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Interviewers: Michelle Kelly

Kelly: In your view, when did the Phase One Program begin? You mentioned that you had initially been starting this program from the start.

Johnson: It was in the year 1992. It got started with the NASA management and [Daniel S.] Goldin originally reaching some agreements to do--at that time it started off as one flight. There was going to be Norm's [Norman E. Thagard] flight, and it was kind of equal in the sense that each country would contribute. Our American astronaut would get launched on the Soyuz launcher and go up to Mir. It was kind of a follow-on to the Apollo-Soyuz [Test] Program, because it was going to try out the new docking system, and we would dock with the Mir station. At the same time, we would take a Russian cosmonaut up on the Shuttle. So we'd have an American astronaut go up on the Russian rocket and then we'd have a Russian cosmonaut go up on the Shuttle, and then we'd prove out and jointly develop this docking system.

Initially that was all that was thought of, was just the one mission similar to like we did for Apollo-Soyuz, where there was just one flight mission and that was it. But before that mission got under way very far, then it was decided to expand the program to be what we refer to as the Phase One Program for Space Station, and we ought to gain experience by having more of our astronauts up there on longer-duration missions. At the time, as you may have heard from Jim Nise, there was a contract developed between us and the Russians that would cover the Phase One Program and some of Phase Two.

And also in the fall of that same year, of '92, they decided to organize the joint program similar to the way we organized the program back in the Soyuz-Apollo, because that was very successful, where we formed technical working groups. We had co-chairmen of those working groups. Then I got selected by Charlie Harlan, who was my boss at that time, because of my previous work with the Russians on the Apollo-Soyuz Program, to be the joint co-chairman of what we referred to as the Safety Assurance Working Group.

Kelly: And that's what you did during the ASTP Program?

[note: Johnson misunderstood the question]

Johnson: Right. One of the first assignments I had was to develop a safety policy statement for both countries, and so myself and Boris Sotnikov, who is my Russian counterpart, we worked together and developed this joint policy statement that then became the beginning oversight of what we would do safety-wise for each country.

Then we had our first meeting. We started telecons with our Russian counterparts in the fall, and

then we had our first meeting actually in Russia with them in April of '93. I'll give credit to my Russian counterpart. He had put together, on one sheet of paper, an organization of how we could organize the safety work. That shows up in the diagram here. It's best to probably show you. I immediately accepted the Russian concept for organizing our work, because it made a lot of good sense and it served us very well. What it consisted of was, on one diagram, it shows blocks with flow diagrams. It showed, on one side in the actual document he provided, it showed little symbols, but it showed what the Russian side would be responsible for, what the NASA side would be responsible for, how these documents would interrelate, with the final being a Certificate of Readiness for Flight.

Kelly: Is this with respect to safety?

Johnson: With respect to safety. And the very first document and the document shown in the middle were the ones that we would jointly develop together. The others would be developed by each other, but they were all, of course, signed. The first one became the actual policy and guidelines for the whole program, and it also outlined these various documents and how they relate. We started off by developing a set of requirements for each other and of compliance to those requirements, instead of joint.

What I mean by joint is, in our safety analysis, initially we had to do a lot of work because the Russians don't have a formalized safety process like we do, which we refer to as a hazard analysis, where you identify a hazard like fire, for example, and you would outline what all could cause fire--electrical, chemical reaction, thermal heat sources, any of those--and then we list what are the controls. In the case of electrical, we identify the fact that we have circuit breakers on all of our wiring and it's insulated and it's protected from arcing or shorting. Then you have a list of verifications on those controls. And how do you know that that's in place? And we'd reference testing and what have you.

So it took us a while to explain that process to the Russians, because they weren't familiar with doing it, but they quickly adopted that process, and that process is used in these documents. The thing that the Russians brought to the table is they organized our whole set of documents, how they'd be interrelated, who was responsible for what documents, how they would interrelate. That's served us very well in the program.

In the case of the fire, we have the one document. For example, when we are docked together, if you had a fire, then the controls for that take into account that--both crews must react. In other words, when we were separate, the astronauts would take care of the Shuttle and the Russians would take care of the Mir. But once we're docked, each crew has to do something. The Shuttle guys have to do something. The Mir guys have to do something to counter that.

So those hazards and those controls were in this joint document. We eventually wound up with a Certificate of Flight Readiness. We developed that very early with them, and that's served us well. It's one of the few sets of documents developed by the working groups that management signed on all sides. I think that does a couple of things: it shows the significance that both countries and the management [placed] on safety and the fact that those documents would be signed by the higher managers in the program. And we've been fortunate that both the Russian and the U.S. managers have been very strong about making sure we had a good, safe program in place.

The other thing he [(Russian counterpart)]showed on the sheet of paper was the schedule of those products and everything. So I thought that was very clever that something we, on the U.S. side, would take maybe a book to explain--documents and the contents and who's responsible for what--he showed on a simple sheet of paper all of that information. I thought that was very actually profound.

One of the cultural things with the Russians--and it's been a struggle for us--the people in the U.S., we always [tend] to write everything down. In other words, before I remember anything, when somebody tells me about something, if I really want to retain it, I need to write it down. And we're always taking written exams in school and so forth. The Russians, on the other hand, everything's done orally. All their exams are orally. All of their instructors give oral briefings. There's very little in the way of textbooks or written material. Our astronauts have had a problem with that when they go to Russia to train, because everything's provided oral[ly] and they've having to [take] oral exams. We're used to doing everything in writing.

The Russians, at the same time, have trouble understanding why we have to have everything written down. I didn't understand that till Shannon [W.] Lucid came back. She said when she was on the Mir, they would tell her something and she'd say, "Wait a minute. Let me write it down." They said, "No, you don't have to write it down. You remember it." And they don't understand our concept of how for us to really remember something, we need to write it down, and that's the way we've been raised. In their culture, because, from little [childhood]on, everything's been oral, their memory retention for verbal is much better than ours. I'm always amazed. My counterpart--you tell him something, he'll remember it. I have to write it down. He doesn't have to write it down. So in their case, they're extremely efficient with how they use paper. They have very little of it. They don't understand why we have so much of it. But we both work together.

I think the other key to working with them, of course, was walking in with an open mind --and my counterpart was this way, too--about trying to learn what's best from each other and apply it. It wasn't a case that, "Mine's best. You've got to do it my way." It was trying to listen. Just like the management

concept here. When I first saw Boris lay that out, I wasn't going to argue, "That's the way we ought to do--," you know, because we did have a plan on how we thought we would do our work. But I could see right away a far superior way, and I adopted that concept. Likewise, he learned to understand the way we did safety analysis and agreed that that's how we'd do our safety analysis. So we both took something from each other to develop the program, and it's worked out real well.

Kelly: It's an interesting insight. Can I go back a little bit and ask you what you did during the ASTP Program itself and how it led you into your position here?

Johnson: Okay. Back then I was just a young electrical engineer in engineering, and I worked with what they called Working Group 4. I was just a working member of that working group. I was responsible for the electrical wiring and cabling related to the TV cameras that we were going to carry over to the Russian Soyuz vehicle. That working group mainly dealt with TV and communications and so forth, and I had a small piece of it. But I worked with my Russian counterparts, with their electrical systems, and so we got to know each other very well.

It was a lot more difficult then, because they were very close with what they told us--it was difficult to get information about their systems. They were very close about what they--they would provide [unless] there was a real strong understanding that that was really needed in order for us to accomplish our mission. But they were very reluctant to give out information compared to what we were. Of course, back then their society was very stringent. Also they were watched the whole time they were over here, and they were being even monitored in our meeting. So they themselves had to be very careful, and if they felt somebody was getting too friendly, they might get punished by not allowing that person to come back over on another trip or whatever. So it was kind of a strained relationship.

But at the individual working level, we really got to know each other. It was engineer to engineer. So even though it was a different language, we could communicate well. We really got to like one another, and so one of the big things that I enjoyed when I finally got back to Russia was getting to meet some of the people I had worked with twenty years before, and vice versa.

Kelly: Did you work with a lot of people back then that you're still working with currently?

Johnson: No. Oddly enough, I dealt with them a little bit, but the main group I'm dealing with now, none of the people were the ones I dealt with back then. The people that the Russian side picked to work with us were the ones that were familiar with the Shuttle, that had worked on their Buran Program, and they will admit to us that they copied the Shuttle. They did copy the Shuttle. They were directed by their military at

that time to copy the Shuttle, to cut down the time. It wasn't their choice. I deal with some of the others that are working on Space Station in some areas, but they're still working in engineering area versus the safety-reliability area that I'm in now.

The other thing I was fortunate in when I was back on the Soyuz-Apollo, our working group was one of the few working groups that got to go to the Baikonur site, which was very difficult to get into at that time. Tom Stafford and the crew had to almost refuse to fly or something before we were allowed to be in, and most of the time I was over there that first time, we were actually working at the launch site.

Kelly: What types of things do you think you brought with you from your experience in the Phase One Program?

Johnson: I think a willingness to accept someone else's ideas and thoughts, and a little bit of understanding the way they thought from an engineering perspective, from having to work with them that period of time. And a general interest in Russian culture. It just generated an interest in knowing more about them and what they were doing. Then, of course, since they were the main people involved in the space program [with us], there was a mutual interest there.

Kelly: That's interesting. Can you tell me a little bit more, from your own perspective, what you think the major accomplishments and events that happened throughout the Phase One Program were? For instance, I know that each of the missions and each of the highlights of those missions, but were there any other types of events where you realized key turning points or milestones for the program?

Johnson: I think, of course, going to the longer-duration program was a major turning point, because we were going to be working together. It wasn't like we were going to work together a short time and finish that job and go on to something else; we were going to work over multiple missions. So I think that allowed us to be thinking more of a long-term role.

I think the other factor was, of course, the things we gained from being in space a long time with the [Russians and]--probably, the cultural. The Cold War. Not having the Cold War there was a major thing, because it was a lot freer. They felt more free to talk with us. However, it was still more reserved, even then, at the beginning. The Russian culture, is they have to know you real well and learn to trust you before they ever develop a [relationship]--so it's very important, when you're working with them, don't say that you're going to do something or commit to something unless you yourself personally know that you're going to be able to carry that out, because if you just say something to reach agreement and you're really not able to carry it out, then, of course, they're going to lose that trust in you. So I was always very careful

about making sure that when I made a commitment, I knew I could carry it out. And so we developed a strong area of trust.

The other factor that was a turning point was, I invited them in my home on a social basis to meet my family and eat with me. The Russian culture is such--and I was aware of this--that they need to get to know you [at] more of a personal level. Also they're more concerned about what all you did when you worked. They rely heavily on experience and somebody having worked on important things. So they want to know a lot about you. Once they had met my family and knew that, of course, the other thing that helped me was having known that I had worked with them back on Soyuz-Apollo. That kind of broke the ice. They were a lot more free about providing information. It may not necessarily [be] written down, but they always answered all of my questions I would ask about something. And, of course, I tried to be very open with them. So I think that was kind of a little breakthrough there when you culturally get to understand and trust each other. Then it's a lot easier to work.

The TTI interpreters often laugh a lot when they're interpreting, because Boris and I have worked together so closely and think so much alike that when there's a big discussion and we'll usually try to come in to settle it or decide on something, Boris will say, "Let's do this," and I'll say, "Let's do this." I'll be, of course, in English and he's in Russian. And the interpreters will sit there and look back and forth and say, "You guys are saying the same thing." And that happens a lot with us. We just think a lot alike and worked a lot like that. So that's been a big help.

The other big breakthrough--and I'm sure others will mention--is when we had these major problems on board Mir. It forced us to work closer together. The other thing was when we flew the Russian docking module on that second mission. That was a major piece of hardware that had to go through our safety process over here, like any of the other people do. They had come over here a lot and then defend their design. They're not used to doing that. That was something. And then, of course, they had to deal a lot with our KSC [Kennedy Space Center] and how we process hardware at the Cape. So it was a big change there.

But then the problems we had on Mir, after the fire and then later because of the depressurization event, they were a lot more--even more so open about sharing information. Prior to that, our safety philosophy has been that when the cosmonaut's on the Shuttle, we're responsible for safety. When our astronaut's on the Mir, they're responsible for safety. So we didn't, let's say, review or critique or get heavily involved in each other's vehicle. We only did this safety analysis I told you about, the formal safety analysis, when the two vehicles were actually on mission and were joined together because we're both affected.

Well, because of the fire and so forth, and a lot of concerns, we changed. We even made a change to our safety policy that said, well, because we have an American astronaut up on the Mir all the time, we need to know more about what you're doing and the problems you're having and be involved in working those. So that forced a closer, if you want to call it, relationship. And the Russians themselves recognized, "Hey, we've got to work together more on this. We're in this together. The more information we give you guys about what we're doing and so forth, the better you're going to be able to answer the congressmen and other folks that are concerned about this." So those were major points in the change in the way we're doing business and the way we're doing work and all.

Kelly: That's really great. I have some questions for you with respect to safety and what the differences were in the two programs. You said more or less some of the differences were that you were responsible for your own vehicle. But what were the major differences in being more responsible for your own vehicle itself?

Johnson: You mean for this program or before we started the program?

Kelly: Even before and after, during.

Johnson: Okay. Their concept for before was more or less around what actions one would take if something happened. It was more what we refer to, that the flight controllers use, about [off nominal]_____ procedures or something like that. Well, this radio quits; you switch over to the redundant radio or so forth. It was not a case of like our process where you and identify all of the hazards: collision, fire, etc., the major ones--and then list all the causes and then go down the list and make sure you've got controls, [for] all of them, and verifications.

Their point was that if they had a real good design, they didn't worry about the "what if" about if that tank were to rupture. They'd have said, "Well, we've got a very good design. We won't worry about it." Whereas our safety analysis, you'd always say, "Hey, look. What if that breaks and spills the fluid out? What's the controls we have? What's the safety factor on the tank? And even if it does break, what do we do about it?" There was that difference in philosophy. And the Russians themselves, I was surprised when they were giving a talk over here, they indicated that our safety process was a preventive type of analysis versus a reactive, which is the way theirs was.

What we've been doing in the program safety-wise is, besides that analysis, particularly since those accidents, anytime the Russians want to do an experiment--let's take this last one like the Inspector that they were going to fly around the Mir--we did a separate review along with them to make sure that the

controls were in place, if it didn't work it wasn't going to collide with the Mir, and so forth. And some of that goes back to--well, it does go back to when the Progress had the collision, because we were not involved in that special test they were going to do. We weren't consulted. We weren't asked. In retrospect, if we'd have been involved or when we look at some major task, we make sure the crew's trained, and we get all these things in place and so forth. They really hadn't done that. So we've insisted, since that point in time, that anytime they plan to do anything new or different, that we both review that. And they've seen the benefits of that.

We developed safety criteria. There was a lot of this talk about, "Okay, are we going to allow the next guy to stay on the Mir?" So we jointly developed a set of--and I don't know if it's in this document; I can provide it if it's not--we developed a set of criteria that says you've got to have redundant oxygen-generation systems, you've got to have at least your thirty-day spare supply of food [and] water. It was a set of criteria. The temperature conditions ought to be such and such. It's a set of criteria that says this all has to be working and those conditions have to be in place before we'll allow an astronaut to be over there on a long-term basis. So we actually developed a joint set of criteria, as we call it, and we assess that before each one of the flights, to make sure that they've got the redundant carbon dioxide removal system working, they've got the oxygen-generation system, they've got spare food, spare water, and so forth, and make sure now all that's in place before we allow an astronaut to go across. There wasn't really a formal review of all that beforehand.

Kelly: It was most a list of criteria.

Johnson: So we have a formal agreed-to list of criteria that we actually go down and make sure.[of] They send in reports that we refer to as our consumable reports that's against that criteria. Here's one you can probably have. This is the later one. It lists how much propellant they have, how many days' worth of various things that they have and so forth. So they send that in to us so we can track that and make sure.

We do make allowances. For example, they have spare hardware. So we do allow that if one of the oxygen-generation systems quit, that there's allowances made to replace it or fix it. So it's not like, "Oops. We're not going to go across if you don't have two of those." As long as there's oxygen-generation capability there and they have the spare hardware on board and they know how to fix it and so forth, and it's just a matter of time, we allow for that. So there's a clause in there that says, "Given you can maintain it or replace it or so forth, that's allowable." So there is some allowance in that regard. Of course, on the station, unlike the Shuttle, it's up there all the time. Things are operating slowly. There's plenty of time to go fix things or repair things.

Kelly: What if, for instance, there were a problem with one of the vehicles? For instance, one of the Soyuz vehicles. Would the Shuttle go up and help out in the event that something really happened?

Johnson: We could do that if it was close to one of the times when our Shuttle was getting ready to launch, and it would have to be one of the Shuttles that was planning to go up, because the only ones that have the docking system in it. Now, the Russians themselves can respond much quicker with their Soyuz system. They usually have another system that's close to being ready. Unless it was fairly close to one of our launches, my guess is they would be able to launch one of theirs.

Of course, they keep one vehicle up there all the time that they can suddenly come back in, but if something were to happen to that, then, of course, that's one reason we maintain, or try to maintain, something like thirty days' worth of food and supply. That thirty days is based on the fact that they feel like they can always launch another Soyuz or resupply vehicle or something within that period of time.

Kelly: That was most of a personal question. I'm just very interested in that. Who are some of the people that really stuck out, in your mind, as being very helpful in these areas or have been really focusing a lot of their efforts and hard work in both the safety area and just as well with some of the events that you talked about, like the fire and the depressurization?

Johnson: Well, in the very beginning, in terms of support for the safety program and all, and actually allowing us to develop a program, Tommy Holloway, of course, and Frank [Culbertson] became his deputy. Then Frank picked up. Both of them have been very instrumental, as well as Jim Van Lack. My counterpart has been very instrumental. Bob Peercy and the Boeing-North American people, which used to be Rockwell. Rockwell was the company that was involved in the Apollo program, so they'd worked for the Russians way back then. They were knowledgeable with them. The Russians respected the Rockwell people. Bob Peercy--and you'll see his name on the articles here, and he even presented those papers--was one of the key members on my team, along with Miles Whitnah from NASA Headquarters, and then the rest of my group. Nancy Steisslinger is my backup co-chairman, and she came along a little bit later in the program, has been very instrumental.

The other has been the other strong working group chairmen. A lot of the other working groups, there was change in who headed those up. There was a lot of turnover, which bothered the Russians, by the way. They wanted more stable--since it takes them a lot of working with somebody to get to know you, they get very upset if that changes very much, because then they don't know how to calibrate the next person. It bothers them more so than it would us, because we're more involved in change. Jim Nise is

fortunate. He's been with the program since the very beginning. I've been with the program since the beginning, on my working group. I think just about all of the other working groups, however, have been through multiple changes in terms of who headed them up and so forth.

The astronauts themselves, of course, were very instrumental in key people. Norm Thagard came back and provided a lot of insight. He was very vocal about things [that] [needed] to be fixed, and he caught some criticism about maybe griping, but from an engineering and programming sense, it was very good, because what we did is then worked on the things to improve on what Norm--so all the follow-on crews benefited a lot from Norm's feedback on what was happening.

So Shannon Lucid's been a very key crewman. Some of the other crewmen who have flown have left and so forth. Shannon's still here. She's a valuable resource. She's still been the one that's been up there the longest. [Jerry] Linenger was up there, of course, during some[of the] major problems with the fire, [and] Mike Foale was up there with the depressurization that they had. We've learned a lot from them and all of us have improved a lot from them.

I think, on the U.S. side, our crewmen tend to be a little bit more open and vocal about their experiences, more so than the Russian side, but I think that's been helpful, because even my Russian counterpart's indicated he's found out more in some respects the way the crew--some of the things that really happened from what our crewmen have said, more so than what they get from their crewmen.

Kelly: Do you have any postulations as to why that is? Is it just a matter of culture?

Johnson: It's more of an open--you know, they still are struggling with--see, for years--and a lot of people over here don't understand it because a lot of things change politically, but you could say something to somebody over there. They had several changes, for example. When Nikita Khrushchev was there, he loosened things up a little bit. Then people would start to maybe talk to Westerners or something, and then [Leonid] Brezhnev came along and kind of clamped down on things. So those same people would often get arrested or taken away because, well, they spoke to a Westerner, for example, or they gave away too much information or got too friendly.

So, because of those things, they were always very careful about what they said and they monitored their own people a lot. So if you're being monitored and recorded all the time, that can be a factor, too. So it's been tough for them to open up, if you want to call it that, like we would. So I think that was just part of their heritage and culture.

I got invited to Star City for one of the cosmonaut debriefings, and there hasn't been many of us been involved who have been able to do that at Star City. I was surprised--and this has been later--that

their cosmonauts were very open to their engineers about the problems and what needs to be fixed. They would say what things U.S. had that was better, and which things of the Russian stuff was better. They were very free about it. So I was surprised that they were pretty open in their debriefs, telling their engineering counterparts on the ground about the problems and so forth. They probably had a case where not as much of it got out into the press. On the other hand, they got exposed to that a lot during the missions, and because of that, a lot of them didn't even know how to deal with the press. So there was a lot of thinking they were misquoted or them not being very careful about what they said or so forth. That could cause some problems. So they've had a learning experience in that regard.

Kelly: Who are some of the Russian engineers or program managers that you felt were very effective on the Russian side?

Johnson: Okay. Valery Ryumin, their program manager. My counterpart, Boris Sotnikov. The others ones involved were General Glazkov from Star City, Colonel Kargapolov, who is his deputy. [Aleksandr P.] Aleksandrov, who worked the EVA things. We've got Bogomolov from Institute of Biomedical Problems, that worked the medical side of things. Lebedev worked the science part of things. Pavel Vorobiev worked a lot of the logistics and manifesting of things that went up and down. Let's see. I think that's the major ones that come to mind and have been key players. They've been very consistent with their people. Like I said, unlike our side, where there's been a lot of change, just about every one of their major people involved has been the same one.

Syromyatnikov and Victor Blagov, by the way, for the operations, and Soloviev for operations. Syromyatnikov is the designer of the docking system. He designed the Soyuz-Apollo system they had, their other design. He's very influential and very important. Syromyatnikov also speaks excellent English, by the way. More of the Russians can speak English than vice versa.

Kelly: How does that make them feel, do you think?

Johnson: And a lot of them can read it more. I think that they get concerned. Of course, I've been trying to take lessons and trying to learn it. I think a lot of it has to do with the fact [that] they study a lot of foreign literature and stuff in their work, so a lot of them, even if they can't speak English, they can read it fairly well. My counterpart can read English fairly good, speak it fair. So there's more of their understanding in that regard. Of course, that's been a help. At the same time, both sides have to be very careful about making sure--and even on my case, where a few people know how to speak Russian--that we make sure in our formal meetings that we speak through interpreters all the time so everybody hears the

right thing. Our interpreters are trained to try to make things accurately translated and so forth. So in our important meetings, we always try to make sure we're talking each other languages and use the interpreter to make sure there's no miscommunication. That's been an ongoing thing.

Even with that, because of differences in terminology and thinking, there's been times we've gone for a year--I know even in our work, in the safety work, about a year later, "Oh, that's what you mean!" All of a sudden it would dawn on you. So there's always that chance of miscommunication, so you have to be very careful and go over things and make sure you understand and repeat back to them what you think your understanding is. That's very important.

Kelly: You mentioned a little bit about some of the processes that we've gone through as far as analyzing some of the safety risks that are out there. Can you tell me a little bit more in depth about what our process is compared to the Russian process and how we've got to integrate the two for the Shuttle-Mir Program?

Johnson: Well, like I mentioned once before, our process we've developed over here as been this safety hazard analysis that we formally--and also what we call failure modes and effects analysis, where you analyze the hardware for its failure effects. And we document very carefully any of those hazard controls that result in flight rules or procedures, because those can be controls that get documented, written down.

The Russian side tends to be more not doing this analysis so much up front, but more or less while you're operating the vehicle. If this happens, this is what you do. It's not like making sure you do all these things ahead of time to prevent it. And they do that in a lot of their design. They also rely very heavily on testing to make sure things are safe. We rely more on our analysis, as well as tests, but we rely a lot more on analysis. They do a lot more testing of the actual flight hardware.

Kelly: Do they test prototypes?

Johnson: They actually build multiple copies of the flight stuff and really test it. That's been a deficiency in our programs a lot of times. For money reasons, we will make an engineering model or a test model or something that's close to being like flight and to run tests on and do some work, but usually we'll only have like one flight model. You take right now for the Space Station, we've only built the one node that we're processing. The Russians, on what they call the FGB, have seven FGBs they've built. They're used for various test models, but if you go look at them, they almost look identical to the flight hardware. In other words, they're not wooden mockups; they're actually built on the same assembly line as the other units. So if something were to happen--which they did have a problem with the FGB early on in a pressure test--they were able to take some hardware off of another unit fairly quickly and apply that.

Kelly: And would they then equip the other, say, six units then for further testing?

Johnson: They have them broken out in separate tests, yes. They'll have one for structural tests, they'll have one for electrical tests, one for pressure tests. They've all got their unique test that they're planning to do with that hardware, so they didn't build just extra ones for extra; they build them for--but we might have one unit that we send through multiple tests. They'll have individual units. Then, of course, in our testing a lot of times we can't test as far as you'd like, because that's the actual flight hardware, but we rely a lot on our analysis based on that testing, plus analysis to show we're okay. But the Russians, like I said, rely less on the analysis for that.

Kelly: Then after the actual analysis and/or testing for each of those different programs, how'd they then go through the process of determining what is safe and what is not, or what the actual risks are? It seems like the Americans are more geared to, like you mentioned, the preventive procedures, as far as trying to figure out what could happen.

Johnson: Yes. Their philosophy was to make things, test it and make sure it wouldn't break. They'll make things extra thick or put extra margin in it, in that sense. The other thing that they rely on for their safety or reliability of their hardware, they don't change it much. The Soyuz vehicle they're using now has been modified, but it's basically the same vehicle they flew back in Apollo, for Apollo-Soyuz. So their approach on all of their hardware is, if something breaks or something needs to be fixed, they fix that item. They don't redesign the whole thing.

Kelly: Like, if it's not broken, don't fix it.

Johnson: Right. Now, that limits them, however, in applying new technology. Like right now they're well behind in the so-called avionics area, in computers and electronics and software. A lot of their components that they used on their spacecraft were the early relays and so forth that they had way back in the early days and the days we did on Apollo and so forth. But that's how they gain their, if you want to call it, safety or experience, is they've got well-proven hardware that they've used over and over again, they know it works, they know how to build it, they know how to build it accurately, and so forth. And the changes that occur are usually to make something better rather than completely redesign. So that tends to reduce risk and they feel a lot better about the safety of the hardware and all.

They are concerned about safety, they really are, and they were concerned about some of the things that we did in that regard. A lot of their concerns stem from our lack of testing. They've had a concern

with the fact that we're not testing everything on our Space Station at the Cape like they would like to do. There's been big arguments about the fact that they do vacuum tests actually at the launch complex in their total hardware to make sure it's leak-tight, doesn't leak. We didn't plan to do that in the program. Now we're rethinking some of that. So they've got a concern that we don't test and that we don't have a long history on some of our things because we've got some of this new stuff, whereas, like I said, we tend to rely on analysis and all of that more.

Kelly: Are there any other areas that you think we have the potential to learn from the Russian program as far as safety is concerned?

Johnson: Let's see. One thing, of course, that was important was, like I said, organizing your work, make sure you know how all your safety analysis is going to fit together, make sure you have a clear understanding of policy, and have a final goal and product in mind. Unfortunately, for our Space Station we don't have a well-organized, integrated safety program like that, and the Russians are concerned about it. We were fortunate we were able to develop that, well laid out. The station program's been under way for a long period of time. It tends to have individual processes, but they're not well laid out and tied together like we have in the Phase One Program. So one lesson we can learn is to try to develop, simplify, and go to not many, a lot of different processes, but go to one that applies and try to make it streamlined and efficient so you don't get burdened down with all the paperwork, if you want to call it that, and make sure you're focused on the things that are really important.

And even in the safety [area], making sure we could gain something by running more tests. They were more stringent on their tests. They were more stringent on their off-gassing, and they off-gas and test everything, whether it's toothpaste or lipstick or whatever, anything you take up there, because you're within a can. You're going to breathe whatever you take up there for a long period of time. You want to make sure it's all okay. So they're real stringent about that. So I think we've learned from them in that regard, that safety means more than analysis; it means making sure that we test everything and analyze everything very carefully before we put people up there to stay for a long period of time.

Kelly: On the flip side of the coin, do you think that they have learned some things from the American program as well?

Johnson: They have indicated that they saw merit in our formalized safety process, they've seen merit in how we have these formal reviews before a panel and justify how safe something is, and you have panel members critique you on that. They felt there was good merit in that. They've seen merit in--we've also

done a lot of analysis about micrometeroid and debris and our concerns about that growing threat. We've been modeling that very well and pretty accurately. They've recognized that that's probably a lot more important than they thought it was, and they need to pay attention to it also.

They've also come to appreciate our analytical capability. They were amazed when Rockwell, who is now Boeing-North American, built an analytical model of this Russian docking mechanism.

Later, when they had to do some off-limit-type testing, the Rockwell people ran their models, predicted what the results were, and the Russians were really surprised when they ran the tests, that the results matched very closely [to the] analytical results. So I think they've come to appreciate that, hey, there is some merit to this analytical modeling and analysis, computer things you can do. So they've learned to appreciate what's being done there, and I think we're learning to appreciate that there's still areas we need to test, if nothing else to validate those models.

Kelly: One question that really has escaped me is, what is the policy and what are some of the objectives concerning safety of the Phase One Program?

Johnson: The policy was, like I said at the beginning, was that each country didn't want to have to go do a big safety analysis on their launch vehicle and we didn't want them to be doing a big safety analysis on the Shuttle, and we both recognized that we've had longstanding space programs that have been very safe in the way they've been operated. So there was an acceptance at the beginning that we would accept each other's program in that regard, and then, like I said, when one was on each other's vehicle, they were responsible for safety. That's still true. Each one is still more responsible. But at the same time, we've learned to review each other's capabilities jointly together a lot better to make it even safer yet for each of them, for each group. They're more involved. They get more involved in what we're doing on the Shuttle. However, typically we were involving more of them in the beginning than they were vice versa, so I think more the change has been our involvement in Mir more so than Shuttle, because they were all fairly heavily involved.

One of the complaints even our astronauts had was when their cosmonauts came over here, we tried to train them to actually be a crew member, operate the RMS arm or do something with the actual vehicle, rather than just be a passenger. One of the complaints we had from our early astronauts on the Mir was they were just a guest, you know. They really didn't get a chance to participate and maintain the Mir station or get training on this or that. That's changed now. Of course, we're now doing EVAs. Our guys are getting to go do an EVA in a Russian suit and operate their equipment, so now our astronauts are allowed to be more what you might, quote, a "Mir crew member," rather than just being a guest on board their ship and all.

Kelly: More as a passenger. Can you say a little bit, then, about some of the crew training? It seems that the Russians have been primarily responsible for training the American astronauts on Mir. Have the Americans been involved at all in that training? If so, how have they been?

Johnson: They've been involved. We maintain a group of people actually at Star City, that support them, and we have a group that's following--it's mainly from the science standpoint in the Control Center all the time, they're following experiments. So there is always kind of a support group, if you want to call it, there in Russia when our astronauts are over there going through training, and because of our knowledge and so forth, we've generated a lot of written material now to help ourselves out in terms of studying their systems and so forth.

Then, of course, their cosmonauts over here go through the training, and even if they're not going to fly on the Shuttle, they come over here because a lot of their cosmonauts are involved in our experiments. So they'll come over here and participate in the actual running and seeing and looking at the hardware that they're going to run when they're up there in space.

Kelly: Who are some of those people involved in that effort?

Johnson: Okay. On the training side, Charlie Brown is Working Group 5. They do the crew training. They're responsible for crew training and all of that. So Charlie Brown would be the person to contact, and he could give you a little more depth and detail. Tommy Capps supports him heavily in that crew training area.

Kelly: That would be really helpful. Going back a little bit to what you mentioned before, you said something to the effect that you don't want the Russians looking through the Shuttle and telling you how you should make the Shuttle safe and, vice versa, in the case of Mir. That, to me, seems like a very reasonable, logical statement.

Johnson: Well, what we meant by that, no, we'd like to hear--don't get me wrong. I've been open if they felt something needed to be changed or so forth. As a matter of fact, we had to document things on the Shuttle that were, let's say, not [two] failure-tolerant and so forth, and they would document the things on the Mir. They would point out to us if they thought something needed to be changed or better.

But what I meant by that was, it would take up time and resources because we would have to spend a lot of time proving to them that the Shuttle was okay. They would have to take a lot of time telling us, before Norm went up on their Soyuz launcher, why their Soyuz launcher was okay and what their

process was and all. Of course, we'd each been launching each other's crewmen for a long period of time, so it was a mutual respect for the concerns of each country, is the reason that's the way the policy came out. I think on both sides there's been a willingness, particularly as the program went on, a willingness to try to learn from each other on how to improve, from flight operations to crew training to everything.

Kelly: I would think that would be the ideal philosophy, not only as a matter of respect, but essentially if you're designing and building a Shuttle and operating it, I would defer to you in questions concerning the Shuttle operations.

Johnson: Right.

Kelly: And vice versa. I have a few questions for you that I'd like to ask you to comment about--some of the congressional complaints in that area and some of the inquiries that were held concerning safety in that area. How do you feel about that?

Johnson: Well, first off, of course, we were concerned because we felt like the people had a lot of wrong information. There was a little lack of understanding of the way--with the Mir station being up there for a long duration, it wasn't going to fall out of the sky right away. The other thing about safety was, they always had like an ambulance or escape vehicle right there. Okay? And like the Russians kept pointing out, they said, "You don't have an escape vehicle on the Shuttle. If you have a problem, that's that." So their point was, even though these problems were what we'd call safety problems, they didn't feel it was a safety problem for the crew because the crew could go get in the Soyuz and come home if it got bad, really bad, up there. It's not like they were going to be stuck, to die right there. So a lot of our activity became trying to explain to them and show to the outside groups what our safety process was and so forth.

I think, in retrospect, I'll have to say this. I think they made us better, you know. We had to go through things a little bit more rigorously and so forth. For example, this criteria we came up with, that was a fallout of a lot of this concern about the safety. We didn't have a formalized criteria, and that was a good thing probably to do. So I think we improved our overall program with that outside critiquing.

At the same time, I felt very good in a sense that after providing all this information going back from the beginning, and the people going through it, we never got any complaints that our safety program had holes in it or wasn't sufficient. The only thing they wanted us to do was was for us to do more. For example, like I pointed out to you, once we separated and we were separate, we didn't have this formal analysis; each country was responsible. And they saw that in our policy documents, so it wasn't a complaint that we weren't doing what we should be doing. They recognized we were doing everything we

should be doing. As a matter of fact, they indicated the program was very good. Their point was that, "Well, wait a minute. Since we still have an astronaut in there, you ought to be doing the same formal analysis while the Shuttle's gone." So that led to us making this change in our policy. So it was more or less what you were doing wasn't a problem, it's just that we want you to do more than what you were doing.

So as a result of all those reviews, we've expanded the scope of our safety analysis and joint work. But it created a lot of work on us. We had to go back through and provide a lot of records, go through a lot of data. The way it was handled, it was upsetting to some people. I've talked to the IG [Inspector General] Office about that, because typically in the government, when the IG's called in, it's like a criminal investigation, so people get scared. Do I have to have a lawyer? And congressional groups actually have two outside groups: the IG and then they have the GAO [Government Accounting Office] that goes in and does audits. So my understanding at the time was, I didn't know why Sensenbrenner didn't choose--if this truly was an audit of our process and safety, in my mind, the right thing to have done was dealing with the GAO and done that, because they're familiar with doing those audits.

Well, it turns out the IG Office does do these other type of audits. When I was talking to the head IG person about that, she admitted that one of the lessons learned was they didn't make it clear to a lot of people when they came in here that, "Hey, we're not doing this criminal audit type thing that you recognize us for; we're doing an audit function from analysis or similar to what the GAO does, provide a report." If they'd done that, I think that would have helped alleviate a lot of people's concerns and so forth.

Kelly: Were you involved with NASA's initiative to respond to Congress then?

Johnson: Oh, yes, in terms of providing a lot of the write-up that went into Frank Culbertson's report and so forth. Since the emphasis was on safety, we had to do a lot of that. We had to provide a big formal briefing--or I had to do that--to the Stafford Committee, and I also had to brief Fred Gregory and the HEDS (Human Exploration and Development of Space) Assurance Group, which is a bigger panel, too. Frank Culbertson had to provide a briefing, too, but I was there to support him and I had a major briefing, and really going through what our safety process was and so forth. At that time we were in the process of developing this criteria, so I went through that--we had developed this criteria and what we were doing to assess it against that criteria and all of that.

Kelly: Do any other names stand out along with your own initiative?

Johnson: I think Goldin himself made the final decisions in that. Fred Gregory at NASA Headquarters was heavily involved. My boss particularly got involved in this safety--John Casper was involved. Each

one of the working groups--Bob Peercy. The people supported me very heavily in putting together these presentations. Linda Gavin from Frank Culbertson's office pulled together a lot of the work and was interfacing with the IG's office. George Nield and Jim Van Laak, a lot of people in his office were heavily involved in that. Let's see if there was any--I think that's probably all that comes to mind, at least offhand.

Kelly: It seems like a lot of people made the effort.

Johnson: Oh, yes.

Kelly: Can you tell me a little bit more about what you see as this whole program in itself benefiting Space Station, and then, in a general perspective, just the Earth and people, other nations in general?

Johnson: In terms of Space Station, I think it's been a big help for learning to--we're going to have other countries up there to live and work together. There's been a lot of things due to the problems that have occurred on Mir, that have made us rethink, "You know, gee, maybe we'd better get serious about--" For example, we in the safety world were starting to have problems on station. People are often wanting to run cables through hatches and a bunch of things, rather than design a way around it, because it's more difficult or more expensive to do that. But when we had the collision and the depressurization, all of a sudden people saw, hey, there is a need to maybe suddenly be able to shut that hatch quickly and help yourself out. So those sort of problems have provided a lot of focus, from a safety standpoint, on the things we really need to look after and do for the International Space Station.

I think we've been rethinking our testing. I know for a fact we've been doing some additional testing we originally didn't plan to do on our hardware, based on the Russians' concerns and what they're doing.

I think it's helped the general public out in the science that we're getting back. It may not be visible right away, but a lot of the life science that was being conducted on cells and calcium loss and all that should hopefully benefit others. And I think it's brought the two countries closer together--"We're in this together" type thing. It should help us a lot when we go dealing and working with the Japanese and the Europeans later for the International Station. It's also allowed us to work with somebody where somebody else is just as knowledgeable on operating in space as we are. Some of the countries accuse us of thinking we're the best and know how to do it all and not willing to accept. I think the Russians have taught us that, hey, there's other ideas out there besides ours. And I think that's been good.

I think it's been a lot more information to the public about space and what's going on, not only the risks, but there's been a lot more exposure on television and so forth about the work that's being done. So I

think overall it's going to be very useful.

Kelly: That's good. I'm just looking at some of these other questions I have here. It seems like we pretty much have gone through everything that I had down here, but do you have anything else that you'd like to add, or any other areas which you felt were particularly relevant for the history of Shuttle-Mir?

Johnson: Let's see. I think it's important to define a group like the working-group concept, formally define that, and then, like I said, hopefully provide some stability in your working relationship. And it's important for you to try to understand the other person and their culture. Just like I said, we used to get frustrated about their not providing us written documentation, but if you understand that, likewise, they have trouble understanding why we need it, once you understand that their whole culture through school and everything has been totally different than ours, then you can kind of begin to appreciate why they don't have to write everything down and why everything's not written down, at the same time, for them to appreciate why we need to write things down and so forth.

Kelly: I think you made a really good point. You mentioned earlier that some of the working-group situations evolved from ASTP. Is that correct?

Johnson: That concept. The working-group concept. The other thing it might be good for you to talk to is some of the TTI people that are interpreters, particularly in the area of what they feel has worked and hasn't worked. I've gotten feedback from them that there is some working groups that haven't worked nearly as smoothly. I may have kind of a false impression, because I've heard, now, and one would have go to independently. I'm not trying to brag too much here, but at the same time I've gotten feedback that our group seems to work very well together and so forth. So it might be desirable. Now, I've heard some groups, there tended to be more of this, "Well, you've got to do it our way." Of course, if you go in that way, that creates a problem.

The other factor might be--and I think it is important--is the fact that I've been the same person working with them, going back to this. I also invite them to my house. We try to socialize. We took them places. In other words, when the day ended, we didn't go our separate ways and that was it; we actually made an effort to go take them shopping, to go take them somewhere. Of course, we did it with our own money, but we did that so we'd learn to understand each other better socially. Because we had heard--and rightly so--that that's part of their culture. So that's made us much closer, working together and so forth.

But TTI would give you probably some good feel for even lessons learned about what works with working--because, see, they work with multiple groups. They get to see a lot of different groups, on what

works and doesn't work. Like I said, one lesson learned is that you would think if you had somebody on your team that spoke Russian real well, that it would be a help in the conversation, but we found out that if that individual's talking to my Russian counterpart in Russian, I don't know what they're saying and what's going on, and you're not sure that things are being done right. So we make a rule right away that even if you can talk English--and the Russians understand that themselves, even though they can speak English very well, some of them, they make sure that in informal meetings they always talk through an interpreter, except for social. So it's very important. Like I said, that's been one of the biggest things that created a lot of problems in the beginning, is this misunderstanding. You thought you knew what they were saying or you thought you understood what it was, and then you found out later that, no, that wasn't right, etc. So it took a long period of time to really get things understood, and also for us to recognize we've really got to concentrate on that and make sure each other understands, because if you don't, you're going down a wrong path.

Kelly: Do you know how that concept even evolved through ASTP? You mentioned you were in a working group yourself.

Johnson: Well, the concept, of course, of getting groups identified and working together, that concept was developed then and carried through and worked very well. The other things I don't think we got a lot out of. Two reasons. Most of the people that worked on that program weren't working on Phase One. There was only a few of us that worked back then, so there wasn't really a lot of carryover, if you want to call it that. The other was that there wasn't this real long-term many missions' worth of work, so you didn't have a chance to go--and there was not this openness, as much sharing of information and so forth.

So even in my case, I don't think there was--I think the biggest carryover was the working-group concept, the management concept, and knowing a little bit about the culture. That is, that you had to get to know each other and make sure you trusted each other and work together before something was really going to work, or before they would tell you things, and vice versa. And, of course, the importance of having interpreters. But beyond that, at least from my perspective, I don't think we had a lot then. Also, even back then there wasn't a separate safety working group. I think a big plus in the Phase One Program is we had a focused safety working group. Of course, the need for that wasn't quite as great during Apollo-Soyuz. It was one mission. There was just a short time together and all. There was some analysis done, but it wasn't in a separate group and focused nearly as much as what we did here. So we didn't learn much about each other's safety program back then because there wasn't that much dealing and working together.

Kelly: So you didn't have a real basis to go back on.

Johnson: Right. There really wasn't. Right. So there really wasn't any basis. For example, when we were setting up this safety stuff, there wasn't any basis to go back for that.

Kelly: When you were at your initial safety meeting, did you and the corresponding person in the Russian agency, or the Russian counterpart, did the two of you sit down together and decide, "Okay, this is what we need to do and this is how we should do it," both presenting your cases, or was it more or less one of you presented, "Here's my idea"?

Johnson: No. At the first meeting, we presented our concept and they presented theirs.

Kelly: And how were they integrated?

Johnson: To be perfectly honest with you, it wasn't that well integrated or thought out. It was more along the lines of the way we'd been doing safety work. Okay? But we didn't have laid out a structured process that was very clear on who did what, how it fit together, and how it related at the end. We were thinking about, more or less, one safety analysis document. Of course, like I said, the thing we brought to the table is this formal safety analysis. It was more or less like we'll have this one document and we'll go have others review it and so forth, whereas they said, "Let's first have policy. Let's have requirements. Let's see how we meet each other's requirements, then how many documents we're given." It was a big help to us because I think other working groups struggled a little bit with their documentation. So we both brought our ideas together, but I recognized, and some of my people--I wasn't the only one, and we all worked together--we recognized that, hey, that really makes a lot of sense. I said, "Great. Let's do this." Of course, that made their acceptance of our ideas very good, too, the fact that we were willing to accept their concept and go forward with it.

In all fairness, in those early meetings there was a lot more arguing of each other's cases, you know. There was a lot more kind of setting each other's boundary conditions and so forth. And we didn't have quite that much understanding and trust yet, see. So later, you know, now there's very little of that. Still we'll make a strong case or something, but it doesn't take us long to reach agreement and so forth now, because we really do think a lot alike.

Kelly: Initially, did some of the other working groups adopt your practice, what you learned on your meeting, or did you share ideas afterwards?

Johnson: After each one of the flights, the program managers got us all together and we tended to share ideas and put that information out. Now, I don't know how much of it applied to other groups or not.

I do know that one of the problems was, like I mentioned, the other groups, there was a lot of turnover. You take, for example, in the science group, oddly enough, in the very beginning it was Dr. Carolyn Huntoon, who was later Center director, and then it was, I think, her deputy, John Rummell, that took over. Then it was Dr. Peggy Whitson who now then got selected for the Astronaut Office, so she got replaced by another lady doctor, and unfortunately I can't remember her name just offhand. Presently it's John Uri. So there's like six or seven changes. And yet on their side, it was always working with Dr. Lebedev.

Kelly: More of the continuity.

Johnson: So once he got familiar with working with somebody, see, he had to go through a process of changing. I know on the astronaut side that they changed a lot. Like with Charlie Brown's crew training working group, there's always somebody from the Astronaut Office that supported that activity. Steve Nagel, who used to work in our office, was an astronaut, and he served in one of those, and he said he could see that was very traumatic on his Russian counterpart that he worked with. He'd worked with him for six months and they got to know each other fairly well, and then he cycled out and someone else stepped in. So most of the other groups have had changes like that.

Fortunately, when it comes to program managers, we've been very stable in that regard. Tommy was there, but then Frank came on fairly soon as his deputy, and so there wasn't that much of a transition when Tommy left.

[End of interview]