

# NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

## ORAL HISTORY 2 TRANSCRIPT

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INTERVIEWED BY CAROL L. BUTLER  
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BUTLER: Today is November 30, 2001. This oral history with Rod Loe is being conducted for the Johnson Space Center Oral History Project in the offices of the Signal Corporation in Houston, Texas. Carol Butler is the interviewer and is assisted by Sandra Johnson and Kirk Freeman.

So you were talking about the development of the Mission Control Center [MCC].

LOE: Yes. We had been using the—I'll say the more experienced guys. We had a bunch of contractors that were Philco [Ford Corporation], and they were hired because they had experience tracking satellites for the military. So when NASA got ready to do some flight controlling, they called on their experience.

But even the NASA guys that had been around on Mercury, all the display devices back then were meters, hard meters, and the meters had limits, you could set. You can pull a tab down, and then if the needle got above that tab, you'd get a red light. You could do the same thing down at the bottom. So along came the Mission Control Center here in Houston, and here's going to be this computer driving our displays, and that worried a lot of people, myself included. Here was another piece of equipment that could fail, that would be between us and the spacecraft, and would cause us to lose data.

And also the idea that we'd be looking at the data coming down in the digital format. In other words, you'd print cabin pressure and you'd print out cabin temperature and bus voltage and what have you. So we did a couple of things. Number one, we installed meters on our console, hard meters on the console. We picked—and I'm not sure how many we had. We

probably had twenty maybe of what we considered our most critical and important parameters that even if the computer went down, we'd still have these.

And then—looking back on it now, I can laugh about it, but we also decided that meters was really the way to look at data. So we had the computer draw meters for us on our little TV displays. We'd have like twelve meters on each TV string, and we had it set up to operate just like our hard meters did. If you went out of limits, you'd get the lights and everything.

Well, after a few years and a few missions, we finally got away from that and learned to trust the computer, but I've thought back on it since then that that was really pretty silly to have a computer drawing meters for us.

BUTLER: Well, that is a hard adjustment to make, though.

LOE: Yes.

BUTLER: Computers were still such a new phenomenon, and we see nowadays that new technology doesn't always work perfectly to start with. So I can understand that.

LOE: And the idea on the meters was that—the guys that had done it a lot would tell you that you could just scan the meters, and you didn't have to necessarily stop and see that cabin pressure was reading 5.0. You just scanned and you saw that it was in the range where it was supposed to be. So it took some getting used to, going to the actual digital displays.

And the lead time on developing displays was quite long back then. We would draw up what we thought we wanted the display to look like. In fact, you'd draw it up on sheets of vellum that were computer-screen-sized. So you draw the display up in the actual size you wanted, and then we'd turn those over to another organization, I think they called a Flight

Support Division, and they then would take and program the computers and turn them into the actual displays.

BUTLER: Oh okay. So this was early on in the Gemini Program initially.

LOE: Yes, yes, yes, when we first started out in Gemini.

Another thing I happened to think of that we learned in Gemini, and I can't tell you if this happened during a sim [simulation] or during an actual mission, I suspect it might have been a sim, but those of us that had command capability to the spacecraft, like the EECOMs [Electrical, Environmental, and Communications officer] back then had commands to send telemetry on, telemetry off, tape recorders on, what have you, all the commands that the INCOs [Instrumentation and Communication officer] now send in the current Shuttle days and even later in Apollo, but all that was EECOM's responsibility back then, and the guys down on the Agena console, their EECOM equivalent had the same thing.

Well, our commands would just be buttons on the console, and when you wanted to send TM [telemetry] On, you'd just reach up and hit the "TM On" button. At some point down on the Agena console—as I say, I think it was during a sim—there were right—I'm here and my console's right here, and then just the other side of the console there's probably a foot-wide step before you go down to the next level. And quite often, people that wanted to talk to you would come stand on that step to talk. Well, down on the Agena console, I think it was Mel [Melvin F.] Brooks came to talk to somebody, and he reached over, put his hand over the top of the console to pull himself up on the step, and he happened to be touching some of the command buttons, and blasted out a bunch of commands. I think that happened during a sim. But we learned a lesson real quick, and we put little covers over all the command buttons. So when you meant to send it, you would send it, but you didn't send one inadvertently, or somebody else didn't send one inadvertently.

BUTLER: That's interesting, because they had thought of that type of incident on the spacecraft, because of things floating around, but you wouldn't think of that right offhand in the control center.

LOE: Yes, just reached up and said, "Hey, how's it going?" and pulled himself up. [Laughs]

BUTLER: Oops. [Laughs] Well, then that shows the value of simulations again.

LOE: That's right, you bet.

BUTLER: To find all the little details as well as the bigger ones.

Were there any other thoughts that you had on the early programs?

LOE: No, I think we covered them pretty much last time.

BUTLER: Okay.

Well, then moving on in your career. We had talked up through Apollo-Soyuz [Test Project, ASTP], I believe, briefly, and at that time you were in the Electrical Environmental Systems Branch. At what point did you begin to get involved with the Shuttle systems? Do you recall if that was before Apollo-Soyuz or after or even during Skylab?

LOE: Now, Apollo-Soyuz was after Skylab, right?

BUTLER: Apollo-Soyuz was in '75.

LOE: My sense is, we started getting involved with Shuttle immediately after Skylab.

BUTLER: Okay.

LOE: We reorganized. Like all through Skylab, I had what was called a Saturn Workshop CSM [Command and Service Module] Systems Branch. So we had all the systems onboard Skylab.

Then after Skylab, we split it up, and we took the traditional EECOM stuff, and that became my branch. We made it basically a GNC [Guidance, Navigation, and Control] branch, and that was Neil. Neil [B.] Hutchinson ran that. And then right in there sometime is when we also made the INCOs a separate branch, the INCOs and O&P [Operations and Procedures] officers. But it must not have been right then, because Ed [Edward I.] Fendell was in my branch for a while. Ed was, of course, head of the INCOs.

So I guess we just had the systems split into the two branches for a while, and we had Neil's branch and my branch, basically the GNC branch and the EECOM branch. My recollection is, that happened right after Skylab. So we must have been in that configuration for ASTP.

BUTLER: As you were gearing for Shuttle, and here we are—ASTP did come briefly in this time frame, but that was single mission, very focused. So the time between Skylab ASTP and Shuttle was a number of years. Shuttle didn't actually launch until '81. What were your responsibilities during that time, and how much training did you do, and how much did changes in the development of Shuttle affect your role?

LOE: Well, now, don't forget we had the Approach and Landing Tests [ALT] for Shuttle.

BUTLER: Was your group involved with that?

LOE: Oh yes.

BUTLER: Okay.

LOE: I don't recall how many years that was before the actual launch. Maybe a couple of years?

BUTLER: I think that was in '77-'78 time frame, so it was a few years. It was kind of right in the middle between the programs.

LOE: Okay. So, we had, what, a couple of years then from ASTP till we started flying ALT.

We were very, very busy developing the systems handbook for Shuttle, and developing systems handbooks was such a great way to learn the systems. The walls out in the halls would be plastered with drawings and guys out there marking up their drawings and stuff, because we didn't have the big tables and stuff in the folks' offices where they could lay out drawings, and we didn't have the nice drafting tables and stuff. We had people that did the drafting for us. Kentron, I think, was the company that did the drafting for us.

So our folks would turn in a rough draft over to Kentron, then Kentron would do a nice drawing out of it. It'd come back and, like I say, it'd cover a wall. Then the guys would spend hours out in the hall checking over their drawings and going over drawings.

Then we got ready to sign drawings off, they'd bring them in my office, and, here again, we'd go over them very meticulously, and we used that time to really get familiar with the system. The engineers that had produced the drawings, they would go through, and in explaining the drawings, they'd basically be explaining how the system would work.

We would play a lot of “what if” games as we were going through the drawings, which later led to mission rules and stuff. So were developing systems handbooks. We were developing mission rules.

At some point, we came up with something called system briefs, and those were written descriptions of how systems operated and how they might fail, and all their operating characteristics. The systems briefs were written by, let’s say, the engineer working on one aspect of the thermal system or the cooling system, and it was our way of sort of picking his brain or her brain, and then letting the other controllers benefit from that.

Back in the early Gemini days, I guess even in Apollo, you didn’t have that many people, so you had the luxury of, let’s say, all the electrical power system [EPS] folks sitting in the same office. So there was a lot of chitchat and “what if” games played there in the office. As we got into Shuttle and everything started growing, all the EPS people might not be in the same room anymore. It might be one here and somebody else down the hall. So systems briefs was a good way to pick people’s brains and get that knowledge out.

But then when the Approach and Landing Tests rolled around, we built a little control room for that. I guess it was the old recovery room that was used back on Apollo. We turned that into a—it was a one-room control center, and approach and landing was—the duration was so short and all the responses had to be so quick, that we didn’t necessarily have a back room that I recall. We just had the one room, the one operator. Jack Knight happened to be the EECOM, although that was one of the things I sort of regret. We didn’t call him EECOM back when we started into Shuttle, because EECOM, as we’d talked last time, Electrical, Environmental, and Communications.

Now that Shuttle’s coming along, we’ve got some other systems that the EECOM guys are going to be responsible for—mechanical systems for one, the payload bay doors, the RMS [remote manipulator system] – the arm, the APUs – the auxiliary power units. So we had a mechanical aspect that we hadn’t had before on Apollo or Gemini.

That was also back during the CB [citizen band radio] craze, when everybody had CBs in their cars and trucks, but we named what then was the EECOM, we named them SMOKHEEs, S-M-O-K-H-E-E, and that was Shuttle Mechanical, I think Kinomatics, and the EE was electrical and environmental. We should have left the name EECOM. We never should have gone to another name, but we put up with that SMOKHEE thing through approach and landing, then quickly went back to EECOM. So I guess Jack Knight was the only SMOKHEE we ever had. [Donald R.] Puddy was the only flight director that ever got to call somebody SMOKHEE, but looking back on it now, I wish we would never have done that. So that was the years getting ready. So not only were we developing the handbooks for the approach and landing configuration vehicle, we were also developing the handbooks for the orbital Shuttle—handbooks, mission rules, and stuff.

We've talked a lot about SPAN [Spacecraft Analysis Room]. I don't recall even having SPAN during approach and landing. It was just a different kind of an operation. It really was a test operation rather than a mission that we'd been used to in the past.

BUTLER: You mentioned that Jack Knight was the one working that console during the approach and landing test.

LOE: Right.

BUTLER: What were you doing as head of the branch? Were you there for some of those tests, or were you just helping him with coordination and such?

LOE: As I recall, like I say, since we didn't have SPAN, the managers didn't really have anyplace to sit. So I think there was a viewing room maybe that we could go watch the operation, and we all had speakers in our offices where you could listen to the thing. You could



listen to the flight director's loop and the air-to-ground loop and stuff. So we were able to keep up with it that way.

BUTLER: As Shuttle began flying—well, actually, building up to it, as you were developing these systems handbooks, the system briefs, Shuttle was very different then than earlier programs—the Gemini, the Apollo—in its ultimate size and its use, that it was going to be a reusable vehicle. How different were the systems for Shuttle versus from the earlier?

LOE: Of course, APUs that I mentioned, they were totally new to us. We'd never had APUs before. We'd never had a hydraulic system before. We'd never had things like payload bay doors that opened and closed before.

We had some systems that were similar. We had cryogenics. In fact, we'd had them on Apollo. We'd had fuel cells like we'd had on Apollo and the later Gemini flights.

We didn't separate like we had done on Gemini and Apollo and leave the service module, you know, to burn up, and only enter the command module. We entered the whole thing, of course.

We put a great deal of emphasis on the thermal system, the tiles and stuff. That was totally new. But there wasn't a good way to monitor those, although there were some temperature sensors underneath the tiles, and you could see the PTC, what we called passive thermal control, when we'd barbecue the vehicle. You can see that with those sensors.

So some of the systems, obviously, a fuel cell, you know, it wasn't the same fuel cell, but it was a similar fuel cell. I mean, you know, a fuel cell's a fuel cell. It uses oxygen and hydrogen. Shuttle fuel cells cool themselves differently, let's say, than Apollo fuel cells did. The coolant loops, we had radiators on most spacecraft.

Yes, there were some differences and some similarities.

BUTLER: Do you recall any of the systems, particularly the new systems on Shuttle, that you were specifically involved with, having any particular challenges to you as you were developing the systems handbooks? I know on a larger scale, some of them did for, like, the thermal protection system that you mentioned, they were having problems with the tiles, but I'm not sure, did that directly affect you as you were developing these procedures and such?

LOE: Well, on the thermal protection system particularly, we struggled with a way to depict that in a handbook. I don't think we ever did do a very good job of it. It didn't lend itself to handbook kind of stuff, although we did put some drawings out that were, I would say, useful, and we learned a lot developing them.

The APUs, the auxiliary power units, were a whole new kind of system to the EECOMs, in that it spun up to a very high RPM [revolutions per minute]. It's almost like a jet-powered system, had overspeed protection with it. During the development phase of the systems, they'd had some of these units go overspeed, and they'd actually destruct and throw out shrapnel and everything. So we were very concerned with that.

We had the capability, or the crew had the capability, to override the overspeed shutdown in a real emergency. So we had to agonize over what are the cases where we'd use that capability, where we'd try to override the thing. [Unclear], I guess, for the [unclear].

BUTLER: As the Shuttle reached flight status, as STS-1 approached after you'd gone through the approach and landing tests, they were bringing on the vehicle, and, actually, with the Shuttle, it was done a little differently, no unmanned flights were flown first, whereas in the previous missions, they had. What were you doing as the flights began? Did you have a chance to work the console at all, or since you were now in this management role, did you just help facilitate? Were you in a SPAN room or FOMR [Flight Operations Management Room] situation?

LOE: We had SPAN. Yes, that's right. We'd gone to FOMR—we called it FOMR back in Skylab—but then when Shuttle came along, we went back to SPAN. We had pretty much all the same setups that we'd had on Apollo where we had a Mission Evaluation Room [MER] over in Building 45 staffed by the program office or run by the program office and staffed by the engineering people. We had SPAN on the mission operation side.

We added astronauts into SPAN. I'm guessing that started with STS-1. We had astronauts come in. We had people from the scientific side of the house since we were going to be carrying experiments and stuff, payloads. So we had people from the payload side of the house come in.

Mission operation took over the logistics and the operation of SPAN. Back in Apollo, the Apollo Program Office had run the room. They provided the secretaries and the runners and stuff. For Shuttle, mission operations took that over, so we provided all the logistics support and everything for SPAN.

I think our breakdown back then, we would have a SPAN manager; we would have a SPAN systems person that sat down on the right; we had a SPAN payloads person that sat out on the left; and then the astronaut rep sat between the payload guy and the manager. I think we had four people sitting at the console. And then the program office reps would be back at the table behind us.

I can remember being in the control center for STS-1. The thing that really impressed me was how fast that thing got off the ground. Of course, we'd run sims with it, simulations, but you never saw it on TV. I mean, you didn't have TV up for sims, of course, and nobody had ever taken a picture of this thing going off, because it had never gone off. But that really impressed me, how quick it got off, because the Saturn V was, you know, slow lifting off and getting speed the more it went up, but, boy, that Shuttle just went "Bang!" and it was off and going. As soon as those solids [solid rocket boosters] lit, it was—somebody told me, I think it

was—I don't know which crewman it was. It might have been Cripp [Robert L. Crippen]—said, “When those things light, you know you're leaving town. You're going somewheres.”

BUTLER: Did you ever have a chance to see any of the launches in person from the Cape [Canaveral, Florida] for any of the programs?

LOE: Not for Gemini, not for Apollo. In my program office years, after I left mission operations and was in a program office, yes I was able to see about three or four.

BUTLER: Does it still look as speedy in person, or by then were you used to seeing it?

LOE: Huh?

BUTLER: Did it still look as fast at that point when you were able to—?

LOE: Well, by then, you were used to how quick it got off. What I never did get used to the times that I saw it was just the feel of the thing, the sound and the feel. It's amazing when you see and hear that thing. It's a lot of power being unleashed there.

BUTLER: Yes, it is.

LOE: Yes, I was able to see—I guess 3 or 4 when I'd be down at the Cape maybe for other reasons.

Jim [James C.] Adamson, one of the astronauts that used to work in flight control, we were real good friends with he and his wife, and he'd invited us, my wife and I, down for his launch.

BUTLER: Oh good.

LOE: But that one didn't go, had an engine problem, I think, the day, the night before launch, and that one got called off.

But my wife did get to see another one. We went down to see—it was a night launch, too. I guess it was Bill [William F.] Readdy's flight, we went down.

BUTLER: Okay, that's great.

LOE: In fact, Readdy carried some—Bill had come to me at some point. Let me digress here a little bit. Back in 1979, George Abbey decided that flight operations should have a chili cookoff, and each organization, each branch, came up with their own chili team. The EECOM branch, we came up with a team called BARF, B-A-R-F, and that stood for the Bay Area Refuse Firm, and our theme was that we were garbage collectors.

We had some folks in the branch that had played musical instruments back in high school and college, and they ginned up a little band called the "Trashcan Five": Milt [J.] Heflin, who I guess you've talked to, Milt was in the band, and Al [Granvil A.] Pennington was in the band, Barbara [J.] Newton, Larry [V.] Minter, and I can't remember who the other one was.

Anyway, later on then, after a bunch of reorganizations and everything, the old branch was no more, but the BARF team lived on. So Bill Readdy came to me before his mission—you know they were going up to the Mir—and said, "Would BARF be interested in cooking up some chili for them to take and to serve to the Russians?"

And we said, sure, we'd do that.

And then, somehow, in the logistics, the chili wasn't able to make it on board. I think they took some of Pe-Te's barbecue from a place down across from Ellington [Field, Houston, Texas] instead.

So Reedy said, "How about this?" Said, "If we can't do that, I'll carry some of your chili spices on board, and then when we get back, we can make up some chili out of these spices that have flown in space."

So Reedy took a package of spices on board with him, and my wife and I got to go down and see that launch, so got to go down as guests, not because of the chili spices, but Jay [F.] Honeycutt, who was [Kennedy Space] Center director in Florida then, invited us down to see that launch. So she got to see a launch also.

BUTLER: Oh, that's good. It's good that after having lived, in her own way, all these years through your NASA career, that she got a chance to experience that.

LOE: Yes, that was good.

BUTLER: It's neat. Oh, that's quite a story, the chili. Yes, chili cookoffs certainly have become a very big production here.

LOE: Yes, yes. Have you ever been to one?

BUTLER: Yes.

LOE: Good.

BUTLER: Yes, very interesting experience, very unique.

Well, with the STS-1, you mentioned that you were in the control center, that you remember the launch, in the SPAN. Do you recall any specifics about the mission, any of the discussions about some of the tiles that had fallen off? I know it was a short mission then.

LOE: Not a lot of specifics. In fact, I was talking to somebody about that the other day—Bob [Robert D.] Legler, I guess it was. I don't know if you guys ever talked to Legler or heard of Legler, but he's a—

BUTLER: We're hoping to talk to him soon.

LOE: Okay. But we were talking about STS-1 and the tiles that we lost, and I want to say that we called up some ground-based telescopes and looked at the Shuttle, convinced ourselves that everything was going to be all right, but, yes, that had a lot of people scratching our heads.

Other than that, my recollection of STS-1 was that most of the systems worked pretty good. It may have been that we were concentrating so much on the tiles that I may have forgotten something else, but my recollection was they all worked pretty good.

BUTLER: Well, I think they did. I think everything worked pretty smoothly, especially considering that this was a first flight and completely hadn't been done at all before, so pretty successful one.

As the missions progressed up until you moved—in 1984, you changed positions, but during the '81 to '84 time frame, did you continue to work in the SPAN room supporting the various missions?

LOE: Yes, yes, every one of them, yes. Yes, that was always a great break from office work to be able to go over and sit in SPAN during the missions, and you'd even take the midnight shifts just to go do it. So, yes, SPAN was always a lot of fun. Working the missions was a lot of fun.

BUTLER: I could imagine that, and certainly it's a very active job and you have to be on top of things.

LOE: Yes.

BUTLER: Do you recall any particular memories from any of those flights or any incidents that happened either technically or on an anecdote side that you'd like to mention?

LOE: Of course, we had two different floors over there. We were flying some DoD [Department of Defense] missions. So we had two different rooms for SPAN, one on the second floor where we flew the majority of the missions, but then when we'd fly a DoD mission, we'd all have to troop up to the third floor and be very secure.

We got to be very close with a lot of the astronauts that either had flown or were going to fly, just because you'd sit there right next to them eight hours per shift, and sometimes in the middle of the night, things were very, very slow, so you'd get to swapping stories. I got to be real good friends with Ellison [S.] Onizuka that way. He was with us one or two missions.

Then we headed on a—not so much SPAN, but on a social standpoint, I don't know if it was Crippen or [Richard H.] Truly, we had an organization called the Ace Moving Company, and we would help people move. Truly was president; Crippen was in it; I know Puddy was in it; I think Dan [Daniel M.] Germany, myself, Honeycutt, Onizuka may have been, because he helped a lot. I can remember doing a luau. Onizuka taught us how to do a pig in the ground over at Dan Germany's house one time. I had a pickup. So Joe [H.] Engle and I were the Sand



Committee. We had to haul sand in my pickup to put around the fire pit. But we had some good times like that.

BUTLER: That's good.

LOE: But as far as any specifics systems-wise, no, I guess I can't think of anything right off the bat.

BUTLER: Well, you mentioned the DoD missions. How did that work differently on the staffing side of things, or did it? Did the individual selected for either working the mission or working in the SPAN room, was that done differently for DoD missions? Did they have to have a different training or security clearance, or was that something standard for everyone?

LOE: My sense is that everybody had enough of a security clearance to work those, and I guess it probably took a secret clearance. So, yes, I think all the flight controllers had secret clearances. Probably just about everybody out here at the center had at least secret clearances. So, no, I don't recall any difference in the staffing. You had to be careful in what you said after you left the control center, because now you're in an unsecure area.

I can remember turning myself in one time for a security violation, because we'd been over in control center working a problem, and probably on a sim. It might have been a mission. But came back to the office and ended up on the telephone saying something to somebody over in Building 1—I can't remember now who I was talking to, but said something that I knew I shouldn't have, that theoretically was classified. So in order to abide by the rules, I had to turn myself in, write a letter, and say, "Hey, I probably violated something by saying the wrong thing over a telephone today."

So you had to watch out for doing that. But within the control center, most of the procedures that I recall were probably the same no matter what floor you were on.

BUTLER: Was there a DoD representative that would come into either the control center or the SPAN during those missions, do you recall?

LOE: Yes, DoD had a whole control room—they had another SSR, staff support room, which is what our back rooms were called. There was one staff support room that was totally DoD, and since these were DoD payloads, they, I'm sure, reported to the payload officer out in the front room.

So, theoretically—see, there was nothing classified about the Shuttle. We could talk about our systems all day long, and that wasn't classified. The real classified things about these missions was the payloads. I think they used to classify the time of launch. Probably the orbit that we were in was classified. But most of those things didn't affect EECOMs, so we didn't have a lot of stuff in the office that we had to be real careful about safeguarding.

BUTLER: So they would probably only tell you what you needed to know that affected your systems for those types of missions?

LOE: Well, as you went through and started developing things like mission rules and what have you, yes, you would become exposed to some of the classified aspects like what time a launch was, say, what kind of orbit you were going to, that sort of thing. Yes, you just found that out.

If it had been possible, you probably could have done all your EECOM duties and never had to know any of that stuff, but because it would come out in the mission rules review, because when you'd go review mission rules with the flight director, you'd have the entire team—EECOMs, GNCs, Boosters, everybody in there, going over the rules.

So when you got around to the payload rules, yes, some of the classified stuff would come out, but EECOMs didn't really need to know that since our systems just cranked along and did what they were supposed to do to, you know, keep Shuttle running.

BUTLER: Certainly a different aspect to things.

LOE: Yes.

BUTLER: Well, eventually, in 1984, you moved into a new role in the Vehicle Systems Integration Office. What were your duties in this position?

LOE: Looking back on it now, I asked [Eugene F.] Kranz—I think I'd had enough supervisory responsibilities, and, like I say, looking back on it now, I think I was taking it personally, say, when one of my employees didn't get his promotion that I thought he should have and stuff like that. So I decided I wasn't sure I wanted to do supervisory stuff anymore.

Yes, I got out of running the branch and went down to work with Dick [Richard A.] Thorson in the Vehicle Systems Integration Office. That office was basically representing flight operations to the program office. We'd sit on a number of boards all the way from the Orbiter Configuration Control Board [CCB]. We sat on the Shuttle Program PRCB, Program Requirements Control Board, the software boards—what were they called? OASCBS, I guess, Over Avionics Software [Control] Boards.

So we became the focal point of flight operations over to the program office. It did a couple of things; It allowed the program office to have one contact that they could come to within flight operations—mission operations, whatever we were called back then. We went through a number of changes. We were flight ops for a while, and then we were mission ops for a while. But allowed the program office to have one contact, and it allowed us to take some of

that sitting-in-meetings work off of the flight controllers. We covered a lot of that. So we became very adept at going to meetings and stuff.

BUTLER: So was this more of an organizational-type role rather than getting into the technical specifics of the systems, or did it deal with the technical specifics and organization?

LOE: Oh no, it dealt very much with the technical aspects of the systems, because when you were at these meetings, you had to be prepared to argue the pros or cons of some issue that might be on the table that you might be discussing now, and yet those discussions were almost always technical. So somebody might be wanting to make a change, say, to the APUs or the fuel cells or any system on the Shuttle, the propulsion system and stuff. So, yes, you had to be familiar enough with the systems to be able to intelligently discuss that at the meetings.

BUTLER: This is all Shuttle systems then, including payloads.

LOE: Yes, everything that FOD [Flight Operations Directorate] was responsible for, so, yes, including payloads.

BUTLER: You said you were taking some of the meeting role for the flight controllers so that they wouldn't have to spend that time. If a topic came up that you needed input from the flight controllers, that was one of your roles, was to interface with them to do that?

LOE: Yes. Yes. We would try to have pre-tagups to make sure that the people within FOD were able to make inputs. In fact, let's say there was a change coming through the system to change something. One of things we would do, I think we had some evaluation sheets, and we would look at it and see which flight control disciplines might be affected by this change. We'd send

them a description of the change and ask them to evaluate it for us. The input would come back to us, and then we'd take and meld the inputs together from the different areas that we had gotten within FOD, and then we'd take that to the program. And many times the flight controllers themselves would come over and participate in the meetings when they were really interested in one of these changes, or when we'd ask them to come over, because we thought that we might need their help or something. So, yes, we were very actively involved with pulling all those inputs together.

BUTLER: Were these changes something that would come about for specific missions, or were they changes that would come about just as the program grew and as different situations were discovered or new techniques were decided to be employed, or was it kind of some of both?

LOE: Some of both. Yes, you might talk about adding a payload to a mission, to leading a payload for a mission, or you might talk about a hardware change to a fuel cell or an ohms thruster or something. So, yes, it could be both.

BUTLER: About how frequently would you have these meetings?

LOE: The PRCB used to meet once a week, the CCB once a week. Most all of those meetings were once a week.

BUTLER: Pretty busy schedule for you then.

LOE: Yes, yes. Oh yes, it kept you busy.

BUTLER: But it sounds like it was an interesting task, you know, trying to coordinate.

LOE: It was, yes, it was, very much.

BUTLER: Do you recall during those times any specific changes that came up that were either problematical or that produced interesting results or anything that you'd like to mention?

LOE: No, nothing that I can think of right off the top of my head. Nothing stands out.

BUTLER: Sure, that's okay. Certainly a lot of missions and a lot of things going on. So I can understand that.

LOE: By the way, let me say that I think—my recollection is that I also even—I'm sure, yes, even with doing that, I took the SPAN duties with me. So, yes, I was still doing the SPAN, sure was, yes, still doing the SPAN stuff.

BUTLER: Okay. Well, that would definitely keep you busy, then.

LOE: Yes, yes.

BUTLER: When you would work the SPAN, would you just kind of work your schedule around the meetings so that you were able to do both, or would someone fill in for you during the meetings while you were in the SPAN room?

LOE: Yes, we'd just have someone sit in the meeting for us, yes.

BUTLER: Did the astronauts and crew participate in these configuration meetings, control meetings, the boards?

LOE: When we were together as one organization, they were just another one of the groups we were representing. So they would be one of the groups that we would send evaluation sheets out to.

Then at some point we reorganized again. Yes, I guess at the time that I went down and joined Thorson, George Abbey was head of flight operations, and Gene Kranz was his deputy, and then at some point we reorganized again, and the astronauts were in with us. So we were representing them at the PRCBs and the CCBs as well as the flight control folks.

Then at some point, we reorganized and George took the flight crew and the folks out at Ellington, the airplane people at Ellington, and they became the Flight Crew Operations Directorate [FCOD], and Gene took the flight controllers, the trainers, payloads people, and then that's who Thorson and I went with. We were the Mission Operations Directorate [MOD]. So at that point then, we were no longer representing astronauts, and they would represent themselves at the meetings.

BUTLER: Certainly a bit of changing and reorganization had gone on throughout the time frame.

LOE: Yes.

BUTLER: When you were working in this role, actually, you continued to have a lot of involvement with integrations throughout the rest of your career at NASA, but early on was when the *Challenger* incident occurred. What did you, in your role with, at this point, the Vehicle Systems Integration Office, what was your involvement in that recovery process after *Challenger*?

LOE: As you recall or may not recall, when we had the fire back on Apollo, that was on January 27<sup>th</sup>, which happens to be our anniversary. When *Challenger* rolled around, I had decided not to work that mission. My wife and I were down in Galveston, celebrating our anniversary on the day it should have launched, but I guess we came on home on Sunday, and I think we should have launched Sunday, but didn't.

So I went on in to work Monday morning. I told her, "I'm going into work, going into the control center and watch the launch from there." So I was in the control center sitting in SPAN. I wasn't actually at the console, but I was sitting back there at one of the tables just watching and listening when *Challenger* happened.

As far then as the recovery process, the meetings, the PRCBs and everything, of course, picked up, and all the changes that were being made, went through there. I don't recall any specifics. After the fire in '67, I was on the investigating team that went down to Florida, but on *Challenger*, no, I didn't. But my recollection is, just kept up the basic TRCB work and stuff that was trying to redesign, recuperate after that.

BUTLER: Certainly a very difficult time for everyone to live through, especially having been there in the control room watching it. That must have been hard.

LOE: Yes. At some point, Thorson—I think Thorson had left. He had gone. At some point Dick had left and gone over to the Shuttle Program, but that may have been post-*Challenger*. I guess that was post-*Challenger*, but before we flew again, was when he went over to do that, he and some of the guys, the Hal [Harold A.] Lodens and those guys.



BUTLER: Well, in 1988, the Shuttle did come back online very successfully, and, also in '88, you moved into—and this may have just been one of the reorganization changes—now under the flight director's office as Assistant for Program Integration. This is what we found in your—

LOE: Yes. And that was an effort, and that's where the job still is today, but that was an effort to try and figure out where best to put that function. We had decided it probably wasn't big enough to be a total office on its own. So we were looking for a place to put it, and, yes, we thought, "Hey, you know, the flight director office, they interface with all the controllers, they're very interested in all the changes and stuff that are going on. That seems to be a good place to put this thing," and so we put it there, you say, '88?

BUTLER: Yes.

LOE: Okay. And that's where it still is today. In fact, I was talking to a guy the other day, one of the ex-EGILs [Electrical, General Instrumentation and Life support officer] back on Skylab, Steve [J. S.] McLendon, and he said that he's doing that job now in the flight director office for Space Station. So it's still going on. So we must have made a semi-good choice.

BUTLER: Certainly sounds like it. So this was essentially the same role and same duties, just different—

LOE: Yes. I moved to a different office to hold us.

BUTLER: At this point, this is in 1988, so there was discussion going on about the Space Station. Were you at all involved in any of those, or was that still a level where it didn't affect the flight controllers as much?

LOE: No, I was not involved in any of those.

BUTLER: Okay.

LOE: At some point, Kranz's group, mission operations, actually generated some Space Station offices, but I think that was even after I'd left. So, no, I never had anything to do with Station.

BUTLER: Okay. Well, eventually, you moved up to NASA Headquarters in the Office of the Deputy Director for Space Shuttle Operations, and there you were in charge of the Space Shuttle Operations Integration Office. How was this different than your role at JSC? Obviously, it's at the Headquarters level.

LOE: It was a Headquarters badge, but it was still here at JSC.

BUTLER: Oh okay.

LOE: See, I was sitting in the outpost one afternoon and Cripp came in. He asked me what all I had done and everything. He said, "I think I've got something for you."

So the next thing I know, he's asking me to come over to the program office. The way Shuttle was organized back then, you had a chief for programs and you had a chief for operations, and Cripp was the chief for operations, and he had offices here at JSC, he had offices at Marshall [Space Flight Center, Huntsville, Alabama], and an office at the Cape. Dick Thorson had been running the office here at JSC for him, and they wanted Dick to go to Space Station. So Dick was going to go over to Space Station, so Cripp asked me to come run the office here for him. It was a lot of the same guys that had worked in Thorson's old Systems Integrations

Office back in '85 or whenever I joined—Hal Loden and Rip [Ryborn] Kirby and a lot of the same guys.

So I said, yes, I'd come do that. So although on paper you were NASA Headquarters employees, the office was still here at JSC.

BUTLER: So you were essentially still doing the same type of—

LOE: Yes, we were now sitting on a lot of those same boards as operations reps, not replacing the mission operations people, because they had a rep on the board also, but we were the program office side of the operation, and our function was sort of to oversee mission operations, flight crew operations and their mission preparedness. We'd go sit in on mission rules reviews. We would go and watch simulations. We sort of acted as Cripp's eyes and ears into the operations aspect of it.

Then about that time, Cripp became total program director and Brewster [H.] Shaw [Jr.] became the new operations guy. I think Brewster and I happened about the same time. Cripp had hit me up to come do that, but then by the time I got here, Cripp was on his way to Headquarters. So Brewster and I were doing that, and I had Brewster's office here.

BUTLER: So this is a little more of an upper management type of role. You were no longer interfacing directly with the flight controllers. You were more interfacing at the board level.

LOE: Yes.

BUTLER: Okay. You remained in this role for a few years. The Shuttle-Mir Program came into play during this time frame. Were you involved with dealing with that aspect of the operations integrations side of things?

LOE: Not so much from that office. That office was responsible for, among other things, the landing sites worldwide, the Shuttle landing sites, including the abort sites, the TAL [Trans-Atlantic Landing] abort sites. And we were also responsible—I mentioned to you out in the hall last time, one of the funnest jobs I've ever had with NASA was, I was in charge of the Shuttle ferry program.

BUTLER: Yes.

LOE: And it was from that office that we did that.

But on Shuttle-Mir, I can't recall, from that office, ever getting really involved in Shuttle-Mir other than just it being another mission.

Later on in another reorganization, we got under great pressure to reduce the number of squares on org [organization] charts. Since we had like a six-man office, that was a prime thing, to combine us, put us someplace else. So they put us into an integration office that also handled the payloads. We had the payload integration officers, the PIMs and FIMs, the flight payload integration managers and the flight integration managers. So they put us up there as part of that.

In that area, I got involved with Shuttle-Mir, because I was the deputy in that organization, and the FIMs and the PIMs got very involved with the Shuttle-Mir stuff.

BUTLER: You mentioned the Shuttle ferry program.

LOE: Yes.

BUTLER: And that was one of the funnest jobs that you've ever had. Why was that so fun? What was your involvement with that project?

LOE: Should a Shuttle end up someplace you didn't want it to be, you wanted it to be someplace else, either from a landing in California, or you needed to take it back to California to get mod [modification] work done on it. Way back in early ferry days, they inadvertently flew a Shuttle on the back of a 747 through some virga. Virga's rain that's not even hitting the ground. They were in the virga for like ten seconds, did—I think the figure I heard was two and a half million dollars' worth of damage to that, and I've seen photographs of it, and it was like they'd hit those tiles with BBs. They were just totally chewed up.

So they then developed some flight rules for what kind of weather you ought to fly in and what kind of weather you ought to avoid, and needed somebody to be in control of that, in charge of that. So that office, Dick Thorson before me, and then Dick immediately following *Challenger*, and then me a couple of years later after Dick left, did that.

So we would take a team of folks. We had quite a few people supplied from KSC [Kennedy Space Center, Florida] that were Orbiter-type people. We'd have some tile technicians with us that in case we sustained some damage on the road that we could put them in cherry pickers and they could get up there and repair it.

We had some safety people, some SR&QA [Safety, Reliability, and Quality Assurance] people, a security guy. We then had an Air Force outfit called DDMS [DoD Manager for Space Shuttle Support]. DDMS is a joint military outfit that's here. They're mainly Air Force, but rather than reporting directly to the Department of Air Force, they go up through the Joint Chiefs of Staff. They were our interfaces on the military bases that we went to. DDMS also supplies military people on all our TAL sites, and there are interfaces there at those TAL sites. Anything NASA needs from the department of FIMs, we go through DDMS, and they'll get it for us. So our DDMS guys would go ferrying with us, and they'd be the guys who would interface with the bases that we go to.

So our job was pulling all this team together, and then when we actually got ready, we would hold a ferry readiness review. Let's say we landed in Florida. We would hold a ferry readiness review after the guys got the Orbiter stacked and made it on top of the 747. We would hold a review to determine our readiness to go, and then sign off on the fact that "We've accepted the thing and we're ready."

Then we would charter an Air Force C-141, and we would fly in it, and we acted as the pathfinder for the 747 with the Shuttle on top, and we'd fly out about a hundred miles in front of them looking for weather, turbulence, whatever, anything that could hurt us.

On the Air Force 141 would be this team of folks that I talked about, the safety people and stuff from KSC, because, especially if you were flying one that had landed in California, there was no way to unfuel the thing out in California. You had to get it back to Florida to unfuel it. So it still had fuel in the OMS [orbital maneuvering system] pods and the RCS [reaction control system] stuff. So every time we'd land—that fuel is very toxic—the guys would be out with sniffers on long poles, sniffing around the jets to make sure nothing was leaking.

So those folks would all fly on the 141 with me, along with the airplane technicians that maintained the 747. We took our own maintenance people with us in case we ever had a breakdown or anything on the road, they could fix it right there. So we probably had a team of, oh, twenty to thirty people in the 141, flying as the pathfinder. We'd do that until we got it back to where we were taking it.

BUTLER: So on the 747 itself, it would just be the crew that was flying the plane, is that correct?

LOE: Yes, because of the hazardous nature of the fuel and the possibility of a leak, when we were ferrying an Orbiter that had fuel onboard, we would only have four people on the 747; that

would be the two pilots and the two flight engineers. And they had the air packs on board so that in case there was a leak, they could don the air packs and at least get out of the airplane.

Now, when we were taking Orbiters to and from California to Palmdale for mod periods, they wouldn't have fuel onboard, so we can fly more than just those four people onboard, and quite often did.

BUTLER: You mentioned that they would come back from California still with the fuel onboard. Was there discussion about this beforehand about whether there should be some way set up to remove that fuel, or was that reviewed and determined that the risk would be acceptable in the transport? Do you recall any of that?

LOE: That happened way before I ever got involved in it, but I know there were environmental concerns. That stuff is so hazardous that you have to have special methods and means to dispose of it, and I know that played into it. I think expense would have just been so much to try and build a facility out in California to get all that fuel off, that I think it was just deemed better to fly it back with the understanding that we'd handle it, or we procedurally were able to make sure it wasn't leaking. But we did everything we could to keep it from leaking also, with plugs and heaters. We could power up the Orbiter from a 747. So we powered up the heaters and stuff that heated the lines that the fuel might be in so that we didn't freeze them as we were flying. And then we also protected against that by limiting ourselves to the altitude that we'd fly at when we had the Orbiter on top. So, yes, we did everything we could to protect against something happening.

BUTLER: And nothing has so far.

LOE: Nothing has, yes.

BUTLER: How would that work then with the Shuttle? You said you were also involved in the landing sites and the abort sites, the overseas sites. How would it work with getting the Orbiter back from overseas sites? Were there different considerations that had to come into play with ferrying it back?

LOE: Yes, in fact, one of the things that we used to have to do was to go down and report to the—before each Shuttle launch since *Challenger*, there's been a flight readiness review where all the various organizations stand up and say, "Yes, we're ready to go." The Orbiter project, the SRB [solid rocket booster] project, the ET [external tank] project, all of them had to stand up and say, "Yes, we're ready." The ferry project had to go down and stand up and say, "Yes, we're ready to support if you need us."

When I first got involved in it, we weren't landing in Florida. All our landings were out at Edwards [Air Force Base, California]. So we were doing a lot of ferrying back then.

So one of the things we would do was before a mission, we would evaluate what our TAL sites were and go over again our route of how we were going to get home. Thank goodness, we never had to bring one back from over there, but you would have had to have done is go down the west coast of Africa and then stop in at Ascension Island down in the mid-Atlantic, and then you'd come into Brazil and then up the coast and up the chain islands, come back to Florida. So that would have been a long, rough trip. And you had to come that way, because you're limited on the amount of fuel, limited on the total amount of weight you could put on the 747. So you could only put so much fuel on. Didn't have enough to fly nonstop across the North Atlantic.

BUTLER: The Orbiter certainly does add quite a bit of its own weight to that.



LOE: Yes. And we would have had to have taken a lot of equipment off, had they ended up over there that we didn't have to take off out in California.

BUTLER: Oh, equipment off the Orbiter itself?

LOE: Yes.

BUTLER: Oh, that's interesting. Would you then be able to transport that back by other means?

LOE: Oh yes.

BUTLER: Okay. Hmm, hadn't thought about that aspect of it.

LOE: Well, I also had another interesting project we got into. Of course, out at Edwards and in Florida, you'd have a way to lift the Orbiter up, and that's what you do. You lift Orbiter up and roll the 747 underneath it and then put it back down. If you're over at a TAL site, what are you going to do?

There's an outfit in Baton Rouge, Louisiana, that has cranes that can lift this thing, but then the question is, how are you going to get the crane over there?

The Air Force had modified two C-5s, I think. There's a troop compartment in most C-5s back in the back, and they took those out. Well, these DDMS guys that I talked about earlier, somebody came up with the idea, "We bet we could get those cranes inside a C-5," one of these modified C-5s.

So we brought one of the C-5s into—we did this over in Lafayette, Louisiana—brought it into Lafayette and brought a crane over, and they worked and worked, and sure enough, got it in

there. So then we knew. From then on, if we ever had to go do a TAL site, we could get our crane over there by air and not have to put it on a barge and get it over. So that was a big relief.

BUTLER: Yes, that would certainly add to the time required in getting it back. And it's good that you don't have to have that equipment at every site already there.

LOE: Yes.

BUTLER: And luckily the Shuttle hasn't had to land in any of those sites.

LOE: That's right.

BUTLER: Up to date anyway. So everything seems to be going well.

Well, you said those were some of your duties in this role dealing with the landing sites, the ferry program. You were still involved with these boards. Were there any other aspects of your job as you were filling this Headquarters role?

LOE: No, and then this last reorganization I mentioned where we went up to the payloads area, by then we reorganized to where the job came back to JSC. It didn't stay as a Headquarters thing anymore. So I was back at JSC then, back with JSC paperwork, anyway.

BUTLER: Okay. And is this when you were under Tommy [W.] Holloway? Was this the Customer Flight Integration Office when you were deputy manager?

LOE: Yes, by that time, Tommy, who used to be head of the flight director's office, Tommy had come over to Shuttle Program, and—oh, what was he doing? He later became head of the thing.

Anyway, Tommy had come over to the Shuttle Program, and I was working for Tommy then. Then we reorganized and Richard [M.] Swalin had the payload area, so I was Richard's deputy, but we still all worked for Tommy, because he was now head of the Shuttle Program.

BUTLER: Okay.

LOE: Talking about the ferry, one time, probably about the second one I was ever on, really impressed me. We were on the C-141, and I don't remember what I wanted to do, I wanted to get a cup of coffee or a glass of water or something, and I asked a young airman onboard, I said, "Can I do something?" and I don't know what it was, but he almost snapped to attention.

And he said, "Sir," said, "you can do anything you want to do." They have some order, some standing order, and I don't remember exactly what it's called, but he said, "In our orders," said, "there's the president and there's vice-president and there's you."

BUTLER: [Laughs] Well!

LOE: So that whole ferry thing commanded a great deal of respect from the military and from all the bases we went to and everything.

BUTLER: Well, that's good.

LOE: Yes. You know, it had been classified a national resource, and so it was worth—I think *Endeavour*, I think the price on it was two and a half billion. So it was a valuable piece of equipment we were hauling back and forth across the country.

BUTLER: And it sounds like they were taking their jobs pretty seriously.

LOE: Crippen told me one time, he said, “I’m more worried during ferry flights than I am during missions.”

BUTLER: Really?

LOE: He said, “I’m convinced we’re going to hurt one during a ferry flight.”

BUTLER: Well, now, that’s interesting. Although I guess since it is going through the atmosphere, there is a lot more that can be happening that’s not as easy to control.

LOE: Yes, and, you know, it’s reachable by kooks, if you want to put it that way. I can remember the one time at Barksdale Air Force Base up in Shreveport [Louisiana], the security guy came to me and said, “There’s been reports of some guy out in the woods here shooting at planes.”

So they were advising us to take off—I think it was to the north or south, whichever way, so we didn’t go over his house with the thing.

BUTLER: Well, that certainly is a very big concern.

Well, I’d like to take a brief break here if we could and change out our tape.

LOE: All right.

BUTLER: Talking still about the ferry flights. You just mentioned the story about landing in Louisiana and having to watch out when taking off, being shot at. Were there ever any other

particular security concerns that came up during the ferry flights that you can think of that were—

LOE: We had some misunderstandings that it took us a while to work out. KSC has some very, very strict security procedures, and they're there for good reasons, I'm sure. For instance, I think it's fourteen years of age—anybody less than fourteen cannot go out to the launch pad, cannot go—I don't know about the OPF [Orbiter Processing Facility]. They can't go out to the launch pad around the vehicles.

So the KSC security guys that were tasked with the security on our flights, their thought was that these same security procedures and guidelines that we have at KSC, we're going to use these on the road with the Orbiter and the 747. My thought was that this is a unique opportunity to show this thing off and let the American people see it and get up close to it. So we did have some misunderstandings along those lines about the age and everything. By the time I had left, I think we had it where schoolkids and everybody else was going onboard the 747 to see the thing. Actually, I think it's a great opportunity to show the thing off.

Now, of course, if you have one that's fueled, you're not able to do that, but there, we enforced a very strict—nobody within 1,500 feet of the thing that didn't have to be there. Of course, the people that were refueling the 747 and stuff, they had to be there, but that's after we'd already sniffed it out for leaks and stuff, but we wouldn't go bring in the public out to an Orbiter that was hazardous.

But the ones that we were taking back and forth to mod periods, yes, we started showing it off to the public, and I think that was a good thing to do. But we mostly went into military bases for that reason, that security was good, we could control it. A lot of times, we'd leave it up to the base commander, say, "If you feel comfortable letting people come in and look at it, it's okay with us, but, you know, you're the one that's going to get the finger pointed at if something happens to it. So if you think you can control crowds, bring them in."

Some commanders liked using that as a community relations tool by bringing people in, and some didn't feel comfortable doing it. So it varied from base to base.

BUTLER: Were there ever any other weather-type incidents? You had mentioned the one where they briefly flew into an in-the-air rainstorm. Were there any other—

LOE: Well, we had some pretty harrowing times. One I recall, in fact, the time we were in Barksdale, I'd only been there once, and we got out that morning. We knew we were getting socked in, and there was a front coming through, and we knew that if we didn't get out the next morning, that we weren't going to get out for a while.

So that night I called the guys together, and we got together up in my hotel room, and I said, "Look, there's bound to be a speed that we can go through some amount of moisture that's not going to hurt us."

So we devised a plan where the next morning when even though we were taking off in fog and clouds, that as long as the C-141 didn't get any drops on the windshield, that we'd say okay for the 7-4 to come off, and we did.

But then we got up, and we had to find out a way to get through that front. So we got permission from—I think we were under Fort Worth Center's—because, see, the 7-4 and the 141 have to abide by air traffic control just like a commercial airliner would, but we got clearance from the center to let us run up and down that front, which we did in the 141 and finally found a hole in the thing, and we were able to get through it. Called the 7-4 and told them where we were, gave them our coordinates, so they came through and found the same hole and went through. So the ol' pathfinder really earned its money that day.

We set a record one time on the amount of time that it took us to get from California to Florida, and I think that was ten days. In fact, another Air Force function I forgot to mention a while ago that we carried with us was weather people. The Air Force provided weather folks,

and these are the same Air Force people that do the launch weather predictions down in Florida. They're stationed at Patrick Air Force, out there at Cape Canaveral Air Force Base. But anyway, they would go with us and do our weather predicting for the ferry flights.

They wrote this up in some Air Force weather magazine. They called it the "Ferry Flight from Hell" or something like that. Mike Adams was the officer that was our weather guy on that flight.

When I say ten days, we weren't airborne, obviously, that whole time. What we'd do is start the clock ticking after we had the ferry readiness review and said, "Let's go."

Then the next day was day one. I think we had the readiness review, and it was raining in California, so we couldn't fly the next day, and we were on the ground for a few days in California. That may have been when I sent everybody home. I know one flight, it was around Eastertime, and it looked to me like we weren't going to get out of there for three or four days, and so I said, "Look, anybody that wants to go home for Easter, take off," and some folks did.

But anyway, I know on that flight we got as far as El Paso [Texas], and I think this was *Endeavour's* first flight, first orbit. It landed at Edwards, and we were bringing it back to the Cape, but we got to El Paso and had some thunderstorms moving into El Paso and behind us. And, of course, with thunderstorms, one of the things you worry about is hail, because that would just tear up those tiles, too, just sitting on the ground.

But I remember Mike wanting to turn around and go back to Edwards. He didn't feel comfortable sitting on the ground in El Paso because of the thunderstorms coming in, but we finally convinced ourselves that they weren't going to be that severe. So we got rained on, but we didn't get any hail. We didn't like to get rained on on the ground, but I always tell everybody, all that hurt was our pride. That doesn't hurt an Orbiter.

But I think from that mission, from the time we started until we finally got it to Florida, was like ten days.

BUTLER: So there's no method for protecting the Orbiter then when it's on the ground on top of the 747 at these various bases that you'll stop at? There's no hangars or anything large enough to—

LOE: No. No, the only hangar—somebody told me the other day that they found one at Edwards now that they can get in, but I think it involves taking the air out of the nose tires on the 747, and so you sort of nose it down like that, and you still can't get the tail in, but you can get everything but the tail inside of it. But, no, there's nothing on the road that you can get it out of the weather.

BUTLER: Certainly a big stack of vehicles.

LOE: Yes.

BUTLER: Well, you mentioned while we were during our break, you mentioned getting Kennedy's runway ready so that the Orbiter could land there on a more frequent basis, and that, of course, is quite a concern. The runway has to be built to withstand the weight of the Orbiter coming in. What were some of the processes there and the challenges of getting that ready?

LOE: The original Kennedy runway, of course, was there, I'm sure, yes, for the Air Force STS-1. When they drew up the specs on how to build that runway, I think they envisioned the Orbiter being an all-weather kind of vehicle, maybe even landing in the rain, because nobody knew then the effect rain would have on tiles and stuff.

But the specs on the runway had things like it had to be able to shed two inches of rain in an hour or something like that, an enormous amount of water, and they had to ensure that it didn't hydroplane and stuff like that. So that runway was very, very rough. It just ate up tires like you wouldn't believe. And if you got into any kind of crosswind where the Orbiter was coming in a



little bit cross, or the tires were hitting the runway a little bit across, it'd just chew the tires up totally.

I guess we actually—we blew a tire. Yes, we did. On one of the missions, we landed down there and blew a tire, and so now we're back to landing at Edwards all the time, because we can't land—we have convinced ourselves that landing at Florida's not safe in any kind of crosswind at all. You know, if they had a wind right down the runway, you're probably good, but any kind of crosswind was not going to be good.

There was a NASA plane way back in the—must have been in the sixties. Convair made a run at the commercial airline industry, and they had an airplane very similar to the Boeing 707. It was a Convair 990, and I guess it never really panned out for the commercial, but NASA had one of these 990s, four-engine jet, looked a lot like the 707. Somebody came up with the idea, and I was told it was a guy out of our office, Drum Simpson [phonetic], Drum, along with some others, came up with the idea that we'd put a Shuttle landing gear in the belly of this 990, and we would have a hydraulic system that could deploy the thing and turn the thing, and so then what we would do is land the 990 at Shuttle landing speeds and then deploy this gear out of the belly of the thing, and we could simulate crosswinds by turning it at various angles, and we could simulate the force with the hydraulic system, and by driving the flaps down and putting all the weight of the 990 on this thing, you could simulate Orbiter weights from landing to pitchover. So we were able to take this 990 down to Florida and prove that you ought not be landing Shuttles down there.

In the meantime, there were some guys at Langley that were soil and landing-field experts, and somebody ran across an outfit, their name was Skidabrator, S-K-I-D-A-B-R-A-T-O-R. Saw them written up in a magazine where they were taking concrete off of a freeway over in Louisiana, and the Skidabrator worked on a principle as it shot BBs down onto the concrete, to eat away the concrete, but then the back part of the machine swept up the BBs with a big vacuum cleaner kind of a thing. So they could, in essence, smooth out runways.

So we took and we developed some test strips. We had the Skidabrator do a strip for us. We had various grinding techniques. There are all sorts of outfits around that can grind concrete. And we had different people that knew all to grind concrete come down and grind test strips, and we went to various smoothnesses. We did this on the Kennedy runway at one end and off to the side a little bit.

Then we flew the 990 against these test strips and ran a bunch of tests, a bunch of tires. We had TV cameras in there that could see what was happening to the tires as you flew against these various services. And we finally ended up with the Skidabrator to do the job.

One of the things that we found out that really surprised everybody, when we started this project, everybody thought that the smoother we could get it, the better. But it turns out, 990 proved to us that smoother is not better, because with a slightly rough runway, you're tearing off minuscule amounts of the tire, and those pieces of tire that are leaving are taking temperature away, just keeping the tire cool by shunting them off.

So we found the right thing was Skidabrator, and we did the whole runway down there and have been landing back at Kennedy ever since. So that really worked out good to be able to do that. We couldn't have done it without that 990. That was just a super thing. It was built by the guys at Dryden [Flight Research Center, California], piloted by the guys at Dryden, but our office oversaw it here and oversaw the testing and designed the tests and stuff that we did down in Florida.

BUTLER: So that still managed to meet the concerns about water in the runway, hydroplaning, running off the—

LOE: Yes.

BUTLER: Good.

LOE: And, of course, also since we learned that we're not going to be landing the Shuttle down there in the middle of a rainstorm, that we didn't have to be as concerned with water on the runway. But, no, it's still very adequate for getting rid of water. I would bet it's the best runway in the United States for getting rid of water, still.

In fact, the Air Force folks down at Edwards, after they saw what we had done in Florida and saw our test results, because we also took the 990 out and did tests on the concrete runway at Edwards and then test on the lake beds also. I know one of the things, right before I retired, the Air Force had come to us and said the Kennedy runway is now so good that they'd like to do the same thing to the Edwards runway. Would we help them out money-wise? And of course we said, "No, the Edwards runway's just fine as far as we're concerned. So we don't have the money to put in to modding your runway."

Yes, it turns out rougher's a little better than totally smooth.

BUTLER: Interesting.

LOE: Surprised everybody, even the big, really super smart engineers that we had looking at it.

BUTLER: So are the tires replaced after each mission then?

LOE: Yes. Now that you mention it, those tires may be able to be used again, I think, but the main landing-gear tires are replaced after each run, or at least they were when I left. They may have gotten better now, I don't know.

BUTLER: Probably makes sense. While Shuttle tires are probably a bit more complex than normal tires, it's still a good idea to have a good pair on them. Well, that's certainly an interesting aspect to the Shuttle Program itself that we haven't heard a lot about.

Are there any other pieces to the ferrying side of things that you'd like to mention that we haven't touched on?

LOE: Like I say, I love taking it around and showing it off. I love trying to bring it in here to Ellington. I'd love the people at JSC to see it, just because people here don't ever get to see the hardware very much. People in Florida, I tell them they're spoiled. They've got the hardware right there. They can walk up and look at it.

So we'd bring it in here as much as we could. We were so restrictive on weather, though, that our public affairs people, we stood them up so many times that they had gotten to where they didn't even want to announce that we were coming in, because a number of times, we'd say, "Yes, we're gonna try to get there," and then we wouldn't show up because of weather someplace else.

It'd be a beautiful, sunshiny day here, and in Houston everybody's standing around wondering, "Where are they and why aren't they here? The weather looks good." But we're hung up out in Abilene [Texas] or something like that.

But we were able to get it in here a few times, took it to Huntsville, Alabama, once. I let the folks at Huntsville see it.

One of the best show-and-tells we ever did was the senator from Utah. He's a big space guy. Utah has a Space Week every week, and, of course, the solids, solid rocket motors are built at Morton-Thiokol, so the Marshall people get involved with this Utah Space Week because there's Morton-Thiokol up there.

So through Marshall, the senator's office got in touch with us and said, "How about bringing the Shuttle?" We are taking one to Palmdale for a mod period. They said, "What's the chance of getting that thing up to Utah?"

Because it turns out the NASA administrator, Dan [Daniel S.] Goldin, was going to be up there as part as some Space Week activities. So we said, "Yes, that sounds like a reasonable, doable thing, and we'll try to do that."

We got delayed in Florida for some reason. I can't remember why now. It might have been weather. It might have been that the bolts that meld the thing to the Orbiters, sometimes they had a hard time getting those to just the right torque, or other reasons. You're always running into troubles mating. Anyway, we didn't get off. So we didn't get up there in time to get Goldin while he was there, but we did get off with the expectations that we were going to go to Utah.

Of course, we were in the Air Force C-141. We took off. The 747 was behind us, but we could hear them on the radio, and we heard them talking to the ground crew at the Shuttle landing facility where we took off from, and they told the guys on the ground, said, "Hey, we think we may have hit a bird on the way out." It turns out it came out over the cockpit. The guy said they even ducked when they saw it come over.

So the guys on the ground went out and called back and said, "Yes, sure enough, there's a dead osprey out here on the runway."

So our scheduled stop was in Fort Worth [Texas] to refuel. So we landed in Fort Worth and got up and got to looking, and, sure enough, we had hit a bird. The bird hit the Orbiter, and I think it had damaged like fourteen tiles or so, and it may be that the bird didn't take all of them out, but the fact that now you have an exposed edge exposed to the airstream that's not supposed to be exposed, that damages them, too. I think we had fourteen tiles to repair, so we had to get the cherry picker from the base and get the tile folks up and get them to repair it. So that took us a while.

And in the meantime, the people are gathering in Salt Lake [City, Utah] wondering, “Where are they? Where are they?”

So then that afternoon we get ready to go, and we get out and get on our C-141, and it’s got a problem; it won’t start. So I’m on the phone to the Marshall PAO [public affairs office] guy up at Utah, and I said, “Look, we’re not gonna make it there. Our C-141’s broke.”

So he said, “Let me get back to you.”

Turns out there was a KC-135 that belonged to the Utah International Guard, it was in somewhere in Oklahoma having some maintenance work done, and it was on its way back to Utah, and they caught this airplane over Colorado someplace, and they said, “If we can get that plane to you, can—,” and we’d already checked. DDMS couldn’t get us another 141 right away.

So the Utah International Guard offered to send us KC-135 back for us. So we said, “Okay, we’ll do that.”

So they got back, and, sure enough, we got everybody on that plane and took off, left our C-141 there in Fort Worth, went on to Utah, but got there just as the sun was going down. We also wouldn’t fly it at night. That was one of our flight rules, we wouldn’t fly through clouds; we wouldn’t fly at night. But we got there just at dark.

At Salt Lake where we landed, we landed at the Salt Lake International Airport at the field, but the Utah Guard has half of that airport, so we parked the thing over by the guard base, but we finally got it there and got buttoned up for the night.

Hal Loden was with me, and Hal and I were driving, we’d gotten our car and were driving off the base at like ten-thirty, and there were still people coming on the base to see that thing. It was just amazing, the interest that that thing would generate wherever we took it. That’s such a good tool to use for show-and-tell.

BUTLER: Well, space exploration has always been very exciting.

LOE: Yes.

BUTLER: As you said, most people don't ever get a chance to see it up close and personal.

LOE: That's right, yes.

BUTLER: It's neat.

You mentioned in this example that the bird that hit the Orbiter and there was tile damage. When you would do those kind of repairs in-flight like this—well, on the ground, but during transfer—did that require actually replacing those tiles, or was it a patch-type job until it could get to the final destination?

LOE: It was a patch-type job. They had some kind of epoxy that they would put in and basically, you know, fill in the holes that had been made and then smooth off the edges. So it was a patch-type thing.

BUTLER: Okay. So no more would come off in the airflow as you had mentioned.

LOE: Yes.

BUTLER: Okay.

LOE: Because you weren't actually doing any damage to the skin by flying without the tiles. It was just you were trying to protect other tiles from air and stuff.

BUTLER: Sure. Well, it certainly does sound like it was interesting job.

LOE: It was, it was a fun job and totally different from the control center and everything else I'd ever done. So it was enjoyable.

BUTLER: The interface between NASA and the military—as you said, they were a very big support for this—it sounds like it was a pretty good working relationship there. Is that correct?

LOE: Oh yes, yes, very good, very good. Another thing this office did, our office over in the program office, we were in charge of the budget for all the landing sites, but we also had the budget for the DDMS, the military that I mentioned, and one of the things the military did for us was to put rescue forces in Florida and at the TAL sites in case somebody had to bail out, and we had them at White Sands [Test Facility, New Mexico] and also at Edwards.

But, you know, after *Challenger*, we built the capability into the Orbiter to let the crew bail out of the thing. So then you've got to say, "Okay, what are you going to do?" Once they've bailed out, now you got to find them and rescue them.

So we would station—we had some C-130s that would come down to Florida for launches and had PJs, parachute jumpers, that would go in the water to get to folks, and that's called a Mode 8 rescue, where crews bailed out over water and you go get them.

So we'd have a Mode 8 sim once a year where the various PJ units would fly. I know there's one unit that's up on Long Island [New York], one unit stationed at Patrick [Air Force Base, Florida]. Let's see. There used to be a unit at Homestead [Air Reserve Base, Florida], but I think they moved it up to Patrick now.

Anyway, the various units would come down and participate in this Mode 8 where we'd actually dump dummies out in the water, and occasionally we'd put a live guy out there. Some of the astronauts, in fact, would volunteer to be our live subjects, and we'd put him in a suit and



a life raft and put him out there and let the PJs come find him and pick him up and put him in the helicopter. So that was another interesting aspect of working with the military and doing all that.

BUTLER: It certainly sounds like you were keeping plenty busy with this.

LOE: Oh yes, yes.

You had asked earlier about the Shuttle launches. The ones I was able to see after I got over into the program office and doing this ferrying stuff, were ones that—one we just went down there as tourists almost, as I mentioned, as Honeycutt's guests, but the other ones, I just happened to be down there getting ready to take an Orbiter out on the ferry flight and was down there, you know, at the same time we were launching.

BUTLER: Okay. Well, it panned out well for you in two cases then.

LOE: It worked out well. I did it a couple three times. I was down there to pick one up at the same time we were launching.

BUTLER: Well, good. Conveniently overlapped them that way.

LOE: Yes.

BUTLER: Well, you did move in—I think we began talking, and we're back a little bit, moving over into when the job transferred back as a JSC function, as Customer Flight Integration Office.

LOE: It had transferred back as a JSC function even before that.

BUTLER: Oh, okay.

LOE: But I guess we've maintained our same name. So, yes, we were back at JSC.

BUTLER: And so these same duties and all still kept going with that?

LOE: Yes.

BUTLER: Okay, okay. Good.

LOE: But then they did, yes, somebody did move up into the Customer and Flight Integration Office.

BUTLER: Okay. At any point after this, did you begin to get involved with—I believe you'd mentioned earlier that later you became more involved with the Shuttle-Mir Program when it became merged with that payloads?

LOE: Well, no. When I got into the cargo and—what'd you say the name of it was?

BUTLER: Customer Flight Integration Office.

LOE: Customer and Flight—yes, when I got there, as I mentioned, I was the deputy there under Richard Swalin, and we had one section that had flight integration managers, one section they had the payload integration managers. So, yes, at that point, acting as deputy of that organization, was very much involved in the payload and stuff, and, yes, we were very involved with the Mir stuff, because a lot of the flights by then were going to Mir. So I was probably

around for, oh—I was going to guess how many number of flights to Mir, but I guess I won't guess, because I might be totally wrong. Anyway, all of them that we were flying then—I just can't remember what percentage of the flights were going to Mir and which ones were still carrying payloads.

BUTLER: Sure. Did that present its own unique challenges in organizing and integrating the flights that were designated for the Mir as compared to the normal operations for a Shuttle? Were there different aspects to it?

LOE: My sense was, yes, it did. So much of that was already established from the time I up there that, and I say "up" because those offices were on the seventh floor and my offices had been on the fifth. But, yes, by the time I got up there, so much of those procedures and how they were working with the Mir, they were called, what, Phase Two Office, I guess, was what they were called. Phase Two was under [Frank L.] Culbertson [Jr.], right?

BUTLER: Phase One.

LOE: Phase One. I guess we're in Phase Two now. Yes, Phase One was under Frank. But so many of those procedures were all established and everything by the time I got up, that I wasn't involved in setting up those procedures, but I know it presented a big challenge to the folks. I say "big challenge." They handled it all very well. But having another NASA organization, Phase One, and then you had the Shuttle guys that were carrying the—the Shuttle was carrying the stuff up to the Mir, and it seems to me there was lot of who's-in-charge kind of questions that weren't as smooth as things had been in the past.

BUTLER: That's understandable with kind of a new way of doing things that hadn't been done before.

LOE: Yes, because all this cargo that you were hauling up to the Mir and bringing back, it wasn't really a payload in the sense that we'd been used to having payloads. We'd have Hubble Space Telescopes, or we'd have, you know, other deployables or Spacelabs or whatever. Now, although it was still a payload, you were hauling it up in the bay. It wasn't necessarily a payload, and there was some other NASA people in charge of it. So my sense is, that was not the smoothest of times.

BUTLER: How closely did you work with the Russians at this time, or did you work during—

LOE: No, I didn't work with them at all.

BUTLER: Okay. Did you at all have any involvement in—as you said, when you came into this role, the details had been ironed out to a pretty good extent for the Shuttle and the Mir operations. Were you at all involved in planning for a space station at that time as they were beginning to gear up for Phase Two?

LOE: Yes, they were starting to gear up, but, no, we weren't really involved with Station. We were learning a lot of lessons off Mir, I think, that were going to be valuable in Station. And our people, our PIMs and FIMs—I guess I mentioned that—our PIMs and FIMs and us two were involved in getting some of the station elements ready to be carried up on the Shuttle. So, yes, in that way, we were involved with the Station folks.

BUTLER: Involved in being able to integrate those into the Shuttle system for the transport?

LOE: Yes.

BUTLER: Oh okay. Was that much different from any of the other planning that had been going on, or was it kind of similar to some of the Hubble-type sized—

LOE: No, I think it was very similar to the Mir stuff, but it wasn't—here again, because you had another organization that was saying, "What happens to this piece of hardware once you get it on orbit?" And I'm not sure, as we talk here, that we had ever launched even the first piece of hardware for the Station by the time I left. I know we'd done a lot of planning on it, but I'm not sure we'd ever put a piece up there yet.

BUTLER: Okay. It certainly sounds like there was a lot being learned. You said lessons learned. It sounds like a lot of them were on the organizational and management side of things and making the program work.

LOE: Yes, and especially on Station, and they have worked out the way they do this, but like you've launched people on the Shuttle, and you've got a flight director and his team of people that are controlling that mission. Now you've got a Station up here. Now you've got a flight director and a team of people controlling that mission, and when you get the two together, who's in charge, and when does this team say what to do, and when does that team say what to do? So they had to work all those out, and I wasn't a party to all of that, but I can imagine there were some hurdles to overcome there.

BUTLER: I'm sure there were.

LOE: Yes.

BUTLER: Well, you did eventually decide that it was time to retire from NASA. Have you just pretty much retired and are taking time to enjoy yourself, or have you been involved with any contracting or any other—

LOE: No, I haven't yet. Had a few nibbles when I first left, but I wasn't interested in doing anything right then, and I guess the longer you're gone, the less the nibbles become. So I haven't had too many nibbles here lately.

A couple of guys had told that me, said, "You ought to draw your line in the sand, say, 'I'm going at this time,' then stick with it," and look forward to it for two or three years, you know, draw your line in the sand two years before you really do it, or three years before you really do it.

And that's what I did. I said, "I'm going to go at sixty," and I did. I was still having an awful lot of fun. I'm sure I would still be having a lot of fun out there today if I was still out there, but I drew the line in the sand. I said, "Okay, I'm gonna go at sixty." So that was it. There was nothing dramatic that made me want to retire on such-and-such a date or anything else except a birthday.

BUTLER: Well, that's a good reason.

LOE: Yes.

BUTLER: By then, you've earned a right to just kind of do whatever you want to do for a while, play some golf.

LOE: With retirement in mind, I took up golf again. I never had time to play golf after we got to Houston. I think I played once, and I had learned to play again when I was in Seattle [Washington] at Boeing. The great Northwest up there, it stays light so late in the day during the summer that you could get in your eighteen holes after work, and some of the guys in the office played. So I took it up and played some in Seattle, but after I'd been here to Houston, I played one time, and then it just took up too much time, didn't have time to do that. So I took it up with the idea that I was going to retire and I'd try it and see if I enjoyed it again, and I did, and it's good.

BUTLER: Good, okay, everybody should have a hobby like that.

LOE: Yes, yes.

BUTLER: Looking back over your career at NASA, we've talked about several of the people that you worked with, but is there anybody in particular that you'd like to mention that either had a big impact on your career personally or that you think was very instrumental in the space program as a whole?

LOE: Kranz impressed me when I first met him. I think I mentioned to you that I came into his office at the Stahl-Meyers Building to interview him. I'd interviewed a number of guys that day, I think some of them in Landing and Recovery [Division].

But I came into Gene's office. He had a board behind his desk with names and different remote site locations on it, and he was on the phone saying, "Okay, I've got so-and-so and so-and-so hung up in New York. They're at the airport ready to go, but they need passports. You've got to get their passports to them, and I got this and that and that."

And Gene was a young guy. He was older than I was, but he was sure much younger than the supervisors I'd been used to at Boeing. I've since accused him of setting up all that, "I've got so-and-so and so-and-so" in these different airports and all these remote sites just to impress people. [Butler laughs]

That was very impressive. Chris [Christopher C.] Kraft [Jr.] was a super impressive guy. I remember Gemini VII, I bet it was, Chris was my flight director, and we were having problems with fuel cells, and the SPAN back then was run by the contractor, McDonnell Douglas, and these were high-level McDonnell Douglas people, vice presidents and stuff, and they, I'm sure, didn't respect us, well, not very much. You know, "These snotty-nosed, young NASA guys, trying to control our spacecraft that we built and we tested."

But anyway, I remember being back during Station passes one time, and I happened to be back there talking to him, and Kraft came back, and they started giving Chris some spiel about, "We ought to do this and we ought to do that."

We were standing there at the console, and I remember him putting his arm on his shoulder and said, "What do you think about that, Rod?"

And, well, I'll tell you what, the attitude that the big boys have towards you—and Kraft does that—really changes. It was his way of showing you support, and I guess he knew I was struggling a little bit, and he fixed that right up. Kraft was a great guy.

Sig [Sigurd A.] Sjoberg was a super guy to work for. Sig was one of the world's nicest guys, just super guy. Arnie [Arnold D.] Aldrich, super good guy. Arnie was just as smart as he could be, but very much of a people person. I think I mentioned last time John [W.] Aaron, one of the smartest guys I ever knew. He had a photographic memory.

George Abbey—God, who could ever say that Abbey's not a special person. When I know when we first saw George, I couldn't figure out who he was. He'd come into these meetings back on Apollo, and you'd see him, he might come in and just stand over in the corner,



and he'd write something down every now and then and never say anything, and then leave. And you'd say, "Who's that guy? I see him all the time."

Then for some reason—then George discovered us at the Singing Wheel up in Webster [Texas] , and by then, Jack [Harrison H.] Schmitt was onboard, who was one of the—you know, Jack was the geologist astronaut that flew on Apollo 17, and he and George were big running buddies, and George would bring Jack into the Singing Wheel. John Aaron and I were probably the unofficial shuffleboard champs, and George and Jack used to love to come in and try and shoot their way out of a shuffleboard victory or cheat their way into a shuffleboard victory. So George was a special person.

George did things for you that I think you didn't even realize he was doing, and later on, you'd suspect that maybe George had something to do with that or maybe George really did do it.

I remember he offered me one time—one of the plum NASA jobs was the NASA rep to Australia. NASA has two overseas reps: one's in Australia, and the other one's in Paris. The Australian position was coming open, and George asked me if I'd be interested or willing to do that. At this time we had kids, and I guess our oldest son was in high school, early high school, and the other ones were coming up behind him, and I just didn't think I wanted to uproot them and pull them over and do that. You know, you tell them that now, and they said, "Gosh, why didn't we do that? That would've been great to go to Australia." [Butler laughs]

But anyway, George is special, always will be. George was very much this "Get people involved and get people together." You know we talked about the chili cookoff. He started that. He was big in St. Patrick's Day stuff. I remember we trained every year to go pull the tug-of-war to St. Patrick's at the Highland Games, I guess they were called, even talked Bob [Robert K.] Holkan into throwing the caper, that telephone pole-looking thing. Holkan was the biggest guy around, so he threw the caper, and some of us pulled on the tug-of-war. But George was really good at getting people involved in doing that.

This Bob Legler that we mentioned earlier, he has sort of become, I guess, the unofficial flight control historian. He's a pack rat. He's kept everything that has ever come across his desk, and I think he's got it in storage someplace, but he says one day he's going to write a book. I hope he does, because he's so into that, though, he really sets himself up for things.

I remember one time he left flight control and was going offsite maybe to work in the Philco corporate office or maybe a Philco Planning Payloads Office or something. Anyway, he was leaving flight control. So we had a going-away party for him at the Singing Wheel, and traditional in flight control and all over NASA now, I guess, you got a signed picture with everybody's signatures on it. So we had a picture for Bob, and had astronauts and Kraft and everybody to sign this thing.

Somebody took this picture and meticulously copied all the autographs onto another picture, and it wasn't a real good job of forgery, but it was enough to fool Legler. So at the presentation that night, somebody was up presenting this thing to Legler, and we had another friend, Hershel [R.] Perkins, back in the back, and Hershel starts yelling, "Hey, wait a minute, wait a minute. I was supposed to do that. I was just downstairs. I was supposed to do that."

And he comes up, and the other guy's saying, "No, no, I'm already into it. Let me have it."

And Hershel said, "No, I'll do it."

And they argued and they tear the picture. And Legler's face just fell. It took him a while to figure out that we were really pulling his leg. But he put such importance on all that sort of stuff, that he was the perfect one to pull that on.

I mentioned Ellison Onizuka, astronaut office. He was a special guy, became a good friend in SPAN and at the luaus that we would have.

In the office that I just left and in the ferry business, I got to know a lot of those pilots real well. Gordon [Charles G.] Fullerton, an ex-astronaut, Gordon is now out at Dryden as a pilot. I guess nobody loves airplanes like Gordo does. You know, being an astronaut, no telling

what he could do out in the corporate world, but he'd rather fly airplanes. So he's a pilot out at Dryden now, and also one of our 747 pilots.

There's been a super number of people here that have been great. I guess I can't name them all, or we'd be here all day long.

BUTLER: Well, it certainly takes a good team of people to make all of it happen.

LOE: Yes. And wives. Another thing, I thought about it the other day that our wives put up with so much with us being gone. Hershel, that I mentioned to you, they lived across a back fence from us when we first moved here, and I was supposed to go, I think, I guess it was Gemini II, I was supposed to go down to Florida, because we had our control center down there, and we monitored it from here in Houston, but I begged off, because my wife, Tina, was pregnant with our second child, our second boy, and she was supposed to have that baby right about the time. So I begged off and stayed here. Hershel, who was a remote-site guy, lived right across the back fence from us. He wasn't able to beg off, or maybe he didn't try to beg off, I don't know. We worked for Philco, but his wife, Ginger, had their third baby just a day behind us. So Hershel missed that. He was down at the remote sites. But the wives, they put up with a lot of traveling and working late and staying out late.

And something else—you know, this doesn't have anything to do with space stuff but just the way we lived back then—nobody had two cars. My wife, Tina, was recalling the other day that Hershel and I would carpool together sometimes to go to work, and that left a car home for the women, and so they'd do their grocery shopping and stuff that way. They'd carpool to do their grocery shopping and stuff. Yes, but we didn't get our second car. I guess I was thirty years old before I got my own car.

BUTLER: Well, that's certainly an interesting aspect to things.

LOE: Yes, it was different. It's different than the way things are today anyway.

BUTLER: Very different, and, you're right, it does take that good family support to make it possible to do all of this and know that they're at home taking care of—the wives are at home taking care of the family and any little details that are coming up.

LOE: I'm sure I missed a lot with the kids, and we weren't totally isolated. I mean, I was involved in the Little League and stuff like that, but there were a lot of nights that we probably didn't get home until the little ones were in bed already.

BUTLER: Did your kids understand what you were working on?

LOE: You asked that the last time, and I think now that, no, they did not, and I get that just from maybe some of the questions that they ask now. So yes, I think, no, they didn't. They just knew Daddy had a job and Daddy went to work.

BUTLER: Of course, they were immersed in their own community with all their friends and stuff.

LOE: True, yes, yes.

BUTLER: Would have fathers doing the same thing.

LOE: Yes, yes.

BUTLER: Well, they'll get a chance to listen to all this and find out details about what you were doing. [Loe laughs]

Well, looking back over your career at NASA, what would you consider to be your biggest challenge, and then, alternately, your greatest accomplishment?

LOE: That's a tough one. The biggest challenge was probably, I guess I would say the total Apollo Program experience. You know, we were definitely doing things that nobody had ever done before. See, I guess I would have to say Apollo.

And greatest accomplishment—I don't know, all of it lumped together—nothing really sticks out in my mind that—getting that runway fixed down at KSC was a good thing, but it's certainly not anything I did single-handedly or anything, but just to be involved in that was a good thing for the program. It saved a lot of time and money. But I don't know. I can't think of any one thing.

BUTLER: You certainly did have a number of important contributions and things that you accomplished while you were working at NASA.

LOE: Yes, sometimes, yes.

BUTLER: Well, I'd like to take this chance to ask Sandra and Kirk if they have any questions if that's all right.

LOE: Sure.

BUTLER: Sandra? Kirk?

FREEMAN: Actually, yes, I have a couple of questions, if you don't mind.

LOE: No.

FREEMAN: Earlier, you mentioned that you were involved in the landing tests. Can you go into some detail about exactly what kind of processes you went through? You know, you didn't really explain what you were doing to prepare for the flights of the *Enterprise*?

LOE: Oh, in the Approach and Landing Test.

FREEMAN: Yes.

LOE: My recollection from a branch chief's standpoint was that most of the effort involved in getting the mission rules written and getting the procedures written fell to the flight director, and that was Don Puddy. It was almost like times were changing back then. The branch—our responsibility had sort of become making sure that we gave Puddy a good, qualified flight controller, and then Puddy sort of melded the team together that he needed. So we gave him Jack Knight, and Jack was obviously the most qualified EECOM or SMOKHEE that we had. I say obviously, not obviously. Jack was a super guy.

But as far as being involved in the, "Here's gonna be our go, no-go points, and here's gonna be—you know, I need to make sure everybody's a go X number of seconds before we actually release them, and here's what we're gonna concentrate on getting down and everything," that more fell to Don and his team that he put together.

FREEMAN: The other is—I don't know if it would be too technical for me to understand, but you were mentioning the difference between Apollo and Shuttle in releasing heat. Can you explain

those two differences, how fuel cells were able to release heat between the Apollo and the Shuttle for somebody who doesn't really comprehend the technicalities?

LOE: Let me think. Let me think. You know, it may not have been that big a difference. I guess in both cases, they interfaced with the primary cooling system—the coolant loop. So it may not have been that different now that I think on it. Yes, I may have misspoke there, because now that you ask, I'm not sure I can pinpoint any big differences specifically.

FREEMAN: Okay.

LOE: I'd have to think on that for a while. But both of them, as I recall, both of them interchanged heat with the main cooling system, and we dissipated that heat either through radiators or through water boilers or flash evaporators. So, yes, there may not have been that big a difference.

FREEMAN: Okay. That's all I have. Thank you.

LOE: You know, another accomplishment I'll mention that I'm pretty proud of—over in the program office, airplanes, you know, I mentioned I was involved with the landing sites—airplanes navigate to sites using a device called a TACAN, T-A-C-A-N—Tactical Air Navigation, and a TACAN gives them range in varying—a TACAN sends out a signal to beacons. It sends out a signal. It gives them a range and a bearing to get to a site. So we have TACANs at all the Shuttle landing sites. I mean there's TACANs all over the place, but we have them at all the commercial fields, and it's all across the U.S. and in the world.

One of our sites was at Zaragoza in Spain. The Air Force, in closing down a base, gave us a super-duper TACAN probably worth \$100,000. They said, "Here, can you use this?"

Said, "You bet."

And they did this through the DDMS. So we took the TACAN over and installed it, and when we'd go over and bring that base up to support a tile mission, we would turn on our TACAN. The Spanish Air Force now turn theirs off. They had an old dilapidated one. It didn't have a lot of power. It still had old vacuum tubes in it. So they would turn theirs off, and their pilots knew to change their frequency settings so they could home in on our TACAN now to get to the base.

At some point, we cut a deal with the Spaniards. Anyway, we cut a deal with the Spaniards that said, "Hey, we'll turn this thing on and leave it on if you will maintain it for us, and we'll buy the spare parts, because we've got a bunch of spare parts already. We'll send them over there."

And we knew that they had two TACANS like this in country—one at Madrid, and I can't remember where the other one was—but this thing wasn't totally foreign to them. In other words, they had schools, and they had ways of knowing how to maintain the thing. So we did that. We cut that agreement and said, "Okay, look, these guys will maintain it for us, and, in turn, we'll turn it on and leave it on. They can use it."

So that was a win-win for both things, but I ended up having to go to Zaragoza and sign the treaty or the agreement with the Spanish Air Force that said we'd do all that. So that was pretty neat. Because that was going to very, very expensive to have either the DoD, the Department of Defense, maintain that thing for us or to turn it over to our Lockheed contractor at KSC to maintain for us, because they maintained a lot of the equipment at these remote sites. But to turn that over to Lockheed to maintain for us was going to be very expensive. So that was a good deal we worked out with the Spanish. It was a winning thing for them and a good thing for us. And I've got the agreement—a copy of it anyway—at home in Spanish.

BUTLER: Okay.



LOE: So that's sort of nice.

BUTLER: That's good. Did you have a lot of—in this role working with these remote landing sites, the TAL landing sites, did you have a lot of contact with the people at the different bases, nationals from those countries in situations like this?

LOE: No, I did not. Our DDMS people would go over our—actually, the people from Florida, from KSC, were the ones that actually manned up the sites.

There were some people from JSC that would go over to them. Usually somebody out of the astronaut office would go to the various sites, and they would fly the weather observation planes on the morning of the tile site, or they would be onboard the observation planes as weather observers. The Air Force would fly the planes. But they'd be onboard, because, well, you know, you'd fly them out to your needed distance from the runway to see if you could check your visibility. They did much the same as the STAs [Shuttle Training Aircraft] would do for us down in Florida, just before launch they're flying around checking out visibility and stuff. We had some small DoD aircraft that would do that for us at the sites.

But, no, so nobody from our office usually had to go out to the TAL sites. KSC pretty much ran those. We funded them, but KSC ran them.

BUTLER: Is this someone or a team from KSC and the astronaut that would go to these sites shortly before the missions?

LOE: Yes, yes.

BUTLER: Oh okay.

LOE: Just in case.

BUTLER: Okay.

LOE: And, in fact, when I went over to Zaragoza, we timed it so that it was right before a mission, so that the NASA guy, Bobby Fleming [phonetic], who was GOM, the ground operations manager, Bobby was going to be the GOM at that site at Zaragoza. So we met him in Madrid and drove over to Zaragoza. And my wife went with me. I paid for her to go over with me. It was a super opportunity for her to see Spain and for me to see Spain.

So while we were there, we had gone to Zaragoza to sign the agreement, and then we another site at Moron, which is outside of Sevilla, Spain. So we then drove from Zaragoza to Moron and was there at Moron for launch day to watch their preparation—how they got ready and everything for the launch. It turns out we didn't launch that one. Something happened—I don't know what, but we didn't get it off that day, so we had to come on home.

But that was a good experience getting to see those two sites. Now, the two sites in Africa, I never did see—the one at Banjul in the Gambia and the one up in Morocco— Ben Guerur. I never saw either one of those.

BUTLER: Well, it certainly sounds like a unique opportunity, though, as you said, to go see Spain.

LOE: Yes, and it was good, because it was something I needed to see, and it really helped me a lot to go over and watch these guys get ready to support a TAL site—like the MSBLS [Microwave Scan-Beam Landing System] was another landing aid that we used. It's a beam that we actually fly down to—you get to watch them set up the MSBLS, watch them—we had

another thing that was developed after *Challenger*. We had barriers at the end of the runways that would stop the orbiter in time, because not all those sites were as long as you really needed. So we had barriers that those guys would erect, and we got to watch that and see that get all set up.

BUTLER: Now, what did those barriers consist of? Were they concrete, or were they something with more cushion?

LOE: Oh no, nylon rope.

BUTLER: Oh okay. And so the Orbiter wouldn't sustain too much damage by running into those.

LOE: Yes, it did hurt a little bit. It probably damaged some tiles, but it was better than going off the end.

BUTLER: Right.

LOE: So, yes, that was developed back sometime after *Challenger*, I think.

BUTLER: It does operate in conjunction with the parachute as well?

LOE: Actually, that was before we put the drag chute on. Yes, the drag chute came on later, very much later. But, yes, they were in conjunction with the drag chute.

BUTLER: Oh okay. That's interesting. I hadn't been aware of those before.

LOE: Yes, they're only at remote sites. We used to have two sites in the Pacific also, one at Hawaii and one at Guam. And we finally convinced ourselves sometime in the Shuttle Program that we didn't need those. Of course, it cost money to send people over there, every mission, and then it cost money just to maintain the equipment and stuff. So we finally turned down the Pacific sites, and the reason we did it—we convinced ourselves we would always be able to get back. We couldn't think of any scenario, a reasonable scenario that would make us not be able to get back to KSC or Edwards or White Sands.

BUTLER: Okay. Interesting. Well, is there anything that you can think of that we haven't talked about that you'd like to mention for any of your career?

LOE: I'll probably think of that tomorrow or the next day or something.

BUTLER: Well, we could always add that in anyway.

LOE: No, I can't think of anything.

BUTLER: Okay. Well, we appreciate you very much coming and sharing this with us.

LOE: Oh, I've enjoyed it. It's good to relive some of those times again.

BUTLER: Yes. Well, it was very interesting times—very interesting. We've enjoyed hearing about them.

[End of interview]