

ORAL HISTORY 5 TRANSCRIPT

JOHN S. LLEWELLYN, JR.
INTERVIEWED BY KEVIN M. RUSNAK
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RUSNAK: Today is April 4, 2000. This interview with John Llewellyn is being conducted in the offices of the SIGNAL Corporation in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Sandra Harvey and Sandra Johnson.

I thank you for joining us again. We were just talking a little bit about the transition from Gemini to Apollo and some of the personnel differences. So why don't you go ahead and continue on.

LLEWELLYN: To go back, we talked prior, the transition between Gemini and Apollo was really significant for NASA, because at that point we started, a lot of the guys became more managers, whatever that is. Since we didn't have any manager training, that's what we were anyway. That was quite a change for us, the idea of, as I spoke before, we spoke before, of delegating authority to the guys that were going to be taking over our positions, and then realizing the experience and how much training they should have to do it. Plus the fact that we had to build another real-time system. That's what the flight controllers did.

Interesting thing, we built our own tools. We came and then they would write requirements against what our job was. That was quite a good thing. I don't know how that got started, but writing the requirement for a system, and then going away and having different groups of people implementing those requirements, like the software requirements, the

hardware requirements, the stuff we needed to know about the onboard systems, and, of course, the mission rules.

You mentioned Gene [Eugene F. Kranz], that he always kind of liked to follow the mission rules. Those things took on really new meaning there, because now we had real solid, not that we didn't before, but we really had, we got more a say, organized, and we had data that was signed off on. We called it SODB [start of data block]. That brought in a lot of new changes, because those controls really became important and that really helped us out, that particular management technique of having the systems run, the ones we saw, the ones that were on the spacecraft, the piece of equipment. We actually had all the test data and everything that we could look at to make sure that what we were doing and what we were calibrating and what we were putting in the real-time system, to build a real-time system, was the emulated system, emulated the total world that we lived in, the real-time system, and all the things that were added on to it, like—that's the word, but I'll think of it.

Like I had the SSR [Staff Support Room], the Flight Dynamics SSR, that was a responsibility of the Flight Dynamics people and, of course, a lot of different people. Most of it supported reentry guys, because we had so many studies going on and so many different contingencies, and, remember, our job was done by a whole—affected almost like a farm. We had weather problems, we had where the recovery ships were, what kind of stuff we didn't want to go into anywhere close to countries that were not friendly, and that kind of thing. And when you think about it, we were going all over the world, and the more we got in it, the better understanding of what we had to do. It really worked out good.

From that standpoint, we brought that with us to the Apollo program. But the Apollo program was very complex with the number of vehicles and the pieces and the new people, and

the new trajectory stuff we had to learn and build. I mean, that return-to-Earth process was a huge development.

Then just the determination of the trajectory parameters between the Moon and the Earth and how you did that. I don't know if you've listened to this before, but there's an arbitrary thing that we did. We had a lunar sphere influence and an Earth sphere influence. I don't know if you guys know it, but you can't solve the two. I mean, that's as much as you can ever do with two-body problems. You can't have three. You can only have the Earth and the spacecraft, or the spacecraft and the Moon. You can't have all three of them in it. Nonlinear and it's just tough to do. In fact, that's probably why they came up with quantum mechanics, because they couldn't do it otherwise

But anyway, and deciding what that was and how you do it, and, gosh, we had so many guys working for us in those days. I mean, people, the support from places like MIT [Massachusetts Institute of Technology, Cambridge, Mass.] and TRW [Thompson-Ramo-Wooldridge, Inc.] and the NASA centers, like the one at Langley [Research Center, Hampton, Virginia]. Certainly I don't want to discount "Hun's patch," [Marshall Space Flight Center, Huntsville, Alabama] but I mean, they were in it with us, but I mean these other centers we had, the heating stuff out of Ames [Research Center, Moffett Field, California], the aerodynamic stuff, all that stuff. And then the Air Force at Tullahoma [Tennessee]. I mean, the stuff that we had. I can't remember the kind of support we had from different sectors of the U.S.

A lot of times, I think, that without that kind of support, I mean, I think the United States was the only one that could ever do anything like this, because we had that kind of freedom to move from all these different things that we were doing. I mean, people would call me on the phone and tell me stuff.

Then we had really great support of the military, even though NASA tried to separate itself from them. I don't think we—I mean, without the U.S. Navy and the Air Force, I know whatever the Army and all that stuff, and the flight surgeons and all that, I mean, to create a place like that, that we were going to get that guy, no matter where he went to, any contingency, and those guys did that themselves. We didn't have to tell them. We said, "This is what we want to do. You come back with your plan, and then we will write it into our rules and you'll have your set and we're going to have ours." It really worked good. That's the kind of thing that [Christopher C.] Kraft [Jr.] was sitting talking about.

But it turned out that that kind of stuff spilled into the other organizations. I'm sure that we crossed-fertilized. A lot of the stuff they gave us was good, but we probably gave those guys a lot of new ideas on how to do things, especially on the system that we were building. I don't think anybody ever realized, just to go in orbit what we were doing and going around, we could go around the Earth sixteen revs [revolutions] in twenty-four hours, just back where we started from. So that's how that all went.

That being put in and that kind of thinking that we already had developed that consciousness or whatever, that level of—then we applied that to going to the Moon. When you think about it, I was wondering if it was working. Can we do the same thing here, I mean, on the Moon as we can do here? I know the cosmology—the principle says all physics are the same, and that helped. And there's no doubt about it, that never changed.

But to go ahead and, for example, don't even think about the landing, but to go through a countdown and launch a guy off to the Moon and rendezvous in orbit was kind of an interesting problem to solve, to me. Then to turn around and do a TEI as soon as you could—a trans-earth

injection is what we call it. And not knowing the real physics of what we're doing, because we'd never get that straight. We never did really.

I've always thought about going back and really running this. I've talked to some guys about it. We really—those two spheres didn't really work. There's nothing wrong with Newton, it's just I don't think we know enough about gravity. I don't know if anybody's ever said that, but that's true. I know that we went up there and had a lot of trouble the first time, because we had those mascons [mass concentrations], because the Earth—I mean the Moon didn't have a CG [center of gravity] in the center, it had what they call a dumbbell. All it was, was just off center, but it really caused a lot of trajectoring strange—not strange, but introduced stuff in the orbital determination that we really had to learn how to do, and we did it real quickly.

After that first flight, we came back and really got to working on it. I was surprised how much—I forget who did the modeling for that, but it was with NASA and somebody else. But that really worked out good.

So the idea of progression concept of starting off and going in Earth orbit and understanding that, and then doing maneuvers and rendezvouses, and then going into lunar orbit was what worked. Probably that's the only way we could have done it, but I'm just saying we couldn't have never done it the other way, just to get the experience and the knowledge and developing this new flight operations concept and control centers.

You can go anywhere in the world and you've got control centers. I mean, you do it anywhere. These big network operation control centers like we're going to build that handle all these communications we use and all these sophisticated—all of that's done by—all the things that we've got are done by these servers and routers and software and hardware. That's how all

this bandwidth is distributed. And those things had people sitting in there, they've got the same problem as we do. It's just like pipelines.

I don't know what they did before with pipelines, but I'll bet you they picked a lot of that stuff up from us, was real-time systems. I know the skater stuff came from us, for pipelines and monitoring and telemetry and all that real time. So that thing was something that is a step in the paradigm shift that we're in right now, because without that, without knowledge of these geosynchronous satellites and all of this, and how to work through that, none of this stuff that we're doing today, this new paradigm shift, this thing that we're doing with telecommunications and information or whatever you want to call it, I don't know what it is, the World Wide Web and all that, that's there.

That all kind of got started with this kind of thinking, because COMSAT was a direct outgrowth of NASA. It was all government, and they finally, to put it theoretically, it's supposed to be commercial, but it never was. Same way with [unclear]. That's all government and regulatory. So all those systems that we kind of messed around with, and I don't think I'm being—I don't think I'm being biased. I think it all started right here in this country.

RUSNAK: I wanted to ask you, related to what you were talking about a minute ago, with doing the Earth orbit rendezvous and going to Moon, that kind of thing, these are all components of the lunar orbit rendezvous system that they eventually chose. I was curious to hear what you, as a trajectory guy, thought about the debate between Earth orbit rendezvous, the direct ascent, and lunar orbit rendezvous for the different modes of Apollo landing, if you had any—

LLEWELLYN: We did about the same thing, as far as the way the rendezvous was done, coming up from the bottom. I think they do it the same way, you know, doing a catch up.

RUSNAK: Do you think the other two were even feasible?

LLEWELLYN: I don't know. It's kind of like Beta and the two kinds of TV, right? One won. The guy [unclear], the firstest with the mostest. No, I think the idea of being able to come up and catch up and looking at it had to be a good way to do it. That's my simple-minded way to do things, and kind of like Occam's Razor, of all the things to do, do the simplest, because that's probably—if you get too complicated, it's not the right thing. So that's how I looked at it.

Now, I didn't really—I knew they had some real problems with the different orbital cases there, and the guy like me, the entry guy, really had them, because, believe or not, I was handling all the aborts one way or the other, the position I had. If they ever had to abort during a lunar descent or touchdown, you've in serious trouble because you're in all kinds of crazy orbits then. Because they fired. They fired through the hole and it blew off of that. You can get some very strange orbits around the Moon from that, which we would have to make sure that we could take the SPS [service propulsion system engine] and had enough to see us in to go get him, because we had to go get him. He couldn't—he's through.

That probably bothered me more than anything, and I think it bothered anybody that was involved in that. In fact, the best thing you tried to do is forget it. But we used to do it a lot. A lot of the flight, a couple of them I'm not going to mention them, because I'm afraid that I wouldn't say the right one, but we spent a lot of time with the CSM [command and service module] command pilot, especially for Apollo 11, running those kind of trajectories, just him in

there by himself, and not tell the crew, not the lunar crew. We'd get in there and run, take cases that were more likely to happen, fixed-time aborts and what have you, and what procedures. Then we'd see what we got into and see if we could do it. And we spent a lot of time doing that. I spent most of that spring doing that before the lunar mission, I mean before Apollo 11.

That took lots of what you're talking about, rendezvous plus trajectory support and getting a vector, and having the right set of equations and make sure our solutions were compatible with the onboard system, no matter how that got, but we had to be able to make sure that what he was seeing, even though it might not be completely correct, was good enough to do the next maneuver. You don't want to have two things going bad for you.

So all that stuff was—and we were constantly watching it on the ground and having people do it to make sure that the systems and the navigation and all the systems were in concert. So that was a big change, and especially as we—this is almost—anyway, you'd expect that, but the closer you got to doing it, the more effort you'd put in it, because you realize—and that's what we spoke before about some of the books. I wonder if somebody would really like to tackle explanation on that without getting too much involved in the physics detail stuff, because all of that was very important. I guess, as you said, that was the big—that next step, from Earth around the Moon, to all the stuff we had to do around the Moon, around the Earth.

RUSNAK: Well, before we get into the Apollo mission specifically, I was wondering how much time you were spending preparing for Apollo as the Gemini missions were still flying, since they ran somewhat simultaneously.

LLEWELLYN: We spent an awful lot of time. I'm sorry I didn't cover that clearly. That's the major change for me personally, was getting away from Gemini and letting the guys that I had trained that came along, what I thought, and then me taking on this new administrative role that where I had all these new decisions to make and we spent a lot of time doing it. I mean, we'd come in on Saturdays for mission rules review and writing requirements. I mean, we worked at night and developed these real-time systems.

We had a computer over in the IBM, I don't know how much time I spent over there just looking at trajectory runs that TRW was doing, just to see if I could understand them. I mean, you know, if what they were putting out made sense to the people that had to do the job. Because those patch conics and all those things, before you're going to make a decision on a number, you've got to know if they're right. Just because a computer puts out a number doesn't mean anything. In those days, in fact, it meant a lot less than it does now.

So that time we did put a lot, and I did get away from the Gemini stuff. I'd go over there, like before entries and stuff like that, but I realized that that was not good for the guys either, for me to be there. They wanted to let them know that everybody knew that they could the thing. So we had that to work through. That was a big thing.

I think all of us did that. I think [Glynn S.] Lunney and—I know both of us, and, I guess, [Philip C.] Shaffer and [unclear], and Charley [B.] Parker and Will [William E.] Fenner and all those guys that spent a lot of time with their new hat on, getting ready for the lunar stuff. We argued with everybody, too. It got to be—I have a feeling when people saw us coming from Building 45 or 30, they actually went out and bought a lot of chow, because they knew we were coming over and we were going to argue and holler at them and all that stuff. So that was

really something. I'd like to just mention directors since, I don't know what those guys were thinking about. But anyway, that's how it was.

RUSNAK: How did the training for these new guys that were taking over Gemini, how did that compare to the training that you went through? Was it more regimented, or was it still as much on-the-job training?

LLEWELLYN: Remember that by the time they'd gotten there, that it was different from when I did it. Just like [Eugene F.] Kranz said, we had really not much—we just didn't have the construct there. It was more or less each mission. By the time we got there, we had a pretty good idea of what a training syllabus was, and what you had to know, and we knew you had to know your mission rules, you had to know your systems, and you had to draw them. I mean, even trajectory guys had to understand the piece of equipment that they were using and depending on, and what the schematics looked like, and what was wrong with them.

Plus the fact we really had to be—spent a lot of time with the young guys on trajectories and going over with them a lot of the stuff that they probably had in college, but it really was not applicable to what we were doing since we were really doing it. Plus the fact that the software and requirements and going to reviews and running the checks with them, and testing all that stuff out, they could do, which we didn't have a chance to do. So the real-time system and being able to emulate a mission and being able to play it together, and then if you had a problem, you could run your part of it, was one of the best training tools that we ever had, which made the guys really bright and smart.

I hope that answers your question. And really that's what happened to the Apollo guys. I mean, as we got out of that and I went onto Skylab, I really didn't want to leave, because, see, I left there about Apollo 13, right after that. I still talked to them and went down and listened to them and all that, but really I got into the Skylab, and before I knew it, I was absorbed in that and all the other things we were doing.

We had a Viking mission that we were going to try to fly here and we tried to get that to go, and then we had that Mars thing and all that stuff we were doing, was following up with Apollo. A lot of stuff we wanted to do for that. Has anybody ever mentioned that?

RUSNAK: I think we have briefly.

LLEWELLYN: Wasn't that all kind of confidential? I don't know if anybody ever talks about it.

RUSNAK: I'm not sure how that was classified at the time.

LLEWELLYN: Kraft, ask him when you have him. See what the other guys got out of all that, because we spent a lot of time thinking about that.

RUSNAK: I also wanted to ask you what you thought about some your contemporaries like Glynn Lunney and these guys moving up into the flight director's chair for Apollo.

LLEWELLYN: Glynn, yes, he did a good job. Glynn was probably one of the finest guys they ever turned out here. No doubt about that. Interestingly enough, I didn't see him at the funeral. He must have been out of town.

RUSNAK: That can very well be. I didn't see him last night.

LLEWELLYN: Guys like that. All of them. And Gene and all those guys, they all were good.

RUSNAK: Ever had any thoughts of moving into a flight director position yourself?

LLEWELLYN: No, we went through it a couple of times. For some reason I don't really know why, but it really wasn't that important to me. I probably could have gone in, but by that time, you know, once you do what I've done, that all kind of doesn't fit. [Laughter] How could you have a better job than me?

RUSNAK: That's a good perspective on it.

LLEWELLYN: That's the way I look at it, man, because I was the best. In fact, I used to joke around and tell PAO [Public Affairs Office] and all those guys, and guys like that, I told them that I wanted the Russian retrofire officer and have a match who could hit the target areas better. I'd beat him every day. I used to tell those guys that. I said, "You guys are nowhere when you come up against me." It's like being the best shot.

RUSNAK: That's true, with a really big bullet.

LLEWELLYN: That's right, and you got to know where it's going. I think back on it, all that haranguing we did with the Navy, that they didn't know where the ship—we knew for a long time. I couldn't—the Navy didn't know where they were, and I finally got the Navy guys to say it. Remember what Schirra told that the Navy guys on that great big carrier we had? He says, "I've got my new IP [impact point] and you guys are about four miles away from where we're supposed to be." He told that. I think those kind of [unclear] remarks, I think Schirra and I made a few of them, to be perfectly frank. I had a couple of them like that. I mean probably, if you really wanted to write a book on that, it would just seem to me that in itself would be a good reason not to be a flight director, especially by Skylab, because by then it went political. It got more political by that time. Headquarters got in it. The world knew who we were. You know. Don't you think? I mean, after the lunar flights, I mean, God, you couldn't hardly not know who we were. But to answer that question.

Plus the fact, I don't know if anybody's ever gone through—and you didn't ask me this question, you're going to ask Kraft or Lunney or somebody like that. I really could tell somewhere, and I don't know where it was, it was probably before [Apollo] 13, that we didn't have but so many flights left, and I couldn't understand it. I really could not understand. I think we realized it was coming in at [Apollo] 17 for some reason. And we had a lot of boosters left. We had the spacecraft. I felt like that we should really get in there and try to bring some stuff back, like some of these H₃ and some of the stuff that we were really—you know, the things that we were trying to do, because we just scratched the surface. We knew what we were doing.

We were confident. I didn't have any trouble at all, and I'm sure the crews didn't care. You know, that reentry's hairy.

And I think when I found that out, you know, and I knew that it was going to come to end, I think I changed the way I looked at things. I think a lot of that. I think the thing to talk to guys about, too, is the transition after Apollo, when you knew it, because that really was a change for me, after ten years of what we did or even more. It was probably even more for me. But let's say from [19]'59 to '69, those ten years were really incredible, and then all of a sudden not to do it anymore, I think it impacted a lot of people's lives that realized that once that you've done that, then what else are you going to do? I mean, what do you find to do? People say, "Well, look, Llewellyn, that's a wrong thing to say." But I'm serious about it, that if you had that job and that's what you were doing, how are you going to go, to go to work? Really think about it. All of you guys have a career changes and things have happened to you, and you got to start all over again, but think of that start, and look what happened to the center. Look at the morale problem that Kraft had going through the seventies. All of us.

Of course, I quit and went to Belize. Is that the one you were going to ask me about? That's what I did. I decided that I was going to be a cattle baron. I had done all I was going to do, and unfortunately that turned out to be good, but it wasn't what I wanted to be. I came back here for Shuttle. That's what I did. But we all did something. After Skylab, it was really—it was tough to come to work. I could see it was. I didn't stay here. I got out of here. But that's a tough one.

RUSNAK: It's hard to top sending guys to the Moon.

LLEWELLYN: It is that. I told Kraft that. We lost the best job we ever had, and we didn't do anything wrong, you know.

RUSNAK: Just the opposite.

LLEWELLYN: The thing went away. And, you know, that's happened to a lot of people. I see it all the time. These young guys I see, I worked with, they've got Mercedes and they've got top of the line, they've got all that money, and it can happen, whatever you're doing, it can go away and you'll have nothing. Not nothing, but you'll have to start all over again. That happens to a lot of people.

So as far as all of that was kind of going on at the same time. So to answer your question, sure, I'd like to have been a flight director. But I think I would have done it, I just decided that that was not the thing I wanted to do. I think I decided somewhere that NASA was—I had to do something else now that this thing was over with. I just couldn't—I think this is the first time I've said this publicly, I just didn't want to stay around and not flying spacecraft and be in flight ops. There just wasn't anything there for me, even though I had the aircraft program, I went out there. I was out at Ellington. I managed the aircraft—well, the ones that [Joseph S.] Algranti didn't have. I had all the earth resources airplanes and the KC-135. I had that job. That was a great job, too.

RUSNAK: Well, if we could go back to the beginning of the Apollo flights. Apollo started off on a down note, I guess, with the Apollo 204 fire. I wanted to ask you what you remember of that and your thoughts on the investigation and the aftermath of that incident.

LLEWELLYN: Well, I was on the console when it happened, so I heard it all. It was unreal. In fact, to tell you the truth, I had just left a meeting, and it was the one we voted on how we were going to do the lunar entry, when I walked over to that to run the test that they were running. In fact, I was going to meet Gus [Virgil I. Grissom] and all of them the next day. I was going to leave that night, and I was going to meet them in California, to go over all their trajectory stuff and all the things we were working with, because we were training those guys using a backup system. Okay. Because our simulators hadn't worked yet and we hadn't started working yet. I mean, Building 5, those guys hadn't had a good what they call Apollo simulator.

We really realized, I realized that we were coming in this thing not really prepared as we had been in the past, but the operations guys really didn't have much to say. Well, we had a lot to say about it but we couldn't. You can't be that negative.

Well, this thing happened, and the guys, the night it happened, in the control center, I mean, guys were seeing really things like, "What does this mean?" I said, "Don't you understand, this is the end for a while." I mean, man.

Then the rest of that, from that [19]67 thing, gosh, it was hard. I'm sure the guys went through the same thing after the *Challenger* [51-L] thing. But, God, that was so bad, and it really made guys like the flight control—well, me, personally, I felt that somehow I was responsible for it. We were the ones saying that was going to happen, or something like it. I didn't ever know that thing was going to happen, nobody else, I didn't mean that. But we knew that the Apollo system was not flight operations ready, or at least I, from my end.

Of course, the reorganizations were so big, and I guess that's when George [M.] Low came, and I guess that's when George [W. S.] Abbey shows up at that point. That's a good

point. A lot of people don't realize that's why he came. He came in right after that. He might have been here, but he really started working after that, so that was a change.

If I hadn't had some other stuff to do, I don't know what I would have done. By that time, not only was I working, and was running cows and had a lot of that kind of thing to get away from. But we really worked hard to get it back together. You know, you say about '68, after we flew Apollo 7, we were really. That was really a letdown to do that.

RUSNAK: The turnaround time between the fire and once they started getting the Apollo missions running, Apollo 7 and Apollo 8, where they go around, the Moon was remarkable, given the events.

LLEWELLYN: It sure was. It's more than that. It's hard to even know, except, I guess, that we knew what we were doing. We knew how to fix it and we had good leadership.

RUSNAK: Were there any significant changes on the operations sides of things from the fire that you remember?

LLEWELLYN: We got more really professional, not that we wasn't before, but our controls and stuff, I guess with Boeing coming in and putting program controls on stuff, and that really changed a lot. It seemed to me that they were wire-brushing people who really didn't need it, but we felt like the flight ops people got really—went through it and spent a lot of time going over that stuff and what we did wrong and why, that kind of stuff, and other people, too. But I really felt like that of all the people, we were blamed. I felt almost childish that, "Why you

blaming me? I didn't do it." But then I got out of that. I said, "Man, this is something." It's just a guilt trip I guess we all put on ourselves. But it was really something, especially that first spring after it happened, getting it all together again. Thank goodness we'd already gotten through the Gemini Program in December.

RUSNAK: What did you think of the addition of that Boeing contract?

LLEWELLYN: I just happened to remember that. When we got the program management and we went in kind of a new level of stuff, you know, I would imagine from a standpoint—see, I wasn't—at that point I was down—a lot of this stuff I'm talking about is just what I see and what I think is going on. That thing had to be done, and it changed. It changed the way Building 1 worked. It changed the way we did management stuff, because we got a lot more controls, and we had a lot more bureaucracy set in. I'm searching for the words to describe the change, but it's a good change. It did, and obviously it worked, because those stuff that we did in those days, everybody still uses, program review boards and SODBs, and I forget what they call them now. But SR&QA [Safety, Reliability, and Quality Assurance], all that stuff was brought in at that time, going through the CCBs [Change Control Boards] and all that stuff that's done now, I still think it's done. The preliminary design reviews and critical reviews, all that came out of that, as I remember. Fact is, there's computer programs now that you can—applications that almost have that stuff in them. You don't have to think about it. Just fill in the blanks.

RUSNAK: Let's talk about some of the manned flights. You mentioned Apollo 7. What shift were you running during that, and do you remember anything in particular from that mission? I know there were some issues between the flight crew and the flight controllers during that.

LLEWELLYN: Remember, this thing started as a result of the disaster, okay, so the flight crews really got—and I can't blame them. I think they felt betrayed in some way that that happened. But I would like to say it another way, and I think I've kind of said it. It was a change in the attitude the way NASA was going to be run. It was kind of like the guys that did Mercury and Gemini came up through the ranks and all that, were now exposed to a more highly sophisticated product, really probably more exposed to the public. I think headquarters was taking a bigger role; it was more of a [unclear] for whatever power that they thought they needed out of all this.

NASA was getting, besides just being some really neat place to work, and what we were doing, it was actually becoming—I can see now it was becoming a real impact on the whole world, how they were looking at it. I mean, all of a sudden you can actually see what the Earth looked like.

If you remember all the stuff that was going on, we had the Vietnam War, we had all those uprisings and almost chaos, and here we were in the middle of it doing something that made sense. And that, certainly, once you get that going, then there's always guys that, "What do we do? How do we conduct ourselves?" And that's when the PR [public relations] thing got in. I'm sure that that had a lot to do with all the changes that were being made, with guys like Schirra and I and the guys that came that way, and the new guys that were coming in, the new managers. Because we got a lot of them. We got some new people.

That, I think, is a good question, and it was a tough—I was prime on 7 because of the very fact of what kind of mission it was. I mean, there was no doubt that somebody else could have taken it, but I was the prime guy on that because of the problems that we had encountered in AS-204 or Apollo 3 or whatever it's called. By the way, do you want that—I've got that flight plan. I've got the countdown.

RUSNAK: Sure, that would be great.

LLEWELLYN: I took it out of there. I wasn't supposed to. [Laughter] I took it with my leather couch.

But anyway, that's it. That was pretty tough. We did make changes there, and because we kind of went from a kind of an open cockpit flying thing to something more like an airliner or something. I don't know if that's a good—there's got to be a good analogy. You can pick one up from that. It was different. It really hadn't made its change in Gemini. That's a good question. I hope I did all right with that. It was a tough thing to do, and it was a lot of changes in the way people thought. It was not only—it's not between the crew; with the way we conducted our business within NASA. I mean, that almost became two different kinds of people, and it continued right up until the eighties when they got rid of all us. [Laughter]

That's a good question. I'm sure nobody will say that. Anyway, they got Kraft and a lot of guys, because that's not the way they wanted NASA being run, I guess, because it was running in Texas. Houston was it. We were in the space business. We ran it right out of here, and that had to change, because that's not how you do things in the government.

So that's my opinion. And it really—but, see, it took that year and a half after the disaster to get us back on line, and then you could start doing things normal again after [Apollo] 8 and 10 and 9. Well, 9 was hairy, but if there's anything normal about going to the Moon, it flowed better. But you had to come back with it, because we didn't have—those guys, we didn't have any simulators that were working. We spent so much time at the Cape, down there. Kraft was worried about all the entry stuff. Well, everybody was. You know, how we going to do it. We spent a lot of time doing that with the new spacecraft.

In fact, I even put a line on a window again. That 13.7 line on the windows is the one I stuck on there. They didn't have one, and I argued and argued to put one. See, if you ever lose attitude or lose everything you got, as long as you've got your thruster, you can put that line on a window, and when you do that, you're at right attitude. You can always get back. And nobody wanted to do it with Apollo because they said it was too much. But you know what we did with it? When we did Apollo 8, that's how they checked to make sure they were in the right attitude before the burn that purge your burn.

Because I don't know if you know it or not, but you come up on that Moon, that last day is scary. For a long time it looks like this. They didn't like to look at it, because when you looked at it at an Apollo spacecraft, all you saw was the Moon like you were going to hit a big bulls-eye. And you know that's got to be scary, especially when we didn't have any idea—we really were fighting to understand that lunar—and we were shooting for a 16 nautical mile [unclear] the Moon, with one burn. That's when I came up with the idea of using that line, because that's all geometry. It didn't have a damn thing to do with math. [Laughter] You know, if you were there at the right time, you were there. If you don't, get out.

RUSNAK: It seems keeping in line with you "Keep it simple."

LLEWELLYN: And we had a burned in there. We had to know exactly what to do. If that thing wasn't there at the time we told you, you'd better turn around and get out of there, because you're not in the right place and we don't know where you are. Right? If it is not there where I'm looking at, you could be too far or too close. You can argue about which side of the line you were on. We used to argue that, but to me, it didn't make any difference; something was wrong.

So that kind of thinking went on during the period of that year that we talked about, that period between. That's the kind of stuff that was brought to bear, I think. That's just my experience. I'm sure that you could talk to guys at the party you went to yesterday, Aaron, all those guys were doing the same thing. John [A.] Aaron was an Apollo guy, he came into Gemini, but he was good at it.

RUSNAK: While we're talking about Apollo 8, I was curious to hear what you thought about sending it to the Moon already after just one manned Apollo flight. After having 7 been the only one going up, and now on the second mission, here we are sending three guys to the Moon.

LLEWELLYN: Well, no, as soon as we got through Apollo 7, Kraft had a meeting and told us. But really, that whole summer I was down at the Cape running lunar reentries, so I knew that he was—somebody—I couldn't believe that we spent as much time on that, because I should have known that they were planning on doing it. And it was a great idea.

RUSNAK: That's interesting.

LLEWELLYN: And that's the time that while we were doing and battling the world and getting it better, that's when they brought up the new guys, and that's when Chuck [Charles F.] Dieterich flew the launch, and he had the lunar stuff, and I was the second guy, because of all the stuff I did. It was kind of after that, I was always like the senior guy there and I could do any of them. But it was Apollo, most of that stuff, I had gotten to the point where I was more a manager and a guru than actually a participant, because the guys by this time were doing good.

And Apollo 13 is different. I came back and did that, regardless of what all the book said.

RUSNAK: Well, let's work our way up to that mission. Nine, you described a little bit ago as hairy, so I was wondering what you remember from that mission.

LLEWELLYN: It was, because when you're doing those kind of big maneuvers in orbit, making massive maneuvers, what we call burns, gosh, it doesn't take much to reenter or to go way out. It doesn't. When you turn those big engines off and on, and trying to do what we were doing and rendezvousing and with systems that were not based on Earth's gravity, but was based on another system, to me, I thought that was hairy.

I forget what role I played in it, but I think that was the first time that even on Apollo 7 or 8, I think, we had more things go wrong with that than we did 8. We lost the real-time system in a very serious problem. We didn't get it back during that burn, because we [unclear] and both the dynamic standby went down and so did the hardware in the control center, locked up. We found out once that happened, it was hard to reconfigure and get back. Took a long

time. We ran the mission, I think, out of Goddard and whatever we could get out of the ACR [advent control room], the offline system. We got the vectors and stuff, put them in our computer in Building 12, but that was really something.

That's the first time I understood that movie—in fact, I saw it about the time it happened, *2001*, about Hal, because that's what happened. The computer rebelled and got us all. We could never, ever let that happen, ever. That was a good experience, because what we were doing, we actually were—what happened was is when you do those major burns, what you do is, we were integrating. We were taking data in and doing almost like a launch trajectory in orbit, and getting a vector while it was burning and making decisions off of it, on how good it was going and where were your limits. That was something that we had to do also on the Moon. I mean, we had to be able to get that either from telemetry or radar data. So that part was—then we did the EVAs [extravehicular activity] and all that. That was always something.

Then it was 10, which was an interesting one, too.

RUSNAK: There they learned a little bit more about the mascons and did the dress rehearsal for the landing.

LLEWELLYN: Sure did.

RUSNAK: Did you think that was a necessary step to do?

LLEWELLYN: Sure did. I probably would have done another one, because we made mistakes.

RUSNAK: Which ones are you thinking of?

LLEWELLYN: The simulated approach, that was kind of scary.

RUSNAK: So then we moved on to Apollo 11 and finally get the landing accomplished. Do you recall where you were when they landed and then did the first EVA?

LLEWELLYN: Yes. I was on the landing team because of the abort stuff.

RUSNAK: As they were going down, they had the couple computer alarms.

LLEWELLYN: Yes. We had heard so many of those, it was just business as usual. [Laughter] I mean, I listened to it all, and I saw what was happening, and the dust and all that stuff, but I had listened to enough of it that I knew that they were going to land. I could tell that. And especially that signal [Steven G.] Bales guy. See, that was part of bad science, because we'd spent all the time getting ready to go to the Moon and then somebody finally decided, and all the scientists said we were going to kill the crew because we had something like eleven meters of sand or some damn thing like that. I mean, why tell us now? [Laughter] To me, I thought, "This is really too much," and because of the way we're doing things now, you really had to watch what you said to people. In those days, I had a real good answer for a guy like that, but in these days you had to really be careful what you were doing.

Then we put those stringers on. Did you that? Did you ever see those things? It was on there. That's good, because Apollo 9 had them on. You could see the little things hanging

down. That was supposed to touch and make sure if it was dust or something, they would abort. God, can you imagine that?

That's the thing that got me. Put this down. Really what got me, when I got into that lunar thing, did you know that they had more ways to abort than be successful? I couldn't believe that. I said, "What in the hell? I mean, we got eleven aborts and not one landing. We're not here to abort." I mean, I would go berserk with that. "I mean, why are we doing this? We didn't come to the Moon to find out how close you could get and come off. That's not what we're doing here, gentlemen."

Another one we got into is the software changes. You know, people like them right at the end, like the crew. I mean, they didn't fit them, what they wanted. They always wanted another one, and, you know, in those days nobody wanted to go back and change the software on any of that stuff. They had a hard enough time proving it was working anyway, and you put one in at the last minute, that's a good way to die.

So I'll never forget this, we got in this thing, but Armstrong wanted to look at the Moon before he—he wanted to pitch over command. We argued and this and that. I'll never forget, [Charles C. "Pete"] Conrad jumped up literally, and he said, "Look, why don't you just sit this one out and let me go. I don't give a damn if I see it or not. Okay. Just let me fly the thing. You don't even have to go." That stopped that one. [Laughter] I'll never forget that. That was the end of that discussion. We never had that software change ever come up again. That was so neat. He says, "I don't want to pitch over. In fact, I don't even want to look at it. I just want to get there."

RUSNAK: Pete Conrad was quite a guy.

LLEWELLYN: He was. He's another guy that somehow slipped through the crack and got into the new way of doing things and got caught at it. You remember all that stuff, coming back from the—he was supposed to be put in quarantine. Conrad never stayed in quarantine, as far as I ever knew. I don't think he ever stayed anywhere.

RUSNAK: I guess we hadn't heard that story about him avoiding quarantine.

LLEWELLYN: Well, that's what he was. All those guys did that for a while.

RUSNAK: Fortunately you proved that the quarantine wasn't all that necessary.

LLEWELLYN: No, in fact, a good friend of mine, Dr. Shells [phonetic], is a guy you ought to get in here. He's up building stuff with Smithville, Texas now. He's the young man that took over that after the guy—remember the guy, I forget his name, the guy that did it and had a nervous breakdown. Whatever his name was. Really a smart guy. I'll ask Bill what his name was next time we come here and listen to all that story. That whole quarantine thing about, you know—that's another one, right, that we were going to bring stuff back. Did you ever hear the story about, maybe this is—we ought to get off this thing. What time is it?

RUSNAK: It's almost 10:30.

LLEWELLYN: I got to go.

RUSNAK: Okay.

LLEWELLYN: I can't sit still more than that. I'm too old.

RUSNAK: All right. Well, we'll make arrangements for another meeting.

LLEWELLYN: Let me tell you what I was going to tell you. Did you know there was a girl who jumped into the quarantine with him and he couldn't get her out, because once she got in there it was all over? The whole place went crazy over that. You all never heard that?

RUSNAK: No.

LLEWELLYN: Nobody ever said—tells that?

RUSNAK: No. What mission was that?

LLEWELLYN: That was after Apollo 11.

RUSNAK: Oh.

LLEWELLYN: Oh, yes. Somebody ought to—you'll never heard that?

RUSNAK: Not at all.

LLEWELLYN: Ask Kraft. [Laughter]

RUSNAK: I'll add it to the list. [Laughter]

LLEWELLYN: See what he says. Serious. You guys ought to look into that. It's part of this history thing here. Whole bunch of that stuff.

Did Gene put in there about me and the submarine? I haven't read the thing yet.

RUSNAK: In his book?

LLEWELLYN: Me putting a submarine underneath the [unclear]. Is that in there?

RUSNAK: You mentioned it to us last time, I think.

LLEWELLYN: I don't know if he put that in there.

RUSNAK: I don't know if he mentioned it in his book or not.

LLEWELLYN: He said he would, but I haven't read it that much. I just read the first part of it.

RUSNAK: I think he does talk about going to requisition money for that for you, I think, but I don't remember the specifics.

LLEWELLYN: No, that's a good story. We had a lot of those good stories like that. But that's all for today, gentleman.

RUSNAK: Okay. Well, thanks again.

LLEWELLYN: Thank you guys.

[End of interview]