to do any more air-to-ground, and I supported him fully. I mean, I've heard he's got some bad rap on that, but I understood where he was coming from. We tried to use the electronic means for the packet system they have--

*Davison:* That's kind of like an e-mail system?

*Sang:* Yes, like an e-mail system.

*Davison:* Let's shift gears a little bit here and talk about what were the interactions with the science and payload community? How did they deal with the crew and what kind of feedback did you get on the experiments?

*Sang:* I guess when we were over in Russian during our wake periods, the United States is usually asleep. Before the flight, though, we sat down, or I sat down with all the principal investigators at one point or another, trying to get a feel for their experiment, to understand where they're heading. I have all the documentation available to me to read up on it, too. You have your points of contact list if you have questions, plus you have the mission science group under John Uri, who does a good job of gathering the information that we need in answering all your questions about the science. I guess as interactions, we talk to the payload community comfortably, because you're going to run into problems with your hardware on board.

*Davison:* If I heard you right, there was no or very little real-time updates, or if there was a problem, you'd be able to get real-time repairs.

*Sang:* Well, sometimes we have PIs [principal investigators] in Russia with us. One is the group from Canada that has the MIM, the Mir Isolation Mount, the microgravity experiments. We had them in Russia to support us real time because a lot of times we do need real-time input to a problem. If he gets this signature on a hardware, you can't wait eight hours till somebody wakes up to get the answer[unclear]. So sometimes you need people there, or you go ahead and wake them up. I mean, we were given the okay to

wake people up. The scientists have a vested interest in getting the answers to this.

*Davison:* So it was basically the payload community made the call whether they were going to support from Russia or support from the United States via some kind of phone?

*Sang:* Well, sometimes it's on the ops lead's shoulder to make that call, too. If he knows that, yeah, we've had problems on experiments in the past and it's good to have that person in Russia, where you can get real-time feedback, and occasionally I take a PIs, the MIM PIs, down to the floor with me to talk to Jerry.

*Davison:* That would certainly be real time.

*Sang:* You know, I guess me being a Cap Com was a new thing. I mean, usually in the Shuttle world you'll have an astronaut be a Cap Com. But that's different from the way we handle it, which I think good, because a lot of times [unclear] get Cap Coms. But the PIs or the Mir payload engineer has a better feel for what the experiment is.

*Davison:* How did the Russians and Americans view the inherent risks differ, like redundancy, what we saw as redundancy, what they saw as redundancy on different systems?

*Sang:* I don't think the Russians are that much different from us. Take your life-support systems. You have redundancy in oxygen generation. It went three layers, I guess. As you know, we had failures on a couple of the layers and all they had was gaseous oxygen and were getting to the last leg, but they prevailed and repairs were done, went back on line. They also believe that you need redundancy. They believe you need to add robustness to the systems. So it wasn't like in the U.S. side, we looked at our requirements and tried to design to that requirement, maybe go a little more than that, but they won't guarantee it will go a little more than that.

*Davison:* So is the factor of safety a little bit higher on the Russian side?

*Sang:* I think it's inherently higher because they put robustness in the system.

*Davison:* How did the Mir system engineer position come about?

*Sang:* I guess from NASA 4 on back, we had the ops lead chasing down the Mir systems, the core systems, the life support, motion control, the status for that, reporting back to the management here at JSC. But that took away a lot of time from the ops lead to do what he was really there to do, to do science. Yeah, he was supposed to look out for the well being of the crew, but all those jobs can pile up on a person.

I think I was the last one that did the combination of all those jobs, and my flight had the fire. When the fire happened, I concentrate on finding answers about the fire. I tried not to let the payload side slip too much, but it took a lot out of me. After that, I think the management decided, well, we need somebody dedicated to follow the Mir systems, the core systems. And that's how the Mir system engineer position came about.

*Davison:* Is this about the same time that MOD flight director started to get involved and started getting the station folks to interface with the Mir, or is it different?

*Sang:* I think the station folks had always had this concept to do flight following. They did that during NASA 3 and a little during NASA 2. That was good, because they put the MOD system people into contact of the flight controllers for the Mir, who happened to be, or will be, flight controllers for ISS. So that was a good move on MOD's part.

*Davison:* For the Mir systems engineer position, was that an extra one person for each flight?

*Sang:* An extra one person per flight, extra EP. We have essentially three people rotating in that now.

*Davison:* What difficulties were experienced in integrating the American and the Russian space programs?

*Sang:* Language. [Laughter]

*Davison:* That would certainly be a big one.

*Sang:* That's a big one. Language has always been a big part. We have good translators there, interpreters, translators, and that's probably the key for some of our success. These guys know how we operate now. We've had seven flights. That was good.

Other things I guess I experienced difficulty in, you know, coming from MOD background, I wanted to see details of everything. Maybe I don't need it, but I want to see details of everything.

*Davison:* You mean like drawings and technical specifications.

*Sang:* Drawings, schematics, operation parameters and everything. A lot of times Russians don't have that at their fingertips. They take maybe days or so to get that information. Sometimes they don't understand why we need that much detail. But when you have to explain things to management and management asks questions, you need to know the answers. You need to think ahead of what those questions may be. And we've got to know because we have a vested interest up there for our crew.

*Davison:* Was that more of a cultural difference because of the way the government was set up, or was it a management decision not to have that available at your fingertips?

*Sang:* I don't know. My first trip to Russia was for ISS, and a lot of the documentation did not exist. A lot of documentations that they showed me was of the Mir. They showed me a thermal schematic and it says "core module" on it instead of "service module." Or base block. So they're reusing some of their documentation.

*Davison:* Was it like computer-type printouts or was this hand-drawn?

*Sang:* These looked like hand-drawn schematics, but at Krunichev I stumbled upon the lab. I probably wasn't supposed to see that, but it had several workstations there, several rows of workstations. I could see there was like Auto CADD programs running on it with people drawing. So they're improving their system.

*Davison:* Good. How were these differences resolved, the language or the lack of documentation? How did you all work through those difficulties?

*Sang:* Like I say, we were persistent on trying to ask for information, and our language differences were not being a problem with good interpreters. So, you know, I think we wore them down a little.

*Davison:* Were you required to be present when the Soyuz or the Progress docked, no matter what time of night it was? Was that a necessary time you had to be there or felt you had to be there?

*Sang:* Yeah, I felt we had to be there, we had to have a presence in the Control Center.

*Davison:* I know it wasn't always the most opportune time, sometimes at two in the morning.

*Sang:* Whatever it takes. It depends on their schedule. I don't think there's a set time of day that they do docking. They can do docking in the middle of the night or early in the morning or middle of the day.

*Davison:* What was the Russian approach to operations training and engineering? How did that philosophy differ from NASA's philosophy? Whether it be management style or numbers of people, that sort of thing.

*Sang:* I knew that the control team, they get training, but I never saw that. I never saw them go through the integrated simulations. I never witnessed any of that.

*Davison:* I guess the crew training was out at Gagarin.

*Sang:* Yes, the crew training was out at GCTC.

*Davison:* But you never saw any controllers attending any type of classes like that?

*Sang:* No, the controllers were never out there. I never saw a controller out there. They did all their training in the Control Center somewhere.

*Davison:* So it was more on-the-job-type training from your peers?

*Sang:* I don't know. These guys have been doing it for a long time, and there's really nothing new for them. So it's like, "Well, I'm here to do a job that I've done for eleven years," eight years, whatever.

*Davison:* What about their operation? Were their shifts like twenty-four hours long or something like that?

*Sang:* Their shifts are twenty-four hours long, but if you didn't have any satellite passes, you've only got ten-minute or up to twenty-minute passes every hour, hour and a half, kind of thing.

*Davison:* But they had to actually physically be in that building for twenty-four hours?

*Sang:* They were in the building, yes. Sometimes they'll go back to their offices and they have couches there or cots or whatever there, take a nap or something, set an alarm to wake up.

*Davison:* You basically were working when the crew's awake, was your shift?

*Sang:* Yes.

*Davison:* What about some of the paperwork that you sent back to the U.S.? What were the functions of the MMT and the daily reports?

*Sang:* Every day we write statuses of the Mir system, status of what was accomplished by the crew, status of what wasn't accomplished, what problems we had, what science was accomplished, how much com time did we have with the crew, and so forth, and what's their next day's activity, for the U.S. astronaut, at least. And sometimes some cosmonaut activities, especially when it comes to system repairs.

The MMTs happened every Wednesday, and like all MMTs, this is a way for us to report to management a summary of what's happening.



*Davison:* This is Mission Management Team?

*Sang:* Mission Management Team. The Shuttle has the same thing. What was happening and also if we need some support from him or our lead, the Phase One manager, give him an action item.

*Davison:* What level of exposure did these reports go to?

*Sang:* These reports are mainly for internal NASA use. As I understand, they leak out somehow. I'm not sure how.

*Davison:* A PAO had their own report.

*Sang:* A PAO had their own summary report which we used to give them inputs or they usually take from our reports and create a summary.

*Davison:* Tell us about the fire on board and the situation surrounding how you got the word back to Houston and what all you had to go through.

*Sang:* I've actually talked to many people about this. I think I've got the story down to a "T" now. We left the Control Center around ten o'clock on a Sunday night, and the fire happened approximately 10:33, 35, around that time.

*Davison:* You probably hadn't even made it back to your hotel by then.

*Sang:* No, we hadn't. Well, we were close. In that time, I think during that time period we were right at the tail end of the Russian ground sites. I think we were at the last Russian ground site. So the rest of them were U.S. ground sites. I believe they were Wallops. Usually Wallops is there all the time, but only in listening mode. But the problem is, they don't have anybody that speaks Russian. So when we played back those recordings--they record them, also--we got to hear what the crew was saying.

*Davison:* A little excited, maybe?

*Sang:* They were--I mean, from what I know of Russian, it sounded like they were pretty excited, you know, but the problem is that with this the Wallops site, they weren't doing two-way communication. It was a [unclear] for some reason. Another thing that came out, we did a lot of improvements. NASA did a lot of improvements to Wallops and Dryden and White Sands as far as their power output capability, so that helped.

I didn't hear about the fire until the next morning. We got in approximately, I guess, nine o'clock, and I had a ground pass that was dedicated to me in a few minutes, like in ten, fifteen minutes. So as usual, I look at my notes and make sure there's anything I need to pass up to him, any questions, I need to pass up to Jerry. So I go down to the control room, the front room, and I looked around and I noticed there were a lot of people there, more than usual. A lot of them I recognized because I worked in the ECLSS group before and I met all the ECLSS players on the Russian side.

*Davison:* Life-support system.

*Sang:* Life-support system. They had their big boss there, whose name is Edwuardo Grigorev , who has since passed away. He recognized me, too, and a lot of the other Russian life-support guys recognized me. Mr. Soloviev, the lead flight director, come up to me, in his broken English saying, "We have a little problem." But right then, ground pass is about to start, so I put on my headset and I listen. I told him, "Well, if there was a problem," and evidently it was a life-support program, " then you can have the com." So I started listening and I recognized the word for "fire"--[Russian word]. Right then I went, "Oh, no."

So I called back upstairs on a phone that links up back to our room upstairs and talked to the interpreter. I asked them to confirm, "Did they say they had a fire on board?" Yes. So at that time I had to make a decision, and I didn't have a flight surgeon at that time. The flight surgeon was off getting his visa renewed, so he was out of country.

*Davison:* You were doing a dual role.

*Sang:* There was a flight surgeon in Star City, Terry Taddeo. Tom Marshburn was my flight surgeon. So I called Frank [Culbertson]. I got upstairs and I said, "I'll let the Russians go off and get their act together before they come see me." So I went to call Frank, to wake him up. It was probably two o'clock in the morning.

*Davison:* Frank Culbertson.

*Sang:* Frank Culbertson. And I told him the situation. I told him, "I don't know the details, but from our last ground pass, air to ground, sounds like everybody's okay." Because Jerry called down for a brief moment saying, "Everything's okay." He did pulmonary exams on everyone. Everybody checked out okay. We had six people on board this time. There was the next crew coming up and also they had the German astronaut there.

*Davison:* I forgot about that. That's right.

*Sang:* So we had six people on board. That was a houseful.

*Davison:* So two Soyuzes were up at the same time.

*Sang:* Two Soyuzes. One Soyuz was blocked from people escaping during the fire because--

*Davison:* Because of the fire?

*Sang:* Well, the way the "candles" were situated was in the Kvant , and you had to move it down to ignite it and let it burn, burn for a while. You had a fan that was blowing on the bottom, and the power switch was on the other side of the module where the crew couldn't really get to it because it was where the "flames" were spreading. I mean, the fan was still working during the fire.

*Davison:* So basically only half the crew could have evacuated or gotten burned in the process if it had gotten worse.

*Sang:* Yes. Or find a way to shield themselves. If it had gotten worse, yes. I mean, the solid-fuel oxygen generator burns pretty hot, 5000-degrees C, I think.

*Davison:* So what was the aftermath? What did they learn from it or how did the program change from that?

*Sang:* Well, you know, I talked to Soloviev for a while and he told me the lowdown of what happened. I told him, "Why wasn't I called the night before?" He said, "They made a terrible mistake, not calling you." I assume they had the same numbers. When I first got there, I told them, "I'm living in the same place that Bill Gerstenmaier lived in, so I would have the same phone numbers." And I thought Bill told me at one time that they know his phone. But they just didn't call me. I wasn't even on the list of the shift flight director's console for people to alert.

So what came after that, I wrote a letter. Well, first we got pagers, we got cell phones, which I didn't have before. Only the flight surgeon had a pager. So we got one for me and one for the flight surgeon, one each. I wrote a letter documenting where I lived, my local phone number, my PSCN phone number, and so forth. "This is the way you get in contact with me." We've used that letter ever since, too, just changed the name of who's there, and give it to the Russians.

Victor Blagov or Soloviev could have easily called Frank at home, because they have his number.

I mean, it was really late at night on a Sunday, so it was Sunday day in Houston.

*Davison:* Did it look like they had been in there all night?

*Sang:* Actually, I asked them that and he said that, "No, we didn't alert--" Well, the control team was there. They didn't bring in the specialists until the next morning. At least that's what I was told. I have no reason to doubt that. Because everything was safe after all.

*Davison:* After the crew got the fire out, were they able to sleep through the night, or was there too much smoke?

*Sang:* Well, according to Jerry, he said the smoke cleaned out pretty quick, a matter of hours, overnight, but they did have people standing watch all the time.

*Davison:* Sounds like the communication improved and maybe people started having to trust each other a little bit more.

*Sang:* Yes, I think that's really what came out of it. Make sure that they tell us things. We had failure upon failure on the Mir from the thermal lines leaking. It really started leaking bad on our flight, ethyleneglycol getting out in the atmosphere. And it took quite a bit out of me to sit down with the Russians and ask all these questions. I don't know if you've ever talked to the Russians and you sit there and try to think of a question that you know can be translated well into Russian without misinterpretation.

*Davison:* Yes, I've done that a couple of times when we were over there. You have to almost rephrase the question.

*Sang:* Yes. And if you get an answer that you don't think is the answer to my question, you ask it again in a different form, whatever. Try this one.

*Davison:* With respect to policy, what benefit do you think resulted from the Shuttle-Mir Program and what specific knowledge or experience from this program will benefit International Space Station Program?

*Sang:* I think ISS and Phase One, we work with Russians hand in hand. We learned how to work with them. In ISS, we're learning how to work with different countries, which is the biggest thing. I keep on thinking and I keep on hearing that we never can go into space alone anymore, and it's always got to be joint venture, because we couldn't afford it. That's the big thing, is how to work with each other, how to come to agreements. You've got to compromise. I don't think either side wants to compromise. They

know to get somewhere, you've got to compromise.

*Davison:* So I guess through a lot of negotiations with the Russians, there were quite a few compromises on both sides, then.

*Sang:* You have to.

*Davison:* How about operationally? How did the operational experience from the Shuttle-Mir Program benefit the station?

*Sang:* I think a lot of the astronauts who are coming back say, "Don't tie me down to a set schedule. Don't time-line me out to the minute or to the hour. Give me the activities that need to be done. Give me an idea of how long it's going to take," because a lot of times it's going to take longer. We found that out time after time. The times that were documented in the requirements, it was usually maybe 150 percent more or whatever, sometimes even more. So that's one of the biggest things: don't time-line the crew to the minute. Give them some lead ways.

*Davison:* Just give them some general tasks within this certain window and this is what they're going to be doing.

*Sang:* Right. You've got to set certain windows for communicating, air-to-ground communicating. I mean, a lot of times when I look at my time line I see, well, Jerry should be doing this. Why am I disturbing him here? Let's move it over here where he's open.

*Davison:* So it's not in the middle of an experiment or something.

*Sang:* Yes, because he's working way in the Priroda or the Spektr and the COMSATs are back in the base block, so he has to float all the way back. He's got to set his alarms, and hopefully he's at a point where he can stop the experiment.

*Davison:* What about in the Control Center with the ground team? You see lessons learned or changes that we could improve on?

*Sang:* I think they're much like us, except they may not have the documentation that we have, because we have reams of documentation or now we have electronically available. So that's one thing. There's a difference.

*Davison:* But are they constantly monitoring systems?

*Sang:* Well, only during com passes they're monitoring systems. If you don't have the telemetry, you can't monitor the systems.

*Davison:* But are they looking for abnormalities or are they looking at--

*Sang:* That's the only reason you would monitor your systems, to see if there's something wrong. It's okay, out.

*Davison:* What about communications with the crew? Nowadays we do Cap Com. Do you see any type of duty officer idea that would--

*Sang:* I think we're going to probably start off with Cap Com and we're going to start relaxing after a while.

*Davison:* Be a low change.

*Sang:* Yes. Nothing's a quick change in NASA, I don't think.

*Davison:* What was the benefit of the Shuttle-Mir Program to the nations of the Earth in general? How were the Cold War concepts or culture differences overcome to make the Shuttle-Mir Program feasible?

*Sang:* Well, I guess when I started working with the Russians, you know, I talked to my friends. "Hey, you're going to work with these guys? These are communists." Well, not really. They're different now. The people I work with, I see them kind of like me. I mean, they're engineers trying to do a job, because it's a job they like. They thought it was fun. Yeah, there's not much money in it compared to what we make, but these guys do without. They don't get all the luxuries we do. So I didn't really see any of the Cold War philosophies there. Everyone was friendly. I think it's more on the American side. I get the comments, "You're going to work with these Ruskies?" or whatever. These are engineers like us. They went to school like we did.

*Davison:* So you felt like it was more at the government levels than it was at the people level?

*Sang:* Right.

*Davison:* Is there anything else you'd like to add before we conclude the interview, what you experienced

over there and what you can tell the American public?

*Sang:* American public, huh.

*Davison:* The people out there looking at you on the Internet.

*Sang:* I don't think they ought to be afraid of new things. That's what I would leave it at.

*Davison:* Good. Thanks for your time.

[End of interview]