PHILIP L. "PHIL" ENGELAUF

June 24, 1998

Interviewers: Mark Davison, Rebecca Wright, Paul Rollins

Davison: Today is June 24th [1998]. Today's interview is with Phil Engelauf in the flight director's office. We're in his office, in Building 4-North [Johnson Space Center]. We're conducting an interview with Mark Davison, Rebecca Wright, and Paul Rollins.

Good morning, Phil. I wanted to start off with a history of how you got involved in the Phase 1 Program and what your duties were in the beginning of the program.

Engelauf: Well, as a flight director, here in the flight director office, I was pretty much just being assigned to flights in the rotation originally. One of my assignments early, about the time the Phase 1 was starting, was STS-63. At the time that I was a lead flight director initially on that flight, that was not a part of the Phase 1 Program and was not affiliated with the Mir Program at all. In fact, [Robert E.] Bob Castle and Gary Coen had been doing the bulk of that work at the time.

As events evolved a little bit further there, we decided to turn STS-63 into sort of a dry run for the first docking mission, which was going to be STS-71. Because I was a lead flight director there, I obviously got swept up into the activities and had to get pretty familiar with the rendezvous process and the issues that we had addressed for docking with Mir.

Around that same time, Gary Coen, who was the head for our office of Phase 1 activities, was proposing a concept of sort of a cadre, or a core of people, that would be affiliated with Phase 1 and was sort of lobbying to have a central core of people continue to do all of the Phase 1 flights. Since there's quite a bit of overhead in establishing the relationships with the Russians, getting familiar with how they do business, rather than have to train everybody in the office on all those things, we went with that core concept. After I'd sort of gotten my feet wet on STS-63, it was pretty natural that I would continue on with the rest of the Phase 1 activities.

Davison: Can you talk a little bit about your role as the lead flight director on 63? We've heard a little bit about the rendezvous, but can you tell us how it was for you working here?

Engelauf: Actually, it was almost traumatic, I guess. We work as project managers, so to speak, for putting a Shuttle mission together, starting from about a year before the flight. At the time, we had cargo in the bay of a Space Hab, which had a lot [of] science experiments inside, and a Spartan [retrievable free-flying satellite] on the flight. We were working on plans for an EVA test to go out in the payload bay and do some work. The addition of the rendezvous to Mir really didn't mesh very well with the way we had built the mission up to that point. This was my recollection on the order of five or six months prior to the

launch date, the flight that we started talking about this.

We tried, at first, to put the mission together, to add the Mir rendezvous in, in the easiest way, by sort of tacking it onto the flight in the simplest way. It really didn't work out very well. We pretty much had to go back and start from scratch and put the mission together, essentially tear everything apart, start with a clean sheet of paper, and go put the mission back together.

It took quite a bit of work to figure out how to make the mission work, given the constraints and the payloads that we already had assigned to a flight, but we'd already been doing a great deal of work on designing the rendezvous process for Mir in Mir flight techniques, which was our working level forum for working out those kinds of details. So at least we had a good set of procedures and the initial requirements to draw from. But as soon as we started thinking seriously about doing this, I got involved in a large number of meetings with my Russian counterparts, Victor Blagov and Vladimir Soloviev at the time. It took quite a bit of work to work out the final details.

Up to that point, it had been sort of a paper exercise. We were building flight rules and doing the procedures. But when the time between the current moment and the first mission that we were really going to do this suddenly moved up several months to STS-63 from 71, it kind of injected a new dose of reality into that process and it took us a little bit by surprise, but we managed to go off and work out those details and come to some agreements for the close approach part of the phase.

Davison: You also went onto work subsequent Shuttle-Mir flights. I think you worked STS-71, as well. Can you tell us about the emotions that you felt when the docking actually occurred? Where were you in the Control Center?

Engelauf: Yes, starting with 63, really. After we had made the close approach and separated back away from Mir, there was a huge feeling of accomplishment of everybody in the Control Center. A lot of the people who had been working towards STS-71, naturally became affiliated with 63. When we completed the rendezvous and the separation on 63, there was a huge, huge feeling of not exactly relief, but of success at having accomplished it and having pulled that all off properly.

At that point, I was originally assigned to go to Moscow to be the flight director representative in Moscow for STS-71. Bill Reeves had been in Moscow doing that particular job on STS-63, and we were essentially going to switch roles. He was going to come back and work a shift on [STS-] 71, and I was going to go to Moscow. But Bill established a pretty good working relationship with the Russians while he was in Moscow and had really served well in that position because of some situations that arose on STS-63.

At the same time, Bob Castle, who had worked closely with me getting ready for [STS-] 63 and was now lead on [STS-] 71, felt that my experience from 63 would be valuable in the Control Center for STS-71. So our office made a decision to switch those assignments around, and leave me here in Houston and send Bill to Moscow. It was sort of a step backwards, to me, in some ways, because I had been lead on [STS-] 63, and I was now going to be working for Bob on [STS-] 71. But happily, the rendezvous happens at a point in the crew day that's real close to our handover of shifts in the Control Center. So I was able to come in and at least sort of sit side-saddle with Bob during the flight and get to feel like I was having a real participatory role.

It was satisfying to me to feel like we had dry-run the procedures, validated everything, and we did make a few small refinements in the process of getting ready for 63. So I felt like we at least contributed a significant part to the success of 71.

Davison: We've heard the term RIO, the Russian Interface Officer, that was working with the flight director's office. Can you tell us a little bit about their role over Moscow and how they interfaced with you?

Engelauf: Sure. There are two different roles here that are significantly different in function. The RIO, or the Russian Interface Operator, was a Houston Control Center position that we invented specifically for these Mir flights. Because the Russians don't speak a lot of English and we didn't speak a lot of Russian, being able to have the two Control Centers communicate with each other mandated that we use interpreters for most of our communications. But we also wanted to be able to manage the flow of information and the conversations between our groups and have a function that could set up conferences between technical experts for the joint Shuttle missions, Shuttle-Mir flights. So we invented the Russian Interface Operator to be that focal point for communication, or facilitator for communications, between the two Control Centers. They managed fax traffic back and forth to the Control Centers, as well as the voice conversations.

The Shuttle-Mir missions were only a piece of Phase 1. Of course, we had the long-duration crew members on Mir as a secondary, or as a different function. I shouldn't say secondary. In order to support those people, we had a staff working in Moscow to provide long-duration mission support to those people. The head of that group was called the Ops Lead, and their function was to be sort of the primary contact to the NASA crew member on board Mir and to provide all the work on the ground for coordinating answers to questions or updates to science procedures, and that sort of thing for that crew member.

When it came time for joint missions, it's natural that the Russian Interface on our side and the Ops

Lead in Moscow would be one of the primary paths for our communication, either because the crews on board Mir were handing over from the oncoming long-duration crew to the off-going or to help answer questions. Plus, it made it a little easier to have an English-speaking American contact in the Control Center that we could call and ask to go find another individual and set up a meeting.

But for the Shuttle-Mir part of the missions, really the Russian Interface Operator and his Russian counterpart, the PRP [pronounced 'pay-err-pay'] assistant to the Russian Flight Director, essentially, were the official line of information for the short missions.

Davison: So the RIO would actually go over to Moscow during the Shuttle-Mir docking portion of the--

Engelauf: No, he was a Houston console position. He would sit at a console a few feet away from flight director console and would call and talk to his Russian counterpart, which was the POP, or the assistant to the shift flight director.

Davison: I understand now. Would they interface between missions, like between 71 and the follow-on mission? Would they interface with the shift flight directors about what was going to be happening on that mission?

Engelauf: Yes, we sort of evolved the RIO position. We set up extensive procedures between the two Control Centers for exactly what information would be exchanged at what milestones during the mission and the format of the information exchanged. We used the RIO to establish those procedures jointly with his Russian counterpart. Prior to the flights, we would build a document which would define all of the interactions between the Control Centers, and the RIOs were responsible for that document and for establishing those agreements with the Russians.

Davison: If we can get back to the Ops Lead, was that a position that was, I guess, supporting the flight director's office directly or indirectly, or were they supporting Phase 1?

Engelauf: Actually, more indirectly. They were really more supporting Phase 1. The flight director office initially did not have a very significant role in even the long-duration missions. We sort of were in a position of just doing the Shuttle missions themselves. The operations leads were not originally drawn from the ranks of mission operations here. We found out through experience that MOD's operational experience was valuable and applicable to conducting that function.

After Norm [Norman] Thagard's flight, we revised that function somewhat, so that those people were drawn from the ranks of mission operations and had a much more interactive role with the crew

member prior to them launching the Mir, so that they had established a good personal relationship prior to that flight.

The flight director office didn't have direct control over that function. We really sort of manned it from mission operations. But the flight directors were not in charge of that and it was almost a separate function. As that evolved through the duration of the Phase 1 Program, I think that relationship changed somewhat, to where although those people were still autonomous, the flight director office had a closer relationship with them. The fact that they had first-hand day-to-day experience with the status of Mir gave them a new position of relevance to the flight directors in terms of being a good source of information.

Davison: We haven't had a chance to talk to [William H.] Bill Gerstenmaier, but we noticed when we were doing some research that his name appears on the flight director's list there as--I forget the term that they used, whether it was a candidate or something. I didn't quite understand that. Maybe we'll have to ask Bill the background.

Engelauf: Yes, it's best to ask Bill, I think, in that particular case. Bill actually had been selected as a flight director, but he was doing a stint in Moscow as an Ops Lead at the time. He returned and set up shop in an office here in the flight director office, only for a very brief period of time, and was immediately swept away to another assignment over in the Shuttle Program office. So the details of that you'll have to talk to Bill.

Davison: When you mentioned whether they'd come from a flight director's ranks, I couldn't figure out how that transpired.

Engelauf: Well, they didn't come from the flight director's ranks. The Ops Leads were selected across MOD and essentially selected by the flight directors, or nominated, maybe, would be a better term, by the flight directors.

Davison: You mentioned that the RIOs, I guess, were assisting the flight director. We know that Sally Davis was one of the RIOs and since been selected as flight director. I think she's worked one of the missions so far now. So the experience the RIOs gained sounds like it was pretty valuable for what you're doing in the flight director's job.

Engelauf: Yes, I think it was. The people that we picked for RIO generally consisted of people who had a fair amount of operations experience and understood how the Control Center works and how to get things done in the context of real-time operations. Naturally, we tried to pick people who we thought were

talented and had a lot of capability. The fact that Sally fell in that category, I think, is the thing that made her a candidate for flight director. Not necessarily that the RIO job is a training ground or specifically suited to flight director office, but they should attract the same kinds of people.

Davison: Can you talk a little bit about your experiences over in Russia and tell us how many trips you took over there and the contacts that you made?

Engelauf: I'd have to go back and add up the list of travel, but I've probably made ten trips to Moscow in the last three or four years. As I said, I wasn't really one of the original people that started the Phase 1 Program, and a number of others had gone to some of the first working group meetings in Moscow. I think I probably went over on about the third working group trip to Moscow.

Before each of the Shuttle missions, we would have a joint working group meeting, where we would finalize a lot of the agreements that we had been working on. We would make any additions to the flight rules that had evolved since the previous flight. We would finalize the joint agreements. For example, the communication between Control Centers that I talked about before, with the RIOs, joint flight procedures that the crews would be executing and that sort of thing. And we would alternate. First, we would have one meeting here in Houston. Then for the next flight, the meeting would be in Moscow. Then for the next flight, back in Houston, and so on. I went over for three or four of those meetings in Moscow between flights over the course of the program.

Additionally, as my position in Phase 1 elevated to more and more significance, I wound up going to Moscow to be present for some significant events on Mir that were unrelated to the Shuttle. So I wound up making a handful of trips over for other activities, like EVAs with American crewmen who were on Mir, and things like that.

Every time I went over, the experience seemed a little different. At first, it seemed like I just sort of had bad luck. I always went over when it was extremely cold, it was snowing, just miserable. No matter what time of year I went, it seemed like we just really had bad weather. It's kind of strange, because being as far north as Moscow is, the sunrise was late in the morning and sunset was early in the afternoon. You would get up early in the morning to ride the bus out to the TsUP, out to the Control Center from Moscow, and it would be dark. Of course, it was often cloudy because it was winter months. We would go meet inside rooms that often didn't have windows. Then you'd go get on the bus at five o'clock in the afternoon, it was already dark outside. For two weeks at a crack, it just seemed like you never saw the sun.

The atmosphere was quite a bit different in Moscow than it is here because of the economy and so forth. You really didn't just jump in the car and go down to the local coffee shop for a meal. There just

weren't a lot of the things available that we were used to. People would take food with them in their suitcases, snack foods and things like that, because you couldn't just go buy a candy bar at the snack counter and things like that.

The people that we met, though, were just wonderful people. The Russians, I think they were at first a little suspicious of us, as we probably were of them. We've been on opposite sides of the fence for a long time. But as we got to work together and got to know one another and trust and respect each other technically, we really developed some really strong friendships and a lot of deep respect between each other, and that was really what made it liveable in the early days going to over to Moscow. People would take you in, literally bring you to their homes and share whatever they had with you and have you over for dinner and do everything they could to entertain you and make your stay in Moscow as pleasant as possible.

We did the same for them when they came over here. We would set up trips to Galveston or to visit the sites around Houston. Even took them on a trip to San Antonio, in one case, just to show folks around and show them a little bit of American life and culture.

Over the duration of the program, though, the conditions in Moscow changed significantly. My observation is it became much more Westernized. Private businesses flourished. Availability of goods that we take for granted became much greater than it was initially. Westernized shopping became available, so that we could go get toiletries and daily needs that we needed at shops close to the hotel. It changed quite a bit and became a lot easier to survive in the trips over there.

But the thing that was steady through it all was the friendships with the Russians, and we built up some really good relationships there that have been steadfast throughout the whole program.

Davison: One of the stories that we heard was, before the Soviet breakup, there wasn't that many products on the shelf, like what you said, but people didn't really want for anything. But now that the shelves are full of all kinds of appliances and food and everything you want, people just don't have the money in their pocket to buy everything that's there sometimes. So it's kind of a dichotomy that's been set up.

Engelauf: Yes, it's a tough situation. I'm sympathetic to the Russian people. They're going through a hard time. The one thing I can say is, just watching the individual snapshots that I have seen over an extended period, my impression is the conditions are improving significantly and things will improve quite a bit more in the next few years.

Davison: That's good. Let's talk about the transition that was set up between yourself and Bob Castle.

Bob Castle started out as the working group lead for three, and then you took over that job. How did the Russians accept that transition, and how did it work over here with you two?

Engelauf: It was a little bit--I don't want to say difficult for the Russians, but the Russian culture is such that people get into one job and they stay there for a long time. I'm not going to say their whole lives. But it's just not common for the Russians to change position or move around a lot, whereas it's almost standard in American business. If you stay in one place for more than a couple of years, people perceive you as stagnated in that job.

Bob had been with the [Phase 1] program pretty much since the beginning and had been one of the strongest technical forces through STS-71 and into 74. Even though we assigned individual flight directors as lead flight directors, Bob had been operating as the sort of head of Phase 1 for our office after Gary Coen's departure. He established an extremely strong relationship with Victor Blagov. Even after there was an official hand-over between Bob and myself, it was still Victor's tendency to turn to Bob first when there was a question or an issue. I guess I didn't really take much offense to that. I think I understood the situation fairly well. It wasn't like Bob had dropped off the face of the Earth either; he's only two offices away. So it's not like we stopped talking to each other or that he was banished from Phase 1. We still all pretty much worked as a group.

But over a period of time, when I was running the telecons with the Russians for a period of time and took over, of course, I was lead on STS-76, so that put me back into the forefront again for a while, and again on 84 and subsequently on 89. But as I became more prominent and showed up more often, Victor eventually got the idea, I think, that I was the primary guy at the time. We had a good working relationship.

Again, as I said, I'd been around since 63, so I wasn't completely a new face to Victor. It wasn't a terribly difficult transition.

Davison: Let's talk a little bit about the long-duration versus the Shuttle missions and how the operations differ, and maybe what we learned from the long-duration that we're going to bring to Space Station. Can you talk just a little bit about that?

Engelauf: I could probably talk for weeks on that. [Laughter]

Rollins: We only have so much tape. [Laughter]

Engelauf: There were several things that we learned that were actually sort of relearning things from

Skylab. The way we do Shuttle missions, these are short, seven- to ten-day missions typically, sometimes as long as fifteen days, which is the blink of an eye compared to the long-duration missions. The American crew members that flew on Mir had all had Shuttle experience. When we fly Shuttle missions, we staff our Control Center three shifts a day for the duration of the flight. We will call in any amount of support that's required to get answers to questions, because with only a ten-or-so-day mission, you really have to do the most you can to maximize return from the flight. You can't just wait until tomorrow to get an answer to a question; you have to get it now. The crews were used to receiving those answers right away.

When they flew on the Mir, the nature of the long-duration mission was such, coupled with the ground site coverage availability for Mir for the Russians, was such that crews would ask questions to the ground and folks would say, "Okay, we'll get an answer to that." But that meant tomorrow, or "It's Friday. We'll get you an answer on Monday." And that was extremely frustrating for some of our crews initially, not because that really wasn't acceptable, it just wasn't what they were accustomed to, and it had not occurred to anybody to change the expectations for those sorts of things.

The limited availability of communications between the ground and Mir, I think, was also a significant contributing factor to that kind of surprise, so to speak. Again, we have coverage about eighty minutes out of every ninety on Shuttle missions because of our satellite coverage. The Russians use primarily only their ground-site coverage, except for crucial events that can't be scheduled over the ground sites, and then they will schedule up a satellite, but that's very expensive and they try not to do that if they can avoid it. As such, the crews had much less communication with the ground. Much of the communication with Mir was dedicated to running the Mir systems, and so the availability of time for the NASA crew members to work science issues and so forth was really limited. As a result, again, crew members, I think, felt a lot of detachment and sense of separation from folks on the ground.

It took us a while to work up methodologies to combat that and to try to work around that. That was actually part of the genesis of the Ops Lead concept, of being able to provide a familiar voice and a familiar relationship that the crew members could feel more comfortable with when they were talking to people on the ground and to have a feeling that they really had a genuine advocate on the ground who was going to go off and try to help them out. We think that that worked well over the course of the program.

Obviously, it's very personality-dependent. Some people's needs are different than others. But it was something that we think we've relearned, I guess I would say. I think there was a certain knowledge of this already from the Skylab Program. But again, we had been doing Shuttle operations for so long that we'd fallen into a certain mode of operation. It's a matter of changing our expectations back to the other way.

Again, with short Shuttle missions, we'll work the full nine days or ten days of the flight, with hardly any time off for the crews. They work long days. I think we have gotten into the habit now recently of giving crews a half day off on anything over about a nine-day flight. The Mir crew works on much more of a five-day week, with a steady schedule and they have recreation time available to them. So there's a little bit more of a normalcy to those kinds of operations and feeling that you get up in the morning, you have some time to yourself. You have a work day. Then you're off in the evening, and you have your weekends to yourself.

Obviously, there were hardware failures and there's overhead tasks, just like the equivalent of our mowing our lawns and doing our laundry on the weekends, that still have to be done by the crews, but it's much less a sense of having your day totally structured for you the way we do in the Shuttle, where we've pretty much planned the crew's time down to the minute. Again, this is sort of a mental attitude that we had to get used to in planning the day for the Mir crews and something that we'll carry on into the station program.

Davison: You mentioned the communication difference, as far as availability. If you had a Shuttle-Mir flight and you compared it to a Shuttle Space Lab flight, would the communications be different? Say, when you're docked, would you let the crew kind of do their own Mir operations and not have a constant communication with them, like you would on a space plan flight?

Engelauf: Yes, very much so. We tried several different approaches to this during the course of the Mir Program, actually. One of the most difficult things we had to come to grips with was how to do transfer of the cargoes between the vehicles and to keep track of what got transferred and what didn't, in both directions, from the Shuttle to Mir and from Mir back to the Shuttle.

We tried on the early flights explicitly scheduling the transfer of every item, and that didn't work very well at all, quite frankly, because when we would stow the vehicles, what might be the highest priority item and the thing that you'd like to schedule first might not be the most accessible item on the vehicle. If you tried to follow a rigid order or schedule, you would wind up having to dig behind something to get to something else, take it over to Mir, bring something else back to Mir, but now you didn't have a hole big enough to put this in back in the Shuttle. Crews spent more time temporarily moving things and stowing them and relocating them than they did actually transferring them.

So we evolved that process a little bit and came up with some different ideas for on-board tracking using cue cards and lists that the crews could check off the items as they got transferred, and just scheduling large blocks of time and saying, "Go transfer stuff. Go move things around on the vehicles."

That let the crews, who could see the stowage configuration in the vehicles, use their judgment and their time to do that the most efficient way that they saw fit.

Again, over the program we actually did that in a couple of different ways. Before the Progress collision, when we had the Spektr module and a large amount of volume available to us on Mir, they actually staged all of the transfers. They basically took all the things that were going to go to the Shuttle and they put them in one module out of the way, and cleared out space in the different module for all the things that were coming on. That made it really easy. You could take everything out of the Shuttle and move it over to the Mir and put it someplace, and then take everything that was going to come back out of one place on Mir, and bring it over and just pack it in the Shuttle. That was extremely efficient.

But after the Progress collision, when we lost a significant amount of the volume available on Mir, we were unable to do that, and we had to go back to a mode that was much more strategic in terms of, "Let's clear out a little place here and take all these things over. Then we'll bring this big box back and put it in here," and so on and so forth.

One of the other things we did is, rather than trying to account for and transfer hundreds of little individual items, we would have the Mir crew returning, pack or pre-pack bags of return items. Then you had only a large bag with a known inventory of items in it that had to be transferred back. Once that was across the hatch in the Shuttle, then you knew you had transferred all those items and you could check those off. And the same thing going back towards Mir. So we moved from transferring individual items to transferring pre-packaged collections of items and again gained some efficiencies in doing that.

Davison: The communication between the Cap Com and the Shuttle was subsequently less often, since they kind of gained more autonomy?

Engelauf: That's right, because we pretty much gave the crew autonomy to do the transfers. We'd give them their marching orders, said, "Go transfer this stuff," and let them go off and do those things.

With the science missions, routinely the principal investigators on the ground want to participate in that science, so they will talk with the crew and keep abreast of the events all the way along, ask for observations from the crew through the experiments. We did some small amount of docked science while we were jointly docked with the Mir. Not very much. The main job there was to get the transfers done.

Occasionally we would have specific activities that had to be done at a certain time. For example, an item that was powered, that had to be transferred and plugged in in a short period of time, and we had to know where that was going to go. Then we would have some communication with the crew to make sure that the timing worked out properly and that you had the stowage location where it was going to get

plugged in was all cleared out, and all that sort of thing. But by and large, the communication with the crew was minimal during the dock operations in the later missions.

Davison: If we look at how the TSUP communicates with the Mir, I think, if I remember correctly, it was pretty much the flight director and other controllers talking with the crew. We use the Cap Com concept with the Shuttle. What do you think ISS [International Space Station] is going to adopt? Some compromise between that? Or do you think we're going to have a round-the-clock Cap Coms?

Engelauf: I project that at least when the operation matures for ISS, that it will be closer to the scheme that the Russians use now than what we do at this point. As to whether we have a designated Cap Com who is from the astronaut corps to work with the crew through specific items, I expect that we'll probably still do some of that. But I think also, just for variety and keeping the crew members in touch with the ground and providing them with a broader spectrum of contact, I think we'll probably go to a period of having more individuals talk to the crews and be in contact with them. Also, rather than having to spend a lot of time educating the Cap Com on the breadth of things that you might encompass in a long-duration mission, I think we'll go to probably having individuals who are expert on those particular topics come in and work with the crew on an orbit for those particular activities. In a science operation we'll still do, I think, very much the way we do space lab missions or other science missions, where individual principal investigators will have the freedom to talk to the crew for selected periods of time.

Davison: What about the shifts? We run now nine-hour shifts, twenty-four-hour coverage for the Shuttle mission. But the Russians use more of a twenty-four on and forty-eight off, or something similar to that. Do you project us going to something in between one of those ideas?

Engelauf: There's been a lot of discussion of the different methods that can you use to try to skin that cat. I'm a little reluctant to forecast how that's going to play out in the end. We have talked--I think everybody realizes that we're not going to be able to do the high-energy, three-shifts-a-day kind of support that we do in Shuttle missions. That's another thing that we already learned in Skylab. That we don't need to go do that again.

Exactly what format that takes, we've talked about shift duty officer concepts for quiet periods where you could have just the smallest handful of controllers in the Control Center monitoring the systems or available if the crew calls down, but sending most of the folks home weekend periods and quiet times. Most of the folks here are five minutes away from the Control Center if we really needed an emergency team on. But those concepts haven't really been 100 percent nailed down. But certainly we recognize that

you can't do ops the way we've done the Shuttle operations.

I think the twenty-fours on, seventy-two hours off type of approach that the Russians use, we'd have a hard time finding acceptance here initially and probably isn't required. I think it's driven by some aspects of Russian culture in the transportation systems that are available to them and so forth, and not required, given the infrastructure that we have available to us here. So I don't think we'll probably wind up with anything that looks quite like that.

Davison: When was their hand-over when they had that twenty-four? Is it in the middle of the day? Because you mentioned transportation. I noticed their trains stop at a certain time during the night.

Engelauf: Yes, it was usually in the morning. I think it was either seven to eight or eight to nine in the morning Moscow time. So the incoming team would ride the train in, when the transportation was still available for the off-going team to get home.

Davison: Since you brought the subject up, I remember some of the scary trips between the hotel and the Control Center. The traffic seemed to get worse every time you went over there, and more lanes where there weren't lanes.

Engelauf: Yes, noticeably. When we first started going to Moscow, I think gasoline was not terribly available. From talking to some of the flight controllers, simple car parts were not available. So there wasn't a lot of private automobile traffic early on when we started. But it seemed like every time I went over there, it got worse and worse, more heavily traveled. Yes, depending on which direction you were going in the morning or the end of the day, traffic could be quite a zoo. As you say, lanes where there weren't lanes.

I don't want to be critical of the Russians. I think what they do is probably fairly typical of a lot of other European countries. I think it's different from the degree of order that we're used to here in American highways. I won't say whether it's good or bad, but it was sure different.

Davison: Anybody that complains about the traffic on NASA Road One ought to go to visit some of the roads over in Moscow.

Engelauf: That's probably a good point. [Laughter]

Davison: Can you share with us some of your most memorable experiences during the Shuttle-Mir Program, whether they were in Russia or here in Houston?

Engelauf: Well, I had a handful of them. During STS-63, one of the issues that we were most concerned about, or I should say that the Russians were most concerned about, was redundancy of our jets, to make sure that we weren't going to come in and crash into Mir because we lost redundancy, and also contamination of the Mir spacecraft from our jets. As a result of that, we wrote a bunch of flight rules before the first rendezvous on STS-63 that mandated at least two lines of redundancy available for the rendezvous for certain key jets.

As a result of that, we did some work in the first couple of days of the Shuttle mission for STS-63 to test-fire most of the jets on the orbiter, so that we could say we have demonstrated the necessary redundancy prior to the approach. As fate would have it, we developed a leak. Actually, we had leaks on two jets, and those jets were leaking such that the Russians didn't want us to come and approach Mir. That would have been just a terrible thing to have had happen to us. It took quite a bit of effort and quite a bit of thinking and work to come up with a procedure to try to recover those jets, so that they weren't leaking anymore.

These happened the day before we were supposed to fly the approach. I was on the first shift of the day and wound up staying halfway through another shift. We came up with a test and a procedure, really, that allowed us to recover those jets. We finally persuaded the Russians that it was going to be okay for us to come in and fly that approach. But it wasn't until the morning of the rendezvous that we had finally gotten an agreement from the Russians that we were going to be able to go ahead and make the close approach. I was scared for a long time that we were not going to be able to get to that point on that mission, that we were going to lose the rendezvous. I remember that as being a great success of that mission, of being able to recover from that situation.

I also remember a number of other events, one of which ultimately took me to Moscow for a series of other pretty interesting events. After STS-84, in the May time frame of 1997 [in fact, it was June], I had the privilege of taking a trip to Europe with the STS-84 crew. We visited the Paris Air Show and visited a number of the European Space Agency facilities, along with one of our crew members, Jean-Francois Clervoy, who had flown on STS-84. I came back to work and had been only back a day or two. And I'll never forget it. I was just stepping out of the shower. My wife knocked on the bathroom door and stuck her head in and said, "The Russians just had a collision with Mir with one of their Progress vehicles and they're losing pressure. They're talking about abandoning the vehicle." This was being broadcast on the local news, which my wife was observing.

So I threw some clothes on and raced in here to work to find out whatever I could find out, and we had a fairly hectic couple of days here trying to really get our arms around what had happened and

understand the condition of the vehicle. Of course, Mike Foale was on board, so we had some concerns about his welfare, obviously.

[Subject's note: This next paragraph is probably what I said, but it does not come across accurately. We were aware of the EVA plan, and that is what prompted sending me to Moscow. The possibility of Foale doing it is what was new to us when I arrived at TsUP]

I had got orders to pack and head for Moscow as quick as I could get over there. So I got on an airplane and showed up in Moscow late one afternoon, slept the night in a hotel and rode out to TSUP with the other folks the next morning. As soon as I walked into the Control Center, Victor Blagov came up to me and asked to talk to me for a few minutes, and then explained that they were discussing doing an EVA to reconnect some electrical cables, but asked if Mike Foale would be available to do this EVA. This was the first I had become aware of this proposal for Mike to do the EVA. I think it was the first anyone had. I think it was one of those situations where because I had a good working relationship with Victor, it probably made it easier for him to talk with me and propose this than to try to pick up the phone and talk to somebody else in Houston.

For about the next two or two and a half weeks, I acted as sort of an intermediary there and worked with Victor and worked with some of our EVA experts on the prospects of Mike doing that EVA. Of course, the history will show, eventually we postponed that EVA until after the change-out of the Mir crew. But it was a pretty interesting time in Moscow during that period, right after the accident, and watching and learning a lot about the Russian process and how they recovered from that situation.

Probably the one other most interesting period of time was the fire that the crew experienced on board Mir, the oxygen-generation candle mishap. As fate would have it, Victor Blagov and Yuri Antoschechkine, and one of their other technical experts were here in Houston having one of our joint meetings with us.

Engelauf: We were just down the hall in one of our little conference rooms, meeting. We got the word here, from our folks in Moscow, about the fire. We were receiving the air-to-ground and picking up the transcripts and having them translated as quickly as we could. So I think Victor found out about that from me directly, because I'd gotten the information a little before he did. Of course, he got on the phone back to Moscow as quickly as he could, and tried to get a good understanding of that situation. Of course, history, I think, shows where all of that [went] eventually. But it was kind of intriguing to be in that situation of being the first one to break the news to Victor and, again, watch how they handled that situation and how they recovered from it.

Davison: That's interesting. Were you able to bring any of your family members over to Russia for any of the trips that you made?

Engelauf: Never have done that. My wife and I have talked about it. I'd like to be able to take my wife over. Of course, she also works in the program now and is involved in the ISS Program, so we're looking for opportunities when we might both have business over there. If that doesn't work out, we'll probably just wind up when one of us goes over for business, with the other one buying a ticket, and going on over and doing a little touring around. But so far, no.

Davison: I'm sure you painted a colorful picture for her from all the trips you've made.

Engelauf: Had some good stories for her. [Laughter]

Davison: I'm going to see if Rebecca or Paul have a couple of questions for you.

Wright: You worked on [STS-] 63?

Engelauf: Right.

Wright: You worked on [STS-] 91?

Engelauf: Yes.

Wright: It was just really a short amount of time between those two, but yet lots of experiences in between. Can you give us an idea of how you felt, from the exhilaration of being on the first one, to working on the last one?

Engelauf: Sure. This has been dynamic program all along. I don't think anyone could ever say that the Phase 1 got to a point of stable repetition. Clearly, the first couple of flights were far and away the most challenging because we were really laying the groundwork and really kind of polishing the procedures and getting things to where they worked the way we really wanted them to. It was all so new to us, and working with our Russian counterparts, whom none of us could have imagined, even a couple of years earlier, that we could possibly have been doing what we found ourselves doing in those early days of the program.

Now as we've gotten into the end of the Phase 1 Program and worked all the way through [STS-] 91, it's a transition, I think, more than the end of a program. I think all of us who are working in Phase 1

know that as soon as we finish writing our last post-mission reports and things, that our next assignments have already been given to us to work some aspect of the Phase Two Program, which I think has maybe made it seem like a little more seamless transition, but you can't escape the obvious significance of what's happened with this first true long-range joint endeavor.

Apollo-Soyuz was a one-shot deal. While that was valuable and I think we used a lot of that experience, this is the first time that we've had an extended relationship with another group of folks. Some of the people that we worked with on Mir, we may not be working with in ISS. That's unfortunate. It's sort of sad for some of us, because we've built good relationships with those people. But it's been, I think, extremely satisfying to see the evolution of the whole program, watch the maturing of the working relationships with the Russians. I think people take that as a positive springboard into the Phase 2 Program. So while you can be melancholy about the end of this program, I think people think of it in a more positive way.

Wright: There are all kinds of duties and roles and jobs that you could have done during this Phase 1 Shuttle-Mir Program, but you're a flight director. Would you have done anything else? Are you glad that you're in the position that you're in?

Engelauf: I think if you ask that question of anybody, the first thing they'll tell you is, "Well, I would have liked to have flown." [Laughter] But having been consigned to the ground, I think the flight director job was probably the job that I would have chosen if I would have had complete freedom to pick. I've had a fairly high amount of authority and freedom to go do my job in a lot of aspects. I felt like I was able to make a significant contribution. I really think I had an input into things that happened and steered things in the right directions when I had a chance to participate. So, in retrospect, I can't see anyplace where I'd say, "Gee, I wish I had been over there," or, "I wish I had been in a different place or been doing something different at the time." In this period of the program, I think this was the best place to be.

Rollins: When you were a little boy, did you want to be a flight director when you grew up?

Engelauf: Either flight director or an astronaut.

Rollins: Seriously?

Engelauf: Seriously. I'll never forget, when I was a kid, sitting in elementary school with my head down on my desk, listening to Alan Shepard's first flight, and I was bitten with the space bug.

Rollins: I remember that, too.

Engelauf: Through my whole childhood, I didn't miss a launch or a splashdown or a moon walk. I'm sure if you ask a lot of other people my age, I fell asleep on the living room floor in front of the TV, watching people walk on the moon in the middle of the night, California time.

I really did want to be in the program here and steered my education in that direction. Like everybody, I wanted to be an astronaut at one time, you know, but just the statistical probabilities of getting selected into that small pool of folks are tough. But as a kid, I used to remember reading the newspaper, "Flight Director, Gene Kranz," and I kind of thought that that was a fascinating job and would really like to be in that position.

I had a really interesting experience. About five years ago, I sat on a panel discussion in front of some high school students. I was on a podium with Gene Kranz and Henry Pohl and a gentleman from Lockheed. I looked down the row, and was sort of taken aback for just a minute, that I was considered worthy of sitting at a podium with people of that caliber, and that of all of my childhood ambitions, to sit in a chair that those kinds of people sat in, to sit in the flight director console where Gene Kranz had sat, and to be in the company of brilliant engineers like Mr. Pohl, that was probably the first time in my life that I ever really felt that I had accomplished my objectives. Because being the hard-driving type, we're always feeling like we should have done more or accomplished more or wish we'd gone further. But that was a real moment of satisfaction for me.

Rollins: What does one do to become a flight director? I mean, you sit at console for a while, right?

Engelauf: Yes. Most of the folks that work at our consoles come directly out of school and come here to be flight controllers. They're hire on to working in one technical discipline or another. In general, those people will start out in a back room working for maybe two or three years getting smart in that one technical discipline and learning the console skills before they're promoted to a front room flight controller position. After they have achieved that, they'll probably work out there for another three or four years, proving themselves and sort of catching management's eye, showing that they've got what it takes to do that job, showing that they've got the judgment and the technical expertise to do that.

Then as we pick flight directors here every couple of years, a lot of names get thrown in the hat. Some people are cut out for this job, and others aren't. It certainly takes a certain type of personality. You can't be too terribly thin-skinned. You got to think you're right all the time, or you can't do this job. [Laughter] But like I say, it takes a certain personality type. I feel like I'm fortunate to be counted in that

group.

Rollins: Thank you for your time. We enjoyed your stories.

Engelauf: Thanks.

Davison: What's next for you with your next mission?

Engelauf: Right now I'm assigned as lead flight director for STS-95, which will be the next flight in October, which is Spartan and Space Hab and has the crew with John Glenn on board.

[End of interview]