PAUL F. DYE

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Interviewers: Rebecca Wright, Mark Davison

Wright: Good morning.

Dye: Okay. Good morning.

Wright: Today is May 27, [1998] and with the Shuttle-Mir Oral History Project, we're talking to Paul Dye, who's a Flight Director for NASA JSC. We'd like to begin this morning by you telling us what your responsibilities and your duties are.

Dye: The most immediate thing is that I'm the lead flight director for STS-91, which is going to be the last visit to Mir, launching in about six days. As lead flight director, it's my responsibility to put the mission together, integrate it from an operations standpoint, and then execute the mission in real time.

I always like to point out that there are a huge number of people responsible for putting together missions, and everybody's view is from their own standpoint. Everybody's job is critical. So, while I, on paper, have responsibility for putting the mission together, there are an awful lot of people who have responsibility for putting the mission together: the flight integration manager, the flight manager, all the various people who have their little bits and pieces that put it together.

But our focus is on operations. It's on: are we ready to fly procedurally, are we trained to fly, do we have all of the rules in place, have we put together and do we know what to do once we light the fire and until we get the wheels back on the ground? Have we prepared to make the decisions in flight that need to be made? And then once we launch, we actually have to get in there and execute them.

So this will be my third lead in the Shuttle-Mir Program. I was also the lead flight director for [STS] 79 and 86. We rotate the leads around the office, the flight director office. We've basically had four main flight directors involved in Shuttle-Mir, in the project: Phil Engelauf, myself, Bob Castle, and Bill Reeves. Before that, we also had Gary Coen, who really started it, was the first flight director involved with the Shuttle-Mir interaction. But Gary had actually left the program by the time we executed the first dock and mission.

So, coming up here on 91, like I say, six days before flight, we're in pretty good shape. The rules are done, the procedures are done, the teams are trained, and we're ready to go fly.

Wright: How long does it take to prepare for a mission?

Dye: The pat answer to that is about a year, and that's standard. If somebody comes and needs us to fly a mission that's in the scope of what we've done before, but is new or we're going to fly a little bit different

payload, it takes about a year. For Shuttle-Mir, since this is really a cargo operation that we've done many times, we've cut that down, which is really kind of neat, because Shuttle-Mir's given us a chance to use the shuttle in a fashion that it was originally conceived for, flying the same mission over and over again. So it really takes us about nine months of real work on a particular mission for 91. To be honest, I was working STS-86 up until last October, when we landed that. So it's really been about seven months that I've only been concentrating on 91. Our crew assignment was a little bit late for 91, but everything's come together, because we've done this so many times. Now, of course, STS-91 also has the AMS payload on it, which is non-Shuttle-Mir-related, and that took a lot of our time, but the Shuttle-Mir part is really ticking along, because we've done it so many times in terms of ops.

Wright: Do your days get longer from the beginning to the end?

Dye: The days get longer and shorter at various parts in the preparation phase. There are key points in preparing for flight. One is flight operations review, which is at about launch minus four months, something like that, where we bring together all the checklists and all the rules and all the paperwork that we put together for the flight, and this is a checkpoint in time when we say, "Are we ready to begin training, the real intense training for the mission?" So that's a time that gets real busy, and you usually put in about an eighty-hour week there, around flight ops review.

When everything's done there, then we get into the training. This particular flow was interrupted by a big long science flight, STS-90, and so we couldn't train during that time so we had a bunch of sims before and a bunch of sims after-simulations-and so they were crowded together, and so those were very long weeks. Now that we get close to flight, the flight becomes our life. You know, you don't leave town for the last couple weeks, and you're working a lot more and you've got a lot of issues that pop up. So, the closer you get to flight, yes, the busier you get. And then the last couple days before the flight can actually become a little more serene, as the Cape is just working the countdown, the ascent flight director's worrying about everything's that going to go on, and most of the rest of the issues are wrapped up, so we try and take a day or two to catch a breather.

Wright: Tell us what happens during flight, once it's up.

Dye: Once you get in flight, of course, we're operating three shifts a day, so we have the lead flight director operating what we call the Orbit One shift, which is generally the crew's morning. The Orbit Two flight director comes in with his team and catches the crew's afternoon and evening, and then the planning shift comes in when the crew's asleep. The shift nominally runs eight hours, plus an hour of handover to the

next team, but because of flight events, you don't want to hand over during a critical event, so you have to lengthen some shifts and shorten others. So, you generally work about a ten- or eleven-hour day. The lead flight director generally works at least a ten-, eleven-, twelve-hour day because there's all sorts of little issues you work on before you come in, and then you stay a little bit later to keep track of what's going on. So it's pretty much all-consuming once you're in flight. Even when things go smoothly, you're really, really working it.

Of course, we all have NASA TV at home on the cable channel, and so you go home and you turn NASA's TV on, and that's on until you decide to go to sleep, so you don't really get away from it, either. But that's why we do it, because we really enjoy it. It's not a burden, it's just once you're involved-

Wright: It's a passion.

Dye: Yes, it's a passion, and you want to be involved in everything that's going on. You don't want to miss anything.

Wright: Does your job allow you to be involved in all the aspects of-

Dye: That's probably the best part about being a flight director, is that some people figure, they look at flight directors, and they see that we're sitting there in the middle of the room and we're in charge, and they figure that the overriding goal of a flight director is to be king. And it's not. The real interesting part about being a flight director, to me at least-maybe we do have some folks who want to be king-but to me, the most interesting thing is knowing everything that's going on. I don't even need to be the one who makes the decision. As a matter of fact, I like to let the right people make the right decisions. The people who know what's going on are the ones who should be the key ones to choose what needs to be done. I just want to know everything that's going on and to be on the inside. That, I think, is one of the interesting things about the flight director job.

Wright: I wouldn't have to mention that trust and communication are two ingredients that make your job easy.

Dye: It really is. I mean, I tell people that, "You may make a bad decision, but as long as I knew about it and knew what you were doing, I'm not going to get angry. Now, if you make a bad decision and you covered it up or you didn't tell me what was going on, or I find out about it after the fact and have to clean up the mess, that's bad." But as long as I'm kept informed about what people are doing and what direction they're headed and what decisions they're making, I'm pretty happy.

So I find that I'm, a lot of times, saying, "Yep, that's a good idea. Go. I'm glad you did that." People go, "Gee, I wonder if Paul's actually doing anything." Well, I'm allowing people to have their rein. And there are times when we have to step in, however, and say, "Well, okay, this is what we're going to do for the good of everything," because we have to mediate between the various groups. What's good for the payload might not be good for the orbiter. What's good for the Mir might not be good for the orbiter, and so you have to step in and make decisions. But a lot of times they just get taken care of by themselves, by people doing the right work.

Wright: How many of these "right" people feed in to you during your duty as lead flight director?

Dye: Well, there are a lot. You know, it's easy to say that it's a dozen or fourteen people that are the front-room operators in the Mission Control Center, but there's a lot more than that. There are the folks that are involved in planning the mission that I never see on console. Just, for example, the flight planning manager, the flight manager, who's bringing together all the payloads and all the integration, all the paperwork, all the detailed design work that has to get pulled together to make the flight work. It doesn't have a real-time role. But if I were to list, in the planning process, the people that I see a lot in the control center, that I see in the planning process, the flight activities officer, who puts the flight plan together, the payload officer who brings all the payload aspects to the game, those are kind of the key teams that we work with in the integration time frame.

The core orbiter systems, the people who watch over the orbiter-the mechanical systems officer, the electrical, the environmental, the DPS-I may not see very much of them in the preflight planning process, because their jobs might not be significantly different from mission to mission. If there is a significant difference, then they'll get brought into the process, but there are disciplines which are very routine, that are supposed to be routine, and so they pretty much show up for the sims and we don't see a whole lot of them other than that. But almost everybody has some key role, or at some point in the planning process has a key job that has to be looked at and that applies to that particular mission. So, we see everybody.

Wright: Do you experience this with Shuttle-Mir? You've already had two, you're on your third. Have things been routine for you, or have you had experiences that weren't so routine that you had to-

Dye: Well, there are a lot of times. Of course, I've been lead on two, and this will be the third, but I've worked every Shuttle-Mir flight as a flight director, with the exception of 89. I had to sit 89 out, because nobody gets to work everything. But I work more Shuttle-Mir flights than any other flight director. You know, there haven't been any disasters, and so some of the times when I start looking back at trying to think

about interesting things that happened, it's hard to think of any of them, because they kind of seem trivial. We have had everything go so smoothly, in retrospect, on the whole Shuttle-Mir Program, that it's hard to think of any major events. There have been cases where the Mir lost attitude control or we lost attitude control. We lost vernier jets, and then we had to have the Mir take over. That sounds dramatic, but it really isn't.

I think, though, that the essence of our job is anticipating the problems that could go wrong, and when you get into sims, you get those. They give you all these bad problems. And so, in sims, you know, you're always working failures. You're working big failures. You're working fires, you're working cabin leaks, you're working, we docked and immediately picked up a big cabin leak, which means we poked a hole in something during the docking process. Or something bad like that. And you have those over and over. You know, we've been doing Shuttle-Mir for close to five years, and those are the things that stick out in your mind, because a sim, a simulation, is so realistic that it's the same as a flight. Therefore, when you get all these disasters in sims, they remind you, or they're the ones that stand out, and the flights themselves become kind of lower level because they all went so smoothly, if that makes sense. So it's hard to think about the excitement, the bad excitement. The good excitement is, "Wow, we really docked!"

The first time, on STS-71, it all worked. I can't believe it. The crews make it look smooth when you get into flight, and the flight control teams make it look smooth when you get into flight, and there's nothing as much fun as going around the room for "go, no go" for docking and getting a crisp response out of everybody on the team. Everybody's watching, they're concentrating, they're paying attention, and you get around the room in ten seconds, and then they give the crew a "go" for docking and they do it. It's really something.

Wright: The confidence must be exhilarating.

Dye: Yes, yes, it is. You know, everybody is in sync and really running. Probably the things that stick out on the Shuttle-Mir flights are truly the things that if they go wrong or if they had gone wrong, wouldn't have made a big difference anyway. The things that happen are changes to the transfer list in flight. The crew discovers that there's something that needs to go over to Mir that, you know, the person who's going to stay on Mir decided they got on board and discovered that they didn't have enough towels, which sounds trivial. They want more towels. Well, if it's not on the official transfer list, it's got to get put on the official transfer list or it can't get left on Mir. Likewise, if there's something on Mir that the Russians want to come back, if it's not on the official list, it can't come back on board the Shuttle. So you end up working these items like crazy in flight, and they consume all your time. So you remember them, and you go, "Golly, we

worked this so hard and we worked that so hard," but if you hadn't worked them at all, history would never remember it anyway, because it's not a big deal whether a guy had enough towels or didn't have enough towels, you know. They're going to get by.

We ran into, on 86, I think it was 86, we got on board and discovered a keyboard that was on board. Jean-Lou [phonetic], when he was on board the Mir ten years before, on a French flight to Mir, he'd had a keyboard, a musical keyboard that was there. When he got back up there on the Shuttle, the Mir crew dug this thing out and gave it to him. He'd forgotten all about it. I mean, it had been on board Mir. It gives you an idea of how much stuff is stored on board Mir, because they have no way to get rid of these things. And so they gave it to him, and we saw it on board the Shuttle, on a TV downlink, and you would've thought that the whole bureaucracy had fallen apart. I mean, everybody was going crazy over this thing, because the safety folks didn't know where it was, what it was from, what it was doing there, and it wasn't on the list and we didn't know what was in it, we didn't know what the batteries were all about. We had to tell the crew, "Would you please get that off the TV? It needs to be in the Mir, because it's not on the official list, and we'll try and see if we can get it approved to come home."

And after four days of work, we finally got it on the approved list to come home, and then it could officially show up back in the Shuttle. But meanwhile, it achieved a place of prominence in the Mir base block, so that every time we saw a video of the Mir base block, it was clearly there in the picture, so that that was the crew's way of saying, "We have taken it off the Shuttle, we've put it back in the Mir, where you wanted it to be." There were all sorts of people scurrying around on the ground, worried that this thing, worrying this problem, which, it wasn't a big problem. We were docked. That was the biggest problem. I just want to get docked. And then we got the cargo transferred, we got the crew transferred. Those are the big things. So it's all the little things that consume your time.

Wright: Do you coordinate that as well, the crew transfer and the cargo transfer?

Dye: We do. The payload officer has to coordinate all that with the Phase One Program Office and the Russians, and we also have a very important position that I have to mention, which we created for Shuttle-Mir, called the RIO, or the Russian Interface Operators, who, in a certain respect, they're the operator who is our liaison between our control center and the Russian control center, and they do all the work that the flight director doesn't have time to do, all the detail work. They manage the interface between us and Russia. I don't have to call my Russian counterpart and say, "Hey, let's talk about this transfer item that wasn't on the list," or is on the list, or needs to be. I can say, "RIO, go deal with that."

The RIO also is in charge of all of the loops between Moscow and here, and the interpreter cadre

that we have. They can assign interpreters to various jobs and translators to various jobs, and so they do an important job. So, yes, I'm responsible for everything that goes on, but that doesn't mean that I have to do everything. We delegate a lot. I delegate everything, if I can.

Wright: I always heard it was a sign of a good manager.

Dye: Well, it keeps you-it's like some people are surprised that the flight director doesn't talk to the crew. Generally, we don't talk to the crew, unless it's some special event and we decide we want to do it. We can, but we just don't, because we have the Cap Com. The Cap Com is a very important person in the program, because it's always an astronaut, sits right next to us, does all the communication to the crew.

During every flight director's training, there comes a time where you decide, "I want to see what it's like if I try and run the flight control team, run the mission, and talk to the crew at the same time." You either decide or it happens, because the Cap Com leaves and you punch up, and you very quickly discover that you cannot talk and think very well at the same time. And so while you're talking to the crew, you can't be thinking about what you need to do, and the same thing's true of working a lot of problems. My feeling is that a good leader needs to be thinking a lot, and so I try and delegate as much of the talking and as much of the other work as you can, so that you can be looking at the big picture.

Wright: Next week you'll be right in the beginnings of 91. Give us an idea of how your day starts and where it goes from there.

Dye: The day starts really early. For 91, the day is going to start, for me, about three in the morning, here in Houston time, and we'll have to be on console, I think, by about four, most of the days. Actually, we have to shift the schedules around a little bit, so we actually shift backwards in time. I think the first shift, we go in about seven in the morning, and the next shift we come in about four in the morning and then it's about three in the morning, which, golly, means I've got to get up at two.

But you get up early, you get into the control center, and I usually try and get in about fifteen minutes before my assigned handover time. I like to wander around, drop my briefcase off. The first thing I always do is look at the flight director when I walk in, who's on console, and do a face check, and see if things look bad or if things look routine, or if things look really good. You can tell, as soon as you walk in a room, whether this is going to be an easy handover or a difficult handover.

Once I get a feel what it's going to be like, I either sit down and find out what the problems are, big picture, just take two minutes, and I just say, "What's going on?" And if it's pretty routine, then I can relax and I can wander around, maybe wander through a back room for a couple minutes. We set aside an hour

for handover. The first half hour is for a person to come up to speed on what's going on on their console, and the second half hour, we bring a whole oncoming flight control team on a conference loop, and we talk about it, so you find out what's going on with everybody else.

So that first half hour is, you sit down, you read the handover logs, you read the logs, you read all the notes and the flight plan, and you exchange information with the person you're taking over from-the flight director, the case for me-and then you get ready to talk. If that's routine or not, you know, you get through the handover, you talk with your whole team. When everybody's up to speed on what's going on, then you release the previous team. You come up on the loops and you start running things.

Now, if it's a nice day, and the planning team has done their job, you've uplinked all the morning mail to the crew, you can just sit back and let the crew do the job. There are a few things that you have to keep track of, little routine things-making sure that the Com coverage stays there, negotiating attitudes, negotiating communication time with the satellite-but there are people who do that for you.

So basically, you sit there and you hope that everything goes well. You tick off things on the flight plan. And ninety percent of the time, that's what happens. Then people say, "Well, what in the world are you doing there if you're just ticking off on the flight plan?" Because while you're ticking off things on the flight plan as they happen, you're also planning ahead. You're looking ahead for the next day and the day after that. You might be looking out at consumables to see how you're doing on hydrogen and oxygen, and see if you can make another day, get another day on orbit if you have to. You're looking out ahead for landing opportunities. You don't really look at weather until the last couple of days, because weather is just too dynamic to make any sense a week in advance. But you're looking at those kind of things. You're looking at the big picture to see, how are we doing on transfer items, how are we doing on the payloads, are we going to get there, are we going to have a big jumble at the end. And so I would say that most of your time is spent looking ahead.

Now, if a failure occurs, usually they're small things: a small experiment, power doesn't come on, or a computer locks up. You know, these are little things, and so you might tell the crew, if the computer locks up, "Well, try a reboot first." That's what everybody does, you know. "That didn't work." "Okay, well now we've got a failure." So you send somebody to go off and try to figure out what it might be that they have to work on. Maybe they have to work on their software. Maybe they have to have the crew take the computer apart and try to figure out if there's a problem. So, you know, you can deal with those things in a pretty low-key fashion, and your day just goes on like that.

When it comes time to be the end of the shift, you do the handover to the next team, and then I usually go home. On this flight, we'll be getting home around early afternoon. I'll probably stay up for a

while and enjoy the afternoon. Then just before bedtime I'll turn on the NASA channel and I'll see what's going on, see if it looks like the crew's going to bed about on time, and if anything major has happened. If I hear things that don't sound normal, I'll call the console, find out what's going on, so that I can prepare mentally for getting up the next day. And it just repeats. We do that for ten days, and we bring them home.

Wright: What are your duties after?

Dye: Afterwards, if it's been a very smooth mission, you can relax and go to a few debriefs. We usually debrief with the crew as quickly as we can, with the flight directors. Generally, one of the very first debriefings that the crew has is with the flight director team. We sit down in a room and have some handshakes and talk about anything that they didn't like or things that went right. If you have a major problem, of course, you can end up spending a lot of time looking into that major problem. Now, we haven't had that on any Shuttle-Mir mission so far. We haven't had a failure to dock or a big deal. So it's pretty much collecting the lessons learned, trying to write them down, writing a report with the Russians, a joint report, saying, "Hey, we learned this, we learned that. We'll do this differently this time," or, "This worked really well. We'll do it that way again." And then pretty much organizing the history, organizing the logs, saving them off, and getting ready for the next flight. Because you've always got another; there's always another flight.

Wright: That's the good news.

Dye: That's the good news, you bet. Now, Shuttle-Mir's ending, and so we're not going to be doing these anymore, so the next flights are some, are going to be different things, which is kind of exciting, too. We've gotten to where we can put together Shuttle-Mir missions pretty easily, and now we've got to start looking at different kinds of things, and specifically International Space Station assembly.

Wright: The Shuttle-Mir flights have turned into routine, but I'm sure at the beginning, the obvious difference is the fact that we were dealing with international partners. Can you give us some of your experiences on how you worked with the Russians in some of the first meetings that you had?

Dye: Yes. I was fortunate in that I got involved with Shuttle-Mir before it was Shuttle-Mir. Back in-and I forget-you'll have to look up the dates-'92 or '93, I think it must have been '92-I was asked by my division chief, I was a section head down in the Mechanical Systems Section, in the Systems Division. We were the max flight controllers. I have a penchant for doing a lot of mechanical things, and being an airplane kind of

guy, and building airplanes and the like, and so my division chief knew I liked hands-on kinds of projects. He said, "Hey, there's some work going on with the Russians, talking about Soyuz spacecraft, and we need somebody looking at the Soyuz as maybe making it a lifeboat for the International Space Station. So would you take a look into that and talk with Gary Coen?" who was the flight director, who was following it at the time.

So I went over to the JSC library and I picked up every book that I could find that had anything to do with Russian spacecraft, and it was only about four or five books, and I went through those. Then I talked with Gary Coen and he said, "Hey, we're going to go to Russia." Wow! We're going to go to Russia? This was just after the breakup of the Soviet Union. I'm talking a month or two after the breakup of the Soviet Union. He says, "Yes, we're going to go to Russia in August." And so I said, "Well, this sounds like a pretty good trip." And sure enough, I said, "Well, do you think you need me to go along?" They said, "Yes, we'd like to have somebody who's familiar with spacecraft systems. We're taking along a rendezvous person and a trajectory person, and so we need a systems person to come take a look at their systems."

So we went to Russia. And actually, it was a group of about thirty, like thirty NASA people went over there, and we didn't have a program in mind at the time, but we were thinking about the possibility of docking, of their docking systems, and maybe we could do something having to do with the Shuttle and docking. We very quickly decided that what we should look at when we sat down with our Russian counterparts was, we should look at maybe docking the Shuttle to the Mir. I mean, this was very early stuff, and we started looking at how we could do that, and the meetings went on.

I think my first impressions of Russia were interesting, because, I mean, who had any idea what it was like? I remember that the NASA worked with the Russians back in Apollo-Soyuz but most of those people weren't around anymore, so for those of us who had never been there, this was-I grew up in the sixties, worried about bombs and nuclear war and the whole shot, and, I mean, I firmly believed when I was a little kid that the world was going to end in a nuclear war between us and Russia.

By the time I got over there and started seeing the place, Moscow was very smoky. As a matter of fact, right now we're having a terrible time with smoke here in the Houston area, from a bunch of fires in Mexico. But my first recollection of Moscow was this incredible smell of grass fire. They said, "Yes, we're having problems." There were fires in the peat bogs all surrounding Moscow, and they said, "It's been going on for a year, and it's going on for more." And it was hot summertime and so it was very smoky. I always kind of thought of Moscow as a pretty gray, brown place.

But the people were interesting. You could sit down in a room with Russian flight controllers and

you could pick out who the flight directors were, and you could pick out who the systems guys were, and you could pick out who the ground controllers were, because they looked just like our flight directors and our ground controllers and our systems people. I know that sounds kind of funny. It might sound prejudiced. It's not intended to sound that way. It's more of a humorous content. But what we discovered was that their flight directors thought, talked, and worked the same way we did. Their systems flight controllers thought, talked, and worked the way ours do. And they could sit down together and immediately work on problems together with the same frame of reference and the same set of concerns and the same professional outlook on how you do business in space.

The big problem, of course, has always been the language barrier. I don't speak Russian. I tried. If I had enough time, I'm sure I could learn it, but I don't have that kind of time. So we have to do everything with translators, and that takes a lot longer. Of course, we joke about the fact that we made a big mistake, that was not really correctable, in that we hired English-Russian translators, which was great, except that we don't speak English; we speak NASA. We had to train our translators in rendezvous, in spacecraft systems and launch processing, and how you do space missions, so that they could understand the language that we were speaking, and then they could learn the similar thing from the Russian side.

So it took a long time to bootstrap our interpreter cadre to the point where we could just work fluently between the two teams, because when you could see a Russian struggling to communicate an esoteric rendezvous concept that they knew we understood, and we knew that there was something that they were trying to communicate, but the translators didn't have the common language of orbital mechanics yet, which they do now. So it was interesting to work with the folks early on. To this day, we find that their flight directors and their people work so well with us, once we understand, once we get across the language barrier, the things are pretty much intuitive.

We've had subsequent trips. I've think I've been over there about five times. Each time, it's something more interesting. I was over in Russia preparing for STS-86 last summer. We do a week-long meeting before each mission, and we trade those meetings between Houston and Moscow, so it was my turn to be in Moscow for a week. We were sitting down doing pretty much routine stuff. All we were doing was minor flight rule changes and the like, and of course, we had a crewman on the Mir. We were meeting just down the hall from the control room. Victor Blagov [phonetic], the deputy flight director, my counterpart, said, "Oh, we need to take a break, Paul. We're about to dock the Progress. So let's take a break from the meeting and come out to the control center and we'll dock the Progress."

Of course, they don't have continuous communication coverage like we do, or near continuous. So they were LOS for a long period of time, and they were just going to come acquisition a signal and he said,

"Well, when we come AOS, they should've just docked."

Well, Victor went down to the floor and I went out to the viewing room balcony, and I was leaning over the rail of the balcony, and I had an interpreter handy. They came AOS, and it was just nothing but fast-paced Russian. My interpreter said, "I don't understand." I said, "What are they saying?" He said, "This doesn't make sense." I said, "Well, just tell me what they're saying." Things like, you know, "Use all the air, dump all the air. Seal it! Seal it!"

Turns out that what had happened was, this was the Progress collision, so I was in the control room, the Moscow control room, when this happened. It was just, I mean, it was kind of odd that we happened to be there, and watch their team deal with this crisis, and get the Spektr sealed off and get the spacecraft stabilized. That was kind of the end of our meetings for the week. I think that was on a Wednesday, Tuesday or Wednesday, and for the rest of that week, pretty much the Russians were really trying to save the spacecraft and get it stabilized, and we were there trying to stay out of their way but observe it, and watch how they worked in a crisis.

It was really interesting to watch, because it was very similar to the way we would. The first and most important thing is to stabilize the situation, stop the leak, stop the problem, then get your power back and then get your control back, and then start digging out and cleaning up the mess. Worked just the same way we work.

We had somebody over there previous to that. We had another flight director over there when their fire occurred, and I was there for their depress, and we started thinking that maybe it was not a good idea to keep flight directors there, because every time we sent a flight director, they had something bad happen on the Mir.

Wright: You can get a bad name that way, couldn't you.

Dye: Yes. But it's interesting to watch when the things happen.

Wright: Did you feel more confident after watching that whole episode? Did you have some of the same trust feelings there that you did here?

Dye: Well, I don't thing that that incident changed anything in the way I thought, because I've had a good feeling about their competence pretty much all along, since the early days, watching them operate. I've said many times that Victor Blagov is probably one of the best flight directors I've ever met. It doesn't make any difference that he's flying a Mir or he's flying a Soyuz or if he were flying a Shuttle, the decision-making capability, the art of being a flight director is asking questions, asking the right questions.

Somebody brings a proposal to you, our job is to poke the holes. Look for the holes, look for the seams and ask those questions. Victor generally has the right answer long before anybody else has the right answer, and when you do get the right answer, it's obvious and you can't figure out why you didn't have it in the first place. He's been doing it for many, many years.

Similarly, their people are very, very good at getting down to just what needs to be done. I think part of that is because the financial constraints that they have been working under for a long time is that they don't have time or effort or manpower or money to waste, so they need to get to the heart of the matter and do what needs to be done.

They also operate with a little bit different philosophy than we do, because they're running a long-duration spacecraft. There's a big difference to how you react to a problem on a space station and how you react to a problem on a Space Shuttle. The Space Shuttle has to come home, and not only does it have to come home, but it has to come home in a short period of time, which means you have to maintain your capability to come home, and so we not only have to keep things safe, but we have to look ahead and make sure that we haven't lost something that is essential to coming home, or that we've lost redundancy to the point where we'd better come home now or we won't be able to come home.

Things happen quickly on Space Shuttle, therefore. You know, it's a two-week maximum stay in space, usually, shorter than that for Shuttle-Mir. You try to make every minute count. You're always looking ahead. You're protecting your redundancy, you're protecting your weather for landing.

In the Space station, if you have a problem, the first thing you do is say, "Am I going to die immediately?" "No." "Yes? Oh, well, okay, what valve do I have to turn? Okay, we're okay now." Or if I'm not going to die immediately, okay, great, let's sit and watch this a little while. And then you can take time to go on your backup system and look at what the next thing you need to do is. So it's a little lower pace, lower key.

I think that the Russians looked at us as being a bit frenetic about everything. We've always got to solve everything, we've got to solve it right now. But that's because of what we're flying. The Russians tend to pretty much let things happen, let things stabilize, think about the long term, and figure out what they need to do a month from now, to recover from what just happened.

Wright: It sounds like we've learned lots from working with them.

Dye: We did. We either learned it or remembered it. You know, we did fly Skylab, but most of those folks are retired now, and I think everybody knew all along that flying a Space Station is different than flying a Shuttle, and we probably would have come to the answers that they have, sooner or later, too, but by sitting and watching how they do business, and looking at it, I think we probably shortcut some of the

mistakes that we might have made. [unclear] flying our station, the International Station, so we'll see if we've learned the lessons or not.

Wright: Do you feel like we compromised, the two nations compromised, on how we did procedures, or did we follow more of what they already had in order, and then we just meshed with what they did? How did we come to a conclusion on how we were going to handle things, from your perspective, as the flight director?

Dye: My perspective, I think that we mutually learned compromise. I think we learned that sometimes you win and sometimes the other guy wins, and a lot of times both people win. I've had long arguments with my Russian counterparts over particular rules or particular procedures, but they're no different than I would have had with somebody on this side of the pond, over how I want to do something. And sometimes we win and sometimes we lose those arguments.

This might be an overgeneralization, but because of the nature of the Mir and the nature of the way their crews operate it, there is more emphasis on the details and procedures at the crew level. In other words, they let their crew figure out how to do the details, because nobody on the ground has seen the Mir for ten years. The only people who really know where things are and how things are fastened together and how things are tied down are the guys who are on board.

So, for instance, for this flight, we're going to be taking up a bottle of nitrogen with some trace gas in it, and we're going to blow it out the Spektr and see if we can see where the leak is in the Spektr. Our safety people wanted to see the procedures that we had for that, the joint procedures. Part of that involved the Mir crew securing this bottle of gas so that it wouldn't jet around the cabin if the hose came off. The procedure says, "Secure the bottle," and our safety folks said, "Well, golly, it's really not enough detail for us to know that it's been secured properly. What are they going to use? How are they going to use it? How are they going to attach it?" And we asked our Russian counterparts and they said, "The crew will secure the bottle. That's as much as we need to write down." And that's a good example of the fact that the details are left to the crew. The ground tells the crew what needs to get done on a given day, and the crew figures out how to make their day work.

On the Space Shuttle, we tend to put a lot more detail into the time line because if the crew on the Mir doesn't get everything in the day because they did things in a funny order or they just didn't get there, well, they'll do it tomorrow or they'll do it next week. No big deal. On the Shuttle, if you lose that time, you've lost it. And so we tend to time line our crews much more tightly on a Space Shuttle. We won't do that on the ISS. We're going to do the lessons of the Mir. We're going to give the guys a general list of

what needs to get done in the day, the way people work in an office. Nobody schedules my day except myself. I know what needs to get done, or people tell me what needs to get done, and I try and make it all fit. And so we'll end up doing a little less of the details for the crew, probably, and letting them have more discretion in how they do those things.

Wright: You mentioned there were a lot of similarities between the NASA counterparts and the Russian counterparts, that you could pick them out in a crowd. Did you find differences as far as how they handle business and how they may handle relationships between each other or with us?

Dye: Yes, there is a big cultural difference between Russians and Americans, and I can repeat the things that I've been taught about it and have found to be true. I'm not a sociologist by any means, but one of the interesting things that we have been taught and have found to be true is that despite the fact that Moscow is a European-looking city, with brick buildings that look square and rectangular and it looks like you're in Vienna or someplace, the Russians are not primarily Westerners. Their society is primarily an Eastern-oriented society. Their view of time, their view of relationships, are very different from what we're used to. It's almost more Oriental, Eastern than Western. I like some of that, but part of it that can drive us nuts a little bit is that their time orientation and their relationship orientation is so different.

Let me talk about both of those separately. We are very much time-oriented. We see everything linearly, and you've got to do this now, and when are we going to get together to do this and that and the other thing. And the Russians tend to more float around with topics, and they bump from one topic to the next, and they get things done on time when the deadline happens, but they're not so interested in the detailed schedule.

In America, if you're five minutes late for a meeting, that's a pretty big offense. Fifteen minutes late for a meeting, for a Russian, is just normal, and it's not late. It's not. It's not wrong to them. To us, if an American did that to you, that would be offensive, that they were fifteen minutes late to meet you or something, but that's normal for a Russian and that's accepted in their society.

Culturally, also, their relationships are very important to them. To us, as long as there's a person filling a particular job, we'll talk with whoever is filling that job. It doesn't make any difference who's on the flight director console, as long as there is a flight director there. The Russian society depends much more on personal relationships, and it takes them time to get to know you, and until they know you, they're less comfortable working with you, and the relationships don't work as well.

I have noticed, over the years, working with my Russian counterparts, that early on, we had to work every detail over and over, because we didn't have a relationship. They didn't know me and I didn't

know them. To write and approve a flight rule, we might talk about that rule a dozen times and explore every aspect of it and every detail of it and all the engineering aspects, and this and that and the other thing.

Preparing for STS-91, I'd have a rule change, I'd call Victor Blagov. I'd say, "Victor, I think we need to change this and that." He says, "Okay, I'll sign that." And it's not because that there was anything more or less technical about the change than there was about it four years ago, but because he's gotten to know me and I've gotten to know him and he knows that if I think that's right, it's probably okay.

So those relationships are something that we've learned about. In recognition of that aspect of Russian culture, we try and keep people in the same positions that interface with the Russians as much as we can, so that they can get to know people. That's why we kind of had the same four flight directors in our office working Shuttle-Mir pretty much all the way through the program, because the Russians are more comfortable working with people that they've built up relationships with. And so we've altered the way we do business a little bit in that respect.

Wright: They seem like they could have been obstacles, but you quickly overcame them.

Dye: Yes. I mean, they were obstacles early on and we just had to learn how to make that work in order to make the program go forward. Now we're at the point where, I mean, we've got awful good friends. I mean, we really are pretty good friends with a lot of people. We hope we keep working with them on ISS.

Wright: You have so much invested, it would be kind of a shame to lose that.

Dye: Yes, that's right. To lose that, yes.

Wright: Personally and professionally.

Dye: True, that's true.

Wright: As lead flight director, your days are long and they're busy, somewhat stressful, but at the same time, for you, they've been pretty much routine. But during those two missions that you've had, has there been a time where you've had to hold your breath and try to give everything even more attention than normal? Or on the other side, has there been a time where you've been able just to relax and let it go?

Dye: Well, I find that once we've gotten docked, things go pretty well. Things go pretty smoothly. So, you know, you never really relax when you're flying with a big spacecraft and you're responsible for half a million pounds of spacecraft up there, but I think the more tense times come, for instance, in the last two

weeks before flight. We have something that we talk about, that was described to me when I came here. I wasn't here for Apollo, but it was described to me as the "burning rocks syndrome." People tend to keep little problems in the back of their minds until they get really close to flight, and they can't stand it anymore and they have to bring those issues up. It's called "burning rocks" because apparently just before the Apollo 11 moon landing, some scientist, who was well respected in his field said, "I'm really afraid that when the lunar module engine touches the moon, that it could be the wrong composition of chemicals and the moon might explode." And, of course, he brought this up a couple of hours before powered descent. Well, thank you very much, but couldn't you have told me about this *before* we went to the moon? Now what do I do with this problem? Okay, that's an explanation of why we call it burning rocks, and maybe I've got the story wrong, but that's the way it was told to me.

Wright: That's a great story.

Dye: But the bottom line is, this happens all the time, and it happens all the time in the last week or two before flight. These little concerns that some specialist in some area of endeavor has been keeping in the back of their mind, they just can't stand to hang onto it anymore, because they're really afraid. And we've got to hear those things, because some of them are really important and significant. But in the last week, I've probably dealt with a dozen of these burning rocks, things that were just going to stop us from flying 91, because somebody had to bring up, "Well, I never really did give you this rule change, but, you know, we really can't do this."

My latest crisis is that when we dock with the Mir, we have two sets of six hooks each, on our side, which tie the two vehicles together, and you could have a failure, such that only one set of hooks latches. We've known that all along, and we've always said that you could fire our small little jets to maintain the stack attitude control, with six hooks latched, while you tried to get another set of hooks latched up from the Mir side. And one of the Russian structural people has raised a concern that he's just not comfortable with that anymore and he doesn't think we should do any jet firings.

Well, it'll take maybe an hour and a half for the Russians to get their side of the hooks closed, and during that time, the spacecraft is tumbling out of control. The Mir can lose electrical power and analog time, and then you're really in bad shape. Well, this is one of those things you say, "Well, what am I going to do with this? It's been safe to fly this way for nine missions, and here somebody's suddenly concerned." So you've got to talk about it. It's one of these burning rocks.

Last week, I think on Friday, I had four crises running at once. The Space Shuttle was sitting on the pad and they did a test and they were leaking water out of a fuel cell relief valve. Big problem. That

was one of them. And to tell you the truth, I can't remember what the other three were. Oh, the AMS payload had tripped off during a test, power supply had tripped off, and then we're all concerned that we could damage that, and what power supply were we going to use. And there were a couple others that I don't even remember now because they were the crisis of the day.

That's what our life is like the last couple of weeks before launch, all these little things that come up and pop up. Once you get into flight, it can almost be a relief, because things generally go much smoother in flight.

Wright: At least they're somewhat contained in one area.

Dye: Yes, and we also have pretty much control over them, because once you get in flight, there's a flight rule that says that the flight director has complete authority to do whatever is required for the safe and successful completion of the mission, which means, once we're on orbit, we're kind of in charge, and I can tell people to not worry about certain areas anymore. I'm not going to worry about them.

Wright: 91-is it more special because it's the last, or a little sad for you?

Dye: Well, it's a little sad, it's a little joyful. I mean, there's a certain aspect that says, "Wow, we've done this." I mean, people should never forget that flying in space is risky. There are a lot of things that can go wrong, and there are a lot of things that can break that there's nothing you can do about it. So there's a part of me that goes, "Wow, we will have done this ten times, and we're going to be successful every time." [Dye knocks on wood.] "And let's quit before we have a screwup." So there's a part of me that says, "Wow, we've done it and we're successful." It's like running a marathon. When you get done and you're still standing and when you finish a tape, it's like, "Wow, we finished, I'm happy." I can always remember that we did it.

There's a sad part that I might not be working with some of the same people all the time, but I think I'll see those and talk with them on ISS.

There's a little bit of joy in that we're going to start doing some different things, for a change. You can get in a rut, and it's kind of fun to take on some new challenges and look at some new payloads and some new systems and new ways of flying things, so that's going to be fun as well. So it's a real mix of things.

The 91 is actually a little bit shorter dock mission than we've flown in the past, because we have this AMS payload that needs more time. We're not having to transfer a lot of science to the Mir, or any

science to the Mir. We're just picking up Andy [Thomas] and bringing back the rest of the American stuff, so it's a little bit shorter. And in a way, it almost seems almost a little bit of a *denouement*. You know, it hasn't been as much of a Shuttle-Mir mission as the previous Shuttle-Mir missions were, where they were totally dedicated to Shuttle-Mir, so it's almost a little bit of a tailoff, to that respect.

Wright: Since you've been involved with all of them except one, does one mission stand out more than the other to you?

Dye: I think STS-71, the first time we ever docked these two things together, was a big deal. When I was down in Systems Division and we started this whole interaction with the Russians, I was joking with some folks. Everybody knew that I wanted to be a flight director, and it's not easy to get selected as a flight director, but I said, "Yes, wouldn't it be great not only to become a flight director, but wouldn't it be great to be a flight director on the first Shuttle-Mir docking mission?" I mean, that was impossible; that wasn't going to happen.

Well, guess what? It happened, and I was the flight director on STS-71. And when we actually tied these two things together for the first time, it was pretty amazing. It was incredible. Of course, we'd flown around Mir on STS-63, and we'd proven that we could fly around it without pluming it and knocking solar arrays off and doing this kind of stuff, and that was pretty exciting.

Wright: And you were involved in 63 as well?

Dye: Yes, 63 was my first flight as a flight director, and then we got on 71, we were there, and I was in the control center when we docked, and it was pretty amazing, it actually worked.

Wright: Can you tell us about, what was the reaction?

Dye: You know, I don't really remember. You get so focused and so-you know, you're looking at displays and making sure that the capture lights capture and then that the hard dock works. You forget. I guess I'd have to probably watch a videotape of the control center to see what people's reactions were when we did it, but I think, you know, when we got contact at capture, as there is on every flight, that's when you suddenly realize you haven't been breathing for the last thirty seconds, and you take a deep breath. It's not so much the contact light. You expect to see a contact light, but you really hope you're going to see a capture light.

And then I think STS-79 was my first lead, and that was pretty exciting, because the lead flight director is on for the docking, does the rendezvous docking, so it was my first chance to actually be the guy in position there during the docking. So that stands out. But they all kind of do run together. I mean,

that's a lot of flights and they all are a lot alike. You get to where you remember little vignettes, but sometimes you're not sure which flight they were on.

Wright: Any vignettes stand out in your mind?

Dye: I think that when we first saw [Robert L.] Hoot Gibson shaking hands across the hatch on STS-71, that was really something. We got some electronic still photos that were downlinked and they printed them out for us, of that first handshake, and they sent a couple of those out to the front room, to the flight director console, and I think each one of us flight directors stole one. [Laughter] We keep a copy of that.

Wright: Tape's running. [Laughter]

Dye: Yes, I know. Well, you know, it was just paper. But, you know, you kind of hang on to that.

Wright: Well, sure.

Dye: The views of Mir, I can tell you one that we worked real hard on. I guess it was 79. We had an IMAX camera and we wanted a shot. It was a payload bay IMAX and we wanted a shot of the undocking. We worked real hard to set up a shot of the fly-around, with a pass over New Zealand, because it was scenic, in the daylight, with the Mir below us. This is an IMAX shot. We were playing with lighting and we had to make the times work and we had the station keyed at a certain time, and then start the fly-around again so that we'd be on top at exactly the right time to make the lighting work and the position over the Earth work and the position of Mir work. And we tried it in sims, and we got it sometimes and we didn't get it at others. We didn't we think we were going to have good antenna coverage when it happened, so we didn't think we'd see it live either, we'd just get a crew report.

As it turned out, we undocked, we got into fly-around, we got the right lighting. We got perfect clear skies over New Zealand, and got the KU coverage, got TV coverage. We flew over the top and there was the Mir and there was the split between north and south New Zealand islands, right underneath us. It was the most phenomenal shot, Earth shot, I've ever seen from space. The pictures of New Zealand, the glaciers and the mountains and the like, were just crystal clear. It was an unbelievable shot, and I said, "Wow! This is amazing!" Not only is the shot incredible, with the Mir there, but that we actually got it. We set it up and actually got the shot. And it was a fabulous shot in the IMAX movie. That one stands out because of the amount of work we put into making the timing work and getting everything lined up, and you just get lucky sometimes.

Wright: And even though that shot was such a small amount of time that we're looking at it, it was definitely worth your time.

Dye: That's right, it was definitely worth it. We spent a lot of time getting it, and it was just amazing that it all worked out.

Wright: Was there a low time, a time that you felt maybe you got in this position and it wasn't the right thing for you to be in at the right time?

Dye: Those times usually come when you're fighting or when you're arguing with people over what you should be doing or whether this is the right thing or not. I'm afraid that when you get in flight sometimes, you get so focused on what you're doing that you can forget to look at the big picture and realize that you might be having an argument over a particular part in a flight plan or a transfer item or something like that, and if you just step back and realize that this is not a big deal, not only is it not a big deal, it's not worth arguing with people over. I can't think of any significant low times.

Wright: That's great.

Dye: A low time is when you're in the middle of the night, it's planning shift, the crew's asleep, the middle of their night, and an alarm goes off and you wake them up. You know, because there's one rule of planning shifts-I mean, you know, it's not the worst thing that can happen. I mean, for heaven's sake, the dog barks and you wake up at home in the middle of the night. I mean, it's really not that bad, but there's a tradition that the worst thing you can do in a planning team is to wake the crew up, especially if it's an alarm that you could have set the limit differently so it wouldn't go off. I've had that happen, you know. You're just mad at yourself that those things happen.

But I think probably one of the funny scary stories that I tell was STS-63, which I was the planning team flight director. One thing the planning team does is wake the crew up in the morning. So the planning Cap Com has the responsibility for coming up with music, wake-up music. My Cap Com was Mario Runco, who is pretty eclectic, has pretty eclectic music tastes, as do I. We talk about all sorts of kinds of music, and he was picking music. I can't remember whose idea it was, but we kind of collaborated together here in the middle of the night, on our quiet times, and decided that the music we should play for the last wake-up was "The End," by the Doors, which is a pretty radical piece of music.

We talked about this for a couple of days, and we finally decided, what the heck, we'd do it, because when you listen to the lyrics, it really says neat things about beginnings and the future, and things

will be better, and even though, if you look at the details of the entire song, there's pretty bad stuff in there. So we were a little worried about what management would say, but we figured we were waking the crew up at three in the morning, Houston time, management would probably be in bed, so we'd just play it.

So we were already set up, kind of worried about our choice, a little worried about what we were going to hear from our manager about this, but we decided to take the risk and do it anyway. So we played the music, on time, and we didn't get a response back from the crew. We didn't get any answer back. We didn't get a "Good morning, Houston" or "Gee, we liked the music," or "Gee, we hated the music." We didn't get anything. We called up, and we said, "Good morning, Atlantis," or whatever the vehicle was at the time, and we didn't get a response.

So, of course, then I'm starting to worry about, did it go up? "Ground control, GC, did it go up?" "Well, I think it did, flight." "Well, then make sure that the Com system is all enabled, and we'll play it again."

So five minutes later, we played it again, and Mario said, "Good morning, guys." Didn't get any response. And we did this three times, we didn't get any response.

I was starting to worry about, "Well, gee, Com have we got a breathable atmosphere on board, do you know?" And the weird problem was, was we had a very tight schedule for the morning. They had to wake up, go right into the de-orbit prep, and I was worried that if we didn't get started, we were going to miss the landing.

About twenty minutes, twenty, twenty-five minutes after this first call, I was starting to ask how we could set off an alarm. I wanted to set off a master alarm. I wanted to send up a limit that would set off a master alarm that would wake the crew up. We finally had a sleepy voice come up and say, "Houston, have you been trying to call us?"

"Yeah." And it turns out-they said, "Well, we're up now." Turns out that overnight, somebody had floated into the switch, kicked the speaker switch off, for the air to ground, and kicked it off, so they didn't get woken up by the music. But I always thought, and I exhibit that as a funny story, because here we were so worried about our choice of the music, and then, of course, it all got spotlighted. But it was kind of funny. I gave Jim [James D.] Wetherbee a hard time on 86, because he was the commander again, and we reminded him about that. That was kind of funny.

Wright: Sleeping in.

Dye: Sleeping in, yes, on entry day. It wasn't a good idea.

Wright: Now when we listen to the music on 91, we'll know who picked it.

Dye: Well, I don't have to pick it. [Laughter]

Wright: Oh, that's true.

Dye: No, that's planning team's responsibility.

Wright: At least we'll know who the DJ is.

Dye: Yes, we'll have to see what does it, yes, that's right.

Wright: Would you have done anything else? You've spent the last six, seven years doing this.

Dye: Being a flight director, to me, is the Mt. Everest of my career. Everybody goes on and leaves the flight director office and goes into some higher-level management. I mean, we've got Tommy Holloway running the Space Shuttle Program, we've got people in all sorts of positions. Gene Kranz, of course, ran MOD. Randy Stone runs MOD now. Former flight directors have key positions. Ron Dittimore [phonetic] and Jay Green, all of these positions of responsibility.

So there is life after flight director office, but I'm one of those people who just loves this job. Never really believed that I would get this job, and I was fortunate to get selected, and so I don't look beyond much. I can't think of much that I would rather have been doing the past five years, than being involved in this. Sometimes people stop me and they go, "Wow! You're a flight director for the Shuttle and you've been going to Mir. That is really incredible." And I have to remind myself, yes, it kind of is incredible, because it's what I do, and I just kind of have gotten used to it. And you don't want to say "jaded," because it's not jaded, and you don't take it for granted. I've been flying airplanes all my life, and while I might take off and land pretty routinely, I still have in the back of my mind the knowledge that it could go less than routine and that I have to be able to react to that.

The same thing's true of our job. So you're not dwelling on the things that could go wrong when you're ready for them. I can't imagine anything that I probably would have enjoyed more in the past five years than doing the Shuttle-Mir Program, and I hope that I keep enjoying these things and doing them. I tell people sometimes, I tell my management that if they assign me something that I really despise doing, I'm going to just go off and fly a cropduster for somebody, because I enjoy that a lot, too. But this is a great job and we've been working with a lot of great people. It's just a lot of fun.

Wright: I thank you for your time. I'm going to see if Mark has some questions for Paul.

Davison: I wanted to ask one question. When the Shuttle-Mir is docked, who determines whether it's going to be Moscow controlling it or Houston controlling it, and how do you all coordinate that decision?

Dye: That's a great question, because it's been an interesting-the answer to that-the question is asked by people a lot, and we ask that question a lot early on. "Well, who's in charge?" And the Russians used to ask that question a lot, the Russian flight control team, when we were planning for these missions. You know, someone must be in charge when we're docked. We said, "Well, we'll just mutually agree to it." They said-what did they say-"If more than one person is in charge, then no one is in charge." That's their saying.

But to tell you the truth, we never have really resolved the issue. If push comes to shove, and you had to make an instant decision for the good of the stack, there is not, on paper, that the Russian flight director's in charge or the Shuttle flight director's in charge. We mutually agree on a course of action.

We are fully responsible for the health and safety of our own vehicles. The way the rules are written on paper, I could unilaterally undock the Shuttle if I wanted to, and there's nothing that they could do. But I think it says a lot for our understanding of each other and the trust we've built between each other, that we finally realize that-I mean, early on, it was obvious the Russians weren't going to turn over control of the Mir to us and we weren't going to turn over control of the Shuttle to them, and over the years, we have realized that we don't have to worry about that problem, that we think enough alike and we understand the ramifications, the failures and the like, that we will come to the same conclusion, and therefore, we don't need to worry about who's number one, because we agree with other. And we've discovered that through sims and through flights. So we never did resolve the issue of which person is in charge, because we agreed that we would both be in charge.

Davison: What about as far as video? It seems like we get a lot more video downloading, at least from the Mir, when the Shuttle's docked. Is that coming via the Shuttle Coms?

Dye: Mostly via the Shuttle Com system. It turns out that we have-I mean, we have a worldwide satellite system, the TDRS satellites. We have pretty good coverage. Although when we're docked, we don't have as much coverage as we do when we're undocked, because the antenna, our antenna, can be blocked by the Mir. The attitudes have to be chosen. But getting a lot of TV is pretty routine for us. Getting a lot of TV for the Russians is a little less than routine. They don't have the same control over there, relay satellite, as we do. They have to buy time, just the way anyone else does. So they tend to get their TV over ground

sites, which is short bursts. I still maintain that they have the best videocamera on board, in space, than anybody, because they've got a commercial-quality camcorder up there which is just beautiful pictures. But we tend to have a little more time, and so we do get a lot of video from the inside of the Mir through our system when we're docked.

Davison: I notice these railroad spikes on top of your shelf in here. Are they engraved with missions that you worked and do other flight directors do similar-

Dye: Some flight directors have little traditions. My little railroad spikes. Those are-well, let me tell you. Hand me one there. I am known as "Iron Flight." Each flight director traditionally picks a call sign-a color or a mineral or an astronomical object. Those are generally what we've used. It started out when Chris Kraft and John Hodge and Gene Kranz picked red, white, and blue as their team colors. And if you saw the movie *Apollo 13*, you remember there was a step in there where Gene was given a white vest that his wife had done, and that's because he always wore a white vest because he was "White Flight."

I'm "Iron Flight," and I chose iron because I come from the Iron Range of northern Minnesota. And these spikes are taken from the railbed of the Duluth, Misabi and Iron Range Railroad, which is the iron railroad, which was put in to haul iron ore from the iron mines to Lake Superior, where it's then shipped down the Great Lakes. So these spikes came out of that railbed, and I've got a box of them, and after each flight that I fly, that the Iron Team flies, because when I fly, my team's the Iron Team, I clean up a spike and I engrave the mission number in the end. So, yes, we've got all of the mission numbers. Now actually I'm short about four spikes up there, because I've been so busy I haven't had a chance to clean up and engrave some more spikes. But that's what these railroad spikes are all about.

Some guys are bigger believers in tradition than others, and I kind of like to keep that tradition going.

Wright: That's neat.

Dye: So there are two very significant ones: STS-63, which was my first flight as a flight director, and it was our first rendezvous with the Mir, and then STS-71, which was the first docking with the Mir.

Wright: If you were in theater, we'd be saying, "break a leg." Is there something that you tell each other as you get ready to start a mission?

Dye: "Don't do nothin' dumb." [Laughter]

Wright: I think we'll end it with that.

Dye: Okay.

Wright: Thank you so much.

Dye: You bet. Thank you. It was kind of fun.

[End of interview]