

**NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT  
ORAL HISTORY TRANSCRIPT**

J. MILTON HEFLIN, JR.  
INTERVIEWED BY JENNIFER ROSS-NAZZAL  
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ROSS-NAZZAL: Today is May 23<sup>rd</sup>, 2017. This interview with Milt Heflin is being conducted at the Johnson Space Center for the JSC Oral History Project. The interviewer is Jennifer Ross-Nazzal, assisted by Sandra Johnson. Thanks again for taking time out of your day to visit with us. We certainly appreciate it.

HEFLIN: I'm glad to be here. It's fun thinking about the past, because it was such a great time.

ROSS-NAZZAL: Yes, you have a great past.

HEFLIN: I've been very blessed. I have had a very diverse career, which is cool. I haven't done the same thing for long periods of time.

ROSS-NAZZAL: Yes, that's pretty unique around here. After you picked up the command module for ASTP [Apollo-Soyuz Test Project], what were your assignments? What were you working on?

HEFLIN: Initially I got assigned to start, during the approach and landing test [ALT] with the Shuttle *Enterprise* up on top of the 747, using my ground ops recovery background. We were trying to find what kind of equipment could we get up to the hatch on the *Enterprise* to be able to

get the crew out in a hurry if we had to. [One option was] a cherry picker; you've seen fire trucks with certain systems like that. So I was assigned to look at the industry, what was available out there, and find out what NASA might be able to purchase to do that. I was doing that.

I didn't enjoy that very much. There wasn't much to that. It wasn't very challenging and wasn't something I wanted to do. That was 1975. I didn't do that very long because I was part of the approach and landing flight team, so in '76, I think, Rod [T. Rodney] Loe, a branch chief in the Directorate there, back then it was Flight Operations Directorate.

ROSS-NAZZAL: Just like it is today.

HEFLIN: It's FOD again, yes. Rod was a branch chief [for the Electrical, Mechanical and Environmental Systems Branch]. He asked would I be interested in being involved in the Mission Control Center and flight control. So I'll stop there.

ROSS-NAZZAL: What did you think about that idea when he approached you?

HEFLIN: The area that Rod was involved in was electrical and environmental systems, early stages for Space Shuttle. I have a bit of electronic background, more as a hobby. I've got a physics-math major, but I'm an amateur ham radio operator—since 1957—and am very interested in radio and electronics.

I think he had an idea that I had that interest, so [he] asked me would I be interested in coming to work for them. I didn't go seek it out. I wasn't looking for a job at the time. It's

interesting how I think a lot of my career, a lot of places I ended up, I was not seeking to go to those spots. They found me, which was interesting. [He] asked me, and I said, “Sure, I would enjoy doing that.” That’s how it started.

ROSS-NAZZAL: Did you have to become certified at that point since you were going to be just working on ALT? Or was that a little bit different since this was a test flight?

HEFLIN: Yes, I did. Certification basically very similar to what had been done before in Mission Control in the past. Your main exam would be how you handled yourself in simulations. We did a lot of simulations back also during the approach and landing test, during ALT. We did a lot of those. I had to study and learn the systems that I would be working with on the control team: electrical, environmental, mechanical. Did a lot of studying.

Back then we didn’t have all the wonderful tools we’ve got today to where you can sit down at all these trainers. It’s really great today. Ours was mostly looking at circuit diagrams on paper, looking at the circuits and looking at how the system was put together. What this did over here to this over here, then simulations. So I did get certified to be a controller for ALT. I can continue.

ROSS-NAZZAL: It’s fine, you can keep going.

HEFLIN: Okay. Interesting. As I was thinking about coming over here today it dawned on me that I actually worked in the control center before this time, and that was back in recovery.

ROSS-NAZZAL: I was thinking about that too. In the ROCR.

HEFLIN: I actually worked in the Recovery Operations Control Room called the ROCR which was just up on the third floor there, where we flew all the lunar missions, out in the MOCR, Mission Operations Control Room. If you were sitting on your console here to the right, there's a wall. Right behind that wall was the ROCR.

My first mission I supported in the control center was Apollo 9. Of all missions I was at the logistics console. Back then I had to keep tabs on where things were hardwarewise primarily, not forceswise. That was handled by others in the Department of Defense. We had stuff scattered all around the world, and if we needed to move something someplace I would be involved in that.

Back to ALT, Rod Loe's branch, being responsible for those electrical, mechanical, and environmental systems—that was going to be the position on the ALT team that I would learn to be a flight controller. The name of that position [was] SMOKHEE. So I got to tell you the story. You know how we like to [tell stories]. We sat in Rod Loe, the branch chief's office. We sat in his office all afternoon at the blackboard trying to come up with what is our call sign going to be in the control room. We ended up with SMOKHEE, and I'm sure neither one of you know what that stands for. Do you?

ROSS-NAZZAL: I think a couple people have mentioned [the term], but tell us your recollections.

HEFLIN: Shuttle Mission Officer for Kinematics, Electrical, and Environmental. So you could tell we spent a lot of time coming up with that name. What made it real interesting was that Don

[Donald R.] Puddy was the ALT flight director. Harold [M.] Draughon was the assistant. There was no need to have more than that, because this is one team [worked on the test flight]. We were not working around the clock. We were just conducting a test during the daytime. Don did not like that call sign. He did not like that call sign. Thinking back to that period, that was back where citizens band radio in cars was very prevalent. It was everywhere. I think even *Smokey and the Bandit* was a movie that was coming out.

If you think about it, Don Puddy, he's the flight director, so his call sign is Flight. Don, it took him a while to say. "So when I call you I'm going to say SMOKHEE?" He looked like he was really straining when he said that. He finally came around, so we kept that call sign SMOKHEE.

ROSS-NAZZAL: Why not just continue with EECOM [Electrical, Environmental, and Communications]? Just curious about why not.

HEFLIN: Good question. EECOM really didn't own the hydraulics and mechanical systems as it turns out. Of course Apollo was much different anyway. EECOM, that's one of those call signs that will live forever. I suspect the EECOM organization, had we tried to use that in ALT, they might not have liked us to do that at that time, just because it didn't exactly cover all that.

ROSS-NAZZAL: Got you. It just seems very unusual. You were one of two SMOKHEEs, you and Jack Knight. You mentioned in your book [*Go Flight! The Unsung Heroes of Mission Control, 1965-1992*], with Rick Houston that he really helped guide you along with, I think, Bill [William L.] Peters.

HEFLIN: Jack Knight, neighbor of mine, lives two blocks from me. I sat beside him of course. He was basically my mentor on console. Jack is brilliant, a good operator, and just a good man. He really helped me a great deal.

ROSS-NAZZAL: What did you learn from him? Was he TELMU [Telemetry, Electrical and EVA Mobility Officer] for Apollo?

HEFLIN: Yes, he was. Two things probably really stood out. He never guessed anything. Of course not guessing is something that goes back in the control center ever since the beginning, it really does. You could tell he wouldn't sit there and say, "I think, maybe." He would pay attention to the data and take his time. If he didn't know for sure he would tell flight director, "Stand by, I think I've got it here. Just give me a minute."

Since I was riding recovery ships during Apollo and I wasn't in that environment, he taught me all the nuances of being an operator in Mission Control, in the room. How you communicate with each other in a way where you're being very precise, to the point. He studied a lot. I learned all those nuances of being a person that would sit there at a console, look at what you got, decide what's going on, make a decision.

ROSS-NAZZAL: In his interview Jack mentioned that there was a woman who was working with you guys.

HEFLIN: Yes.

ROSS-NAZZAL: Which I thought was unusual. Were there many women who were working in flight control for the ALT?

HEFLIN: Yes. I can't remember her name right now.

ROSS-NAZZAL: I think I have it in here.

HEFLIN: I should.

ROSS-NAZZAL: No, actually I don't. I thought I had it in here. I thought it was Ann.

JOHNSON: Yes, it was Ann Austin.

HEFLIN: Yes. Ann Austin. Oh, wait a minute. Yes.

ROSS-NAZZAL: The one with Larry [E.] Bell.

HEFLIN: To answer your question, we had Linda [P.] Patterson in there back in the guidance and navigation area for ALT. Linda Patterson was there. In fact, I think I sent you yesterday a listing of all the people. It may even show another [woman].

There was no need to spend a lot of money setting up a control room that had all the bells and whistles, at least the bells and whistles that existed in the Apollo days. Therefore, we found

ways to do some of the jobs the old-fashioned way. Ann would sit between Jack and I with a clipboard and graph paper. We had auxiliary power units, APUs, the equipment that generated our hydraulic power. Of course they used hydrazine; they used fuel. She would look at the data on the console. She would look at the fuel quantity number and plot it on graph paper about every minute. Instead of having something that we could look at there [on console] and have it done by the computer, we would look down here at the graph paper, and we could tell if the auxiliary power unit was operating as it should, using the fuel like it should. That's how we kept track of the usage rate of the fuel. That's what she did. She basically provided that service to us, just another set of eyes to look at the data and tap us on the shoulder and say, "Have you seen that? What do you think about that?"

She was also learning herself to eventually become an operator. I lost track of her. I don't know what she did after that. I don't remember.

ROSS-NAZZAL: That's interesting. That's pretty old-school.

HEFLIN: Yes, it is. But sure enough that's exactly what we did. We just looked down at this piece of graph paper. What's interesting is that we did simulations. They would put in fuel leaks. After a while you can tell.

ROSS-NAZZAL: That's funny.



HEFLIN: Fast-forward to when I started doing Shuttle work and we had strip-chart recorders sitting beside us. She was our strip-chart recorder. She was quieter than our strip-chart recorders too that we used in the Shuttle Program.

ROSS-NAZZAL: Oh, no doubt.

HEFLIN: Having said that makes me think. This thought just popped in my mind. It got where I could sit in the back room during Shuttle in the position I worked during that time, and I could tell by the servomotor pitch, the sound of the motors, when things were changing on the spacecraft resulting in the pens moving on the strip-chart recorders. I could tell just by listening to it. I had to go look at it then, but I could say, "Oh, I hear." Pitch gets higher on the strip-chart recorder. "Something's changed." I go over and take a look at it.

ROSS-NAZZAL: You mentioned the sims that you guys did. Was the SMS [Shuttle Mission Simulator] running by that point?

HEFLIN: For ALT? Yes, we had a simulator. Yes, we did. Over in Building 5 on a wall was a model of the Edwards Air Force Base [California] buildings, roads, runways. They had a visual that they could track to come into Edwards from all directions. If you went in Building 5, the wall was like a model Air Force base with little buildings and roads, and it had a camera mounted on it that would move along as they're flying.

ROSS-NAZZAL: As they're landing. That's interesting.

HEFLIN: Yes, we had a good simulator. I got to fly it one time as a matter of fact. They put in things to make sure you wouldn't damage the model, because I didn't fly very well. I headed for hangars and other buildings.

ROSS-NAZZAL: From what I understand the SMS was not very reliable in those early days though. Did that create a problem for you guys when you were doing those integrated sims?

HEFLIN: Not for ALT it didn't, but boy, I tell you getting ready for STS-1, it was hell. We flew in '81, STS-1. I think we were starting to sim I want to say '78, certainly '79. We simmed a long time. A lot of it had to do with the fact that the simulator was pretty rough. When the simulator would come up, and we're now in Mission Control in the rooms over there, and you're looking at all your displays. We had displays over there. It was a bank of status lights: red lights and yellow lights and green. Status lights on a lot of data.

That simulator would come up and just almost every light on that thing would be on. In other words, the simulator wasn't in sync with where it should be relative to [what] the spacecraft data should look like this. It didn't look anything like that. It took a long time to get all of that cleaned up. Big effort to get all that cleaned up. A lot of simulations early on in Shuttle, not so much in ALT. There were fewer systems to worry about too in ALT, simpler systems too, since we weren't taking the *Enterprise* into space. It was much easier to deal with. But yes, it was tough. Simmed a lot.

ROSS-NAZZAL: I'm sure you did. You mentioned that you and Jack were sitting together. Were you always sitting together two to a console during the flight tests?

HEFLIN: The ALT? Yes, we did. We divided a little responsibility. One of us was prime and would speak to the flight director, but we both shared some of the duties of watching certain displays. I've forgotten the number of flight tests that we ran. We did a number of them which we called captive active, where the *Enterprise* stayed on the 747. Then we released the *Enterprise* for approach and landing. We came close to splitting them, where I was prime and he was my backup, so maybe a third I might have been prime. I don't remember.

I owe a lot to Don Puddy. Maybe it's hard to believe, but I did lack some self-confidence during that time learning all this stuff. Don sensed that I was ready to be prime on that position, and after one of our tests and our post-test party he came up to me and said, "Milt, I think you're ready. Why don't you take the next one?" I had no idea when or how I would end up in the prime position for one of those tests. Don said, "Come do it." That was a big boost to my confidence and was a step along the way to feeling comfortable with what I was doing.

ROSS-NAZZAL: We never had a chance to interview Don Puddy. He passed away before we got that opportunity. I wonder if you can share some information about him, especially being flight director for those test flights.

HEFLIN: He was born and raised not far from where I was born and raised in Oklahoma. I came from a small town, Fairfax, and he was [from] Ponca City, not very far, both of us in Osage County. I'm not too sure I can characterize us Okies. But it seemed like we had a lot in

common, maybe common sense sort of thing. Don was really sharp, but it was sometimes hard to tell. A technique that he would use to bring out more in conversations and dealings is he did not overuse the fact that he knew a lot.

Something I think I learned from him too is he would work to be sure, “I’m trying to solve a problem here, but I want you to tell me how we’re going to solve this problem. Maybe up here [demonstrates] I know exactly what I want to do, but I want you to [tell me].” It would reinforce what he was thinking, but also he’s teaching too. He’s teaching the person to be confident enough to come up with the solution.

ROSS-NAZZAL: I also wanted to ask you about Deke [Donald K.] Slayton. Obviously you had worked on ASTP [Apollo-Soyuz Test Project], and he was head of the ALT Program. Did you work with him much at all?

HEFLIN: No. Not really. I only saw him in meetings that I would be in leading up to either an Apollo mission or ALT. I did not know him well at all. Certainly glad that he got to fly even though it was the last Apollo class mission.

ROSS-NAZZAL: I’m sure he was glad too.

HEFLIN: Oh yes. That was a good crew. Tom [Thomas P.] Stafford, fellow Oklahoman.

ROSS-NAZZAL: When we get to it, Shannon [W.] Lucid told me that you were her flight director for her first mission. It’s funny how you guys all have that connection as you pointed out.

HEFLIN: Shannon is one of my favorites. She made an excellent CapCom [Capsule Communicator] too in Mission Control. She was one of the best. Of course she has a voice that you can hear pretty good too. She's good.

ROSS-NAZZAL: She's a very congenial person.

HEFLIN: Yes.

ROSS-NAZZAL: What are your memories of the various test flights? Anything stand out for you from that time period?

HEFLIN: Of the ALT period? I was thinking about that yesterday, what kind of anomalies that we had. I think we had an auxiliary power unit problem. We had three [APUs]. I think we had a problem with one of those. I remember the time when it happened. I don't remember whether I was prime or whether Jack was prime. In simulations we have failures all the time, and we had very few during the ALT test, very few. When we had something, it was fairly significant. It wasn't dangerous, but it was a significant problem with the APU. I remember when we took care of it and it was done, I thought to myself you know what, that didn't feel hard at all. It just didn't feel hard at all. Thinking about that, it probably says a lot about how you prepare for or train to do that job.

ROSS-NAZZAL: Gave you that extra dose of confidence that you could continue down that way.

HEFLIN: Yes.

ROSS-NAZZAL: Flight controllers are known for playing pranks on each other. Did you guys have any pranks or any jokes during the ALT Program?

HEFLIN: Oh gosh. Now do you know something? I'm sitting here. One doesn't pop out.

ROSS-NAZZAL: I always like to ask people.

HEFLIN: Actually there's a prank we'll share on the Shuttle side whenever we get there. We had some characters for sure. Hershel [R.] Perkins was a guidance and navigation kind of guy. The thing about Hershel, he was a jokester but not in the control room. Outside the control room, this guy could do all kinds of weird things.

As far as anything during ALT or training during ALT, none of that occurred that I can think of. Puddy wouldn't stand for it for one thing, and people knew that we shouldn't do that. Outside the control room we had a great time.

Linda Patterson, like Ann, sat with us to watch APU fuel. Linda Patterson and the guidance, navigation, and control for ALT, she was to look at what was called differences in pressure between a couple of systems that were used for providing data to guide, fly the *Enterprise*. She had her own little position. It wasn't a prime position, it was a position in support of one of the prime positions in the room, but she was in the room. Her call sign was Delta P, D-E-L-T-A for delta P, delta pressure. Delta P. That was her name. Somewhere along

the line we came up with a version of “Delta Dawn” for Linda Patterson. Believe it or not, when we were all done with ALT, [and] we’re having our big blowout party, I sang it to her in public. I think I’ve got the words to it at home somewhere.

ROSS-NAZZAL: If you have them we can put it in your transcript.

JOHNSON: In the official record.

ROSS-NAZZAL: That’s right.

HEFLIN: As long as I don’t have to sing it.

ROSS-NAZZAL: You don’t have to sing it. We’ll look for the video now that you mentioned it. Maybe somebody videoed it.

HEFLIN: “Delta P, what’s that pressure you all see?” Oh gosh.

ROSS-NAZZAL: You got to have something to break the tension.

HEFLIN: Yes.

ROSS-NAZZAL: Did they reconfigure the ROCR much for ALT?

HEFLIN: Oh yes. The consoles in there were somewhat different. We had a number of big plot boards that we used in the Recovery Control Room, plot boards on which a TV was on top looking down, a map of the landing area, where you kept track of ships. Back in those days, early Apollo for sure and not so much later on, we had ships all around the world, aircraft staging bases all around the world primed and ready to go.

Yes, it was different. Interesting you ask the question because one of the guys that worked there sent us an e-mail here a couple weeks ago. He came back here. He lives out of town now. Brought some grandkids and they went into the ROCR as it exists today. It's a storage room.

ROSS-NAZZAL: Yes, that's what I've been told.

HEFLIN: What's really weird about it is it's got some old TV monitors, quite a few. I'm thinking, "Why haven't we exsessed all that stuff?" I can't believe it's still there. The room looks nothing like it used to.

ROSS-NAZZAL: There's an effort to restore the MOCR. That room is not included; they're just going to replace that window.

HEFLIN: I stay in tune with that a great deal. Oh yes. Try to get the MOCR restored to Apollo 15 configuration, which is what they've got the most documentation on. Get it ready for the fiftieth anniversary of Apollo 11. That'll be cool. If they can truly put that room back together



to where there won't be anybody in it but it will look like the team just walked out, that'd be cool.

ROSS-NAZZAL: Yes, I think it will be. They have good plans. After ALT was finished what were you working on until STS-1 flew? Were you working on flight rules? Subsystems?

HEFLIN: All the above, all the below. I continued to work in the Electrical, Environmental, and Mechanical Branch, and I was training to be electrical power system [officer]; EPS was the call sign. In the back room, the MPSR we called it, the Multi-Purpose Support Room—[I sat in] the back room for the front room position called EGIL [Electrical Power, Instrumentation, and Lighting Systems Engineer] for STS-1. I was in training to be the ascent EPS position working for Bill [William J.] Moon, who was the EGIL, he was going to be the prime EGIL for the launch of STS-1. I continued to learn the systems. We started doing simulations. We've talked about that. Did a lot of simulations in preparation to support the first launch.

ROSS-NAZZAL: How did you keep up with all of the systems? It's my understanding that things evolved over time. They weren't just static at that point. So how did you keep up with all the changes that were happening?

HEFLIN: It wasn't hard for us. Take the electrical system for example. The position that I worked in, we were basically the light and power company of the Shuttle. We were in charge of the fuel cells that generate electricity. We were in charge of and had to be knowledgeable of all

the distribution boxes scattered around the Orbiter that would be switching units for the distribution of the power.

We fed electricity to everybody. If they had any kind of change in their system we had a mechanism to bounce that through all the other systems, make sure everybody else knew we're changing. If we changed something we did the same thing. Any time you did something like that, there was a drawing change. We had a way of tracking all of the contractor drawing changes that were done, hardware changes, and then we would take that. This is, I think, one of the beauties of that whole system. We were responsible for putting together our own set of schematics that were based upon the wire-to-wire drawings that the contractor provided. We had to take all that and convert that into a drawing that we could use to develop procedures and flight rules. The drawings we put together were functional. In other words, there would be a box here on this diagram and a box over here. This box was something that would distribute something over here or get data.

Instead of following wires, we followed functions. This is what this did to this. That's how we learned not only how our system worked, we learned how we provided our services to others and vice versa. This was done by all of the systems folks that took care of the Orbiter.

ROSS-NAZZAL: Were these personal drawings that you did?

HEFLIN: They were published. We ended up with a big book, *Systems Handbook* it was called. The drawings would all have signatures on them. I did the lighting drawing. All the things in the Orbiter that had lighting, whether they were back panel lights or whatever, all the lighting,

we had a drawing in there for all the lighting. I had my signature down in the little signature block for the drawing.

That *Systems Handbook* [was a] big thick document. All those were done by flight controllers in various systems. When you were charged with coming up with a drawing, you learned the system. That was brilliant. I think that [Christopher C.] Kraft and [Eugene F.] Kranz came up with that idea some time ago, to do that as a learning tool for the flight rules that we developed. Knowing how the system worked, knowing what its limitations were, developing these things allowed you to come up with not just the procedures but the troubleshooting procedures as well. That was a fun time.

For approach and landing, I was very much involved in developing what we called cue cards. These were malfunction procedures, or sometimes [we placed them] in books. If something really needed to be done quickly we would build a cue card that would be Velcroed in the Orbiter next to the switches that you would use to troubleshoot something.

I was involved in electrical systems, so I myself and crew members developed a cue card if there was a fuel cell power problem. Here were the steps that you would do, looking at this cue card. Again by doing that you learned it. You knew how it operated, [that was a] very powerful tool. It's still done. It was done for Space Station and certainly all through the Shuttle Program. It's a wonderful book.

ROSS-NAZZAL: Did you spend much time out at Rockwell getting to know some of those engineers and the vehicle?

HEFLIN: Made many trips out there. Didn't spend a lot of time out there. We had a great staff of Rockwell folks here, very handy, very personable. I was very close to the fuel cells for the Shuttle Orbiter. We had the contractor expert. Engineering here at the Space Center had somebody who was assigned to the fuel cells. In operations myself and my colleagues, we were responsible for the fuel cells too. We were a very close-knit group: operator, engineer, contractor all together in sync. These documents that we built, these drawings that we did, they were all done collectively, we worked on them together so that everybody would be in sync with that.

It was almost a very formal informal way to learn all this stuff. You weren't sitting in a classroom having somebody [teach you]. You were doing it yourself.

ROSS-NAZZAL: It sounds like a great hands-on opportunity.

HEFLIN: Yes.

ROSS-NAZZAL: Something you have a lot of people do, I definitely have learned that way.

HEFLIN: Oh yes. In fact, I prefer that way if I can.

ROSS-NAZZAL: What sort of flight rules did you come up with with the fuel cells initially or even the lighting? That sounds unusual to come up with flight rules for lighting.

HEFLIN: Lighting wasn't involved. Wasn't anything on lighting that we had to do. The fuel cell, you would monitor pressures and temperatures, electrical current. You knew what the limitations were. With temperature measurements inside the fuel cell at different points you know how this thing is working, and you know how it should work. You see a temperature change in a certain area, you wonder, "Now okay, what's that? What's happening there." You learn to see a piece of data. When you see a piece of data, it's a piece of data. It's maybe one thing. You need to know now what else can I look at to see if that's real.

Again you can see how all this gets tied together from a learning standpoint of building all these procedures and all these rules. You build your displays. You come up with your display in the control center that you design, and you have it built in a way so that you know it's set up so that you can look at it and almost instantaneously get a feel for what you're seeing.

ROSS-NAZZAL: Take us back to that first launch attempt of STS-1, which didn't go off as expected. What are your recollections of that day and the next day?

HEFLIN: I can't remember. Can you remember how many attempts were tried?

ROSS-NAZZAL: I think it was twice.

HEFLIN: Gosh, all these run together. For me as a flight controller, this is my first time to be sitting here monitoring some systems with a spacecraft going into space. I simulated [missions], but this is for real.

Bill Moon was the EGIL out front in the front room. Of course he and I had little conversations. For some reason even though the simulator never showed this—and it makes sense—somehow I thought at liftoff I'm going to see some changes. This thing has been sitting on the ground. I'm watching fuel cells, electrical power distribution. I can monitor electrical currents in all portions of the Orbiter. I can see what was going on. Strip charts are running at high speed now. There's a whine going on. We lift off, and I'm expecting to just see some changes.

Man, a minute, two minutes, three minutes into this launch, and nothing's changing on this system. It's just humming right along; nothing's happening. That was a big surprise. Why I thought that would happen I have no idea, because I never saw it in simulations. Folks knew that it wasn't going to change much. Hell, I should have known it wasn't going to change much. But I expected man, when this thing gets up and goes, I'm going to see a lot of changes. Didn't. That was a big surprise. Did that come close to answering you?

ROSS-NAZZAL: Oh yes, I have no answers here. You're the expert, not me.

HEFLIN: Having said that, let me take you to the next flight, on STS-2.

ROSS-NAZZAL: Which you were in the front room according to the paperwork I have.

HEFLIN: I was in the front room. That was my first time. I was an EPS during STS-1 in the back room. Then I was an EGIL on one of the orbit teams. Chuck [Charles R.] Lewis was my

flight director. We had an ascent team, then an orbit team, and I think I was on the next team that came in. I think it was crew sleep. They were heading to go sleep.

I was trying to shift circadian, trying to sleep differently. When I woke up it was maybe in the early afternoon. I went out in the backyard, [it was a] sunny day, just to get some fresh air. Had a radio with me, just listening to stuff. Over the news I heard that we had lost a fuel cell just a few hours into the flight. I'd already gone to sleep. Don't think that didn't get my attention, because now I'm getting ready to go in on my first shift at the position that's responsible for fuel cells. Holy cow.

I got in and by that time the fuel cell had been shut down and the other two fuel cells were working fine. I got smart in a hurry on what the signature was that they saw, what it looked like. Of course if we hadn't made a decision, the decision was made soon after that that we were going to cut the flight short, come back sooner.

One thing when this failure occurred with fuel cell 1, I think it was that [one that] had the problem, fast-forward, it turned out to be a flooding problem. When the fuel cell works, [it] makes electricity and generates drinking water, good water; we keep that water. The pump associated with getting the water out of the fuel cell had a problem. We learned that much later.

There's three fuel cells; there's three major power buses that run throughout the Orbiter. Several things are powered redundantly for more than one circuit, more than one fuel cell, as a redundancy. As the fuel cell fails, its voltage gets lower. The way the Orbiter was wired was the other fuel cells, those that were redundant, they were beginning to pick up more of the power that was required. In other words, as the fuel cell was failing its electrical loads were being shifted automatically by nature, being shifted off that fuel cell to another fuel cell. The other fuel cells were shown to be working harder, providing more current. Good thing.

Also this is something we learned, in the Orbiter there's three power distribution units. All this equipment, just based upon things that happen in the Orbiter thermally, back in the payload bay, as things change, temperatures change. It will result in a piece of equipment operating a little bit differently if it's hot or if it's cold. Its power needs might change, because a lot of this stuff has heaters. It's natural for the power to move from one fuel cell to another. Long way of saying during my shift I was noticing that this was, I thought, working very well. I could see the two fuel cells that we had left over to start with. One of them was working harder than the other because more of the power was being used. It was working harder. It was working fine, but still it was having to work harder to provide power. It was beginning to adjust. Both of those fuel cells, they were beginning to share the loads better. This was a good thing. When I called the flight director to tell him this bit of good news, "Flight, [EGIL]."

"Go ahead, [EGIL]."

"Flight, need to tell you I'm seeing a shifting of loads here between fuel cells 2 and 3."

He remembered that when he came in he was briefed. There was a big shift in loads because the fuel cell was failing. So I planted a seed with him right then. He thought I was beginning to tell him, "We're having another fuel cell problem." I didn't recognize that he had taken that [that way]; I had either said it wrong or didn't explain it well enough. So it took me a little bit to back out of that and be sure that Chuck knew, "No, no, no, this is good news, Flight. I'm telling you something good; it's working fine." Lesson was learned there by the way too, a good lesson was learned. Sometimes it's how you say it, and that goes along with it too and can make a difference.



ROSS-NAZZAL: What did you guys find out about those fuel cells once they were back on the ground?

HEFLIN: The one fuel cell, like I said, when they make electricity, one of the by-products is water, and that gets pumped out of the fuel cell into a water tank. The water pump for that one fuel cell had failed. “Okay, what can we do now? What do we need to do to fix that in the future?” All that was done eventually.

ROSS-NAZZAL: Before the flight flew, there was an issue with the APUs. Was that something that you were involved with?

HEFLIN: On STS-2?

ROSS-NAZZAL: On STS-2.

HEFLIN: Let’s see. Interesting about the APUs. We learned a lot about the APUs as we were flying of course. I’m trying to think was there some temperature something associated with it.

I don’t remember. It’s interesting how over time, boy, we learned a lot through the early Shuttle flights, really learned a lot about the hardware and the APUs in particular, [which are] fairly temperature-sensitive. Of course they’re not used once you’re in space; [they are] shut down. You got to babysit them, you got to be sure that the temperatures and the heaters associated with the APU system in the tail end of the Orbiter is working right, the temperatures

are going to be okay. In the Shuttle Program I do recall the APUs were a topic quite often pre-flight. I just don't remember all the details of how that happened.

ROSS-NAZZAL: It was a long time ago.

HEFLIN: At that time too as an EGIL, different than ALT, I no longer was responsible for the APU mechanical system.

ROSS-NAZZAL: I did not know that. I assumed that was part of your system.

HEFLIN: That was STS-2. It was either STS-3 or 4. EGIL went away, and EECOM showed back up. Or EECOM was there already, and we had a position for the mechanical systems: MMACS [Maintenance, Mechanical, Arm, and Crew Systems]. They had the APU system back then. EGIL eventually went away, and the electrical power system moved back into the EECOM realm. I ended up as an EECOM later, I can't remember, STS-4, something like that I guess.

ROSS-NAZZAL: I was curious about that. Do you know why that happened, why that switch was made?

HEFLIN: Let me think now. Looking ahead to flying Spacelabs—we flew a lot of Spacelabs.

ROSS-NAZZAL: Oh yes.

HEFLIN: Starting with STS-9, I think, [we] flew a lot of Spacelabs. We were wanting to consolidate as much as we could into one position. The fact that Spacelab was coming online eventually was one of the reasons we did that.

The EGIL position really just had the electrical power distribution. We didn't have any environmental [systems]. I think it just made sense. [It was] less overhead. [For the] flight director, at least there's one less person to deal with on the team. Same branch. I think it was just the simple thing. "Hey, we just don't need the position anymore."

Even though we had that one fuel cell failure, and later on we had fuel cell problems throughout the whole Program for 135 flights, you'd have some funnies go on later on. It was a system that didn't require [much attention]. It was a good system, it worked very well. It was, easy is not the right word, but dealing with it, watching it, taking care of it wasn't a hard thing to do.

ROSS-NAZZAL: Your bio sheet says you worked through STS-9. I wondered if there were any other missions that really stood out to you between STS-1 and 9 for EECOM or any issues that popped out. You mentioned Spacelab; STS-9 was supposed to be challenging because the power requirements increased, which increased the workload for the EECOM by about a third.

HEFLIN: Yes. There's nothing that stands out to me now during any of those flights that I worked. [STS-3], it wasn't a problem with any of the systems that I was responsible for, but we landed at White Sands [Northrup Strip, New Mexico]. I can still see on the TV one of the network [reporters] out there talking about this. This reporter was standing there, and he could

hardly even stand up in all the wind. I can remember, “We’re going to land there?” We did. Somewhere along the line we did a night launch, didn’t we?

ROSS-NAZZAL: I think it was STS-8.

HEFLIN: Which was a big deal to do that.

ROSS-NAZZAL: Sally [K.] Ride’s flight—.

HEFLIN: Is that right?

ROSS-NAZZAL: No, that was Guy [Guion S.] Bluford, but Sally flew on the previous flight, on STS-7. Don’t know if that was anything new. STS-5, you flew mission specialists for the first time. None of those relate to your systems, but I don’t know if those [stand out].

HEFLIN: No, nothing really stands out. I know once I got to where I was an EECOM there isn’t anything that really stands out as being something that was really significant that I dealt with.

ROSS-NAZZAL: Let’s turn our attention to flight director. You decided at some point you wanted to become a flight director. How did you reach that decision?

HEFLIN: That's another one of those [stories]. Bill Moon was my section head at the time. For some reason, I waited till the afternoon of the last day. Of course I had to get my supervisor to do some stuff too, the last day.

Bill and I are very close. Walked into Bill's office. I cannot tell you exactly why I stalled for so long and then what caused me to do that. I don't really remember what caused that. I walked in and said, "Bill, I think I want to go ahead and put my application in for the flight director job." Which was okay with him, but he looked at me and said, "Do you know what I got to do?" But he did it.

I'm not kidding you. Obviously I had some help. Randy [Brock R.] Stone for example, very very dear, rest his soul, friend of mine. I owe him a lot. I even made the comment in my part of the book [*Go Flight! The Unsung Heroes of Mission Control, 1965-1992*], about the fact that he was in my corner when I didn't know I needed him in my corner.

ROSS-NAZZAL: Can you tell us about that? That was one of the questions I wanted to ask.

HEFLIN: I came close to not making the grade as a flight director. I came real close.

ROSS-NAZZAL: I read that in the book about Tommy [Thomas W. Holloway and his reservations about your abilities].

HEFLIN: I came real close. I'll put it to you this way. I was not assertive enough. I was too nice of a guy. Mr. Holloway, who was my boss, let me know that. I've had fine supervisors throughout my career, some better than others. I've had a good set of supervisors, but Mr.

Holloway was the first and really only supervisor that I had that took me aside and said, “Heflin, you ain’t going make it.”

ROSS-NAZZAL: That must have been a hard conversation to have.

HEFLIN: Oh yes. I was in the Flight Director Office, and I’d already worked a few missions as a flight director that went well. It was basically, “Heflin, you have got to find a way to be large and in charge. You can’t always be a nice guy.”

This was right around the *Challenger* [STS-51L] time too as it turns out, because he had scheduled me for a class in Louisiana, I think, a training course to go to learn how to be assertive. *Challenger* happened, and we had to reschedule it. It was during that period of time. That was a rough period for me, really rough. Rescheduled it for me and had to take it in New York City, and that was another story, just surviving a cab ride in New York City. I’m lucky to be alive today.

ROSS-NAZZAL: You mentioned Randy Stone, and how he was always in your corner, which led to our discussion about Tommy.

HEFLIN: Yes, he stood up for me a lot during this period. I know he talked to Holloway. I didn’t hear the conversation, but I’m sure that he convinced Holloway, “Hey, let’s don’t give up on him yet.” Yes, interesting. It’s hard to believe that that’s a true story, but it is. I look back during that time, and I could see where there were times when I needed to be a little stronger in certain situations than I was.

ROSS-NAZZAL: Can you give an example or two?

HEFLIN: I think one of my strengths is I know how to not get in the way of good people that are working for me. I really do. I think that has been a strength. People would ask me, “How in the world do you ever stand the pressure of being a flight director in Mission Control?”

I say, “Look around me. See what I’ve got in here. These people will tackle me before I do something stupid.” I believe that.

Also I’m a good listener, but I think I probably listened too much. I did not enter the conversation as much as I probably needed to do during these times. I didn’t ask the questions I probably should [have been] asking. Eventually these things came out, but I could have helped by being just a little more aggressive, “Tell me why you’re thinking that. I’m not sure I understand that. Tell me that again.” I may be sitting there thinking, “I like what I’m hearing from this person,” but make him prove it. Come on, let’s be sure that this is really what we want to do. I just needed to be more aggressive in those sorts of situations.

ROSS-NAZZAL: Part of that tough aspect of MOD [Mission Operations Directorate] at that point? Tough and competent?

HEFLIN: Tough and competent. Tough and competent. Sure, yes. Maybe I’m stalling here.

ROSS-NAZZAL: Oh, you’re not stalling. I’ve got a few more questions.

HEFLIN: Do you want to know where a flight director who his team members like a lot because he's a nice guy—it got me in a situation one time. One of the questions I get asked when I do any kind of public speaking is, “Tell us about what might have been your most uncomfortable time in Mission Control.” I allowed a joke on me during real time in a real mission [on STS-44].

Let me tell you. I worked 20 Space Shuttle flights. This was halfway through the 20. I was rocking and rolling, things were good. I had learned how to be assertive, I got past that period, so I did much better. This was during a flight; it was either the day of Thanksgiving [or the day before]. The crew was asleep. I was working on the planning team as the flight director, the overnight shift, getting the plan together for the next day.

Middle of the night, it's two o'clock in the morning I guess, flight dynamics officer, FDO, calls me. “Flight FDO, need to tell you something. Got some word here from the mountain.” The mountain back in those days up in Colorado was the agency that tracked all the debris in space. It's got a different name now, I think. It's the DOD [Department of Defense] folks that warn us if we've got something that's coming anywhere close to us.

FDO said, “Well, Flight, I've just heard from the mountain, and they're telling me that we've got an object that's going to be fairly close to us coming up.” He said to me, “It's a spent satellite, they believe, of Turkish origin.” Turkish origin. It's like I didn't know. Are you catching on already? Thanksgiving. I heard Turkish, but I will tell you this is back when we were already getting very sensitive about these kind of things and there was concern. We've moved the Orbiter before, we've moved the Space Station a little bit before, being concerned about those sort of things. So that's serious. This was early in our understanding of how we need to pay attention to this. I was very sensitive to that, so I didn't hear. Turkish didn't stick. The fact that the mountain was telling us something.



“Okay, come on, tell me what you got.” I said, “When’s the time of closest approach?” He gave me the time. I looked at the clock. I said, “FDO, we’re at the tip of Africa, we’re going LOS [Loss of Signal].” This is back when we didn’t quite have full coverage. We had a 15-minute LOS between satellites down there in that region of the world. It was going to be during that time, and we’re 15 minutes away from being in that. It’s like 15 minutes from now.

I was really pissed. I said, “Why are they just telling you now? Why is that going on?” He said something and I said, “Hey, the crew is asleep. We’re not going to get them up. It’s a big sky. Heck, [we are] not going to do anything, because I don’t have time to do anything.” I’m really irritated, not so much at him. I’m irritated at the mountain, the guys there. Why did it take them so long? Why are they waiting so late to tell us about this?

So we have LOS. I walk down to the EECOM position. I’m right up here, and EECOM is right down here. [Demonstrates] I walk over to EECOM because I want to tell him this face to face, not over the loop there. I said, “Hey, when we come up AOS [Acquisition of Signal] here in the next few minutes I’m going to look at you. All I want you to do is give me a thumbs-up, or you start talking to me. If we had a problem here, if something hit us, and we have a problem with the cabin, I need to know about it right away.” I said, “Not going to make a big deal out of this. Just do that.”

He said, “Yes, sir, I’ll do that.” Then I needed to go to the bathroom, [I] walk out. As I’m doing that, FDO said, “Flight, Flight, Flight, come here, Flight.” He said, “Flight, we had put this up on the Eidophor, the picture. We have it on the tracking.”

I said, “I don’t give a damn.” I didn’t even look at it. I walked out of the room. He had put up this picture of an orbit and a turkey. He was trying to get my attention.

ROSS-NAZZAL: To laugh, break the tension.

HEFLIN: He was trying to tell me, “Flight, I’ve been playing with you.” I went to the bathroom, and I’m still really unhappy. I’m unhappy. I walk in. By this time there was some collusion. That’s a good word to use these days. There was some collusion going on between FDO and the FAO [Flight Activities Officer] position, because FAO owns the projection stuff up there, displays.

Both those guys. I’m not going to give their names. Both of them, they were ready for me when I came in the room. They got in my face, they said, “Flight, Flight, Flight, stop.” They told me what they had done. “This isn’t real.” I was immediately really mad, and I was immediately really relieved. You know what I mean? I’m really mad. I look at those two guys and I said, “Hey, when the shift is over, meet me down here in room whatever, and we’re going to talk.” They tucked their tails and went back to their consoles.

When I got back at my console, one of the branch managers who was in the control center—we had a room called SPAN, spacecraft analysis, 24 hours [a day] we had somebody there from management in the Mission Operations world. Basically [they were the] go between us and the MER, Mission Evaluation Room, people, the engineers. Any time things were being worked, those guys kept track of it. They helped the flight controllers in the main room and the back room. They helped them get the data they needed from the MER. They tracked all that stuff. One of the guys who was down there came up and was sitting at my console when I got there.

I looked at him and he looked at me and I said, “Hey.” I said, “You know what?” I wasn’t sure why he was there. I said, “Hey, what’s going on?” I looked at him. I said, “Hey,

you know this thing that we just heard about, it's not real. It was a joke they were trying to play on me on Thanksgiving." He turned white as a sheet. Turned white as a sheet. I looked at him. I said, "Hal, what's wrong?"

Said, "I came up here to tell you that I heard all this, and so I called Brewster [H.] Shaw."

ROSS-NAZZAL: Oh, no.

HEFLIN: Who was MMT [Mission Management Team] chairman at that time. "I called Brewster Shaw." It was four o'clock in the morning or whatever [time] it was. "I woke him up, and I told him about it. He was irritated that the mountain had not informed us either." So now I've got a new problem.

I'll end the story. [I] said, "Brewster will get in here and see." I got off at 4:00, 4:30, towards the end of the shift I guess. Brewster usually got in there before the MMT, got in there maybe 6:30, seven o'clock in the morning. I went home. I typed up a note on the typewriter, not on the computer, with what had happened. I didn't sleep. I didn't even go to bed. I just took a shower. Went back up to the control center.

I'm sitting in Brewster's chair waiting for him to show up, so when he can get there I can tell him what happened. Brewster had a hard time not laughing when I was telling him the story too, by the way. You could tell. He had that manager face on, but you could tell. He knew I had been had. Part of my story was, "Hal, I've taken care of these guys. I've talked to them." Both of them thought they were going to lose their job, but they didn't. That's a long story.

ROSS-NAZZAL: That's a great story actually because when I was reading Rick Houston's book I was surprised because of where you went from there. To hear that, that must be a very inspiring story for people in MOD and FOD. Knowing that you can find those kind of challenges.

HEFLIN: I tell a shorter version of that any time I have a chance—for the young folks getting in this business or anybody thinking about getting into management. I counsel some people from time to time. One of the things I certainly learned from this obviously is that there's a command presence. The flight director in the room has to have a command presence at all times. Got to have a command presence. You can't let that go. They did that because they liked me. They knew this is just a joke, and it's going to be funny. The atmosphere obviously that I had on that team of mine during that mission was things are easy, going fine.

From that I learned, when you're in positions where you have this kind of responsibility, you can be a good person and not be a nasty person, but you've got to be sure that you are always presenting yourself in a way that—you don't want them to relax that much. You know what I mean? You don't want them to relax that much. From that day forward I probably got just a little bit tougher in the control room.

ROSS-NAZZAL: Did you have a speech like Gene Kranz when he gave the speech about Apollo 1? Maybe you had a speech for your team after that incident.

HEFLIN: After that? No, I did not. We'll have to save that for the Hubble stuff. Let's save it for Hubble. I'll tell you about a speech relative to the Hubble Mission one of these days. No, I didn't get the team together. In fact, at the time the room eventually figured out it was a joke.

When I heard what this was I didn't bring it up on the loops, I didn't talk about it anymore. But it got around that uh-oh, Heflin got hooked here.

That ended up [in the press] in December, two weeks later or so. What do you call these kind of newspapers that are behind-the-scenes goofy newspapers? One of those, some tabloid thing. There's one in Houston, I don't recall what it was called.

JOHNSON: *Houston Press*?

HEFLIN: I think it was *Houston Press* a couple weeks later had a column in there about—the title had something to do with turkeys and Mission Control. No names appeared. In fact, it didn't even say that the flight director got hooked on this thing, but it said a prank had been made in Mission Control.

After talking to Brewster, I never heard from anybody. Nobody bugged me about it. So Brewster probably did a little stuff in the meantime to calm things down too.

ROSS-NAZZAL: I did want to go back and talk about just a couple of missions prior to *Challenger*. One being your first mission, which was [STS]-51D, because that was a pretty significant mission. You were on planning shift. That was the flyswatter mission. I wondered what your role was in coming up with that concept and those ideas.

HEFLIN: On the planning team, probably [the] thing I did best was I didn't get in anybody's way. My very first shift as a flight director [was] on the planning team, that's where you start. By the time I was on shift the people in the daytime had already figured out how they were going to fix

it. Actually it was a good period of time for me because my role was to be sure that the package we were sending up to the crew of the next day's activities—that was our job—was exactly what they needed.

My team's job was to take these ideas and the raw procedures and get them dressed up enough to send up to the crew. [This was] back in the old days where we had a teleprinter on board and had stuff printed out. As far as me contributing to the concept, I'm pretty sure I didn't have anything to do with that at all. I simply was one who helped make sure my team had the package put together. I'd forgotten the old flyswatter thing.

ROSS-NAZZAL: Were you in the room when they tried to reactivate the satellite?

HEFLIN: I was not. I wasn't on shift then. I don't remember exactly how I had heard about that. It was a good attempt.

ROSS-NAZZAL: Yes, it's an interesting idea.

HEFLIN: Remember when we grabbed the satellite by hand, the three folks? I worked that flight as well. I really feel that that was one of my better times. [I] was again on the planning team. I can't remember which mission that was.

The planning team puts these packages together and [has] got to do them right. A lot of effort would go into making sure they're right. We had to rendezvous too, which we hadn't planned on doing. How did this go? Is that right? We had to rendezvous. Help me out here. Had we deployed and it not worked?

ROSS-NAZZAL: I think that was the case.

HEFLIN: That's right. I had an EVA flight controller, and we were going to put three folks out. I had an EVA flight controller who was one of my favorites, not going to tell you who, but they talked too much. That was how they operated. They just talked too much. I say they, I'm not telling you he or she, I'm using the word they. They had been assigned to work this thing. When that person walked into the room that night to help put the package together, [and I] saw the person walk in, I thought, "Oh God, no." They talked too much.

Person walked up here, flight director console is here [points], and EVA was at that time I think over here [points], one console away or something, close by. Walked in. I'll say he. He walked in. Walked to his console. I looked at him. I said—I'm being assertive now, okay? I had him sit down beside me, and I looked at him. I said his name, and I said, "You know what?"

He said, "What?"

I said, "Not tonight. Not tonight. I can't have you talking tonight. I need short answers and so forth." He got the idea.

Then I carried it a step further. When we were reviewing all the stuff put up there, we typically cross the t's and dot the i's. All the stuff looks nice, the teleprinter is up, it's perfect. I told the team, I said, "Tonight, folks, making something better [is something] we're not going to do. If we misspell something and it's still the right word, we may not be correcting it. We haven't got time. If what we put up there tells them what to do and helps them but it's not pretty, or we misspell something, we're not going to take the time to redo it and get it done."

That was probably my contribution, because we had a lot of stuff to do that night. That's the beauty about being a flight director. You are in charge, and you can do that. Probably sounds funny, but I'm not kidding you. You can do that. When you're at conference rooms and other places doing stuff, sometimes you can't do that. But in that room you can do that. Worked out great.

ROSS-NAZZAL: You were flight director for some interesting flights, for [STS]-51G. Shannon told me you were flight director, which had a Saudi prince. Also [STS]-61C, which [Congressman] Bill Nelson flew on. Curious if you could talk about some of those.

HEFLIN: The Saudi prince was a prince of a person for one thing. I remember that, but not much on that one.

I got a good Bill Nelson story. I don't mind telling this story. Make it public someday if you want to. It's great. Bill Nelson was a camera hog. Let me back up. First of all, Jay [H.] Greene was the lead flight director but I was training to be lead flight director, so I was basically doing a lot of the lead stuff.

One of Nelson's trips out here, they went out to eat, Jay Greene and his wife, Nelson, I don't know who else, a small group of people. I didn't go. During the meal Nelson looked at Greene and said, "Jay, now let me get this right. There's an Orbit 1 team, Orbit 2 team, Orbit 3 team." He read off their names. He looked at Jay and he said, "Who does the other orbits?" True story.

ROSS-NAZZAL: Oh my goodness.



HEFLIN: True story, yes. During the flight Nelson was also a camera hog. He liked the camera. Here's Heflin, who allowed somebody to do a joke on him, and I'm about ready to do the same thing on this senator. Back in the days we had middeck, flight deck, and any time you turned on the camera you told the crew on board, "Hey, is it okay if we come on board on the middeck?" Just to let them know [you are watching]. They say yes or no. Usually it was yes.

The PAO [Public Affairs Officer] is changing around, looking at different stuff. I'm sitting there watching this thing. I noticed that every time we switched to one deck, just a few seconds later Nelson was there. Watched this for a little bit. Sure enough. Couple swaps of camera, [there was] Nelson. INCO [Instrumentation and Communications Officer], a position in the control center who maintains and controls those cameras [and] commands them, [could] do split screen. I looked at INCO and I said, "Hey, INCO, can you give us a split screen, please?" Nelson didn't know what to do. I'm serious.

ROSS-NAZZAL: That's funny.

HEFLIN: Yes. Actually he sort of knew what to do. He was here, then he was here, then he was here, then he was here. True story.

ROSS-NAZZAL: Did it change things having a politician on board compared to other astronauts that you had worked with?

HEFLIN: No, Nelson was a good listener. He knew there were things that he's not going to mess with. Any time I saw him at any gathering, it was rare that he would say anything. He's working with the crew, but in our technical meetings or flight techniques, [he was] just a good listener. I never noticed anything except the things I've told you about. I never noticed anything to cause us to have any difficulties in integrating him into the process.

ROSS-NAZZAL: You mentioned you were training to be a lead flight director. Would you tell us what a lead flight director is and what some of the roles and responsibilities are?

HEFLIN: Lead flight director is usually assigned much earlier than the other flight directors. You're the point man, or woman today, working the flight much earlier than anybody else would be from the Flight Director Office.

We have a standard set of meetings called flight techniques for every mission that we would run. We had flight-specific flight techniques. The lead flight director would chair that flight techniques meeting. This is in a conference room where you start dealing with all the bits and pieces of the mission plan and what you're going to do and how you're going to do it.

You're responsible for the flight-specific flight rules. Lead flight director owns that book basically. Your team puts that together. You're in charge of seeing how that does come together, the flight techniques, the rules.

When there's special procedures and training to be done in the mock-ups, Building 9, as lead flight director you would go over and observe and early on watch the development of the procedures. During Hubble [I] did a lot of that. Spent a lot of time with the crew, for Hubble probably more than anything else. We'll talk about that later.

You don't pick your team. The branch chiefs and the divisions that support [the Flight Director's Office] provide the flight controllers. They have folks, but as lead flight director [you] get to see that. [There was] only one mission, I think, I had where I did have some concerns with one individual, but it worked out okay. I did not have him taken off of the team; I decided I probably could work with him. I wanted to make it work if I could. But you're obligated to go through, look at the team, see if there's any[one] that you'd like to swap. Occasionally that would occur, but I never had to do that.

ROSS-NAZZAL: We're getting close to time today. I didn't want to start talking about *Challenger* [STS-51L]. But I did have one other question for you. In '85 the first woman was selected as flight director, Michele [A.] Brekke, and I was curious if you had any opportunity to work with her and mentor her. She didn't actually end up [working as a flight director].

HEFLIN: I did know Michele, and I was pleased when she got selected, and disappointed that she and Rick [Richard N.] Fitts, who was also selected at that time, both decided—well, *Challenger* happened. They both decided as we were getting closer [to Return to Flight], they both decided to not stick with it. I can't tell you why Michele did that because I really don't know. ... But I was pleased. I think she would have done a good job. Over the years I'd see her. It was just disappointing that she didn't stick with it at the time.

ROSS-NAZZAL: We're going to be interviewing her next month. Good timing. I think this might be a good place for us to close. Next time we could pick up with *Challenger* and definitely Hubble. I know that's going to take a while.

HEFLIN: I hope this has been useful to you.

ROSS-NAZZAL: Absolutely, I think that this is great material.

[End of interview]