NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

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HEFLIN: I am from Oklahoma. I grew up in a very small town in northern Oklahoma, Osage County, town of about two thousand. The thing that I really liked about that place was it was a town full of houses that had front porches. I wish I could live in a house today that had a front porch.

Welcome to what I will refer to as the cathedral of human spaceflight operations. [Heflin is in the Apollo Mission Operations Control Room.] That's how I like to characterize this place. Every time I come in here, I can hardly hear you breathing. See how quiet it is? It's a very quiet place. Of course, we no longer use the facility here, but when I come into this room, I'm absorbed by all the history that has occurred in this room, and we'll talk about some of that.

I used the word "history." Let me tell you and share with you that I really admire what you all are doing. NASA has done a very poor job, myself included, at capturing a lot of our background and a lot of our history. By the way, my thirty-seventh anniversary is this Friday, June the sixth. I can remember when I came to work here because it was 6/6/66 when I started here.

I look back upon the time I've spent here, and when I get a chance to talk to new employees, I tell them they ought to do something that I didn't do. That is, you should keep a journal. My problem every time I tried to keep a journal was I tried to write too much in it, instead of just a little phrase, a word, a person's name, a topic, because I found out that's all that's required. If you can just get those things down, then I think years later you can look back

and say, "Yes, I remember that."

I had the privilege of being part of this program and was interviewed some time ago, based on my [landing] and recovery [background] back in the Apollo days when we used to land spacecraft in the water. I went into that somewhat terrified because I felt like I really wouldn't remember a lot, but the folks, like you, who do these interviews, you know how to get people to remember certain things, because there's things you can ask. That's what occurred, so I think it was able to kind of help dredge some of that out of my memory.

I really do respect a great deal what you're doing. You're capturing a lot of the sort of things that need to be done. It's just sad that we've waited so long for this a program to come along and to grab all this. So appreciate your working in that arena.

So here you are in the cathedral of human spaceflight operations. Think of where you were. Some of things I'll probably tell you, you already know. Think of where you were in June of 1965. Some of you've already learned in the history process, that was the first time we used this facility to control one of this country's human spaceflights by ourselves. We had worked this room in conjunction with Cape Canaveral [Florida] and that control room prior to standing on our own, back in June of 1965. That was done with the second two-man Gemini flight. Up until that time, as you probably are very aware, we used to control all these flights from Cape Canaveral.

Go back to the Mercury days, and our control centers were actually sprinkled around the world. We didn't have the satellites in high Earth orbit to be able to allow for a worldwide communication, so every time we came across some island or some area, Australia, with a tracking station, we would have an astronaut, some senior systems people there, to act as a mini Mission Control Center during that communication pass.

Changed a great deal, of course, today. … If you look over on your right-hand side, you'll see a rectangular mission patch. It's an American flag. It's Gemini IV. I love the way NASA does things. It's Gemini IV, but it was the second manned Gemini flight. Of course, we flew unmanned vehicles as well. Gemini IV—that was the first flight we controlled out of here, so all of these mission plaques up on the wall over here on your right-hand side represent the missions that actually flew out of this room. You see all the Gemini flights that we controlled from here, all through the Gemini Program.

Hard to see for some of you, but the very last plaque on the bottom row far right is Apollo 7. That's the first manned Apollo flight that we flew from this room that you're in. I say, "room that you're in." We had a room like this downstairs, looked just like this. That was back in the days you'd fly a flight out of one room, and it would take months to really configure the next room for the next flight, because we operated huge mainframe computers. It took a lot of work to get the computers set up to control the next flight. So you'd be configuring a room prior, and then use the one that's like this one at that time. We also envisioned controlling two spacecraft at one time, which we did in the Gemini Program. We had two of them aloft at the same time, so we had control rooms operating them both.

So Apollo 7, first manned Apollo, and then up in the top right-hand corner over here, the triangular mission patch, the figure 8, is Apollo 8. That's significant, very significant, I think, [for] a couple of reasons, one very personal, and then one from a global standpoint. Of course, that was the flight where we went to the Moon, probably the gutsiest thing this country ever did from a human spaceflight standpoint. That wasn't my original thought at all. That comes from people like [Dr. Robert R.] Gilruth and [Dr. Christopher C.] Kraft and George [M.] Low and those who came before me. It was the gutsiest thing I think we've ever done because if you stop

and think about it, we left the Earth, we left Mother Earth to go to the Moon, and the second time we put human beings into a spacecraft, into the Apollo spacecraft. It's pretty gutsy. Not sure we could do that today.

That's a very significant mission and personally very significant for me, because I was a member of the landing and recovery operation back then, and this was the first time that I served as a NASA advisor onboard an aircraft carrier out in the Pacific for the recovery operation. It was on the USS *Yorktown* in the Pacific for the splashdown of Apollo 8 in December of 1968, and so it's a very, very special time for me.

I ended up on eight primary recovery ships as a NASA advisor to the Navy and to the deployed forces. We were a division of about a hundred and twenty some odd people, counting military people, civil service contractors back in the late sixties. By the time we did our last water landing, we were down to a group of about ten people, and I was one of the ten people. So what I did for the end of the splashdown era, which occurred with the Apollo-Soyuz [Test Project] mission in 1975, I served as a NASA advisor to the deck force on the aircraft carrier responsible for the rigging, for how you come alongside and pick the command module up.

I also interfaced with the underwater demolition teams, the swim team—this was the USS *New Orleans*, a helicopter carrier. So I was their NASA advisor to them. Also, we had an embarked helo [helicopter] squadron out of San Diego [California] that was on board that USS *New Orleans*, and I was the NASA advisor to them. The helicopter squadron, the underwater demolition team swimmers, and the deck force were my responsibility for the very last water recovery.

I'll tell you what. If you ever get in trouble anywhere, you need to be around a bunch of underwater demolition team swimmers or SEALS [Sea, Air, Land], Navy SEALS, as you

probably have heard them referred to at times, even though they're a little bit different. These are young men that if you get in any trouble, they can get you out of any kind of trouble, great bunch of young men.

That's my recovery story. So you go on across the wall there, and you see Apollo 8, Apollo 9, Apollo 10, of course, and then you see the eagle. "The Eagle has landed." Apollo 11 was controlled out of this room. And right here at the flight director console, Gene [Eugene F.] Kranz, flight director, gave the go to Charlie [Charles M.] Duke, the astronaut who voiced up to the crew, "You're go to land."

Very recently, we had a request, a media request, for release of a combination of the air-to-ground voice and flight director loop voice, about forty minutes before landing on the Moon through landing of about ten or fifteen minutes. I was asked to review that before it was released. I'm not sure why. Quite frankly, a lot of it has been released. Nonetheless, I got sent over a CD [Compact Disc] to listen to that. Of course, I've heard it before, but I hadn't heard it in quite a while.

This happened about a month ago or so, so it was real interesting to sit there and listen to the conversations that went on in this room. It's interesting, because as I listened to it, there were a lot more communication problems that occurred between the command service module and the lunar module after they separated and were on the backside of the Moon and coming around for acquisition. There were a lot more communication problems, and it sounded like a really hairy time for the people here. Close to landing the computer systems on board the lunar module were overloaded and still operating but created great pause and they were getting close to losing fuel when they landed as well, but it was really something to listen to again. I really enjoyed that a great deal.

Apollo 13, same Gene Kranz. Now, okay, how many of you have read his book? Have any of you read his book? Okay, that's good. Have any of you read Chris Kraft's book? By the way, that's my favorite book. I think Chris Kraft's book titled *Flight: My Life in Mission Control*, I think is the really the better of the two because of the history that Dr. Kraft goes into. Anybody read the book [*Apollo*] *EECOM* [Electrical, Environmental and Communications]: [*Journey of a Lifetime*] yet? Sy [Seymour] Liebergot, who was the EECOM here in Mission Control during Apollo 13 has just recently come out with a book. I've thumbed through it. I haven't read the thing yet, but I've thumbed through it. It's a good, good book. So Apollo 13 was controlled out of this room as well, and Gene Kranz was obviously a key flight director that worked that flight as well.

While I'm talking about Apollo 13, let me direct your attention over here to this wall. [Points] Right there, there is you see a mirror that's framed. It's a framed mirror there by itself. When you're in a spacecraft and you're strapped down and it's hard to move around or whatever, we use mirrors. You have a mirror so that you can look up here and see something behind you like a switch panel back here to get to. Aircraft uses the same thing. So that mirror is very special. It flew on lunar module 7, call sign *Aquarius*, which was the lifeboat for Apollo 13. It allowed the crew to survive and get back here to Earth. The flight crew elected to present that mirror to the folks here in Mission Control. So it basically says, "Presented by a grateful Apollo 13 crew to the men and women, so they can see who got them back safely," which I think is a very special thing here in the room.

While we're talking about that side, you see all these mission plaques on your left-hand side, those all represent the flights that were controlled from the room I talked about that's downstairs just like this. We may stick our head [in] or walk through that room to show you

what it looks like today, because it's been changed a great deal into what we call the science center. So when we reconfigured that room, we elected to bring all those mission plaques up here.

You see a lot of framed documents there. Those represent a flight director who is no longer a flight director, has retired. Every flight director has a call sign that they can use for the name of their team, and back in the early days, they used colors. The very first flight director was Chris Kraft, and he was known as Red Flight. Gene Kranz was White Flight. So when a flight director retires and they are worthy enough, which we haven't found one that hasn't been yet, then we retire their color or their call sign, and that proclamation states that for those number of flight directors.

Now I have a challenge as Chief of the Flight Director Office today and I can't take total blame, but we are woefully behind on the number of retired flight directors we need to honor. I'm trying to consider a way to get that done here within the next year if I possibly can. I want to take advantage of people like Chris Kraft, Gene Kranz, while they're still here, to be present when we do that sort of thing.

That represents at least a handful of flight directors that have retired, and, by the way, the flight director roll is up to fifty-six to date, from Chris Kraft up to fifty-six. In 2000, my office had to hire ten more flight directors because of the twenty-four seven operation we're doing with Space Station. I've got twenty-six flight directors in the office today. When I came in the office in 1983, I think there were six of us that came in, and there were like six or so in the office at the time. So it's grown a great deal, more than doubled in size since that time due to the twenty-four seven operation.

By the way, as a manager, a flight director is a type A individual. Actually, they're type

double A. Some of them are type triple A individuals. So you can imagine the damage control I've got to do sometimes when I've got that many type A individuals in an office. Although, I will say one thing, though, I don't have to motivate these people at all. If anything, I've got to slow them down sometimes.

So we were talking Apollo 13. We were talking these plaques over here. Another very subtle thing here in the room that I really want to point out to you, if you look down here towards the water fountain, you'll see the Apollo 1 patch, representing the crew that perished on the launch pad in January of 1967. By the way, don't you find it, it's strange? It's bizarre. It's troublesome. If you look at our loss of human life in this business, it all occurred that same week. I mean February 1st [loss of *Columbia*, STS-107] is close enough in my opinion, but if you look at the Apollo fire and *Challenger* [STS-51L] and it's all the last week in January. So that represents that crew.

I was an employee of seven months when that occurred. Right next to that is the *Challenger* plaque. Those two plaques are there for a special reason. The tradition we have here in Mission Control is we like to honor one of the flight control positions in Mission Control or somebody in the engineering staff, somebody we believe that went a little bit above and beyond the call of duty to make the mission a success. What we do is we honor them by having them hang the mission plaque in Mission Control after a mission. We bring in an extension ladder and get the team in here, and they crawl up this ladder, probably one of the most hazardous things we do, and hang the mission plaque.

Until a mission plaque is hung, it resides at a console called GC. GC stands for ground control. The ground control flight controller here is the one responsible for basically the building infrastructure. They're the one responsible to see that this facility is up and running and

supplying all the data to the flight controllers. They also interface with the worldwide network to be sure all the telemetry, voice, television from around the world gets into this building.

The mission plaque resides at the GC console. It usually just sits on the floor someplace, and it stays there until it's time to pass that mission plaque off to the flight director, who will then present it to the person to hang the plaque. So the tradition is, is that it resides at the GC console. This used to be the GC console down here in this room on this corner. So that's why those two plaques are hanging right there, because the missions weren't completed. They're at the GC console. They're on the wall. Sadly to say, when we get down into the white flight control room, the white FCR, the Shuttle flight control room, you will see the *Columbia* plaque, which now hangs by the GC console down there in that room.

Let's see. You would appreciate the fact that we're now getting to the point where we've got some kids that come into this room now, and I can't tell you what age it is for sure, but there are kids now showing up that no longer know what this is right here. [Points] This is a dial phone for those of that you can't see it. [Heflin dials the phone.] It's a dial telephone. I mean really, we've got kids now showing up that really don't know what this is. It just dawned on me recently [in the] last year or two that that was happening.

One of my favorite topics in here is to talk about this. If any of you have any money that you can deposit these days in a bank, you've done this, you've used one of these things. [Heflin shows a P-Tube.] It's called the P-tube. "P" for pneumatic. Why in the world P? I don't know. Why didn't pneumatic start with an N? Bobby [Wright], does that bother you? It used to bother me, by the way.

This is the way we would pass hard copy around from this room to supporting rooms. Everybody that sits in here is a flight controller, except for the flight director. The flight

controllers have people that support them in other rooms outside of this room, so they would exchange hard copy. Also, when you took a picture, basically, of your display here, it showed up in one place downstairs. That operator down there would have to take that copy that you got of your display, look at a number on that, and then know to put it in this P-tube and send it to a certain station, so you'd get a hard copy of your display.

For those of you that can see it, the P-tube station has a little panel where you could select a station you wanted to send to. You would select it. By the way, flight controllers got—in fact, I used to do this. I've worked in this room. There was a way I could kind of sit back here, took some skill, but after a while, you learned how to do it. You could sit here, and you'd just go like that with this thing. [Gestures] You could hit the right little button. If you look at these panels, they're pretty. They got a lot of little buttons on them. You could hit the right button, and then you do it with some kind of flare, you see. People in this room were showmanship kind of people. These are the glory hogs that used to sit out here in this room. All the people that did the real hard work sat in the back rooms, but the glory hogs all sat out here, by the way.

So you know you could sit back, hit that [demonstrates], this little lid would pop up. You take this and drop it inside there, and away it goes. Of course, those of you who are fortunate enough to deposit money in a bank with these things, you've heard the sucking sound that would occur. These things would get sucked away, and when they arrived down below here was a little station down below. And as they'd arrive, they'd sound like this [demonstrates] as they came in.

By the way, there's a little lever down here. [Points] They thought, "We ought to be sure and let people know these things are here, so they'll see them." So they had a little lever that this thing would go up against that would ring a little bell and also a little light would go on

so they would know that they had something that they had to get out of the P-tube container. It didn't take people very long before they decided we don't need that darn bell, so they went ahead and disabled the bell. [If] this wasn't recorded, I'd probably say something else.

So the reason I talk about this is this ended up being the ambiance, the heartbeat of this room. You'd walk in here. There'd be muffled voices, people talking, but the goings and comings of the P-tube was kind of the heartbeat of this room. I'm probably one of the few people that really talk about this. I notice things like this.

When we built our new control center, which we're going to go into here after this, we no longer use the P-tube system. So the ambiance, the heartbeat of the room today, [it's] still got muffled voices, but you could stand in the middle of the room and just listen. You don't hear P-tubes coming and going, [instead] you hear the clicking of keyboards. That's what you hear. You look around, and you see flight controllers and their heads. They're all clicking the keyboards.

I had fun with this the first time we opened up the new control room. By the way, as a flight director, I worked on this side and never did work as a flight director in the new room. I have fun telling people when I'm asked, and I get asked, "Well, golly, you know, you used to really enjoy this job. I mean, you liked being a flight director, and you were good at it. Why aren't you doing it today?"

I said, "Well, let me put it to you this way. Can you envision Gene Kranz at a console clicking a mouse?" [Laughter] That's my feeling, too, you know. I don't want to have to. If I was in that control room working today, I'd have to have a little pedestal with this mouse, because I don't like to sit down. When I operated in here, I was usually up on my feet all the time, walking around. I just couldn't see a flight director messing around with a mouse. You'll

see that when we go downstairs, and I've gotten over that. I tell people that's why I finally got out of that business.

So the room has changed, and it's a flat floor as well compared to this. Let me talk about some of this up here instead of downstairs. Of course, you see the big displays up here. [Points] You'll see them downstairs as well. They're really there to provide what we figure to be situational awareness information for the entire team. Each flight controller who specializes in a technical discipline will have individual data appear on their discipline to look at or whatever. But there are certain things we want all flight controllers to see at one time. We would put those on these displays up here in front, called situational awareness displays.

For those of you that read Chris Kraft's book, you may or may not remember it. I got a big kick out of it when I read it. Early in the book, he was here when Philco-Ford [Corporation] came in to develop this room and build the very first control center. It was down at the Cape, by the way, not here, when he was first involved. As they were building the control center, the contractor came in. One day when Chris showed up in the control room, they had a big display up in front that had a world map on it, kind of a crude thing. They had a world map, a ground track, and they had a way to track the position of the spacecraft on that orbit, probably manually, as it went around the world.

Kraft saw that and just chewed them upside down and the other. He thought that was the biggest waste of money. Why in the world did they do that? We don't need that. He said this in one paragraph in his book. The next paragraph, he says, "How wrong I was." Because he learned he could use that display in a situational awareness position that told him immediately where we were and how much time he had as a flight director and they had as a team to say something to the crew.

On the world map, we had a little circle that shows you. If you're inside that circle, you're above the horizon at that tracking station. You can communicate with the tracking station. You're inside that circle. Sometimes we cross that circle right in the middle. When you do that, you may have five minutes to talk to them. We may cross that circle at the edge of the circle, and you'll see this in the Station flight control room, [we] might cross the edge of the circle. "Uh-oh, I've only got a minute or less." That's what it did for him as a member of the team.

He was able to see that and immediately notice that, "Hey, I've only got a minute to talk to the crew. I don't have five minutes," so he didn't have to think, didn't have to take a clock, and do any math to decide how much time that he had. So that world map display became extremely useful from a situational standpoint. People come in the room and think, "Well, it's really a public affairs sort of thing," but it is an extremely useful tool. It still is today.

Let's see here. Everybody's still awake. Do you have any questions about this room? Now, I think we're planning to go down to the Shuttle flight control room, and we'll probably try to stick our head in. There's a large number of you, but I'll decide when I get done. We might stick our head into the Space Station flight control room before we leave today to let you. At least you'll see it. You may not be inside of it, but at least you'll see it.

Do you have any questions about the cathedral of human spaceflight operations, of which you're in?

BOROWSKI: Can you go over briefly, one sentence, maybe two, what each station was and what it controlled?

HEFLIN: I can do it in probably a dozen sentences or so. Is that okay to? It's probably a good place to talk about it, since [once] we get downstairs, there will be people in the room we're going to go into. It might be harder to talk about.

Flight director is like an orchestra leader. Just think of the flight director as an orchestra leader. Flight director really doesn't need to know how to play trombone, although I do. But an orchestra leader needs to know when the trombone is going to come in. Then you've got musicians, technical discipline experts in the flight control room. Back in the Mercury days, it was new. You needed all the eyes. Everybody you could get looking at the stuff was going to help you from a safety standpoint and mission success standpoint.

Now think about it. A spacecraft [is a] complicated system, so let's put people on the ground that can do the worrying for the astronaut in the capsule, as we used to call them. So the concept came to be. "Okay, then let's break this up by discipline. Let's have somebody who's smart in propulsion. Let's have somebody who's smart in electrical power generation, somebody smart in guidance navigation and control." Basically broke up the room into technical disciplines, and they specialized in those technical disciplines. We still do that today.

Even with Space Shuttle, you have a finite amount of time you can be on orbit, two to three weeks maximum time you could be on orbit. It's expensive to get there, and the more time that the astronauts onboard can devote their duties to doing any kind of observations, scientific work, or whatever, then the better off we'll be and the most bang for our buck that we'll get. And so we still have people on the ground that do this.

So this is broken up into the captain of a ship. In fact, I'll tell you what we'll do. We'll get downstairs. The consoles actually have the names on the console, and I'll talk a little bit about the technical discipline down there. They are broken up into several.

Space Station is much different. I shouldn't tell you this story. The Space Station is really a challenge today, because we're twenty-four seven, and we're trying to find the right kind of way to operate this because you can't have flight controllers sitting around looking at digital data all the time, even though we have teams that come and rotate, [they work] eight, nine-hour shifts. We're getting smarter. We're getting to where on weekends we stand down to fewer flight controllers. Overnight we'll do the same thing, and we're trying to do that.

The concept of having people here when time is critical, like during launch and during entry, during rendezvous and docking, during spacewalks, those times that are very, very time critical operations, having people in here to be able to watch over their shoulders is the reason why I think we've been so successful.

I look back upon the things that have occurred to us, where we've lost people, there's been four times. There've been four times in the history of this country's human spaceflight program that were really, really life-threatening. Only one time did the flight control team have an opportunity at the time of the event to do anything about it. That was Apollo 13, and we were lucky on Apollo 13 that the explosion did what it did and didn't do anything worse. *Challenger* and *Columbia*, at the time of the event, there wasn't anything that we could do.

Any questions before we leave this room?

WRIGHT: Can you talk a little bit about the training that's done in here as well.

HEFLIN: The hardest part of this job is not being here during an actual spaceflight. That's not the hardest part of our job. The hardest part of our job is getting ready to come in here to support one of these missions. We do train as much as a year and a year and a half out. It depends on

the mission. We start training an integrated team leading into a flight. Within the last two or three months, we'll bring flight controllers in here and we'll run through a simulation. We're tied up. We're tied to our simulators on the other side of the commons area. On the other side of the duck ponds over here, we have our simulators. We're tied to that.

We have a training team. Their sole function in life is orchestrate the problems they put into the simulator. I refer to them as the bad guys. Of course, I would go up there, and I'm the first one to say, "We're only as good as we're trained," which is true. They do a wonderful job of getting us prepared for these kind of flights, but we spend a lot of time in here.

In fact, today, you'll see in the room we're going to go to downstairs, they are doing a simulation today which is called a long rendezvous. There's two teams. There's a Shuttle team today and a Station team today that are doing a simulation, an eight-hour simulation, where they're going to rendezvous, dock with the Space Station, and then do some operations after that.

Flight controllers have means by which they can train individually back in their offices on single systems trainers. They can [take] computer base training. They've got workbooks. We've got classes. It's a pretty good training program that they go [through] that was devised back when Chris Kraft invented flight control, back in the late fifties. It's just something we've built on from year to year to get people to where they can come in here and be comfortable being in here.

The most uncomfortable I've ever felt in a control room, generally speaking, was always during a simulation and very seldom during a mission. I've had a couple of times I've felt uncomfortable. One of those was a practical joke being played on me, by the way, and we won't go into that right now. But generally, getting ready is the hardest part.

Rebecca [Wright], was there anything else in particular you want me to talk about there? Okay.

I sometimes come here. As you can tell, I enjoy talking about this room. My office is on the other side of the commons area, but I get over here to kick the tires in Mission Control at least twice a day. I drop in on the real-time team working Station and visit with them, but sometimes I will come up here. Quite often, I'll just walk through here, and sometimes I'll just come here and sit for a little bit, especially when I'm trying to think over some kind of a problem or something.

Space Center Houston, as you can tell, they're back here now, which is good. I'm glad we've got the public coming back, although I've got to admit, it kind of destroys it for me when I hear any voice in here at all. I want to be here, and I don't want to hear anybody's voice. It's a great room. It's a place I really enjoy coming. I hope you've enjoyed being in this place today, too, as well. [Heflin walks to science center.]

All right. We're going to quickly show you [this room]. This is the other room I talked about, which has been modified now as what we call the science center. The idea being people who are customers on Space Station, on Space Shuttle, can operate out of here. It provides them a facility to where if they wanted to bring some of their own principal investigators on some experiment and set up a little team here they could watch over their experiment. That was the idea. This was the other flight control room that we used. Of course, you can tell, except it's flat floor.

It's interesting. We're going to go into, I'm going to show you, the flight control room. Flight control room, FCR, is the acronym. We have the white FCR, we have the red FCR and the blue FCR. The white FCR is the one we're going to go to next, and that's the Shuttle flight

control room. The red FCR was upstairs. It wasn't anything to really show you today. It's one we use for training, just for training. It could be used to support missions if we needed to, but it doesn't have the redundancy that the other flight control rooms have. Then we have the blue FCR, and the blue FCR is the one that supports the Space Station operations twenty-four seven that I'll show you.

The weather group over there, the folks who have been here for many, many years provide our weather support. It's interesting. Typically the things we deal with for launch and entry are typically weather related. If we have a systems problem, we either solve it pretty quick or we're down for the day. As those of you who have followed the program know that weather issues are usually the biggest things we have to worry about, so we have a really fantastic group of people here that keep track of. They understand weather at our transatlantic sites over in Africa and Europe, our sites here in this country. They understand the climatology and the weather for all those places and can help us make those decisions. [Heflin walks to the white FCR public viewing area.]

Rebecca [Wright] is still not here. There she is. All right. Have a comfortable seat. The front row's the worst place to sit, so anyplace but the front row. It's the worst seat in the house, plus you'll get in my way if you're on the front row.

This is the white FCR. This is the Shuttle flight control room. We came into this facility the mid-nineties and started operating Shuttles out of here. We did a similar thing that was done in the old Apollo era flight control room. Back in the Gemini Program we actually followed along with the control of a flight out of Cape Canaveral. To transition here, we had a team control a flight from where you were previously in the other part of the building, and we did that for a while. Then we eventually also did a flight following a launch and an entry before finally

moving into the facility.

The architecture here, of course—you know where we were, that was one-of-a-kind hardware and very expensive to maintain, and sustaining engineering was a big problem. It was time to move up and take advantage of Bill Gates and Windows technology. So we have a control center here with an architecture that's built upon local area networks, and the operating systems that do the computing for you, reside in the console where you're sitting instead of some big mainframe computer. We refer to these console positions down here as workstations. I prefer to call them consoles. I'm a traditionalist, and that's what I want to call them. But they're workstations.

If you take one of those workstations down there, I'm told that the computing capacity in one of those stations is something like three hundred times what we had in this entire building when we landed on the Moon in 1969, which shouldn't surprise you. I mean there's people walking around with watches today that probably had more computing capacity than we had in the Gemini spacecraft and certainly in the Mercury [capsule].

This team today is doing a simulation with the Station flight control team up in the Red FCR, which we didn't go into, but there was a team up there as well. This is the Shuttle team. Flight director today is Paul [F.] Dye. He works for me. He's one of my senior Shuttle flight directors. The CapCom [Capsule Communicator] is Linda [M.] Godwin, Dr. Godwin. Linda has flown four times. She's a veteran, in that she probably will not be flying again, just based upon where she is in her life these days.

Rebecca, do they know I play in a band? You didn't get into that did you? Do they know that?

Linda Godwin played saxophone in this big band I play in for many years, started back in

the early eighties. Linda was with us all through the eighties and into the nineties somewhere playing saxophone, a very good saxophone player. Ron [Ronald E.] McNair, who perished on *Challenger*, was our lead tenor saxophone player for back in the early eighties and helped really build the band. [We] grew from a very small band into a classically styled eighteen-piece big-era band. Ron McNair was very key in making that happen. So Linda's the CapCom today.

CapCom, capsule communicator, we used to fly capsules. Whoever was going to talk to and communicate was the capsule communicator. It's a call sign that we've kept over all these years, and the concept is you can't have everybody talking to the crew here at one time. We have one person that does that. It's usually an astronaut, most of the time a flown astronaut, [but] not always. And since the astronauts who haven't flown get good training by coming over here to be a CapCom, they learn a lot about how we work, so it's good training for them.

Typically, what happens in this room is they all wear headsets, and then we have communication loop that's called the flight director loop, the Flight loop. All the discussions go on amongst the team on the flight loop. You'll be discussing some technical issue, then somebody's got to make a decision what we're going to do. Flight director looks to the flight control team members here for recommendations. If the flight director needs to decide one way or another, then the flight director will do that. The CapCom, who is part of that debate, will voice that instruction or information up to the crew.

When I operated as a flight director, the most successful shift that I could have as a flight director is one where in which I spoke very little. What I liked to do and when it works very well is you hear these discussions go on among the team, and the flight director may be facilitating some of that and maybe not. The flight director may be just doing nothing more than hearing one technical discipline, like EECOM talk about something, and then Flight might break

in and say, "Well, GNC [Guidance, Navigation, and Control] what do you think about that," meaning flight director knows that this other technical discipline has an interest in what the EECOM is talking about, and so the flight director can kind of help do that.

Or the GNC may not need to be prompted, and the GNC may just offer their opinion because they know they need to offer an opinion. And then when it's all done, CapComs are trained that what they say to the crew needs to be sanctioned and endorsed by the flight director. What I like to do, and what I saw that would work an awful lot is you hear these discussions going on, and when it's all over, if I'm down there working and I look at the CapCom and I just nod, or I go like that. [Gestures] We've talked for fifteen minutes about something. Then the CapCom will break that down into maybe a minute's worth or a few seconds' worth of information to give to the crew. They're trained to do that sort of thing.

Sometimes we try to be politically correct on things we're telling the crew to do. We get in situations that might have some political overtones. One of the jobs of the flight director is to be aware of these landmines that are out there in the political arena, you know, try to. Sometimes we've had to phrase something right. It's been funny, because I've been here before when we're trying to tell the crew something. We've had cases where we just know the crew just screwed up. They just screwed up. It's pure and simple, because we do, too. It was simple. That's all it is, just screwed up, but yet kind of embarrassing. You really hate to talk about it publicly, and the air-to-ground conversation is public domain. That's the way we do our business. You try to find ways to say that without really saying that. It's funny sometimes to watch that occur.

I can't recall the exact words, but there's one time I finally just had enough. "Would you just tell them they threw the wrong switch, and I want them to go throw that switch," just to get

the point across. So that kind of thing goes on, believe it or not. I've often said this job would be real easy if I didn't have to work with people.

I know you asked about the technical disciplines or whatever. I'll just tell you a few. The way the room is kind of set up, if you go to the very front up there, on the left hand [side], there's GC by the way. Johnnie Brothers is the GC today, the ground control console at the very front part of the room. I've told you what GC does. If you look to the right, over there is the *Columbia* mission patch from STS-107, [it] now hangs by the GC console on the wall over there. All the missions that have flown out of here are depicted by this wall over here, and we've started down here as well.

To the left of the GC, to the left there, is the area that has the flight controllers that are responsible for the dynamics of flight. You've got trajectory, flight dynamics officer, rendezvous, these are folks who worry about the amount of energy we have as a spacecraft when we're launching to get where we want to go or when we're landing to get back to where we want to get back to. There's energy that's got to be managed, whether you're using actual propulsion or whether you're flying through the atmosphere trying to bleed off this energy. Those folks are the ones who worry about managing that energy.

Rendezvous, of course, is a position that will be here in the control room as we're rendezvousing and docking. They're a specialist in that activity. Right behind them are two consoles, the propulsion system and guidance navigation and control. Their call signs are "Prop" and "GNC". Prop is responsible for all of the systems onboard that provide propulsion, the little small attitude control jet engines, the large maneuvering engines we have. They're responsible for all the fuel tanks, valves, plumbing, temperature pressure measurements associated with that system.

Sitting to the Prop's right is the GNC, guidance navigation and control, pretty self-explanatory. We've got a lot of black boxes onboard, electronic hardware that guide, navigate, and control the Orbiter. So that's what that flight control position works to.

To go across the hall now there, on the [right] side of the room—"Max" is our call sign, mechanical flight controller, responsible for all the mechanical systems, the mechanisms that open our payload bay doors, the landing gear, the auxiliary power units that burn hydrazine and provide the hydraulic power, provide our hydraulic system power, and all the other mechanical systems on the Orbiter.

Also, then sitting to the right of that, is the EGIL [Electrical, General Instrumentation, and Lighting] position. That is the electrical power distribution flight controller. I have served as an EGIL in flight control. I've been an EGIL flight controller. So they're responsible for the power distribution, the fuel cells that generate our electricity on the Orbiter, and how that power gets distributed throughout the Orbiter.

Right behind the EGIL is the EECOM position. I've also been an EECOM on Mission Control, served in that position, and they're responsible for the life support and the thermal aspects of the Space Shuttle Orbiter. Thermal being you generate heat you've got to get rid of, you've got to maintain cooling for the crew and cabin environment, that sort of thing.

Just to the left of the EECOM position is flight activities. They're responsible for the flight plan, the sheet of music that we use to fly by. We've never flown a flight where we've taken off with a flight plan and did it exactly as written to the end. We've never done that. We never will do that. We come in here with a flight plan, and then when we change it in real time, these people have the expertise. They put together a puzzle. The flight activities officer is one in a mission that's packed with all kinds of activities. I mean they have to juggle a lot of

constraints to get everything done, and that's their job.

Across the aisle is the ACO, assembly checkout officer. When we are assembling Space Station with a piece of hardware we're putting on, we will have an assembly checkout officer sitting there, flight controller who basically works as the interface, the grunt work interface, between the Shuttle team and the Space Station team on the assembly operation.

To the left is data processing system, "DPS" is their call sign, over by the wall. They take care of those 1970s 286-computers we have onboard the Orbiter today and all of the hardware that gets the commands from the computers out to the end item pieces of equipment, they worry about that.

Behind that is INCO, instrumentation communication, responsible for the systems that gather telemetry and ship it to the ground. They're also responsible for the air-to-ground voice system, the television system, and that sort of thing, and they worry about all of that.

Behind INCO is where the public affairs officer would sit, telling the public what we do during the flight. Up in front there is a position that we'll bring in. Sitting down there as the PDRS [Payload Deploy and Retrieval Systems], the person responsible for the mechanical arm on the Orbiter. They're doing the simulation today where they're using the arm. So that's where they will sit.

Behind her is the surgeon console, so we have a flight surgeon that's in here during the mission to help with any kind of crew concerns. When I was a flight director, I was a friend of the flight surgeon because I knew where they kept their antacids and they kept their Advil and the aspirins and that sort of thing, which I could use from time to time.

Back here, the booster console for when we're launching. We'll have the person responsible for the Shuttle main engines and the solid rocket boosters. They sit right there.

When they're not there and we do a spacewalk, we'll bring the EVA [Extravehicular Activity] flight controller in to sit in that position right there.

This position down here is called Mission Ops [Operations] Director, MOD. That's either myself, or I have two deputies, a deputy for Station, a deputy for Shuttle, or a senior flight director. The MOD position in here is one that's really not working so much real time as the MOD position becomes the interface between the flight director and everybody outside of this room that wants to help us do the flight. We have a mission management team that meets. Those of you that have been following the 107 accident investigation have been reading about the mission management team and the processes. MOD really serves as the interface to work with the mission management team.

An example I'll give you is if an experimenter onboard the Shuttle has got something that didn't work very well for a few days and they've lost time. They would like to extend one more day in order to get their experiment done. What we do as a team in here is we will recommend to the mission management team, "We'll do that. We've got consumables. There's no problem. We've got to support that." But that is a mission management team decision to be made, because that means the Orbiter is going to get back a day later at the Cape, and that affects processing.

So the MOD will then take that to the mission management team and say, "Hey, this person wants to do that. We can support that. So it's your call, Mr. Program Manager. If you want to support that, we're ready." Then the mission management team will say yes or no, and we take that decision back into this room here. If having a single person prevents having program managers drifting in and out trying to get their two cents in, which they'll do anyway, by the way, but they get their two cents in to the flight director.

There you see are the situational displays that we have up there. There's the world map I talked about. It's kind of hard to see, but on the Asian continent over there, you see the little red circles indicating the Russian ground sites that are active. So as you go through one of those circles, you're within contact with one of the Russian ground sites.

This display on the right is an extremely useful display, because at a glance the flight controller can look up there and get the orientation of the spacecraft relative to the Earth or deep space, which makes a big difference, because a flight controller who has systems on the external of the spacecraft will see different temperatures, obviously. So as things change on their display, temperatures and pressures, [they will notice], "Oh, the temperature's dropping. Look up. Well, I'm on the dark side of the world, or I'm pointed to deep space and not to the Earth." So it's a great situational awareness display.

On the left-hand side, we've got one of those displays which the very top half of the display represents the keyboard activity. When the astronauts are telling the onboard computers of the Orbiter what to do, we can watch those keystrokes down here. We can see what displays they've called up on their on board systems. So we can see that with the top display. The bottom part of one-third of that represents messages that the Orbiter's computers have sensed of a condition or whatever and transmitted that to the ground.

One last story and then I'll open it for questions. For those of you who have seen Mission Control during the mission, and maybe some of you have and maybe quite a few of you haven't, but towards the end of a mission, there will be a vase in here of flowers. Has anybody ever seen the flowers here at mission? Have you seen [it]? There will be some flowers sitting here, if you ever see inside Mission Control.

After the *Challenger* accident, when we returned to flight on STS-26, at the end of that

mission, and I happened to work that mission. [I] was one of the flight directors for the return to flight. After that flight or towards the end of the flight, we had some flowers show up here in Mission Control. There were six roses. There were five red and one white, if I recall. I think I got that right. I think we had five crewmen on board STS-26.

We had a card, and it was basically a card that said, "Congratulations, return to flight. Godspeed, and we support you a hundred percent," something like that. It came from a family up in the Dallas-Fort Worth area, which we found out after the flight. Through the flower shop here we got their address and sent them some patches and pictures and thanked them for their interest, not knowing what was about to happen to us.

After that flight, there has not been a single flight since that time, not one, every flight we've flown since that time, they send flowers to Mission Control. Think about that. We've flown eighty-some, ninety-some flights, including *Columbia* since that time, and they have always sent flowers to Mission Control. They're the only ones. It has become quite a tradition. In fact, it's become such a tradition that there've been some flights where the flowers arrived very late, like the day of landing. In fact, we had one time when they actually arrived after wheels stop, but we were still in control, because this control room is in control until the crew gets out. So basically we were still in control, and that counts. We count that, by the way.

It's interesting because the flight controllers in here will notice that late in the mission. "Well, where're the flowers?" What's interesting also is that this family when they started, they had a daughter, still have one child, a daughter, and I think she was three at the time. She's probably about ready to get into college. Wouldn't it be neat someday if she ends up coming to work here? Wouldn't that be a real cool thing? But it's really very special because these flowers show up every mission from these folks up in the north part of the state. We've had them down

here over the years. We've brought them in, and they've taken part in some of the activities. Like the plaque-hanging sort of thing, it's become a tradition here in Mission Control.

Okay, that's my story. I'm sticking to it. Any questions? Golly, can't believe there's no questions. Go ahead.

ROSS-NAZZAL: When you were in the MOCR [Mission Operations Control Room], you mentioned that you controlled a number of missions from that room. Could you tell us what missions and what sort of memories you have?

HEFLIN: Let's see, memories I might have. I was in either that room, or the one downstairs, now I can't break this up for you, but I did serve as a flight director in that part of the building for twenty special flights. I can't tell you which ones those were. Not because I don't want to, it's just that I probably can't remember all those. I was the lead flight director on seven of those flights. The lead flight director is the one who starts working the mission way in advance, a year, eighteen months out.

My most satisfying time in Mission Control was, by luck of the draw, I was the lead flight director for the first time we went back to the Hubble Space Telescope on the very first repair mission. Of course, that, to me, has been the highlight of my career. I sat in Mission Control and I watched. We went into that pretty lock-jawed, by the way. We were pretty tense as a team. I'll describe it to you. A few weeks before, well, maybe a month or so before the flight, I got back to my office one day, and there was a page out of the *Congressional Record* laying on my desk. Nobody signed it. I didn't know where it came from. To this day, I still don't know where it came from.

Basically it had a few paragraphs of the *Congressional Record* by some congressman or senator that was stating that if we didn't do this mission right, NASA's finished. I mean it was one of those things I looked at and I thought, "Damn, this must be pretty important, what we're about to go do." That was kind of the attitude that went into that flight. Before that flight, we'd lost the Mars observer. On the way to Mars, it apparently exploded due to some propellant kind of problem. So NASA was back. We're in the dumps, and we're out of the dumps. That's kind of our life it seems like.

For me, being in Mission Control during that mission and watching the flight control team go from very lock-jawed to after the first spacewalk, "Oh, we did pretty good here." We got out of the blocks. We were doing pretty well. To watch those lock jaw evaporate and go to little grins and little smiles was really very satisfying.

I'll tell you probably the toughest moment I've had here in Mission Control, and I will share it with you. I alluded to a while ago out there, but since you kind of asked, I'll tell you when I really felt like throwing up. I really, really felt bad. It turned out to be a practical joke. But on Thanksgiving, and I can't recall what year it was, I was in the control center here. It was Thanksgiving eve. We were just becoming sensitive to the space debris and the concern we might have with the Orbiter in orbit. We might have to maneuver now and then to be sure we didn't hit something. We're working [with the guys] in Colorado Springs, [Colorado], the mountain, the folks up there who do that tracking, and trying to understand the processes that went on and how we would deal with this thing.

It turns out that right before we were going to lose our signal, the crew was asleep. They were asleep, and right before we were going to have like a ten-minute loss of signal, about five minutes before that, the flight dynamics officer reported to me on the Flight loop, he said, "Flight

FIDO [Flight Dynamics Officer], I need to report to you that space command has notified us that rocket bodies 5642 or whatever is going to come a close approach, and it's going to be within--." I mean the miss distance was damn near right on.

And said, "Okay, FIDO, what's the time of closest approach?" He gave me the time, and I looked at the clock. It turns out that it was like six or seven minutes later from what he told me. I thought, "What? That can't be right." We're supposed to get more notification before that, but the hook had been sunk in me. So he told me that, and I said, "Well, shoot." I looked at the clock, said, "Well, the crew's asleep." Six minutes, there's no way we could even get the crew up in enough time to even do a maneuver. We couldn't even do this. It's impossible to have done. So I thought, "Well, it's a big sky," and there's this big sky theory. The big sky theory says, "We don't have to worry about those as much as people think we do," so it's like, okay.

We had tracking errors, too, and there's always errors in tracking. Chances are it's not going to be exactly that. But still, this was early in our understanding of this kind of a problem, so I really felt bad. There wasn't anything I could do. We had loss of signal. About ten minutes later we'd have acquisition signal. I had to take a potty break, so as I was walking out went by the flight dynamics officer's console. He said, "Hey, flight, I have put the object up on the display on the right-hand side on the big screen up there."

I didn't even look at it, but what I said was, "I don't care what it looks like. I'm just irritated that"—I think I said, "I'm pissed that SPADOC [Space Defense Operations Center, Colorado Springs, Colorado] didn't tell us," and I walked into the other room. Before I left, I went to the EECOM console, and I sat down by the EECOM and I said, "Look." I did this just by talking to him, not over the communications circuit. I said, "We're going to have AOS [Acquisition of Signal] here in a few minutes. What I want you to do is as soon as we have

AOS, I want you to look at me and do this [gestures] or talk to me." He will be able to see the environment of the cabin right away when we come AOS. So I wanted to assure myself that the cabin integrity was okay, not knowing if we were going to get hit or not, thinking we were, but not knowing. So I briefed him on doing it. I said, "Just don't tell anybody. Just tell me whether, just look at me and go like this if we're okay." [Gestures]

So I walk back in. When I walk back in, the flight dynamics officer, again, tried to get me to look at display. I didn't look at it. I just came back up and sat down. We had AOS. Cabin was tight, no problem at all.

Now, by this time, the representative from the Shuttle Program, Brewster [H.] Shaw was the program manager back in those days. His representative here overnight was a guy named Hal [Harold A.] Loden. Hal came in and sat down on my console, right prior to AOS, and was sitting there. In the meantime, flight dynamics finally had gotten my attention, said, "Need to talk to you." So I went down, and he talked to me.

What he told me at that time was, "Well, look Milt, I'm sorry, but if you look up there and see what's up there—there wasn't any object. This was just Thanksgiving, so we put a turkey up there on this map." It was a turkey that they had up there. We were going to run into a turkey on Thanksgiving eve or whatever. It wasn't anything else out there or whatever, so it was a joke.

Of course, when he told me this, I looked at him and his compadre at the time and I said, "Guys, I need to talk to you after the shift. We're going to meet next door across the hallway there. I need to talk to you."

So I came back and sat down, and of course, the EECOM—the Shuttle Program representative that was there, Hal. By now I know this is a joke. I said, "Well, Hal, it's no

problem. It's no big deal or whatever, no problem." I didn't tell him that this was joke. I said we had no problem, whatever.

He said, "Well, boy, Milt, I'm sure glad." He said, "I called Brewster." This was like two-thirty in the morning. So he woke up Brewster Shaw and told Brewster about this. Brewster was really pissed that SPADOC had not given us half a warning. So now my problem went from what I thought was a real thing I had to worry about to I got to come in here in about three hours from now. In fact, I was getting off shift about an hour after that. I've got to come back in here before Brewster Shaw gets in here, so I can be in his face when he comes in in the morning to tell him what happened. Believe it or not, that's the worst feeling I've ever had in Mission Control as a flight director—during what turned out to be a practical joke.

I'll finish by telling you [that] ought to say a lot about the fact that we typically plan for and do these missions very, very well, and we have good people in here that do those sort of things, so the flight director really should not feel alone. Flight director in here depends upon these people that sit in here. They're very smart people, and it's hard to get in any trouble with all these smart people. I think that's one reason why we're so successful when we have an opportunity to be successful.

Okay, folks, I have talked enough to you, and I appreciate your patience and time. And do you have any questions? I've worn you out, haven't I?

LARSEN: I have a question, Milt. On the Gemini Program, when I was up in the MOCR, I always wore a sports jacket, because it was always cold.

HEFLIN: It was always cold, wasn't it?

LARSEN: Always cold. I see these people walking around like normal people with short sleeves. Is the temperature different, or are they just tougher than I used to be?

HEFLIN: No, it was cold back then. The temperature is different. It's funny that you bring that up, Bill [Larsen], because it turns out, the displays down there in the control room—I didn't get to talk about them much, but there were banks of little displays of lights, indicator lights. You'll probably remember this, because some of the modules had like forty or so lights and little modules that would light up whenever you had a parameter go out of limits. This little light would come on, the computer would come on, the little pneumonic there would tell you what the problem was just by reading it. You could do a lamp test of this entire module at one time. All these lights would come on. You could put your hands up there to keep your hands warm, because I've been there before, too. Yes

Yes, and it's rather fairly informal. Yes, things have changed over there. No smoking, of course, inside.

LARSEN: Right, no cigars at the end.

HEFLIN: Yes, no cigars at the end, no smoking, or whatever. The History Channel is doing this thing for Kranz's book [*Failure is Not an Option: Mission Control from Mercury to Apollo 13 and Beyond*]. Maybe some of you have been following that thing. They did some scenes here in Mission Control here a few weeks ago. It's funny. They had to get a Gene Kranz look-alike and a Glynn [S.] Lunney look-alike. Scott [A.] Curtis, who works in our operations division, played

the part of Gene. I think most of these shots were back of the head, side sort of thing, but he's got a crew cut and he looked the part a little bit.

One of my Station flight directors is Bryan [C.] Lunney. Bryan Lunney is Glynn Lunney's son. Glynn Lunney was the flight director, and he was an Apollo 13 flight director. So we talked Bryan into playing the part of his dad, which was really cool. It was really kind of funny, because Bryan tried to grow sideburns in time for this thing. [Laughter] What was interesting was that, I don't know, Bryan's probably early forties, I guess, got a little bit of gray, but not much. Just so happens that where he really is gray is right about here. [Gestures] That's where he grew his sideburns, so he had this brown stuff right here, then you couldn't see anything except gray right here, which I think they had to color whenever they did the movie.

Any other questions or comments?

KELLY: You mentioned that they're doing a simulation of a Shuttle rendezvousing with the Station. Are there astronauts somewhere?

HEFLIN: Yes, they're over in the Building 5 complex with our simulators. I'm not sure who's there today, but they're there. So we've got two flight control teams. We've got the crew over there. We've got a simulation team. The simulation team we've got here in this building. We have the simulation supervisor, who basically is the orchestra leader of the simulation. You've got the people who run the simulators, and they're the ones who actually enter the problems into the simulator.

Why don't we walk. We'll take a peak at least from here into the Space Station flight control room, the blue FCR. This is where we operate twenty-four seven for Space Station.

Let's see. You look up on the left-hand side at the clocks over there, you see the crew's about two hours away from going to sleep. They typically wake up around morning time Moscow [Russia] time in Moscow.

The positions in here, so we don't burn them out—on weekends, we will take six of these technical disciplines in here, and we go down to what we call the Gemini concept. We have Gemini flight controllers. So we've taken six disciplines, and we break them down into two disciplines, Gemini. Like over here on the right-hand side, you've got ECLSS [Environmental Control and Life Support System]. Up front you've got THOR [Thermal Operations and Resources], which is thermal. PHALCON [Power, Heating, Articulation, Lighting, and Control], which happens to be the EGIL equivalent, that's the power distribution. THOR up front is the thermal. Behind THOR is ECLSS, environmental control. We've taken those three positions, and then on the weekends, we have one super flight controller, who is responsible for all three of those systems. There's limited things they can do.

That call sign, by the way, on the weekend, that becomes "Atlas." In fact, you see the THOR sign up there next to it is Atlas. So the Atlas flight controller on the weekend might be a THOR. So they're real proficient in thermal stuff, and they know just what they need to know about ECLSS and the power distribution to be able to do that.

Then we take the positions over here on this side, and up front you've got ADCO [Attitude Determination and Control Officer], which is like the guidance navigation and control over in Shuttle. You've got OSO [Operations Support Officer], which is like the mechanical person in the middle there. Then you've got ODIN [Onboard, Data, Interfaces and Networks], which is like our DPS or data processing. They become another technical discipline. So that [group] becomes Titan. Those three positions become a single flight controller on weekends

called Titan. So you have Atlas and Titan, and, of course, Atlas and Titan were things that were involved back in the Gemini Program. So we've carried some of the heritage over for that.

The CapCom that's in here, and it's hard to see. CapCom's actually right straight down below here. The flight director is Rick [Richard E.] La Brode, right down below here, and I can't see the CapCom enough to know really who that is. I can't tell who it is. CapComs aren't here around the clock like they are when we fly Shuttles. They're just here during the crew wake period. It can be informal. I mean the flight director gets on the space-to-ground. It's called space-to-ground on Space Station. It's called air-to-ground on Shuttle. The flight director can get on and talk to the crew.

We also are much less formal here whenever we have a technical problem. We'll bring in the experts and sit down at the CapCom console, and they'll get in a roundtable. They'll get two or three people sitting there all talking to the crew about a problem. We don't go through a translator. We don't go through the CapCom in some cases when we're really trying to work some sort of problem.

One position I want to point out here, which is really unique. It's a CIO, right here just up from us. We discovered that there were some cats and dogs on Station that were really giving us fits, that we really hadn't paid a lot of attention to. Such things as where is everything? I mean inventory. Also, how do you deal with this local area network, all these laptops, and so forth? So we basically took some of these really sticky things that get in your way, creature comfort kind of things, and put them into a position. They've kind of become a catchall. C doesn't stand for catchall, by the way. Cargo Integration Officer is what it stands for. We put somebody down there who can help us deal with our inventory management system, logistics, and then, of course, the local area network and the laptops.

We've had technical problems on Space Station. I will tell you that the men and women that are sitting here are as good as what was here thirty years ago doing the same job. These are people very devoted, very smart. They can solve problems, and I've seen them do it. We have not had anything life-threatening on Station, but we've had at least one loss of attitude control on Station where we basically were tumbling, but the tumble was very small, because of computer problems. These people, they solved that problem. They got down to it. This is a hard environment to work, by the way, when you're working with international partners. The Russians in particular are extremely difficult.

I'll give you an example of some things we worry about. Today when I came in, my day typically starts by I read the handovers from the previous shifts, see what's going on, and today I read the handovers, and I thought I almost had to laugh. I thought, "Boy, this is another box of chocolates day." I mean it really is going to be. At eight o'clock in the morning, we have a Mission Operations Directorate-wide tag-up telecon [teleconference]. I report on the Station activities.

Today I started off by saying something to effect that, "In the never-ending venture of spaceflight and the exploration of space, I need to report to you today that we're worrying about harnesses for the treadmill that keep the crew in place when they run on treadmill, and, believe it or not, we're trying to find another can opener that we can put on this logistics module we're going to launch Sunday up to the Space Station." I'm not kidding you, today—today's activities have been associated with two harness assemblies that we got to Russia. By this weekend, we discovered this problem and actually got them over to Russia, and we're trying to get them to Baikonur [Kazakhstan] where the launch will be for the progress.

The crew called down, and they broke the can opener. Well, we only have one can opener. Of course, they've got the old survival kind of things they could use where you put on a can. I'm not kidding you, today is the day for this team has been trying to convince the Russian management to hold up closing the hatch on this logistics module just long enough so we can put two harnesses and a frigging can opener or two on board the thing. Sometimes it's not as glamorous as you might think it would be. That is what Station operations is about. Station operations is about living in space and worrying about things like as where is my stuff and why doesn't that laptop work.

You look down there, and you'll see food that's, who knows [how old]. Sometimes you have to look at the food very closely before you dig into it and make sure there isn't anything growing out of it. It's interesting. Dawned on me after we were here for a while, that we did this wrong from a layout standpoint. For a twenty-four seven operation, we probably needed to do something more in a circle with conference tables in between, make it a more intimate friendlier environment, instead of having everybody looking at everybody's back of everybody's head. But that's our culture. That's what we've done.

I envision one of these days that we might end up doing something different, if we ever get the money to make those changes. Time-wise here, it looks like they're probably close to handover, so there's a few more people in here, probably some folks coming off. ECLSS console looks like the oncoming and off-going flight controller. They're doing a handover now.

Any questions about Space Station? It's the hardest thing we've ever done. I can tell you right now, going to the Moon was easier. I was here. I wasn't in the control room, but I know going to the Moon was easier than what we're doing today in this business, and I think it's easier

because back in those days Congress knew nothing about this. Today they think they do. You're recording this, too, aren't you? [Laughter]

And, of course, there was the goal to get to the Moon before the Russians, so there was a big national, "We've got to beat the Russians to the Moon" sort of thing. But in this politically latent environment that we're in today and with the international partner connection, it's a very, very difficult thing to do. As you all know, we still call this Space Station Alpha because we couldn't agree, and with all the international partners, we couldn't agree on a name for this thing. So it's Space Station Alpha.

I'm not kidding you. This has become, this is becoming, a zero-gravity United Nations. I will tell you, it works better than the United Nations we've got today that's in a one-G environment, but that's what it's becoming.

Okay. I'm going to quit talking again, the third or fourth time or whatever.

WRIGHT: Tell us your call sign.

HEFLIN: I go by "Sirius." We ran out of colors. We got fifty-six flight directors. The roll of flight directors today numbers fifty-six from Chris Kraft, who was the first flight director. He was Red Flight. Gene Kranz is White Flight. Then we used colors for a while when I was in the flight directors class of '83, and there weren't many colors we'd want. There wasn't anything left to pick from, we didn't think. We decided we'd pick celestial bodies, so we've got constellations. I picked Sirius, because it's the Dog Star, also the brightest star in our heaven. That's why I picked Sirius.

It's interesting. The class of 2000, we hired ten flight directors, and one of them is Annette [P.] Hasbrook. Just so happens that Annette has a favorite color, and she chose to go by that for her call sign. Fuchsia. I'm serious, so Annette is Fuchsia Flight. So we were reminded there's still other colors out there. Of course, I call it pink. She wears fuchsia, and she loves it. You see her in fuchsia almost all the time, especially over here. She's almost like the female Gene Kranz. I men Gene Kranz wore the vest made by his wife, Marta, but Annette wears fuchsia colors all the time.

Okay. I'll stop again. Y'all ready to leave?

WRIGHT: Anybody have anything else?

HEFLIN: Hey, I've enjoyed the time with you. I'm really glad I got this opportunity again. I thank y'all for what you do, because this is very important to capture this, and we're really glad that you're doing that. I hope you enjoy your time here and hope you have fun doing it and please keep it up, because it's very important to us.

WRIGHT: Thank you again. We enjoyed it.

[End of interview]