NASA Johnson Space Center Oral History Project
Oral History Transcript

Charles F. Deiterich
Interviewed by Rebecca Wright
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WRIGHT: Today is February 28th, 2006. This oral history session with Charles F. "Chuck" Deiterich is being conducted in Bertram, Texas, for the NASA Johnson Space Center Oral History Project. Interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal and Sandra Johnson.

Thanks again for participating in this project and letting us come visit you when you're home this afternoon. We'd like to start with you sharing with us what motivated you to apply for a position at the Manned Spacecraft Center in August of [19]'64.

DEITERICH: Well, I moved to the Houston [Texas] area in 1951, and I went to Galena Park High School, and I was always interested in space and that sort of stuff. I went to the University of Saint Thomas in Houston, and I remember standing on the library steps when Sputnik [Russian satellite] went up, and we thought that was really pretty neat. So I was always interested in space, and when NASA came to Houston, I went ahead and put an application in. In fact, I put two applications in.

I'd actually worked for a little company called Transport Flight Systems, and they had simulators for airplanes, and I worked on these simulators. They were over on [William P.] Hobby Airport [Houston, Texas]. It was kind of an aerospace—more aero than space, obviously—so I worked on the simulators.

Then I left there, and I went to Dresser Electronics. I worked in an electronics lab, where they were doing signal conditioning equipment and things like that for Titan 2s and stuff. So I worked on that. And they also had electronic controls for pipelines, and I worked on that.

Then they kind of lost their budget, so I got laid off, and I went to work for a company called Test Equipment Corporation, where they built test equipment for transistor checkers and things like that. When I left Dresser, I made an application for NASA, and they looked at it, but they rejected me for some reason or another, and that was like in [19]'63. Yes, that was the early part of '63.

Then I went to work for Test Equipment Corporation, and I put an application in. A friend of mine from Dresser had gone to work for NASA, so he put an application into the Operations area. The other application was in Engineering.

The Operations guys called me up, Glynn [S] Lunney called me up and wanted me to—well, he didn't call me, but one of the people in Personnel, and I went and interviewed with Glynn, and he hired me into the Flight Dynamics Branch. I was assigned to the Apollo Section, and that was under Grady [Grayden F.] Meyer. So I was working Trajectory Operations, and essentially I worked Trajectory Operations until I became a Section Head in 1978.

So for fourteen years, I essentially worked Trajectory Operations. Although the name of the section changed and the name of the division changed and the name of the branch changed, it was still Trajectory Operations of one sort—either the Flight Dynamics Branch or the Mission Operations Branch, whatever you want to call it, but that's kind of the way it worked. You asked me how I got there. It's because I enjoyed space and I had a chance to go down there. My dad always wanted me to go to work at NASA, so I put my application in and talked to Lunney, and then he hired me in '64.

WRIGHT: Can you tell us about some of the first job duties that you had and how you evolved during those fourteen years?

DEITERICH: Well, like I say, I was what they call a Retrofire Officer, which was part of the Flight Dynamics Team. There was a Flight Dynamics Officer, a Guidance Officer, and a Retrofire Officer. We were a team to do trajectory operations, or trajectory control, and we each had our own little areas that we worked in.

The Retro was more concerned about recovering from abort situations and in normal re-entries and de-orbits, returning from lunar trajectories, and things like that. So the Retro was always worried about aborts and just bringing the crew back, either nominally or in an abort situation. The Flight Dynamics Officer was worried about getting into orbit and doing rendezvous and doing lunar landings. And the Guidance Officer was worried about the flight software and the on-board computer.

Of course, depending on who was most active at any given time, the other two would help him. Like, for example, during lunar descent, the Retro was not planning an abort, but he certainly had a lot of things that he would do to help the Flight Dynamics Officer, like we worried about the weights and CGs, the centers of gravity. We worried about the engine thrust [alignment] and those kinds of things. And during the descent, there was a call for when the engine would throttle down, and we had some telemetry parameters that would help us predict that, so the Retro would predict that for the Flight Dynamics Officer.

So as a team, depending on who was in focus at the most time, that was who supported. Like during reentry, the Retro was kind of on the forefront, so the FIDO [Flight Dynamics

Officer] would worry about the ground vector and the Guidance Officer would worry about the on-board vector and those sorts of things. So as a team, we kind of worked together. Of course, that was the real-time stuff, and that was after we had all our tools put together.

One of the things that you asked about, or you mentioned, was what did we do with the getting ready to go? Well, early on, we didn't really have much—we didn't have any tools to speak of at all. We would sit down with the people in Mission Planning Analysis Division, and they had a lot of trajectory runs that they would make, depending on altitude, velocity, or whatever, and we would look and see what kind of conditions would give us problems, like during powered flight, what kind of conditions would give us a problem. If you were to fly too straight up and the engines were to quit, you'd pull too many Gs [gravity] when you reentered. So we knew all those kinds of things, and we would look at the data that they presented us, and then we would take and say, "Now how would we monitor this in real time? What do we need to know to prevent from getting into that kind of a [region] of the flight or into that [region] of the envelope?" So from that, we said, "Well, we need to have these kind of things we need to watch," and there was a lot of stuff had been done in Gemini and Mercury that kind of led us along there, but the problem was expanded when you had all the different kinds of things you could do with Apollo. The Apollo spacecraft had a tremendous amount of energy, much, much, like probably ten times that that the Gemini had. And so when you think about that, you had a lot more options you could do. So we expanded on the knowledge of how that worked, and, of course, once we got on orbit, we had to plan maneuvers, and so we said, "Well, what do we need to plan maneuvers?" Well, you have to put some targets into the on-board computer. You have to come up with these targets, and you, depending on what you want to do, whether you want to rendezvous with something or if you want to de-orbit or if you want to do a mid-course correction on the way to the Moon, so we had these targets that we understood. We put them in the computer, and they'd give us the answer. Well, we had to define what those processors needed to be so that when we got into the mission, we'd had these tools to work with. So it was an iterative process. We started out small. The first two flights were lob shots, where we just went up, re-entered into the Atlantic Ocean on the first one, and we re-entered into the Pacific on the second one, so we weren't even completely in orbit. But then, from that we got our ascent monitoring techniques down, and we expanded on those as we got into the orbital flights with Apollo 7, for example, and we came up with rendezvous processors when we started doing Apollo 9, because they did have the LM [Lunar Module] when they went out and the re-rendezvoused with the LM. So as the program developed, we developed more tools to do the different jobs and the extra jobs that came along.

WRIGHT: Can you share with us the differences of doing your task for Gemini compared to Apollo and then, of course, with Apollo as you were starting to talk about the unmanned missions and how those rockets were different from the manned missions?

DEITERICH: Actually, I never worked on Gemini. I monitored a sim [simulation] or two, a simulation, down at the Cape [Canaveral, Florida], so I strictly worked Apollo as my assignment. And sometime in the early part of [19]'66, we reorganized. We had an Apollo Section and a Gemini Section. The Apollo Section was under Grady Meyer, and the Gemini Section was under Cliff Charlesworth. I'm sure you've heard of Cliff [Clifford E.] Charlesworth.

In fact, that branch really had a lot of people. It had Charlesworth, it had Lunney, it had Phil [Philip C.] Shaffer—I don't know if you've talked to Phil Shaffer. We have Jerry [C.]

Bostick was in that branch. There was a lot of guys that came out of that branch that did very well.

But anyway, so in the early part of [19]'66, we reorganized, and we had a Retro Section, we had a FIDO Section, and we had a Guidance Section, and I think Bostick was the Section Head for the FIDOs, and Charlesworth became an Assistant Brach Chief. Charlie [B.] Parker was the Guidance Officer Section Head, and John [S.] Llewellyn [Jr.], which I know you've talked to, was my Retro Section Head. And they were still flying Gemini, but we were also getting ready to do more Apollo stuff.

Sometime in that time frame, we turned in the Retro Section—no, actually, I beg your pardon. Grady Meyer was the Section Head for the FIDOs for a while, but then he left, and I think Bostick then took that Section Head job.

But anyway, to make a long story short, we were there in Building 30, and we would have these kind of brainstorming sessions where we'd try to figure out what we were going to do, how we were going to fly. We'd write down our procedures, what things we would look at, what things we would monitor. So even though I didn't work Gemini, I'd talk to those guys that did and use some of their expertise, what they had done, and try to move that over into Apollo.

And after Gemini was phased out, those guys moved over to Apollo, and the things were set up. So we kind of did it as a group, although some people were—we were worried more about Apollo, so we were kind of doing the pick-and-shovel work as those guys came on over from Gemini. Don't know if that answers your question or not.

WRIGHT: It does. And we were talking then about the unmanned missions and how you were involved with the first Apollos.

DEITERICH: Okay. I was a Retro on [Apollo/Saturn] 201, which was a lob shot down the Atlantic Ocean, and it landed down there at Ascension Island. What we did is, it was the first Saturn 1B flight, and I forget exactly how high we got, probably 250 miles or so, and then we pointed the SPS [Service Propulsion System] engine down and burned that engine straight down to increase the entry speed. So we were actually above orbital speed, but we were pointed down. It was a heat shield test to get a higher velocity on the heat shield and also to test all the systems. And, of course, after we separated the Service Module off, the Command Module reoriented, and somehow or other, there was a wire that got shorted out, and so it was supposed to fly a full lift trajectory down to land. Well, it actually ended up rolling, so it didn't land where it was supposed to, but they had beacons on it, and the recovery guys did find it.

Then, on [Apollo/Saturn] 202, which was like in August of [19]'66, we again fired the—it was an S [Saturn] 1B—we fired the thing, and we flew over Australia and landed near New Guinea, and we pointed the—we did a big SPS burn again and got the velocity up higher than normal. And 201, we did not have an on-board guidance system per se. It was kind of a very rudimentary autopilot, if you will, but 202 actually had an Apollo guidance computer on it, and it flew a guided reentry, although it didn't exactly land where it was supposed to either, because the L/D [lift to drag ratio] wasn't as high as it was supposed to be. But anyway, so we got a lot of systems tests, and we got some heat shield tests out of that.

There was two other missions, [Saturn/Apollo 4] 501 and [Saturn/Apollo 6] 502, which I did not work on, and they were the Saturn V, where we went way high up, and I forget how high, 20,000 miles or so, and came back, screaming back, almost at lunar velocity for reentry for heat shield tests. Plus it was the test of the Saturn V. Now, on the Saturn 1B, we flew 201, 202, [Apollo/Saturn, AS-] 203, and 204 [-LM 1]—all unmanned. [The AS-204 booster that was on the pad for Apollo 1 was used for the unmanned LM flight, 204-LM1 (Eugene F. "Gene" Kranz was the flight director for 204-LM 1)]. [AS-] 501 and 502 were the only two unmanned Saturn Vs, and 503 was Apollo VIII. So we flew people on the Saturn V the third time it was flown, which was kind of exciting.

WRIGHT: Well, before there was Apollo 8, there was Apollo 1, and I understand that you were on the console.

DEITERICH: Yes, I was on the console. It was in the wintertime. It was cold. And they were doing pad tests, and John Llewellyn always wanted—well, we were required to be there, but he always—anytime the real-time computer was up, anytime there was any testing going on, he always wanted his guys over there in the Control Center just as a learning experience. And so I just happened to be on the console when they had the fire, and it was evening, I think, like six o'clock or something like that. It was in the evening. And yes, I was there. It was kind of hard to exactly figure out what was going on initially. We lost data, and we heard a lot of noise. And then later on, you know, we got to where there was a fire, and I think one of the EECOM [Electrical, Environmental, Communications Engineer] saw a big—they played the data back and saw a big voltage spike where something obviously had shorted out—not a voltage spike, a current spike, so obviously something shorted out. And so that was really kind of a bad day, to say the least. And it put us behind in what we were trying to do, and that was a Block 1 Command Module, and they actually went to a Block 2 Command Module, which had a lot of revisions in it. So I think back, Gemini and Mercury had worked so well, and nobody really had any—there was some dicey things happened, but we never lost anybody, and I think people redoubled their efforts to make sure that we would not ever let that happen again. Each guy has his own area, but it kind of borders up against somebody else's area, and sometimes something that happens over here will affect you. Guys tried to be more broad and understand what other people's areas were, so I think there was a lot more integration of the whole system after the Apollo 1 fire. People were more concerned about not just their own little area.

WRIGHT: Apollo 8 was a significant milestone in the history of space flight, and what was your reaction and your colleagues' reaction when you found out that you were going to go around the Moon?

DEITERICH: Well, you know, it was funny. You asked a question about Apollo 11, but it was really Apollo 8. But, we were getting ready for Apollo 7, and I was on the console for Apollo 7. I was going to be one of the Retros for Apollo 7. And along about September, Bostick called me into his office, because he was a Branch Chief then, and said, "Hey," and he closed the door, of course, and he said, "we're going to go to the Moon with Apollo C-Prime," we called it, because Apollo 7 was called C, and this was C-Prime. "You can't tell anybody, and you're going to be the lead Retro." I'd never even been on a manned mission before. I'd flown two unmanned missions, and oh, boy. He said, "Your other two Retros are going to be Bostick and Llewellyn.

I said, "Oh, great. I've got my Branch Chief and my Section Head supposed to be working for me. Right." So that was pretty overwhelming.

But we had a long way to go. The tools that we had for lunar missions were just now being developed. Nothing in the Control Center as far as lunar kind of trajectories worked until like November. We were trying to do simulations with things that didn't work. We had a lot of backup charts, and, of course, we dug out a lot of the MPAD [Mission Planning and Analysis Division] trajectories and figured out what was sensitive and what was not sensitive.

And of course, everybody else kind of figured out that we were going to go to the Moon—that was the rumor—but we couldn't verify it because we knew that we were going to the Moon, but we were told it was a secret deal. So it was kind of frustrating. So we just played along. They'd say something, and we'd just kind of ignore them and go on and do our thing because C-Prime official thing was just the second Earth orbital mission.

So we had to get all our procedures together. And there was a lot of things in the real-time computer that didn't work exactly right, so we had certain work-arounds we had to do, certain things, when you compute them, they wouldn't give you the right answers so you had to do something to move it around to make it give you the right answer. It was a struggle, and it was kind of a bare bones kind of a thing. We had a lot of capabilities that we got later on for missions when we had the LM, etc., that we had to add later on, but it was scary.

WRIGHT: I was going to ask you, could you share with us what it was like knowing they were going around the Moon, what it was like in the Mission Control Center?

DEITERICH: Well, yes. We did have sims, and Apollo, like I say, a lot of times the computer didn't give us the answer we wanted it to. And I can't remember, but I believe the simulator was at the Cape at that time. I don't believe we had a simulator in Houston.

Jon [C.] Harpold, I don't know if you interviewed Jon or not. Well, you won't get to. But he was the reentry guy from MPAD. He and I went down to the Cape right before the mission, right before Apollo 8. I forget exactly when it was. It was like, oh, maybe the [December] 14th or something like that, the second week, to talk to [Frank F.] Borman and watch some sims down there and then talk to Borman. And in the crew quarters we were sitting there—he had a shaving dispenser with shaving cream in it.

We were talking about blunt end forward, using that as our demonstrator on the reentry vehicle, and we got to eat supper with him. And of course, we had to use some of our per diem to pay for the food, believe it or not. But in walks Arthur Godfrey. He had a cane, and he came in to see the crew. This was before they started quarantining. After the guys potentially could have gotten sick, they started quarantining them, but this was before they quarantined them. So Arthur Godfrey walks in, and he shakes hands with everybody. I go home and tell my kids, "Hey, I saw Arthur Godfrey." Well, they didn't know who Arthur Godfrey was.

So we had so many things to do, and it was really hard to—you almost detach from worrying about anything. For example, we'd provide a lot of information to the crew to do maneuvers. We'd tell them what way they needed to be pointed, what the time of the burn is, how long the burn is. We give them the stars to look at that they can check in their telescope to make sure they're pointed in the right direction. We give them the weight. We tell them which way to point the engine bell so it's pointed through the CG. So it's a lot of information that we give the crew. Well, we hadn't figured all that stuff out for lunar missions.

And Bill [Howard W.] Tindall had a group called the Data Priority Group, or Mission Techniques I think they later called it, but it was mostly the trajectory guys and the crew would get together and figure what we're going to do and how we're going to do it, what kind of stuff we're going to pass each other, how are you going to align the platform, where are you going to point it, what kind of errors can you take and still not have a problem, how much does a platform drift over time, how often do you have to do a platform alignment with the stars, do you turn the computer off while you're flying or don't you, do you leave it on? Do you turn the platform off? All those questions had to be answered.

MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts], who was responsible for the on-board software and, I guess, had a lot to do with the computer and the platform, were involved in these meetings. Bill Tindall would say, "Okay, what are we going to do about this?" and the guys would go away and study it and come back.

Well, during some of these meetings, we also came up with what we called pre-advisory data, or PADs, which was the information we passed the crew. Actually, I wrote down what I thought we ought to have, and in like two weeks we had those things all done. Later on, to make a change, it took months of getting approval and all that sort of stuff. When they got the Shuttle, I think it was even worse. So we were doing a lot of things as a small group because we were all these secret guys. They were doing Apollo 8 in a small group, so we could get a lot of things done in a hurry, and we didn't ask for a lot of advice, so we didn't get a lot of advice.

And, like I say, Tindall really did a very good job of pulling all that integration together. He used to put these things out called "Tindall Grams," which would explain why we would do things, and we would write down the rationale of why we did all these things, and he would publish these minutes. We probably wouldn't have made Apollo 8 happen had he not done those kind of things, and the trajectory guys, the flight dynamics guys, were so involved with that.

The systems guys didn't really get too involved in the early data priority meetings, because it was more of an exchange of trajectory and flight planning kind of information between the crew and the flight dynamics guys. And I think the flight planners, which were actually in the crew directorate, the Crew Operations, the Flight Crew Operations—when we were in Flight Operations Directorate, they were in Flight Crew Operations Directorate, which had the flight planners, the guys that wrote the flight plan, the crew and some of the support people worked in that directorate. And then Flight Operations had Mission Planning and Analysis, who did the pre-mission trajectory work, and then all the Operations guys. So we were not too close together, but this was one place where we did get really close together.

And you asked a question there about interfacing with the astronauts, and it turns out that early on, there wasn't that much interplay. The crew had checklists that the flight planners wrote for them, the checklist writers, and we didn't really have a lot of access to those early on. Later on, it became very apparent that the ground team and the on-board team need to really work together. So we used to get copies of checklists and copies of flight plans, and then we'd keep updating. There'd be updates, and we'd update our books as new pages came out. So somewhere around Apollo 8, that whole integration activity started getting a lot stronger, which was good, because those guys would also participate in the flight techniques meetings.

WRIGHT: While we're talking about Bill Tindall—as you know, we won't be able to talk to him either—those meetings that you all had together, was it a pretty free flow and exchange of information, or how did Mr. Tindall keep some type of order and exchange going within that group?

DEITERICH: It was a big conference room, and I don't remember exactly how—I don't know if he had an agenda or not, but it never got out of hand. Anybody could say anything they wanted to. We always had what we called block data, which was data that you would use—it was a maneuver and return to Earth if you had a problem and you couldn't talk to the ground. Now, when we were in Earth orbit, we always had what we called block data, which would give them a de-orbit opportunity to put them down near a ship or someplace.

When we were going to the Moon, we had the same kind of thing of going out, and if they lost com [communications], they could do this maneuver and get back to the Earth. And I remember sitting in a chair and saying, "Hey, here's what we ought to do. We ought to have one here, here, here, and here." And it was based on almost using all the Delta V [change in velocity] but getting back as quick as you could but at different times, about eight hours apart all the way out, and it was the data I'd gotten from MPAD.

Everybody said, "Hey, that's the right thing."

We did that, probably, in fifteen or twenty minutes, but it probably got revised a little bit later on. Anybody could say anything, but people usually paid attention, and it never got out of hand that I can remember.

WRIGHT: How often did you meet and for how long?

DEITERICH: Well, the meetings were always a couple of hours long, and I think they were like once a week. They were pretty often, because, we had from like September to December to get ready. And of course, what we would do, and I don't have any, but they would write—TRW [Incorporated], I think, were the secretaries for the data priority, and they would put out a document, because I have one on retrofire for Apollo 7, and it was a document, it's about that thick, and it tells you everything that you've got to do, all the flow, all the data flow, who does what, what the errors are, and they had one for rendezvous, they had one for the lunar return, and all that sort of stuff. So—I don't know where we were, but I got off on that. But anyway, all that stuff was documented, and—I lost my train of thought.

WRIGHT: We were talking about how long the meetings were and how often.

DEITERICH: So after the minutes came out, then they would put together the document, and people would review the document and mark it up. So we had a couple of documents that were put out before the mission that would kind of describe how we intended to do things.

And a lot of the mission rules—and I'm sure you know what mission rules are, the things that, if this happens, this is what you're going to do. A lot of the mission rules, from a trajectory point of view, flowed out of those data priority meetings. Like how bad does a state vector on board have to be before you update it, or how far does the platform have to drift before you fix it, and those kinds of things.

And where you do maneuvers, like, for example, when you're coming back from the Moon, we had three maneuvers that were scheduled. One was right after we passed the lunarsphere [of influence], like fifteen hours after trans-Earth injection. Then we had another one about twenty-four hours out. Then we had one that was two hours out. And I think we started out to have—I forget exactly how it was, but after the first flight, we decided it was too close, and we moved it back an hour because we didn't have time to do the maneuver and get ready for re-entry. It was those kinds of decisions that were made in those data priority meetings. They were very important.

WRIGHT: We seem to, today, live in a time period where lots of things get leaked out or secrets get shared before it's time. Did anybody have any doubt that Apollo 8 would remain a secret until it was time to announce it?

DEITERICH: I don't know. When you're sitting in a room and you're talking about lunar trajectories, it's pretty obvious—although we had talked about lunar trajectories—we do things two or three years in advance anyway, so you really never knew. I don't know how much the public knew about it, because I really wasn't paying too much attention to the public. I knew people in the office kind of suspected what was going on. But I don't know if the newspapers said much about it or not. I don't think they did.

WRIGHT: I think it was a surprise until it was announced.

Well, after Apollo 8, you became a lead on a number of flights after that as well.

DEITERICH: Yes, I was. On Apollo 10—let's see, Apollo 9 was Earth orbit LM mission. I was not on that. Apollo 10, I was on the launch team. No, I was not on the launch team. I did not work Apollo 10. I did work Apollo 11, and I was the lead on Apollo 11, and I worked the descent with Jay [H.] Greene and Steve [Stephen G.] Bales. And that was kind of interesting. It was a lot of fun. I enjoyed that.

It got to the point where guys just kind of fell out, that we needed a lead Retro, and he'd done all these things, so I ended up being lead on everything from—from [Apollo] 13 on, I was the lead on all of them. I didn't fly all the different phases, but I always flew the mission, but I was always the lead.

What the lead does is he negotiates with all the other elements in the Control Center. If you need to have some sort of an agreement with an EECOM, the lead would take care of that. Now, he'd ask other guys to go do things, he wouldn't do it all, but he was the guy who was really responsible for making decisions or for integrating with the other areas, and he was always the guy who had to worry about writing the post-flight report and the mission rules and all that sort of stuff. He didn't do it by himself, but he was kind of the focal point. If the other guys had questions or whatever, they would come and deal with the lead. So I was the lead from 13 on.

I was Lead on [Apollo] 8, I was lead on [Apollo] 11, and I was lead on 13. I did fly Apollo 12 [launch], and that was all I flew, and I was not the lead. Tom [Thomas E.] Weichel was the lead on Apollo 12. I was there when the lightning struck and all the data went off, all the on-board Apollo data went off. The booster data had a glitch, but it kept on going. Greene was the FIDO. So we were kind of concerned about what had happened. His indication, the on-board guidance said, hey, we made it to orbit. Of course, it's going to say we made it to orbit, because that's what it targeted for, and it thinks it got there. Anyway, his tracking pretty much said we were in orbit.

But we came over Carnarvon [Tracking Station, Western Australia], and we got data a couple minutes early. Well, the only way you get data early is to get there early. The only way you get there early is not to be as high as you thought you were. And all the systems guys, they were happy as clams, because they're getting their data so they can see what's going on. Greene and I look at each other and say, "Oh, man, this is not good." But then, when we got some tracking data in, we realized it was okay. But he and I were the only ones that were kind of concerned about getting early telemetry.

What it was, it was what they call multi-path. It was some way the waves bounced off the atmosphere and we got data before we really should have, or before you had a direct line of sight. Let me put it that way. So that was kind of interesting.

I was a little surprised that we could get everything pulled together and get the spacecraft—because the computer had gone off and everything was turned down, the fuel cells were off. We got everything back up and running again, got the on-board state vector, and really checked out the whole vehicle as best we could with enough confidence that we were willing to go to the Moon, and we did. But that was really doing things in a real big hurry. A lot of guys worked real hard to get that stuff done.

Of course, for Jay and I, we were on a nominal trajectory, and all we had to do was figure out, well, if they're going to go to the Moon, we'll compute the TLI [translunar injection] maneuver. Yes, we'll do all those maneuvers, but we were going to do those anyway. And all the block data, well, we were going to compute that anyway. So we didn't really have a lot of extra things that we had to be too concerned about, whereas the systems guys had to make sure all their things were working.

WRIGHT: Well, things didn't work well on Apollo 13. Where were you when they received the message that there had been a problem?

DEITERICH: I was in bed, I think, and my wife came over and told me about it. So I went into the Control Center, and I think I stayed there a night or two. At that time, they had a dorm in the Control Center where you could stay. So we went in, and of course, by then they knew what had happened. They knew that they were losing oxygen and that things were not too well. And they still hadn't made the decision what they were going to do about coming back.

My concern was that the SPS really wasn't there and wasn't usable. And we would have had to jettison the LM to do an abort at that point, to come straight back, to do a direct abort. We had been on a hybrid trajectory, which means we weren't going to—most trajectories, our early trajectories, we were free return, which means after you did the maneuver to get you to the Moon, you could actually fly around the Moon and come straight back and reenter. That's called a free return.

But you can gather performance, carry a heavier payload, or get to different landing sites if you go to a non-free return trajectory. And so we did the first TLI, which was the S-IVB [third stage], the big burn, put us on a free return trajectory, but then we did what we did what we call a hybrid. We actually did a little maneuver that took us off of a free return but made our performance good so we could land where we wanted to land on the Moon, but we were non-free return.

Now, it turns out in [James A.] Lovell's [Jr.] book [Lost Moon: The Perilous Voyage of Apollo 13], he said we had a perigee of 40,000 miles. Well, it was 2,500 miles. I went back and found one of my old post-flight reports, and it said 2,500 miles, so I'm sure that's the right number. In fact, I'm not sure where Lovell got that number. I might have given him the 40,000 miles. I might not have remembered then and said, "I don't know, it was really big." Well, if you miss by 2,500 miles, it's like missing by 40,000 miles, it doesn't make much difference. You've missed.

So we clearly weren't going to be able to come directly back. We didn't want to jettison the LM. We needed to get back on a free return trajectory, which was a small maneuver to do that, but just getting back on a free return trajectory put us on to impact on Africa. I said, "Well, if we're going to do this, we ought to do it just enough to get it onto water so we can land on water." So we came up with a maneuver that would put us in the Indian Ocean. It slowed us down a little bit—no, I guess it sped us up a little bit to go ahead and land in the Indian Ocean, and so that's what we did. We did a little maneuver to land on the Indian Ocean.

Of course, they powered the vehicle down and all that sort of stuff, but the next thing we did was then do a big burn to speed up the trajectory to get us home. Now, we had a couple of options, a couple different things we could have done. We were going to do this with the LM. We could have jettisoned the Service Module and come back faster, because we'd have had more energy without that weight. And probably, if we'd done that, we probably wouldn't have been ready for reentry, because we'd have gotten back too fast.

But this PC-plus-two maneuver was always a plan—in fact, we had a plan in our abort scenario, we had a thing we called a flyby. If you had a problem before you got to the Moon, you'd do this flyby maneuver, and you'd fly by the Moon, and you'd come back and reenter. We had another maneuver. If you didn't get into lunar orbit, we'd do what's called the PC plus 2, pericynthion plus 2 [hours] burn to get us back to the Earth, and it would actually speed us up.

So those, that flyby maneuver to get us back to the Indian Ocean really wasn't anything new. It was just that it was targeted a little differently. And the PC plus 2 maneuver really wasn't anything new. It was something we'd always had in our back pocket that we use if we had to do an abort out of [high] lunar orbit [due to a Lunar Orbit Insertion (LOI) underburn].

So we did this PC plus 2 burn with the LM engine to speed us up, and it took us from the Indian Ocean over into the Pacific Ocean, and it started us on our way back. Then we had to power down the platform because our batteries were running low, and all we had was the Lunar

Module batteries. We didn't have any batteries in the Command Service Module. All it had was fuel cells. We had some batteries, entry batteries, but they were not nearly big enough to do what we needed to do, so we powered everything down. That's when it started getting real cold in there.

We had another mid-course correction we had to do. The LM had an evaporator cooler on it, and it was venting out gas, and it was causing the trajectory to wander. It was making the trajectory get too shallow, the entry flight path angle get too shallow, so you wouldn't reenter properly. So we had another maneuver. And what they did is—in fact, we came up with this on Apollo 8, and Lovell remembered it, as a matter of fact—but if you look at the Moon [or Earth], you can see where it's dark and where it's light. That's called the terminator. Well, they would take an optical device in the window of the LM, and they would line that up on the [Earth's] terminator, and that would put them in an attitude that would—depending on whether it was this way or this way, they could do a burn and correct the trajectory. So that's what they did.

Now, we didn't turn on the guidance system. They did a kind of a manual burn. Fred [W.] Haise controlled one axes, and Jim Lovell controlled the other two axes with the hand controllers, and they actually just timed the burn, and then they lit the engine and timed the burn and then shut it back down, and that got them pretty much back in the corridor.

And one of the things that—well, I'll talk about that in a minute.

The water boiler was still boiling water, so we were clearly not being stable—we didn't stay in the trajectory, so we had to do another mid-course correction. We did that several hours out, like five hours out, but we had a different problem than we had before. Before we usually were coming back with just the Command Service Module. You'd do your last mid-course correction, and right before entry, you'd jettison the Service Module, and it has little jets on it that pulls it away from the Command Module. Well, the Service Module was dead, and we had developed—John Llewellyn, bless his heart, made us—he was always worried about contingencies, so we had this book that we developed on separations, and one of them was, you'd be on the trajectory that you want to be on, you'd burn forward a little bit, and you'd turn loose whatever you wanted to get rid of, then you'd back up so you'd be right back on your trajectory, but it would be on a different trajectory. And that's essentially what we did with the Service Module. We thrusted forward with the LM and then separated the Service Module and then thrusted back, and it put us right back in the corridor. That was one of the techniques we had developed.

Well, the second one was, how do we get rid of the [Lunar] Module? Well, I remembered I was in the Control Center on [Apollo] 10, although I didn't work 10, after they had done their maneuvers around the Moon and re-rendezvoused. And [Thomas P.] Stafford—we'd always wanted Stafford to get in a position for separation, and he said, "No, no," he says, "I can do that. I'll just separate it, and I'll get where I need to get."

Retros are always worried about recontact, for some reason or other. Well, we always were. So pre-mission, he decided he knew how to do it. Well, what happened to him is they forgot to depressurize the tunnel between the LM ascent stage and the Command Module, and when he released—when he fired the bolts to separate it, the air pushed it away right into the Sun. He couldn't even see it. So he didn't do anything, and, of course, the LM was going to do another burn and go out to solar orbit, which it did, and everything was fine.

I remembered that's what happened, so I said, "Why don't we leave some tunnel pressure between the LM and the Command Module, and then when we separate the LM, it'll just pop off with that tunnel pressure," and that's what we ended up doing. So we came up with a way to make the two separate.

We had separation issues on lots of flights. On Apollo 8, after they separated from the booster, Borman was afraid the booster was going to run over him. It looked like it was getting closer. So we did a big SPS burn. Jay Greene was a FIDO and I was a Retro. In fact, by the time we left the console, almost everything was done that had to be done before you got to the Moon, because we did the first big mid-course correction with the SPS just to get away from the booster.

On Apollo 10, I told you about the thing popping off into the Sun. On Apollo 11, Jay and I were on the TEI [trans-Earth injection] team, and they came up and re-rendezvoused, and that's about the time we changed over shifts. Well, they closed out the LM, a rev [revolution], two hours early, and we—so our LM was over there powered up, but they had the hatch closed, and we really didn't want to leave them over there that long with the two attached with that thing hot, so we actually had to separate a rev early. So that was another separation thing. Then on 13 we had a separation thing. I guess that's the ones I remember.

And I wrote something down here. "Nothing is easy, but the worth of an accomplishment is in the number of obstacles overcome." And I think that's right, because we always had problems, but we always had some backup procedures. We always figured out how to get around them.

So anyway, the Apollo 13, the other issue was, there was a radioactive cask on board. It was a device that would reenter, but it had a piece of radioactive material in it that [the crew] would put in the lunar surface experiments that would run a radioactive electrical generator, and they would put this thing in there. They did it on [Apollo] 12, too. It's called an ALSEP [Apollo

Lunar Surface Experiments Package], is what the acronym for what the lunar surface stuff was. But that cask was on the LM, and of course, the—it turns out—I'm kind of digressing. Every time you fly a flight, you've done so many things, and the next time, you find another thing that you really need to look at. So we always worked at new things and took care of more contingencies as we got further and further along.

Well, one of the ones that I worked on before 13 flew is, what do we do if we have to come back with a LM, what do we do with this cask? We were really thinking more of Earth orbit, if we did an Earth orbit mission and we had to get rid of the cask. So I worked with a guy named Bill Remini from the Atomic Energy Commission [AEC], and some of the guys in the MPAD, Bob [Robert E.] McAdams primarily, and we developed some aerodynamics for this cask. We figured out what we would do with it, how we would do things. When we came back, we were actually in the Pacific Ocean, and we were putting the LM in a pretty deep part of the Pacific Ocean, and so we had figured out where it would probably go, and we developed these procedures.

And the AEC guys were always—they were listening and watching what was going on, and when we got to reentry, they actually had an airplane out there sniffing to see if there was any radioactive material released when the LM came in. Of course, they didn't find anything. But we actually got a letter from the Chairman of the AEC thanking Bob McAdams and myself and a couple other guys for working this thing out. That was just one thing that we had done before 13 that turned out to be good.

The other thing that we did, the real-time computer was always evolving, and it took almost six months to get any procedures in there. The LM engine, for a docked burn, they would start the engine at 10 percent, and they would throttle it up, and they would throttle it up some more. We could not model that sequence in the computer until Apollo 13. So if we'd had to do that kind of burn on 12, we'd have just had to kind of fake something. We'd have just averaged it or done something, and it would have worked fine, but it was just another one of those things that happened to be ready at the right time for Apollo 13.

The other thing about 13—this may be a little hard to understand, but a platform is fixed in space, and it's an inertial platform. It's like a horizon in an airplane. The vehicle flies around this thing, so it's a little eight ball that tells them what their attitude is, which way they're pointing. This thing is frozen in space, and the spacecraft flies, maneuvers around it. Well, the thing that defines how that thing is oriented in space with respect to the stars is called a REFSMMAT. That's a Reference Stable Member Matrix is what that stands for. It's a mathematical set of numbers that tell that platform how it's aligned with the North Pole, for example, and you have to have that in the computer to tell them what to fly with that little eight ball so they're in the right attitude for reentry or for anything else they do.

Well, the ground computer, was set up so it would take the last REFSMMAT that was used for a maneuver, which would be like mid-course seven, which the Command Module would do, and it would use that for reentry. Well, in [Apollo] 13, our last maneuver was done with a LM. It had a different REFSMMAT than what we were going to have for reentry.

Well, [H. David] Dave Reed and I—he was the FIDO for 13, he was the lead FIDO for 13, and I think this was his idea. In fact, I just talked to him about it not too long ago. We decided we'd better go down and run our processors in the computer downstairs the day before reentry. So we went down and brought up another real-time computer and ran the thing and got our numbers, and the attitude for entry was way off. What can this be? We figured out it was the fact that the Command Module simulation was using the LM REFSMMAT for reentry, and that's why it gave us the wrong angles. So what we did is we put in a Zero Delta V maneuver, a maneuver that wasn't going to happen but it gave us the attitude for the Command Module, and then that gave us a REFSMMAT that we'd use for reentry. Because the REFSMMATs in the computer identified by like current 001 or current 002, and there'd be a current 001 for the LM, there'd be a current 001 for the Command Module. You couldn't tell them apart. So after that, all the LM REFSMMATs started out current 501, 502, and the Command Module was 001 or 002. So that was something we learned. But being thorough, I guess, we went down and said, "Let's try out this thing that we've never done before," the day before reentry, and that's what we did, and we saved ourselves—because there would really have been a panic if that thing would have popped up with the wrong angles just prior to reentry. Because we knew what they were supposed to be. They were supposed to 180,0,0, and with the other REFSMMAT, they didn't come up that at all.

WRIGHT: So many of the different areas were coming up with different information. Tell us how all of you got back together to exchange the information so all this could work out as well as it did.

DEITERICH: Well, part of the stuff was the leads were pulled off, and we didn't fly a lot—although we did fly some of the shifts, we didn't fly all of the shifts. So we would actually go in the back rooms and sit down and—I know we put the checklists together, or John [W.] Aaron kind of—since he had to power it up, he was the EECOM, he kind of pulled that together, but we all had our own little things that we want to see happen. So it was a group—in the books you read, they call it a tiger team. I don't remember it being called a tiger team, but in the books you read, they call it a tiger team. But the guys who were—another group who were off line doing these kinds of things and making sure that the checklist was written, making sure that we had—what we were going to do to maneuver—this whole timeline of doing a mid-course seven with the LM, jettisoning the Service Module, jettisoning the LM, and jettisoning all that sort of stuff, that all had to be—that whole timeline had to be worked out, and then it had to get in the flight plan, it had to get in the checklist. So that's where that all took place, is in the back rooms where we had our meetings.

For example, there was so much debris, you couldn't see stars, because the debris looked like stars. And we came up with the idea that the Sun's out there, and you can certainly see the Sun, and the Moon's out there, you can certainly see the Moon. So we used these bigger objects. Although they might not have been as precise, at least you could see them.

The other thing that we did was, getting in reentry attitude, we always had this line that we could put on the horizon and track around. So we had them—I said, "Hey, why don't we just have them look at the Moon and just stay pointed at the Moon and with the Moon set, just track the horizon around from that? In fact, why don't we give them the time that the Moon's supposed to set, and they'll know, hey, if it sets at the right time, they're on the right trajectory." And we used that Moon set time for all the rest of the missions. So we gave them Moon set time, and it worked right. It was right on, and it blinked out when it was supposed to.

So there were a lot of things that were kind of innovative that we did, but there were things that—we had always—on our sims there were always all these problems, and we always came up with some kind of a way to get around certain things.

WRIGHT: That was a question I was going to ask you, how much the sims played a role in bringing the crew home safely.

DEITERICH: The simulations, a lot of times, they don't simulate what really happens, but they make guys think, and they test our mission rules. So things that do happen are somewhat related to what happened in sims, because I think the alarm that they had on Apollo 11 had happened in a sim, so guys were ready for it. So the simulations are really extremely valuable in helping guys think things through. And a lot of the little things that they do find, some of them happen and some of them don't.

This thing with the REFSMMAT , we never had done that before, and we were happy that we went down and tried it in the computer. So it was kind of a sim, but it was our own sim.

WRIGHT: How was the confidence level for Apollo 14 with Mission Control when it was ready to launch?

DEITERICH: On 14?

WRIGHT: Yes, on 14, after all the issues with 13.

DEITERICH: Oh, I think we were—I was confident. I was confident. We knew what had happened, and they'd fixed it. So I was confident.

In fact, talking about 13, I never had a doubt that we weren't going to do what we needed to do. It never even crossed my mind that we would have a problem. People say failure is not an option. I don't think failure was even in my vocabulary, seriously. Because Dave Reed and I talked about this. He said, "You know, we never thought about that. We knew what we were going to do, we knew we had to do it, and we knew all these things were going to work." I never had a doubt that we would get them back.

And I have a lot of confidence in the designers and those kinds of guys, and when they go back and they do the fixes, I think they're going to work. I never had any conflicts. And sims, much as we do, and you know nothing bad's going to happen in a sim—numbers can come out wrong and you can look stupid, but you do so many sims that once you get to the real mission, it's really hard to tell them apart. So they've kind of conditioned you not to be panicky or what have you when you're flying the real mission. That's my understanding. I may be naïve, but that's the way I kind of look at it.

WRIGHT: Anything else you want to add about 13 before we go?

DEITERICH: No.

You were talking about 14. One of the things, they wanted to bring back the probe because they had a problem with the probe. The only thing that really did to us is we had to find a place to put it, and it changed the center of gravity. And the Retros worried about the center of gravity.

Why does the Retro worry about the center of gravity? Well, two reasons. One reason we do burns, our job was to compute the angles that point the engine bell through the center of gravity so they can do the burn, so you want to be able to compute those angles. The other one is, for reentry, the center of gravity affects the L/D, which is the lift to drag. The lift to drag is those parameters that actually allow the spacecraft to fly.

You can think of it as it actually controls where it's going by the way it points the lift. If it points the lift this way, to the north, it'll fly to the north. If it points it to the south, it'll fly to the south. So you actually do your targeting to land on a spot on the ground by modulating where that lift is pointing. If you point it further over, you won't fly it as far downrange as if you point it straight up. So it's important to have a good L/D.

Plus, the number of Gs you pull during reentry is a function of the L/D, so we had to make sure that the probe was in a good place so the L/D would be okay, and it was. In fact, I think it actually increased our L/D, which was good. Because Apollo started out to have an L/D of about point five [.5], but by the time they got around to flying it, it was like point two eight [.28], point two nine [.29].

That's kind of 14. It was really kind of frustrating, because they kept trying to bang on that thing to get it to dock, and they finally did manage to—I guess—I forget how long, but they flew quite a while in station keeping with the booster until they finally got it docked, because they smashed into it several times pretty darn hard as far as I remember. It's hard to remember those things. It was a long time ago.

WRIGHT: That's okay. How did your role change from Apollo to Skylab?

DEITERICH: Well, we still had a launch to do. We had a rendezvous to do. We had a reentry to do and a de-orbit to do. Of course, the FIDOs are always responsible for the state vector on the spacecraft and the state vector in the real time system, because the flight planners need the state vector to know when acquisition is going to be, when daylight and darkness, how to schedule their experiments, and that sort of stuff. So from that point of view, the FIDO job didn't change. But there was a lot of times when we were just boring holes in the sky.

Now, the FIDOs, by that time we had a secondary system. I think it was called a FOPS [Flight Operations Planning System] or something like that, as well as a real-time system, and you could build data tapes and put them in there. Now, I never told you about block data. Well, of course, in Skylab, block data was—you didn't jump in the thing and de-orbit right away. You had to safe the Skylab or do whatever you had to do, and you had to get in the Command Module and power it up and that sort of thing. So there was some Delta time between when you had an emergency and when you could de-orbit, but we will sent them block data, and we had block data—actually what we'd do is we'd have it available for them, and we'd send it up on the teleprinter, because there was a teleprinter on board. So we'd come in in the morning, we would take all the radar in, get a new state vector, tell everybody where we are and update the FOPS. We would compute the block data, and we'd look at the ground track. Now, the ground track in Skylab was what they call a repeating ground track. I think like every so many days, like every fourteen days, it would go right back over the same ground track, and this was so they could do Earth resources things. They could always look at the same spot and see how things were changing.

Well, that's good, except the spacecraft decays. The orbit decays a little bit, so the ground track moves. So we'd have to come up, "Well, if it gets too far off, we'll do a trim burn, push the orbit back up, and actually overcorrect it and let it drift back across." So we'd do trim burns. So we'd look and see, how's our ground track doing? And we'd say, okay, we need to schedule a trim burn two weeks from now, or a week from now, or whatever.

And that's the time we'd compute the block data, and we'd go. So we were only there about four hours a day, and then we'd get to do a rendezvous or a de-orbit or something, we'd go in two or three days ahead, and we'd work full shifts. So the poor system guys are here watching all these things happen, and they didn't have anything [much to do], just sit and bore holes in the sky. And the flight planners and experimenters were always working some sort of experiment. The trajectory guys, we'd do our job, and then we'd go work on Shuttle or do something else. So it was not nearly as bad. We were on call. Somebody always had a beeper on. They would call us. We were always on call, so if we had a problem, we could go in and do our thing, but—of course, that never did happen. So from a trajectory point of view, it wasn't too bad.

I forget which flight it was. I think it was the second Skylab mission, they had a quad failure, which is where one of the attitude jets on the Service Module, one of the little thruster groups—and we were concerned about what we were going to do. We were going to have to go rescue them, so there was a big task on putting together a rescue mission for that. It turns out we didn't need it, and they came up with a work-around how to control attitude, but we did work quite a bit. So the trajectory guys worked quite a bit on this rescue mission that never came about, and there was a lot of work done. I think Vance [D.] Brand was involved in that quite a bit.

So Skylab was not too big of a deal as far as what we had to do. We had to do the rendezvous. Since we didn't have fuel cells on the Service Module, we just had batteries, our timeline for re-entry was somewhat constrained, so we had a couple of backup procedures for doing RCS [Reaction Control System] de-orbits and two impulse de-orbits and that sort of stuff. And I kind of vaguely remember how we did them, but rather than try to explain them technically, I think I'll just say that we did have multiple means to do de-orbits, either using the

Service Module RCS or using the SPS, because our timeline was somewhat constrained with the amount of battery life we had in the CSM [Command and Service Module].

WRIGHT: Is this about the time where the Retros changed over to becoming Flight Dynamics Officers?

DEITERICH: Yes. After Apollo, everybody was a Flight Dynamics Officer. I was a Flight Dynamics Officer. We had what we called our boy. We called him Trajectory. And Bill [William M.] Stoval [Jr.] and I were the FIDOs, and Mike [Michael F.] Collins and Ron [Ronald D.] Epps were the Trajectory guys. We all worked together as a team. So we did the same thing that the FIDOs and the GUIDOs [Guidance Officers] and the Retros did in Apollo. As far as the job description, it was the same, we just didn't need a prime Retro and a prime FIDO. The FIDO could really handle it all because there really wasn't that much more to do.

Oh, one other thing I was going to tell you about. Retro picked up a lot of weird jobs, like telescope pointing data. We generated telescope pointing data for JSC [Johnson Space Center], for Kitt Peak [National Observatory] out in Arizona, for Jodrell Bank [Observatory, University of Manchester, Macclesfield, Cheshire] in England, wherever it was, and somebody wanted telescope data, so we had a little off-line program that we'd say, hey, take this vector and generate—we didn't really do much with it. They'd just generate it, and then we'd have it teletyped off.

There was this guy—I'll never forget his name was Flight Lieutenant Gilmour, or *Lef*tenant [English pronunciation], I guess they called him, but he was over at Jodrell Bank, and we would send this data over to them, and they would use it to look at the spacecraft. And Andy

[Indulis] Saulietis, who worked in Building 12, was in charge of the telescope there at JSC, and we went over, actually, and saw—I think we saw Apollo 13 before the accident. I remember going over and looking through the telescope, and you could see the Command Module and you could see the booster, and you could see the panels floating around. I think it was 13 when we went over. And then, of course, he saw the explosion. When it exploded, he saw this big cloud of stuff come out, and wasn't a while later that we realized that he had seen it, but that was based on the telescope data that we had passed him. So we did the telescope data.

We also worried about the on-board clocks. We had a special procedure to keep the on-board clocks in sync, because if the clock's not right, you're going to burn at the wrong time. And if you're tracking something on the ground, like the landmark for lunar landing, you would like to land in the right spot, and if you don't have the right clock, you won't start at the right time. So the Retros kept track of the on-board clocks as well. So we did a lot of little housekeeping kind of things.

We did the same thing in Skylab. It was just that FIDO did it instead. We did the CGs, the centers of gravity, and all the mass properties and all that sort of stuff.

WRIGHT: Well, Apollo wasn't over until ASTP [Apollo-Soyuz Test Project]. You were quite involved with that project.

DEITERICH: Yes. I was one of the FIDOs on ASTP, and Stoval was a FIDO on ASTP, and Ron Epps and Collins—Collins was a Retro. We had to go back to a Retro on ASTP, because I was a FIDO, and he was a Retro, and he did the de-orbit computations for ASTP.

They had a sequence of maneuvers where we'd fly around the Soyuz to take the pictures. You know, it was a UVA experiment, an ultraviolet experiment of some sort or other, and I was responsible for computing the maneuvers to fly around that. And then I think—I don't remember. I can't remember who the Guidance Officer was for that mission. So we kind of went back to FIDO, Retro, and Guidance Officer for ASTP.

But yes, that was the last of the things. I did get to go over to Russia for a week and go over to their Control Center, which was kind of neat. It was a neat trip.

WRIGHT: Was that your first time on a trip of that sort?

DEITERICH: It was my first time to go overseas, yes. I'd been up to MIT and the Cape and places like that, but I'd never been overseas. The thing that struck me about the Russian stuff, it was bigger than ours. Their Control Center was bigger than ours. Their hardware was bigger than ours, which was really not a compliment. You know, they had big things.

We were treated extremely well while we were there, and they were very nice to us. I remember one time I had a sore throat, and I said, "I want to go to the American Embassy and get some penicillin." So I got on the subway and went over there, and I came back, and I got on the wrong subway to go back to the space place. Some guy says, "I think you're on the wrong subway." So he must be my KGB [Komitet Gosudarstvennoy Bezopasnosti, Russian State Security Committee] guy that was following me taking care of me. But it was a nice trip. I learned a lot over there.

WRIGHT: Can you talk about how you helped negotiate some of the joint planning and operational procedures? What role did you take in doing that?

DEITERICH: Well, the fly-around, we had to work with them as far as our distance and the training and how we were going to do it, because they are pretty safety conscious, although some of the things they have done is not too safe. But the trajectory guys—in fact, the FIDO, his name was Vladimir Ubersterov, I think his name was. Of course, they didn't speak English, and I didn't speak Russian, and so we had to work with an interpreter. But we did work out the fly-around maneuvers and what we were going to do and what we expected them to do and the mission rules and that sort of stuff.

WRIGHT: Did they come to the United States?

DEITERICH: Yes, they came over. In fact, I think he was—we had some people in Russia during the mission, and they had some people over here during the mission, and he was one of the ones that was over here during the mission. So yes, and then of course when they were working on the docking mechanism, they had some engineers over here for a long time, a year or something. But for quite a while they were over here working on the design with the Americans. So they had a contingent over here quite a while.

And we had a bunch of people that went over to do negotiations, but most of them were Program Office types. And a lot of the flight planning things, when we'd schedule different things, those kind of guys spent a lot of time over there. I think Ed [Edward L.] Pavelka spent some time over there working that.

WRIGHT: How did the end of the Apollo program and the reduction in federal budgets affect the morale and personnel at JSC?

DEITERICH: Well, I think everybody was upset that we had all these Saturn 5s siting around, we weren't going to use them, and we had spacecraft sitting around that we weren't going to use. And I think that it was kind of bad. Of course, I guess around that time they had a reduction in force, and I'm not sure exactly when that happened, but a lot of guys were upset about that. I was never, I guess, targeted for any of that, so I didn't worry too much about it, but it was depressing that we were going to stop flying for a long, long time. Because I guess Skylab was over in the mid-seventies, and we didn't fly again until [19]'80. When was ASTP? I don't remember.

WRIGHT: Seventy-five [1975].

DEITERICH: Yes, right, '75. Yes. So it was five years without flying, except I got to fly ALT [Approach and Landing Test].

WRIGHT: Well, why don't we take a break for a minute. We'll stop here, and we'll come back, and we'll talk about ALT and your involvement, how it started with the Shuttle program.

[pause]

WRIGHT: I'd like to start this next part of the session by asking you when you first became involved with the Shuttle program and how those duties changed as you went through the years.

DEITERICH: Well, I told you, back in Skylab, we only worked four hours a day. So there was actually two teams of us, so each team worked four hours a day. So the other team didn't do anything in the Control Center. When I say worked, in the Control Center is what I'm talking about. We'd have one four-hour shift a day for two teams, so that meant half the time you weren't doing anything in the Control Center for Skylab.

So we'd go away and work on the Shuttle stuff. Primarily, we worked on things like, how do we update the state vector on the Shuttle? We talked about using TACAN for ground navigation aids, which is a kind of a navigation aid that airplanes use. It's called Tactical Air Navigation System. But they send up signals. Well, we talked about how you would incorporate that into the on-board system for flight guidance and navigation, and maybe thought about working our procedures of how we would fly things.

One of the things that happened in the Shuttle that didn't happen during Apollo was, [NASA] Marshall Space Flight Center [Huntsville, Alabama] had controllers in the Control Center that monitored the booster performance, and they would give the Retro the weight and the amount of propellant that was in the booster for the translunar or injection burn and those kinds of things. They would worry about fuel depletion. They had an abort switch. They could actually abort the mission for fuel depletion or certain booster failures.

Well, in Shuttle, the SRBs, the Solid Rocket Boosters, and the external tank and the main engine on the Shuttle were under the purview of the people from Johnson Space Center as far as the real-time system as far as the Control Center is concerned. So the FIDOs had to figure out how to monitor the performance of the Shuttle during powered flight and come up with what abort region you're in, if you have an engine failure or failures, what do you do at this point in time, and if you do, what kind of an abort maneuver are you going to compute? Those kinds of performance parameters were something new that the FIDO was kind of given to him during Apollo from Marshall, but he had to come up with those answers himself.

So that was a whole new area that we had to work on. And that was one of the things that we did do during part of this time, because our buddies in MPAD, they're out ahead of everybody else worrying about these trajectories, and they were working up those kinds of solutions and trajectories. So we would work with them to try to come up with how you do that.

We also were worried about how we do the re-entries and that sort of stuff. So there was a lot of Shuttle data out there, it's just that we would just kind of bring it in so we could operationally use it. So that's kind of what we did during our off time on Skylab.

And then, as we got closer and closer in, we started worrying about how we were going to build our tools in the Control Center. We had what we called an AME, which is Abort Maneuver Evaluator, and an ARD, which is called an Abort Region Determinator. Those kinds of processors had to be determined, figure out how you're going to do those and how we're going to use them, what numbers we're going to look for, because there were some really different kind of abort modes for the Shuttle.

For example, if you had a problem with the booster on Apollo, you just separated the spacecraft away and did your abort. Well, it turns out a big part of the booster is the main engines on the Shuttle, so you've got to recover the booster part as well as the crew part. So that made things a little bit different. We had these maneuvers we called Return to Launch Site, where they would actually burn downrange. They got the propellant down to the right amount, and then they would turn around and come back and land at the Cape. Of course, you had to get rid of the external tank without it hitting Cocoa Beach [Florida] and that sort of stuff. So those were some new procedures that we had to develop and figure out how we were going to do that.

WRIGHT: Can you share with us what your process was for determining these procedures? As you mentioned, everything was new, and you were basically creating new rules for a new vehicle.

DEITERICH: Well, remember we talked about the data priority meetings, and a lot of the questions would be talked about in those kinds of meetings. There may not have been that many—boy, it's hard to remember. But the best I can tell you is we'd just kind of sit around and kind of brainstorm about what we needed to do and then how we were going to go about doing it, what kind of maneuvers we'd have to worry about, what kind of trajectories we'd have to worry about, what kind of failures we had to worry about.

Turns out the biggest failure that you worry about in the Shuttle is loss of an engine. Well, that's not the biggest, but losing a main engine, depending on where you lose it, really tells you what kind of abort mode you're in. If you've lost all three of them, it's a whole different situation. There you're talking about a ditching effort. And I guess from a contingency point of view, the likelihood of more than one main engine failing has got to be pretty low. So the main thing that you were really concerned about was how you recover from an engine failure.

We had some things like, if you lost all three main engines, we had what they call a contingency abort. But that was really probably not survivable. Although the main engines seemed to work pretty well. I don't think we ever lost a main engine, even with all the flights that we've flown.

But to get back to how we determine what we were going to do, we would get the trajectory data, what the altitude profile looked like, what the down range profile looked like, what the velocity profile looked like, and put that stuff on the table and say, okay, now, where do we need to stay with respect to these nominals to stay out of trouble, how far can we let the thing drift off before we declare we have a guidance problem, and those kind of things. And it was just kind of the guys sitting around a table.

WRIGHT: It worked?

DEITERICH: I guess—yes, I think it did.

WRIGHT: At what point did you start getting involved with the approach and landing tests?

DEITERICH: Well, very early in the beginning. As soon as we got off of ASTP, I was put on ALT, or very, very close to that. And so I worked ALT almost from the beginning to the very end, and it was probably my most favorite thing to have done. There was a guy named Bud Foster, who was an Army guy—I think he's a General now—that was working that a little bit right at the end of ASTP, and he left. He was assigned to our branch, so whatever he was doing, I kind of took over. And one of the things he was doing was writing a mission operations plan. And what that did is, that defined all the missions that we were going to fly, whether they were captive where we'd fly around on top of the [Boeing] 747 and then land, or if we were going to have a free flight and separate off of the carrier.

The people over in Engineering had all kinds of tests that they wanted to do, whether it be fuel cell tests or communications tests or aerodynamic tests or whatever, and the mission operations plan took all those different tests and arranged them in a set of flights. Well, I wrote that book, which was really kind of fun, and defined the number of flights we were going to fly. We started out with like fifteen flights, and we ended up with like five. But that was kind of a fun job, to pull all these things together.

And then, once we got the mission operations plan written, we kind of had a road map of how we were going to fly the rest of ALT, and we knew what—there were some tests that had nothing to do with how the vehicle flew, they were just systems tests. There were other tests that were really more based on aerodynamics and the capability of the vehicle to fly. And of course, there were tests on how the computers would work and that sort of stuff.

So we got all these tests, and I worked them all into the five flights, and we ended up with three tail-cone-on flights. Now, the tail cone was a device that covered the main engines. It had less drag than with the tail cone off, which means it would glide further and glide at a shallower angle. So we decided we were going to fly three flights with the tail cone on just to be safe and get more time and make it more benign for the pilot. Then the last two flights were tail cone off. For example, on tail-cone-on, we'd separate at like 25,500 feet, and it would take us five minutes to reach the ground. On the tail-cone-off flights, we'd separate at somewhere around 21,000 or 22,000 feet, and we were on the ground in two minutes. So it was like half as fast, or twice as fast, if you were tail-cone-off.

Anyway, I got involved in that, and it was lot of—it was a small group. Don [Donald R.] Puddy was the Flight Director. It was a small group, and I got to do lots of stuff. I got to deal with the FAA [Federal Aviation Administration] out at Palmdale [California], because when we flew this carrier, we had to fly in their airspace, and when we were doing our tests, we had to fly in their airspace. So I got to negotiate with them, tell them how we were going to do it, what we were going to do, and I would send them data packs which described the flight, when we intended to fly it, where we were going to be, and all that sort of stuff. And so I had a lot to deal with with them.

We had to deal with the Edwards Air Force Base [Edwards, California] radar ground controllers and deal with their air space and tell them what to do. And it worked out real—we had to deal with [Naval Air Weapons Station] China Lake. China Lake is a Navy installation north of Edwards, and we had to deal with them, and all those guys just seemed to work out real—very, very neat. We went out to Palmdale, which is where the L.A. [Los Angeles, California] center is located, and spoke to those guys several times, and it worked out real well. But anyway, I got to integrate with those guys. What I did is I took a little old HP [Hewlett Packard] computer, which didn't have hardly any memory at all, and designed and put in—made a simulation of the Shuttle. I could do tail cone on or tail cone off, and I would fly that thing through the maneuvers that I had put in my mission operations plan and see if I could get all the test conditions done, see how long it took me, and that sort of stuff. Then we'd go over in a simulator, and I'd fly them in the simulator, and then the crew, either [Joe Henry] Engle or [Richard H.] Truly or [Fred W.] Haise or [C.] Gordon Fullerton would go out and fly them in the Shuttle training airplane. Then when we did all that, we'd say, "Hey, we've got a good flight." Then we would document all that stuff, and I'd put together a data pack and send it out to everybody, the rest of the team. I'd send it out to FAA. I'd send it out to [NASA] Dryden [Flight Research Center, Edwards, California], because Dryden, they were actually configuring the vehicle, and they were actually stacking the vehicle on top of the Shuttle carrier airplane, and their pilots were flying the carrier airplane. So then we'd go fly it.

And, of course, during the mission, I would vector the 747 around this race track that I had built, and then I'd count, and I'd give them a mark a minute before separation. Then they'd fly up to the separation point, and they'd separate, then I would manage the trajectory down to the ground. Then I would talk to the CAPCOM [Capsule Communicator], and he would give the crew different cues or whatever.

One of the programs that I wrote was, if you fly in the wind, you'll blow sideways. And if you bank in the wind, you'll not—if it's windy, you won't fly a perfect circle, you'll fly an elongated circle. Well, when you're climbing out with the Shuttle carrier airplane and the Shuttle on top, you don't have very much performance if you get in a very steep bank angle. So what we would do is we would bias their ground track so that when they turned their bank at eight degrees or so, they would come around and come out where we want them to come out. So the ground track wouldn't look the same every time. It would be different depending on the winds.

Well, we would get the winds from balloon data, and then we would get winds from the carrier airplane itself. But when we'd get the winds from balloon data, we'd actually go out and plot a new ground track. They had an inertial guidance system on the 747, so we'd give them some latitude and longitude points, and they would put that in their guidance system, and then we'd vector them around this new ground track and bring them up to the drop point. That little program was just a little HP 9820, I think it was, and a very simple program, but it worked very well.

Then I had a program that was—of course, as the Shuttle flew through the wind, it would blow around, so I would actually bias the drop point so when they finished all their test maneuvers, they would end up pointing at the runway. And the thing that's interesting is later on, when I got to be a Branch Chief, the guys had little programs like that, and I used to make them verify them and run them and test them. Well, we did a lot of runs on the ones I did, but it was not near as thorough. We didn't document anything. So we were a little more—I won't say cavalier, but we were a little more loose with the way we did things.

One of the points to be made, though, is ALT was a small, short period kind of a program, so there wasn't going to be any hand-offs to another group of people that didn't know how you do things. If you're going to have a long-time program and you have some intricate things, you need to document that so when you hand it off to a new team, they don't have to start from zero. And so from that point of view, what we did was not all that bad, because we knew we were going to start and end the program, and our knowledge was going to go with us, whereas the knowledge from a Shuttle guy ten years ago, if he didn't document it, the guy today doesn't know what has gone on before. So the hand-off difference really made it not quite as bad as I made it sound.

Anyway, so ALT was really a lot of fun. I got to go out and ride the STA [Shuttle Training Aircraft] training airplane with Truly. I think I got ten approaches with Truly and ten approaches with Joe Engle. This was in the tail-cone-off configuration, which meant if came down at about a twenty-four degree angle at that time. I think now they're down to about eighteen degrees.

But it was funny. In the Shuttle training airplane, they have this simulation pilot, who is the instructor pilot, who sits in the right seat. The astronaut sits in the left seat, and they have a sim engineer that sits between them. And they had shoulder harnesses and all that sort of stuff for those guys.

Well, the first steep approach which we flew, the sim engineer didn't have his shoulder harnesses on or anything. I reached up and grabbed a hold of his thing because I was standing behind—I think it was Engle. It was Engle. I was standing behind Engle, and he pushes over, and we're coming down—you can't even see the horizon, we're coming down so fast and so steep. And he does his training run, and I turn loose of this thing, and I walk in the back of the airplane and come back up to the next run. The sim engineer has got his harness on, because we're really coming in steep. But you couldn't even see the horizon. And at 2,000 feet, you're only about ten seconds from hitting the ground if you don't pull out. But that was neat. That was really a lot of fun.

WRIGHT: Did you feel five tests were all needed, or had you hoped that you'd be able to do a little more testing?

DEITERICH: Well, there was a couple things I would—one of the things that we never did do, we never did test autoland, and I would have liked to have tested autoland. It was originally in the program, and I don't think we've ever flown an autoland to this day. It would be nice to fly an autoland.

I know the crew doesn't like it because they're concerned about it. They have a problem right near the bottom. Right prior to touchdown, will it upset the airplane, crash, or whatever?

So I know they feel more comfortable by holding the stick. It's just like if you're a passenger in a car, you feel much more comfortable if you're driving it than you do if you're sitting there in a car. And I'm sure they feel the same way about monitoring autoguidance. They fly auto all the way down till they get within 25,000 feet of the ground, then they take over manually and fly it in, and they fly the needles most of the way.

But it would have been nice to have done an autoland, because if they ever had a window problem—and I'm sure if they have a problem, they'll do it.

We did a little autoland on one of the flights. We did engage the autoguidance for a little bit, but then we disengaged it. We didn't touch down with it on. I can't remember which flight it was. I think it was one of the tail-cone-on flights that we engaged the autoguidance for just a bit. What was your question?

WRIGHT: About the five flights, did you feel that was enough?

DEITERICH: Yes. So I would have liked to have seen a little more trajectory kind of work done on some of the flights. I'd like to have seen another tail-cone-off flight. But the tail-cone-off flight was kind of hard on the Shuttle carrier aircraft. The reason being is the disturbance of the air flowing around that blunt back end interfered with the tail on the 747. So with the tail cone on, it smoothes it out, because that's what they use to fly it from California to the Cape or wherever, depending on where they land, so it's much smoother. So they probably didn't want to do any more tail-cone-off flights. Anyway, that would have been nice, to have done some more just to have done them.

WRIGHT: You had worked closely with flight crews before, but this was a bit of a different type of interaction. Is that a correct statement, that you were working a lot closer with the pilots in developing the guidelines and the procedures?

DEITERICH: Probably a little closer. Probably a little closer. Yes, well, it turns out that, back in Apollo, most of the time we were in a different building. During ALT, we were in the same building. I could run upstairs and talk to them. So we were a little bit closer.

In fact, organizationally, we were all now in Mission Operations Directorate, which had both the crew and—the flight crew, the flight op [operations] planners, and the ground team were all in the same directorate now, so we were closer in that respect. So yes, I would say we worked a lot closer with them. I know we did. Yes, we did.

WRIGHT: You worked with the pilot of the carrier as well? Or tell us how that interaction worked.

DEITERICH: The carrier for ALT was Fitz [Fizhugh L.] Fulton [Jr.], and he was a DFRC [Dryden Flight Research Center] guy. And we spent a lot of time out at—I don't know how much, but we spent a lot of time out at Edwards, and so we worked with them quite a bit, not nearly as close as the orbiter crew, but we did work pretty close with them.

They had some flight test engineers, they called them, which were essentially FIDOs, that we worked with and picked up how they did things. Now, they could have done the whole ALT thing, but I think [Christopher C.] Kraft wanted the JSC guys to do it just because they wanted them to be trained, they wanted them to have exposure to the systems, they wanted the trajectory guys exposed to how it flew. So that's why he insisted that even though the mission was conducted out at Edwards, he wanted it controlled from back here just for our training and our experience.

But those guys were pretty good, although they did call us Apollo lunatics every once in a while, and they were always worried about the budget. "Oh, you manned space guys get all the budget. We don't get any budget." But I think if you go back and look, you'll find that they got just as much as they'd ever gotten before the lunar missions and what have you. But they were good to work with, and I did learn a lot.

They had a guy named Jack Kolf, who was from DFRC, and he came back. He was stationed at JSC during ALT just as a kind of an advisor, but he worked a lot of things. He worked X-24s and X-15s and stuff like that. And he was essentially a FIDO type of person back for DFRC.

WRIGHT: I know there were some concerns of safety for both the aircraft and spacecraft when they dis-joined. Were you involved in those discussions of the safety measures for that?

DEITERICH: The separation maneuver itself, Ivy [F.] Hooks was in E&D [Engineering and Development], and she was in charge of the—she had a separation panel, and she worried about external tank separation during a nominal launch, she worried about SRB separation, and she worried about the carrier and orbiter separation. In fact, it was in her panel where we decided what the angle between the Shuttle and the carrier would be, and we determined how we would separate and what the maneuver would be and that sort of stuff, because the orbiter would hold a little bit of a pitch up rate, then he'd pop off, and he'd back off one way, and the carrier airplane would be pushed over, and he would go the other way. So all that stuff was worked out in her panel.

As far as the hardware, that stuff was done in E&D, and we weren't too involved in the development of that, but we were involved in the mechanics of separating and that sort of stuff. And Ivy had this panel that she would run.

WRIGHT: Well, tell us about your memories of STS-1 and your involvement in that first mission.

DEITERICH: After ALT, I was going to be the FIDO on STS-1, and a job came open up in the flight planning area. Now, if you think about it, this is in 1978. I'm still doing FIDO stuff, which I started in 1964. In 1978, a Section Head came open in the Asset Entry Procedures Section in [James W.] Bilodeau's Division, and it was in Ed Pavelka's branch, in the Flight Planning Branch, and I applied for it, and I got that Section Head job. So that job was to work with the crews and put together an ascent checklist and a re-entry checklist. And then there was somebody else that had the on-orbit checklist and rendezvous checklist in another section. So, of course, STS-1 was all about ascent and entry, so we did a lot of stuff to put the checklist together and figure out what the procedures were, which switches to throw and that sort of stuff. I think Chuck [Charles O.] Lewis was the Ascent Book Manager and Bill [William M.] Anderson was the Re-entry Checklist Book Manager. And so my biggest involvement with STS-1 was getting the checklist squared away for the crew to use. And they would go over and do sims in the simulator, and then our guys would go over and watch the sims, and they'd mark up the checklists and that sort of stuff.

Of course, again, CG is even a bigger issue with the Shuttle, because you had a certain band you had to stay in or the vehicle wouldn't be stable enough to fly. It's unstable as it is, but you'd be outside of its controllability. And one of the things you'd do is you would get rid of some of the propellant while you were in orbit, depending on how much you had. So we'd actually burn out of plane a little bit just to dump some propellant.

So Bill Anderson came up with a way for the crew to track the CG themselves in case they lost com [communications]. We built a little hand-held calculator that you could compute the CG with based on what your propellants were and where things were located. So we started out with that, and eventually—this is kind of digressing a little bit—eventually, we put together in our section what they call the SPOC, the Shuttle Portable On-Board Computer, which was like a little laptop that you have today. It was a Grid. It was made by a company called Grid. And they had a pretty good sized screen in it.

You've been in the Control Center, where you can see the ground tracks go by and you see the little circles when you cross over land. Well, we built a program that the crew could actually see the ground track and see where they're flying by putting a vector in it, and they could keep track of what their center of gravity was by putting in stuff. So we actually started that whole little program in that little section, and now they use it to control some of the experiments in the Shuttle. It's grown tremendously, but it started out with that little hand-held calculator then it went to the laptop. And Tim [Timothy M.] Brown and Pearline [E.] Collector were very involved in that activity.

Of course, once we did that, it had batteries in it. Now the Safety guys were, "What kind of batteries you got in there?" and we had to get waivers to carry lithium batteries in the computer and that sort of stuff.

The other thing that we did for the STS-1 is the crew has spaces between their instruments so they put cue cards in there, and they have little Velcro, and they snap these cue cards in there. Our section was responsible for the cue cards. Terry Creighton, who was Terry Stanford at the time—that's John [O.] Creighton's wife, if you know who John Creighton is—Terry, she's an M.D. [Medical Doctor] now, but she was involved in the cue card stuff, and she'd go down to the Cape and climb up in the cockpit and stick them around and all that sort of stuff. So we got quite involved. So we were really close to the crews, because they were using procedures that we helped document and work on.

So from an STS-1 point of view, I was in the Control Center when they flew, and we had people on the console that—I think Chuck Lewis was on during the ascent and Bill Anderson was on for entry, because they were most familiar with the checklist and if a question came up for the Flight Director, those guys were there to answer it. But it was exciting. It was neat.

WRIGHT: What lessons did you take away from STS-1?

DEITERICH: Well, that's kind of hard to answer.

WRIGHT: Were there a lot of modifications for the next few flights?

DEITERICH: No. I think again it was a matter of expanding what we had already accomplished, because once we got to STS-1, we pretty well had a good—the simulations give you a big handle on what you've got to worry about, and so we were just kind of upgrading what we had done. Every time we'd come up with a procedure, we would go over and run it in the simulator. One of my biggest problems was just keeping our guys access to the simulators, because there was other people who also wanted to use the simulators for what they had [to do]. There was an engineering simulator that we were very close to that the E&D guys had, and we would go use it, but then, budget and things, whenever, it got shut down. So most of my problem was figuring out how to get the guys in the simulations to do validation of their procedures. Because, everything was getting to be more and more documented and that sort of stuff.

WRIGHT: Maybe we could talk about the entry procedures and how they evolved over time, because first we're coming in at Edwards.

DEITERICH: Well, once you pick a landing site, the procedures are almost the same. The only thing that changes is when you do the de-orbit with respect to where the landing site is. Now, there were certain backup things that we had. For example, the way the energy was controlled was you bank one way for a while and then you bank the other way for a while. If you flew full lift all the way in, you'd fly too far, so what you'd do is you'd do like kind of doing S turns. So you'd do these S turns. Well, if you stay over this way too far, then you can't get back. So we came up with procedures like if you get more than half the way what your return is, you're going to go ahead and reverse—you'll reverse manually.

And we came up with procedures when you should take over and try to fly—what conditions would cause you to take over manually and fly the vehicle without letting the guidance do it. And there were some displays, analog displays, that showed how the vehicle was flying, kind of like in the Control Center. Well, our guys were responsible to put those displays together and define what they were so that the people who did the programming would put them in the vehicle that way. So we did do the ascent and entry on-board displays as well. Chuck Lewis did a lot of that. But like I say, instead of a big change after STS-1, I feel like we just added to as we went along.

WRIGHT: Well, one of the things that you added at some point in time were night landings.

DEITERICH: Night landings, STS-8. Well, early on—and I'm not sure when we put the PAPIs [Precision Approach Path Indicators] in. I don't know if we'd had that for STS-1 or not. We may have. I'll bet we did. I can't remember when we did that.

Anyway, the PAPIs. [Karol J. "Bo"] Bobko had found some lights that when you were too high, they were white, and when you were too low, they were red. Well, if you were high, above a certain angle, they'd be white, and if you were below a certain angle, they'd be red. Well, if you put four of them out there and you've got them at different angles, you'd be on the right glide slope if you had two of them white and two of them red. And Bobko had found these things somewhere. I think he had them put out at White Sands [New Mexico]. He did. And he got to talking to me about them, and so we said, okay, well, let's see what we can do, because he wanted to put them at the landing sites instead of just out where they were testing there at White Sands.

I don't know where he got his. They weren't very good ones, but we found out that they were made by a company in England, and I think it was Barrel Light Company, I believe, but I'm not sure of the name. Anyway, we said, "We'll go buy some of these things." Well, I didn't realize how hard it was to buy stuff out of the U.S. when you work for the government. It's tough. But we managed to buy some. I forget how many we bought. We bought enough, I think, for the KSC [Kennedy Space Center, Florida] and for Edwards, and then we bought some for New Mexico.

You were asking me earlier about my experience with Dresser and my electrical engineering. Well, it came into play here, because we had to come up with—the way they set the lights up, they were all on a transformer, so if one of them goes out, they all won't go out. But the transformers primaries, which are pretty reliable, are all in series. We had to figure out how to buy this stuff. So we were kind of the blind leading the blind.

But Jim Clement and I figured out how to do it, and we bought these things and went out. They shipped them in out there—I forget where it is, out there by the back gate, and we went out there, and we went through these boxes. "Yeah, that's the right stuff," and then we had them shipped out to White Sands. And then we went out there, and we were carrying some variacs. Now, a variac is a thing that changes voltage when you plug it in. Well, this was before there was a lot of security at the airport, but there was security then. They gave us some fits about carrying these variacs on the airplane, but we managed to carry them on there. We went out there and set them up, set the lights up, and went out, and they [the astronauts] flew against them.

So from that point of view, we got the PAPIs in, which the crew could then fly down the outer glide slope very precisely. If you got too high, you'd see three whites. If you got too low, you'd see three reds. So what you wanted is two reds and two whites. And I've seen pictures out the cockpit window of the real Shuttle, and you can see the PAPIs, and boy, they're right on the money.

And that kind of led into the night landing stuff, because all that would do is get you coming down the outer glide slope. The outer glide slope was almost a mile from where you were going to touch down. So at 2,000 feet, you started pulling up. Well, you lost your target, and you went ahead and landed.

Well, we decided we needed some way for the crew to be able to watch the inner glide slope, if you will, which was a degree and a half, which is really shallow. So we came up with this—we were talking to Rick [Frederick H.] Hauck, and he was talking about how [aircraft] carriers have this ball that they look at, and when it's right on—you hear them saying, "Roger ball," well, that's what they fly—they keep that ball in the center of a mirror. We got to talking about it and drawing things on the board. So we said, "Well, we'll just put a row of lights out there. We'll call that the bar. And we'll put a light up high and call that the ball." And when you line the ball and the bar up, you're on this inner glide slope. And you could watch that ball come down and meet the inner glide slope, and then you just hold up until you go to touchdown. "So we'll just try that."

So now Tim Brown and I were working this, and so we called up to Pasadena [Texas]—we called all around trying to find some lights. We were going to do this night landing thing, tried to find some lights to see if the crew could land at night. And he'd also gotten some night vision goggles, a helmet from someplace in the Army, we came up with these things, so we're going to try these things. So the only place that we could find these lights that we could carry around and crank up and light up the—well actually we went out to [Houston] Intercontinental [Airport, Houston, Texas; now George Bush Intercontinental Airport], and they got a short landing area, they got an STOL [short take-off and landing] landing area, with some night lights on it. So we went out there and flew against it. Well, we decided we couldn't—that wasn't good enough. You couldn't see what you were doing. And we flew in the Gulfstream, the G-1 that NASA has, and I think—what's her name, Ivins? Marsha [S.] Ivins? She was one of the pilots on there, because that was when she was in flight crew. Anyway, so we got these lights from Pasadena, and they trucked them out to Alamogordo [New Mexico], out to Holloman Air Force Base. It was cold. It was in wintertime. George [W. S.] Abbey was the [Flight Crew Operations] Director, and he said, "Yes, you can do all that, but do it when the Moon's out so the crew can see the ground a little bit."

So we set this thing up to do on a weekend so there wouldn't be anybody else flying out there. We carried these lights out there, put the lights on the end of the runway so they could shine on the runway so the crew could see them, and they had their night vision goggles in the airplane with them. And we set these PAPIs up as the bar. I think they were all white. Maybe they were all red. I don't know what color, but they were all one color.

Then we had this light that we'd gotten from Pasadena, and I had a rope. I knew how long it was. I knew how far it was from the bar. And I cranked it up so it would be on a degree-and-a-half glide slope, so the ball was, I don't know, fifty feet in front of the bar. So they were flying the T-38s [training aircraft] against this thing. And sure enough, they could fly.

The night vision goggles were not very good. It's too foreign. You've seen some of the pictures on TV. It's kind of green looking, and things just are not crisp. They said, "No, we can't fly that." And the lights really weren't bright enough. We did have some lights out and some strobes out centered so that they could see those and it would bring them around to this ball bar, but the ball bar worked real well. And later on, we got these great big Xenon floodlights that would shine down the runway. I'm sure you've seen those, where the guys—they could see the runway, but the lights weren't shining in their face, and as soon as they passed it, they could still see down on it. That's what they used for the night landing, but they used the ball bar as kind of an indicator of how they're coming on to the inner glide slope, because—let's see, I'm trying to figure out—the ball starts out below and then moves up. In fact, I've got a ball bar out on my runway out here, but it's not lights. It's just a piece of white stuff and another piece of orange stuff, and it works.

WRIGHT: Do you remember who the pilots were that helped you test this?

DEITERICH: Oh, yes. It was Mike [Michael J.] Smith, good old Mike Smith. And it was Rick Hauck. Those were the two guys. In fact, we went up to—have you ever been to the lodge in Cloudcroft [New Mexico]?

WRIGHT: No.

DEITERICH: Well, it was in February. It was cold. And we drove up to the lodge for supper, and there was about that much snow on the ground up at Cloudcroft. See, Cloudcroft's only fifteen miles from Alamogordo, but it's about 5,000 feet higher. Yes, Mike was a good guy, but Mike and Rick were the pilots.

WRIGHT: This work also was awarded the Federal Incentive Award. Is that correct?

DEITERICH: Yes, yes. We got it.

WRIGHT: Tell us how that worked and what that meant.

DEITERICH: I don't know who turned it in. Somebody turned it in, and I got a letter from [President Ronald W.] Reagan saying, you guys done good. I got $2,000 or $3,000 or something like that for it, and there was a bunch of us. There was several guys involved in that. There was more than just Smith and Rick. I think Bobko was involved. There was a bunch of guys, and there was a lot of guys on the ground, too, like Tim Brown and myself and Dick [Richard D.] Tuntland and a few guys like that.

One of the things that Ascent, Entry, and Procedure Section did do was work on some of the visual aids, because there was a triangle at the end of the runway. There was a triangle at the [outer glideslope] PAPIs. We went down to the Cape to figure out where to put those. Walked out, and they flew us out on the helicopter and flew us around. Then we walked out there and walked on up and got chiggers like you wouldn't believe out there in that palmetto. So that was kind of a fun thing to do, that visual aid stuff. And every time I could get out of that Section Head business and get back to the technical stuff, I tried to do that.

WRIGHT: Not so fun was, of course, the [Space Shuttle] *Challenger* [STS 51-L] accident.

DEITERICH: Yes. You know, that's interesting because I was watching the TV, and I saw all the ice and how cold it was, and I could not believe that we were going to launch. There was nothing that said—there was no black and white thing that said don't fly. There was just too many things that add up that said, hey, you know, this is probably not a good plan.

At that time, I was a Range Safety Manager for JSC, and the Range Safety guys at Patrick Air Force Base [Cape Canaveral Air Force Station, Florida], after we talked about it later on, they were kind of amazed that we went ahead and flew, too. In fact, one of the guys said, "Every fiftieth solid booster fails." Well, I think that was the fifty-first.

But that was pretty bad. When that happened, people went back and redoubled their efforts, tried to make sure—even after talking about Apollo 1, I think guys realized that we were vulnerable and tried to learn more about other people's stuff, what things do affect you that somebody else is doing. I think that even got expanded after the *Challenger* accident. People said, "We need to take a step back and make sure we understand all the different things that can happen and try to protect against them."

I know that after that, after the *Challenger*, I got involved in two activities that I spent all my time on. One of them was a flow process panel. We talked about how the whole process of putting together a flight design and initializing the vehicle for flight was going to be from the flight design point of view, because at this time I was the Flight Design and Dynamics Deputy Division Chief.

Then the other thing I was involved in was all the range safety evaluation. We did change a bunch of things in the way the range safety things kind of happened. So I spent a long time working those two items. We'd come up with questions, and then we'd go away and answer them, and we'd document them. Eventually, that range safety stuff got turned into the—I had to write part for Tommy [W.] Holloway for the Rogers Commission [Presidential Commission investigating the *Challenger* accident].

And the flow process panel, we went out and see—a lot of things were done here, and then some were done here, and they were talking about initialization parameters for the on-board computer and that sort of stuff. So it was not really well integrated. It certainly wasn't documented. So we put together a flight design handbook which described how you do this stuff. Now, the people who had to do that was Rockwell [International Corporation].

Rockwell stepped up to the mark and did document it. And the flow process panel, we talked about where numbers came from, what the pedigree was, and how we were going to control that stuff so we would have a good understanding of where everything came from. And that has been done.

As a result of all that, since I was kind of new from a managerial point of view—I probably knew more about the flight design system and the methodology and the procedures and the process than anybody else in my division anyway. I know that they have what they call flight design managers who would take a flight, and they would make sure everything was put together for that particular flight, all the mission timelines and all that sort of stuff, but they would just do it for that particular flight, and they didn't know so much what was going on over here. But I'd kind of gotten the whole schmeer of the thing.

So Jon Harpold says, "You know, we need a new—," One of the things that we recommended was, "we need a flight design system that's integral, a single tool, one that's put together that you can share data with." And he said, "We need to come up with a flight design system." So I got asked to put together what they call the FADS, the Flight Analysis—I can't remember what FADS stands for anymore.

WRIGHT: Flight Analysis Design System?

DEITERICH: Yes, I think that's what it is. Because we had analyses where you would just go off and study a problem. Then once you understood the problem, you would go away and design a mission using the analysis that achieved what you wanted to achieve. So it was a long, hard, drawn-out battle to get that thing done. I had Rockwell, who were the users, and they knew how they wanted it done, but it had to be built by Mission Support Division, because they were implementers, which meant Loral [Corporation] had to actually build the stuff. Well, they would do something, and Rockwell would say, "I don't like the way you're doing that."

Then Loral would say, "Hey, Rockwell, you shouldn't be doing that. You're doing our job."

And there was like 200 on Rockwell's side and like 50 on Loral's side, but we managed to get the system put together, and it still works. In fact, we got rid of the Univacs, because we were doing some work on the Univacs, we were doing some work on what they called Perkins-Elmer, and some of the stuff was on desktop computers. It was just a hodge-podge, and it was none of it written down how you do it. Like remember me telling you about handing off? Well, it's hard to hand off a process if it's not written down. So that's what we did. And we got the FADS going on that.

WRIGHT: I understand you completed it not only on schedule but within budget.

DEITERICH: Oh, yes. Yes. We were on time and on budget, yes, which is pretty unusual. We converted somewhere around—because a lot of the code was Univac code or in some other code, and so we had to convert it all to work in a distributed system, in a Unix or whatever, because a lot of it was in Fortran. And we converted a couple million lines of code.

WRIGHT: Do you remember how many people this impacted, how many were going to be affected by this new system?

DEITERICH: I would guess probably 300 or something like that, because it was all the flight design people in Rockwell. And then there were some terminals over onsite that the civil servants would use.

But one of the things that happened during Apollo, and it just kept getting worse and worse and worse and worse, back early on, the civil service people did everything. As time progressed, as we closer and closer to the Shuttle, more contractors were involved, and now the civil servants were just contract monitors. It's probably a little hard to say that. They're more than that, but they became more of an overseer and a manager than they did a doer. So you're losing a lot of internal expertise.

So essentially, by the time we got to the *Challenger*, most all the detailed work was being done by contractors, and just the civil servants would kind of look over their shoulder to make sure it was being done right. So that took some of the control away from them. And I don't think you can blame any of the accidents on that, but it certainly didn't help anything.

WRIGHT: It's probably a good time for me to ask you about your participation on the Source Selection Board.

DEITERICH: Yes, I was thinking about that, and I think—when was that?

WRIGHT: Well, I don't think I have the date. I just saw that you had been on there.

DEITERICH: Okay. Well, I think that was like March to June of [19]'85. I think it was like a three-month time. I'm not sure. It was a long time. I know that.

WRIGHT: Felt like a long time?

DEITERICH: I know that. Well, I looked at my calendars, and my calendars are blank for those three months, so that's when I assume I was over in the Nova Building. I was Chairman of one of the panels, and we were worried about flight design, we were worried about range safety, we were worried about some of the flight planning activities. Rick [Richard J.] Hieb, I don't know if you remember Rick Hieb, but he was on my panel. Ken [Kenneth W.] Russell was on my panel, and J'Ann Hanson was on my panel. Pearline Collector was the board secretary, or board technical person.

But we sat down, and we read all these proposals, and we had a room downstairs that was paneled. I called it our lodge room. We'd go down there and have our meetings. I wish I could find my schedule, because I had a schedule where we'd meet and talk about all these different things and write up findings and then answer them. And some of the guys, because there was more than just my part. There was people who worried about the simulators, and there was people worrying about the ground computers. Those guys would schedule meetings on Saturday, and I said, "You know, we may meet on Saturday, and I may come over on Saturday, but I'll be darned if I'm going to schedule a meeting on Saturday. That's crazy. I mean, probably any one of these groups can do the job, so to schedule a meeting on Saturday is not the right thing." So I didn't. So my schedule was devoid of Saturday meetings, although I was usually over there on Saturday. But I wasn't going to make fifteen people come in on Saturday when they really didn't have to. We'd just get the job done when we needed to.

So we'd go down, and we'd talk about the findings, and we'd come back, and eventually, after all of them were done, and we'd decide what were the right words we should put in our report, and I'd write the report, and then we'd turn it in. And we really never were privy to too much of what was going on outside of—where the decision was going to made and that sort of stuff. But I did spend, I think it was three months over there, and it was—I'd never been on a source board before, and then to be put on as a panel chairman was kind of new to me. But we did all right.

WRIGHT: This contract was going to cause a big change for the Space Center, on how Space Center did the—

DEITERICH: Oh, yes. Well, see, because it was really all the Shuttle STS operations contracts, so they were going to do all the stuff. They were going to do all the flight design. They were going to do all the flight planning. They were going to do all the ground computer stuff. They were going to do all the on-board computer stuff. They were going to do everything.

And, McDonnell Douglas [Corporation] had been doing that, had been doing the flight design part of that, for a long, long time. Rockwell thought they were going to get to hire all these people from McDonnell Douglas to come over and do the same job they always did. Well, a lot of that didn't happen, so Rockwell struggled for a long time. And Jon Harpold, he kind of held Rockwell's feet to the fire and made them kind of tell him what was going on and how they were going to solve this problem. And he was always concerned about, what's your safety net, if this happens, what are you going to do? So he was really good about trying to get them on board and up to speed to be able to do the job.

WRIGHT: Do you feel this contract changed the way that business was going to be done in the future for the Space Center?

DEITERICH: Oh, I think so, because now, you've got one area that's responsible for everything. That could be good. It could mean things really get integrated well. But then, it could be that it gets so big that they can't manage it, so I don't know. And I guess they're—well, they're called USA [United Space Alliance], I think now, aren't they? It's essentially the same process, where they've got everything.

Yes, because the tools were Unisys, was part of the STSOC [Space Transportation System Operations Contract] group, and they were building all the tools. Now, some of those guys—I can't think of the guy's name—actually did come from McDonnell Douglas and went over there, but he came over as a supervisor. So I'm sure that's why he went over, because he probably got more money for it. But Jon would really keep on their case to make sure they got the things done right, more so than I probably would have.

WRIGHT: We were just talking about one difference between the Apollo era and the Shuttle era. What are some other ones, since you worked so many years in Apollo and then worked so many years in the Shuttle, -- what were some differences in the environment down at the Space Center?

DEITERICH: Well, I don't know if it was a difference in the programs, but I know that we became much more budget conscious in the Shuttle era, because we were always trying to figure out how to do more with less. Now, that may have been because I was a little higher up in the management that I could see this. I never did worry about it before. But I don't think so. I think it was more of just the climate, that we were trying to tighten our belt, and people had to be more conscious about what they could do and what they couldn't do and what kind of moneys they had.

So I think the biggest factor, I think, was the budget pressure that people were being put under once Shuttle got flying. I really do. Of course, now, the Control Center is now in the new Control Center building, and all the big mainframes and stuff are no longer being used.

In fact, we were talking about the FADS, just talking about it, and that was the first big distributed system that I know of that was put together. We had over 300 work stations, and we had these compute nodes, and we had data nodes. Before that, there was no way that you had that much integration between all the different re-entry, rendezvous, orbit. Now they're even putting the flight planning system in them. The flight planners and the flight plan and the checklist guys are now part of this integrated flight planning system. That's all together now.

I don't know how far they've gotten, but—and I know they've upgraded the hardware some. But that system, when we put it together, it was the first time that we really put together a distributed system. Everything else was on mainframes with cards and stuff. It was the first time we had an interactive system with what they called a GUI, a Graphic User Interface, which is what your [Microsoft] Windows [operating system] is. I didn't know what a GUI was.

It was really funny. Putting me in charge of that was like—I don't know. I knew what the answer had to be from the system, but I had no clue about the system. Every time they'd talk about something, I'd say, "Well, tell me about it. If this was MS-DOS [Microsoft Disk Operating System], how would it work?" Because I knew a little bit about DOS.

And I had one guy who was a consultant that was living in Colorado Springs [Colorado], and he'd come down every week or two weeks and stay for a couple of weeks, then he'd go home. He helped me quite a bit. But he was an old implementer, and he knew how to implement things. And a guy named—you ought to probably talk to this guy, Pat [Patrick M.] Duffin. Do you know Pat Duffin?

WRIGHT: No.

DEITERICH: He was an MSD [Mission Support Directorate] guy. Now, you've got to remember, MSD was the people who developed the systems, and MOD [Mission Operations Directorate] were the guys who operated the systems. Well, I was an MOD, but now, with building FADS, I was really a part of MSD. There was always a little friction there, because we always wanted to tell them how to do it, and they wanted to tell us to stay out of their business.

But Pat Duffin, he really helped me quite a bit, because he was an old implementer, and he was a Branch Chief over there, and he really helped me quite a bit. When I would come up with more of a policy question than anything else, I'd go down and say, "Hey, Pat, tell me about this," and he'd lay it down the line for me. But we put together this system that worked out pretty well.

And Jerry Powell worked for Loral. He was the Project Manager for Loral, and he was really good. He did a lot of good work and kept his guys—we'd sit down and have a conversation with him and Art—Art Nolting was a Rockwell guy, and we'd talk, and we'd hash things out. We had to keep our guys under control. It was fun.

WRIGHT: Well, you're talking now about some of the new technology that is now everyday technology, integrated networks. And then also about this time, I believe, is when some of the PROFS [Professional Office System] Internet or email system came on line.

DEITERICH: PROFS was up at that time. PROFS was up at that time. We could send emails back and forth. In fact, one of the things that was really funny, everybody wanted to put FADS on the Internet. There ain't no way you're going to put FADS on the Internet. There is no way you're going to have a—there ain't going to be a modem near this system, because it's too sensitive. It's not that it has secure data on it, or secret data on it, but it has data that can't be tampered with. It's got flight-critical data on it.

And I had a heck of a time—in fact, security on that thing was one of the biggest problems. We had to record every keystroke. We had gigabytes of security data every day. You couldn't walk up to a computer and stick your little floppy disk in there, because who knows, it might have something. So you had to take it to a system administrator, and he would look at it and make sure it was safe, and he would put the data on it and tell you where he put it. But there was no removable memory on any of that system. There still shouldn't be any. I don't know if there is or not.

But some of the time, the guys could actually get into the Univac from their home computers and stuff, from their modems, but not in the flight design system. That was one of the things I would not let them do. And Loral was really strong on security.

A gal named Charlene [E.] Gilbert—I don't know if you know Charlene or not. She's a Director down there now. I think she's in the—what do you call it when you exchange data? Anyway, she's in charge of a directorate that gives data to different areas, data information. I can't think of the name of it. Anyway, she was an MSD person, well groomed in their policies and procedures, and she was always on my case. She was my counterpart from MSD, although I was in charge, and I kind of had to get on her a couple of times. She would always try to keep me towing the line as far as security is concerned, because she was concerned about it. But that was part of her upbringing. She was raised by Pat Duffin. But she was good.

Actually, she started out working in the Control Center as a contractor for somebody, Lockheed or somebody, and then she got in the civil service, and then she went to MSD. But she's done well. But she was my conscience, I guess you might say.

You talked about IPS [Integrated Planning System]. When we started the IPS Office, I made her my deputy. So the whole flavor of how the flight design is done now is kind of based on the way the flow process panel came up with its conclusions that we needed a more controlled, integrated system, and it has changed the way—there's not so much job shops now. They're more integrated. And, of course, most of it's being done off site by non-civil servants, which is unfortunate.

But I guess, if you take a step back, what should NASA be doing? Should it be doing operations, or should it be doing research. And if you say it should be doing research, then it's time to give it to the contractors, let them do the job, and let the NASA civil servants do the new stuff and be on the leading edge of things. So I don't know. It's just that when you get to doing a job, it's hard to turn it loose.

WRIGHT: You mentioned the Integrated Planning System Office. Did you want to talk anymore about that?

DEITERICH: Well, after we got the FADS up and running, they decided they wanted to put more stuff into the FADS. They wanted to put the flight planning stuff into the FADS. They wanted to separate operating that job from the FDDD [Flight Design and Dynamics Division]. They made me an Office Chief, which is about like a Division Chief, except probably not quite as glamorous. So the job was keeping the things going and also adding more capability, which was like the flight planning stuff. Of course, all we did was talk about budgets, what we were going to do and how we were going to do more with less.

You asked why I left. Well, that's one of the reasons why I left. I got tired of fooling with budgets. And I could. I had my thirty years, almost thirty years, in, and it was an opportunity, and I bought this land in [19]'83, so I had a place to go. And I had a lake house out on Lake Buchanan [Texas] since the early seventies. So that's what we decided to do.

And then, when it was time to take an early out, they brought Ken Russell over to run the office for a while. But yes, that's about all I want to say about IPS, because it was more of a management headache for me than anything else, because there wasn't much technical stuff I could do anymore. When I was doing FADS, I was down in the nitty-gritty figuring out how all these things were going to work together and that sort of stuff, and that was fun. But just managing a system that's running is not a lot of fun.

WRIGHT: Just kind of a somewhat related question before we move to the close of today. We talked earlier about you were so much involved with ASTP, and before you left, the agency became involved in working with the Russians as part of the Shuttle-Mir Program [Phase 1, International Space Station]. Were you involved any at all with the planning or any of those?

DEITERICH: Not really. Not really. Not really. Now, the Mir stuff was kind of after I had gotten into FADS, and it might have even been after I left. I'm not sure.

WRIGHT: What do you believe to be your most significant contribution to the space program?

DEITERICH: Well, let's see. I wrote that down. I think the biggest thing I did was Apollo 13, there was certainly a lot of things that I thought of, but probably other guys would have thought of, too, that I think really helped get that job done, like separating the Command Module from the LM using the tunnel pressure, like using the Moon set time for a trajectory check, using the Sun and the Moon for stars to look at, making sure we had the right REFSMMAT [Reference Stable Member Matrix] for re-entry. We just kind of stumbled onto that. And in general, just the whole plan of how we were going to put the maneuvers together and do that. I think that's probably where I helped most.

And then ALT, which I worried about cradle to grave. I was involved in the whole planning exercise from the very beginning till its execution, and I was kind of the ground operator during the GCA, Ground Controlled Approach kind of stuff. So those, I think, were the two biggest things that I did.

Now, the FADS is not very dramatic, but it contributed a lot to the—the biggest problem we ran into was flight rate. We couldn't get all the stuff done in time. Of course, the flight rate is not what we were hoping it to be, one flight a week. But the FADS really did allow us to be more integrated and have a better understanding and do things more efficiently.

WRIGHT: Do you have an area or an aspect of your career you found to be the most challenging?

DEITERICH: I wrote down here, "Developing the FADS and managing the two contractors, the user Rockwell and the implementer Loral." [Laughter] That was probably the biggest challenge, just keeping those guys together, and it was a big job. It was like a $40 million project, and I had never done anything like that before, so that was really quite a deal.

But I knew enough from a technical point of view that—and I had some guys I could call on to help me out, like Pat Duffin and Jon Harpold, guys that I could go counsel with, and they would give me the straight scoop, and then I could go do it.

But that was probably the most challenging, was working the FADS. Because the mission stuff, we had time to think about it ahead of time. Llewellyn insisted we have about three or four different backups. You'd give me the velocity of flight path angle and altitude at cutoff, and I could tell you where we were going to land. I had charts for all that stuff. I had notebooks that thick of all kinds of stuff. And we didn't have to guess at anything. "Oh, you've got to de-orbit? Well, if you do this right here, you'll probably get within 100 miles of where you want to be," without any computers at all. And we had worked all these procedures. And we'd sit around in the office and talk about what we were going to do and how we were going to do it. So thinking about these things in real time was not that—it was not foreign, and it was not something you had to struggle with.

And the ALT thing, as you know, that was not a struggle, that was just a pleasure, because it was a small group of guys, nobody messed with us. They were all worried about the STS-1 and getting on orbit and all that sort of stuff. We were just off doing our thing. It was a small group of guys under Puddy.

I'll tell you a funny story. We were out at DFRC, and I was driving the car. Why I got the car I don't know. We were staying over in Downey, but we had driven up to Lancaster [California], up to Edwards, which is a long way. So we stopped in Lancaster on the way back, and [Eugene F.] Kranz said, "Let's get some beer."

"I'm not going to drink a beer. I'm driving." I didn't know it was against the law to have an open beer in a car in California. We drove all the way to Downey, never did get stopped. [Laughter]

WRIGHT: That was the good news.

DEITERICH: That was the good news, yes.

But yes, ALT was really a neat, neat, neat project. And that was before there was a lot of security. We'd go out there and walk through the hangars, and they X-24s sitting there, and you could look at those. DFRC would probably have been a fun place to work, probably would have been a fun place to work.

WRIGHT: Well, before we close today, I was going to ask my colleagues, see if they had any questions or anything that you all can think of to add?

You want to take a second to look at your notes and see if there's anything else that you want to add?

DEITERICH: I want to tell you about—we've had some documentaries on TV lately, and my feeling is, they set way too theatrical and sensational a tone. Their tone was way—it may have been the way it was edited, but if they had just talked about the technical history and workings at JSC, it may not have been appealing as the sensational, but I feel they really over-sensationalized it.

My problem is much of the conversations sounded like everyone was always disorganized and close to disaster. Frankly, most were really methodical, had backup procedures in place. It sounded like the NASA designers took chances with the design, and the operators were cavalier, and that's not right. All the guys I knew, they had—in fact, I don't think anybody really had "failure" in their vocabulary. Nobody that I talked to.

There might have been some people in the back room who were concerned, but everybody I worked with were very professional. They weren't grasping for straws. They knew what they had to do and knew how to do it, and all they needed to do was work out the details. And when I watch those documentaries, it sounds like we're on the edge of disaster at any given time, and I don't think that's right, for anything.

Now, let's talk about the [Space Shuttle] *Columbia* [STS-107] accident. I think that accident could have been prevented. I know that on STS-1, we took pictures of the *Columbia* and saw the tiles. They didn't even take pictures. If they'd taken pictures and saw the problem, they could have powered that thing down—and this may not have been able to happen, but it would have at least been looked at—and they could probably have mounted a rescue, and there may have been something they could have done with the re-entry trajectory that would have kept that thing from getting as hot as it did. There may have been a way to shield it, shadow it from the—probably not. But that wasn't even tried.

And like the *Challenger* accident, I don't think—if I had been asked, should we launch, I would probably have said no. Now, it may have been that the management may have just been misguided, but I just think that we kind of maybe got a little cavalier with the *Columbia*. And the thing that's interesting about it is I could have stood right out there and watched it, and I was in the house watching it on TV when it—because I didn't realize it was a low inclination orbit. I thought it was a high inclination orbit like they go to the space station with, and you can't see those from here. But the low inclination orbit you can. And I could have—I'm glad I didn't see it, I suspect.

But I just think that the *Columbia* thing, more could have been done—it was almost like it was ignored, and it shouldn't have been. And now we're paying the price for it.

WRIGHT: All the years that you spent at the Space Center, now that you're away from it for a few years, can you imagine anything else you would have done during those almost thirty years?

DEITERICH: Well, I probably had, next to the astronauts, when I was working in the trajectory area, I probably had the best job on the Center, because that—and the systems guys probably won't like you to say this, but they had really nothing to do unless they had a failure. They had a lot to do then. They had to watch these things, but most of the time, they're just watching and made sure things worked right.

We had things to do. We had rendezvous to compute. We had de-orbits to compute. We had trans-Earth injections to compute. We had all this block data, that we never did use, to compute. We had things to do. So it really was more almost being like a pilot, except you weren't. So I really didn't—except to get a promotion, I would probably have stayed there. But after fourteen years, I decided I wanted to get a little more money.

So I think I had probably the best job on the Center. Now, maybe the Flight Director might have a—because he gets to do all that, but as a trajectory guy, or as anybody, we did try—after fourteen years, you do learn about a lot of the other guys' stuff, how the fuel cells work, and how the RCS [Reaction Control System] jets work, and all that stuff. So there's never a dull day. There was always something new, and you're always trying to expand your little bag of tricks and your little back pocket procedures. So you always had something to do.

WRIGHT: Well, we certainly enjoyed hearing everything and are glad you shared so many of the details. Is there anything else that you'd like to add?

DEITERICH: I can't think of anything.

WRIGHT: Well, we certainly thank you for all your time this afternoon and look forward to talking with you again.

[End of interview]