NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

ROBERT H. HESELMEYER
INTERVIEWED BY SANDRA JOHNSON
HOUSTON, TEXAS – 12 NOVEMBER 2004

JOHNSON: Today is November 12th, 2004. This interview with Robert Heselmeyer is being conducted for the Johnson Space Center Oral History Project in Houston, Texas. The interviewer is Sandra Johnson, assisted by Rebecca Wright and Jennifer Ross-Nazzal.

I want to thank you again for joining us today.

HESELMEYER: It's a pleasure to be here.

JOHNSON: I'd like to begin by asking you to give us a brief summary of your background and how you first came to join NASA.

HESELMEYER: I was always interested in engineering and went to Georgia Tech [Georgia Institute of Technology, Atlanta, Georgia] to get an engineering degree, but was never really much of a long-term planner, and so I didn't really think about what I was going to do for a career until I was about a senior in college. At that time it was a good time to be an engineer, because people were hiring. Companies would come to the campus, and I had interviewed with Raytheon [Company] and Monsanto [Company] and some other companies.

Then I heard that the [NASA] Kennedy Space Center [Florida] and the Johnson Space Center—at that time that was the Manned Spacecraft Center—were going to interview on campus, and a light bulb went off. I had always followed the space program from when I was in

high school through college. I was interested in what was going on in space, but I never, for some reason, thought that I could be part of it. But then the interviewers came to campus, and I thought, "I've got to go be part of that." Maybe I shouldn't have been so surprised, because I can remember where I was when I first heard of Sputnik [Satellite]. It was in high school in science class, and the teacher was telling us about that, and I thought, "What an amazing thing." And, as I said, I followed the space program.

So I hustled on down to sign up for the interviews with Kennedy and Manned Spacecraft Center, and when I got there, all of the spots were filled for Kennedy, and there were a lot of slots. There were a couple of people there for several days, and I think they were half-hour interviews, something like that, and everything was full, so I went over to the Manned Space Flight Center signup sheet, and there were only two or three left. So I grabbed one of those, but started thinking, "I'm not the only one who's interested in going to work in the space program, and I'm one of a crowd." So that was not encouraging, but signed up.

The interview took place, and it was kind of an interesting interview. What the representatives did was come to campus, and they rented a motel room and then you interviewed in their room. So I showed up and was trying to convince the interviewer what a good person I was and how enthusiastic I had become in this short period of time about the space program, because it really was what I wanted to do. He's listening and asking questions, and all of a sudden he kind of starts fidgeting and turns a little green and gets distracted, and he says, "You're going to have to excuse me for a minute." He went into the bathroom and got violently ill.

So I'm sitting there waiting, and he comes out and he's kind of embarrassed. I don't know if it was partying the night before or something he ate or whatever, but he finished the

interview and I walked out of there, and I thought, "I don't know if that's a good sign or a bad sign or my ship is sunk or what."

But as it turned out, I ended up getting a couple of offers from JSC. One of them was in the Facilities Directorate Division and the other one was for Flight Control Division, and I accepted the Flight Control Division offer and was very happy. I was thrilled to come out and become a GS-7 at $7,700 a year and go to work for the space business.

JOHNSON: Did you have any idea at that time what the Flight Control Division was?

HESELMEYER: No. I did know that they were the organization that worked in the [Mission] Control Center and we were going to do the console work for the flights. What all that consisted of, I didn't know and, at the time, didn't care. Whatever it was, I was interested in doing it.

I also ought to mention this was 1966, and the Vietnam War was in full swing. I had a student deferment while I was in college, and one of the byproducts of going to work for NASA was to able to get an occupational deferment. Before I graduated, my draft board got in touch with me and had me go take a—I guess it was a preinduction physical. I didn't have any problem. I didn't have any moral or political objections to the war, but I had learned through a couple of years of ROTC [Reserve Officers' Training Corps] that the military wasn't my cup of tea; the protocol, the regimentation, the requirement to have close-cropped hair. Mine was long. It wasn't drastically long, but I wasn't interested in having real short hair, so I'd tuck it up into my hat whenever we'd go march. Having to figure out who to salute. Just the whole thing wasn't my first choice. So I was very appreciative of having the opportunity to do something for

the country at that time, with the Cold War and the space race and all that, and not have to do the military.

JOHNSON: Talk to us about those first days when you first arrived, where you reported to, where you lived.

HESELMEYER: Packed up all my belongings and drove out to Houston. Found an efficiency apartment up the freeway. Reported to the LM [Lunar Module] Systems Branch of the Flight Control Division in Building 45. At that time I think John [D.] Hodge was the Division Chief. [James E.] Jim Hannigan was the LM Systems Branch Chief. The branch was divided into two sections. There was the Electrical Power, Environmental, Pyro [Pyrotechnics] Section, and [Donald R.] Don Puddy was the section head. Then the other half of the branch had to do with the computers and the propulsion.

So, showed up and asked them what they wanted me to do. This was in October. My first day, I reported October 3rd, 1966.

JOHNSON: What did they tell you they wanted you to do?

HESELMEYER: What we were all doing was learning the LM systems. The Lunar Module was being constructed, and our first task was to get ourselves up to speed on the Lunar Module and the systems that we would be supporting in the upcoming flights. For me in particular, I was assigned the electrical power system, and I think also pretty early on, pyrotechnics. So we had access to the drawings. We worked very closely with Grumman [Aircraft Engineering

Corporation], who was the manufacturer. They would come down here. We made several trips up to Grumman to confer with our counterparts to gain as good an understanding as we could of those systems and how they were put together, how they were designed, and how they work.

What we did with that was to start building the tools that would be used for the console work. The systems handbook was the primary one in terms of understanding the systems, and the systems handbook is each of the systems, electrical power or pyrotechnic or communications or telemetry, custom-drawn. They are simplified drawings; they're not simple drawings. But they show the layout of the entire system with symbology for the flight controller to understand exactly what the paths are, what the switching points are, what the circuit breaker points are, where fuses are, how things are put together, what performance would be expected from each part of the system; and then overlaid on that would be the telemetry points, where things were measured.

For each of those points, there would be information about whether or not it was a bilevel, an on/off kind of thing, or whether or not it was an analog, and if it was, then what the limits were, what the downlink rate was. So what you had on a foldout piece of paper was the entire system laid out such that it showed everything in the system, simplified, but as a quick reference, and converting manufacturing drawings to those kinds of things was a major activity and it took time. It took a lot of back-and-forth to make sure we got it right.

JOHNSON: How many people were working along with you on that?

HESELMEYER: Half a dozen or so. Along with me there were Jack Knight [Jr.] was one of the guys; [Walter] Merlin Merritt; [William L.] Bill Peters; Leonard [E.] Nicholas; Don [Lee] Parrish. Yes, six or eight, I would say, at that time.

JOHNSON: At what point did you start running simulations as far as getting ready for some of the flights with the LM?

HESELMEYER: I don't remember doing a lot of sims [simulations] until much—not much later—later than the initial activity of learning about the Lunar Module and putting together some of the other tools that we needed.

In addition to the systems handbook, we did a console handbook. The console handbook consisted of basically two parts. There were systems—we called systems briefs—and those were like white papers on specific subjects, and each of us were assigned several different topics, and we would learn that specific subject in depth and then write this system brief on it. Could be in the area of the EPS, electrical power [system]; it could be battery performance. It could be characteristics of some of the equipment the lunar module had; couple of inverters, and there would be a paper on how inverters worked in detail. Half of the book was this series of white papers that would help us learn and be a reference on the console for specific parts of the circuits or systems and our equipment.

The other half of the handbook was the console procedures, and that dealt with operating in the Control Center; characteristics of the console; how the consoles worked; what was behind some of the panels, so we would understand how we saw the telemetry that we saw; procedures in the Control Center on how to do certain things. We did a lot of the systems briefs. Of course,

the fine-tuning of the console procedures came later after we got into the Control Center some and started working on those.

We also started working on flight rules, a core product in terms of supporting flights, and the flight rules were a very complicated process in terms of starting with a condition and then figuring out how to react to it; what should happen after that. Those got a lot of discussion. Originally the flight rules were simply the rules. Later on there were rationale added because of all the discussion. We also wanted to preserve the reasoning behind what the rule said to do in a certain situation.

We also did malfunction procedures. Malfunction procedures, an indication of a failure was postulated, and then the procedures were written to go through the various steps to determine what actually failed. It would start with an event light or an off-nominal condition of some kind. Those covered all the systems and were very complete.

But in the very early days, we were learning the LM, working with Grumman. It wasn't long after I got there that the Apollo [1] fire happened. That was in [19]'67. It turns out I wasn't there when that happened. I was on an airplane going to New York to be in the wedding of my college roommate, and I didn't hear about that until I got off the airplane in New York. That was sobering news. When I got back to work, it really impacted people. It was somber. In the Lunar Module world, it didn't affect us directly. We kept on keeping on, but it obviously was a terrific blow to the program to get to the Moon.

JOHNSON: How do you think it affected the program, if at all, after that fire?

HESELMEYER: Oh, it affected it. It woke everybody up to the real dangers of doing that kind of work. Of course, the direct fix for the cause was one thing, in terms of wiring and little things like lost and found; if you keep track of what's in your vehicles and where it is and the atmospheres. But my recollection is it went from more than just an activity of taking what you know and putting it together for the console, it also converted it into the implications being very real for this stuff that you're dealing with and needing to understand that it's got to work, it's got to work right, and you've got to help make sure if something does go wrong, that you are capable of helping figure that out and solving it. There was a seriousness, a jump in seriousness about all this. Not that we weren't to begin with, but the fire really brought it home.

JOHNSON: Shortly after the fire, within the next year NASA had to move from that disaster to actually going to flight, Apollo 4 and then Apollo 5. Were you involved in Apollo 4 at all?

HESELMEYER: No. Apollo 5, that was the first unmanned Lunar Module flight, and I was assigned to go out to the tracking station on the ship, *Coastal Century Quebec*. The team that went out there was [James R.] Jim Fucci, who was the CapCom [Capsule Communicator]; Myron [C.] Hayes, who was the booster support person; [Robert D.] Bob Legler, who was the primary LM support guy; and then I went along as Legler's helper, in effect, or backup. Legler had a lot of experience, a lot of console experience. He'd been there for Gemini. He knew what was going on. I think I was primarily out there to get some console experience, since I didn't have any real time on consoles.

It's interesting on the ship. I remember it took forever to get there. It was stationed in the middle of the Indian Ocean, sailed out of Perth, Australia, so we went to Sydney [Australia]

to begin with and finally got there. Spent the night in Sydney and then went on to Perth. Boarded the ship. We may have waited a day or two. We were on that ship a long time. We were at sea for about three weeks, I think. We may have waited because the flight started to slip. But once we got on board, it slipped some more. So we set out.

By the way, the *Coastal Century Quebec*, I had two impressions of that ship. I had not been on one before. One of them was that it just bristled with antennae. There were more antennas on that thing than you could shake a stick at. The other thing is I was very impressed with concrete decks. It had never occurred to me that ships would have concrete decks, but it did. Why that stuck with me, I don't know, but it must have made an impression.

So we sailed, headed out to where we were supposed to be stationed. The flight started slipping. As we got on station, there was a cyclone—they're cyclones when they're in the Indian Ocean—that was headed our way, and it was getting rough at sea. So what the captain ended up doing, because the flight had been delayed and we didn't have to stay on station, was try to sail away from it, and that worked. We got out of the way of the thing. But there were very rough seas for a while.

We made a roll meter, which was basically a piece of paper taped to the wall with degrees marked on it, and then a little cardboard arrow just hung from a pin, so when the ship rolled, it would indicate how far. The biggest one I remember was something like thirty degrees, which got your attention. Thirty degrees doesn't sound like much, but it was rolling around out there. The other thing I learned—lots of people who go to sea a lot knew that, I'm sure—is that when you're taking a shower and you're standing there, and the water goes like that, too, so you have to go with it to stay getting wet.

The routine on the ship was to go to the Control Room—the ship had a Control Room—and check out equipment; stay in touch with Houston in terms of status, flight date, anything having to do with the vehicles that we needed to know. Do occasionally simulations. There was a tape on board, and the tape would be played and it would be a pass. I don't remember what all problems, if any, there were that we were supposed to look at and solve, but after you've done it once, it's no longer a surprise, and being out there for several weeks and doing the tape every so often got to be not very profitable. But making sure that the ship was ready—which wasn't our responsibility, but making sure our consoles were ready to support and we were ready to support, we did a lot of waiting.

The consoles on the ship are different from in Houston. They were tall because there were a lot of analog meters, rectangular, and they're that wide [gestures], they're that high [gestures], and the needles move up and down and you can set a little limit light on them. A lot of them. Difficult; it took some getting used to looking at these rows of meters and assimilating data from them, because they're moving, and it took some training to know what to look for and when to look for it and to see if things are okay.

The passes, the flight itself, when it finally did launch, being on a ship was a quick window once every whatever it was, ninety minutes or a hundred minutes. The attitude of the vehicle wasn't always great. The ship's moving. So it was a quick pass of ratty data, ratty data, some good data, ratty data, ratty data; and then it would go away. In that period of time we had very specific things to look for or to check for or commands that had to be sent or whatever. It was not a good place to get an overview of the flight and how the flight was doing. We just had this little window every ninety minutes and could see mostly what was going on and report on that, but in terms of the overall flight and the performance, we didn't have a good view of that.

It went okay; it was a successful flight. There were, of course, obviously a few rough spots, but the LM wasn't designed to fly without people in it, so that's understandable.

JOHNSON: Maybe you can just talk about some of those rough spots.

HESELMEYER: I don't know that much about them, and they weren't on our systems. As I recall, our systems performed as well as could be expected. We didn't have any surprises that I remember.

JOHNSON: What did you learn from that flight?

HESELMEYER: I learned I like being on ships. I learned that one needs to be prepared in advance of these passes, to know exactly what you want to accomplish and look for and determine in the limited time involved. We could sit here, and seven or eight minutes would seem like an extremely long time, but when you're trying to do a lot of things, it's an extremely short time. So that was basically the thing I came back with from there.

JOHNSON: The procedures and the flight rules that you'd been working on, did you see how those were going to work?

HESELMEYER: Not very well. Not in a lasting manner. The procedures and all are when there are people involved and when you're in Houston and you have the benefit of more continuous data and a longer operation. That was a very short flight. That thing was, what, several revs

[revolutions]. I don't remember exactly, but it was over in a flash, and it was very focused on the vehicle performance. There wasn't a lot of concern about crew interfaces and checklists and complicated or timed maneuvers with people involved to go accomplish it. It was getting this thing to work; see how it flew. It was very much a test flight.

JOHNSON: Since you came in [19]'66 and you started working with the LM right away, and you mentioned that you went to Grumman, talk to us about the first time you saw the LM actually in person, and what you thought of it at that point.

HESELMEYER: First time I ever saw one was up at Grumman, on one of our trips to Grumman, and I, like most other people, thought it was kind of ugly, but I was also impressed with the built-in functionality. It was extremely well designed in getting everything that was required for that vehicle to do in minimum space with minimum weight. Very impressive. It was a fragile spacecraft. It didn't have to have the structure and the heat shield and all the rest, because it was always operating in a vacuum, so it could stand to be fragile. It was a wonderful example of efficiently. It was ugly, but it operated beautifully.

JOHNSON: After that first test flight, what were your duties before—

HESELMEYER: More of the same. That was [19]'68. We continued on with refining our handbook drawings, developing console procedures, the console handbooks. Flight rules; lots of work on flight rules and malfunction procedures. We eventually started working with the crews or crewmembers in terms of helping them to learn spacecraft. Of course, they had lots of time in

the simulators, too. Working with them on the checklists; developing the checklists for the specific flights; becoming more familiar with the spacecraft itself in terms of the interior layout and knowing where switches are and lights were and the various controls.

Doing simulations. Did lots of sims. There were offline simulators that were mockups of the lunar module, and we did sessions on individual systems. Go in there and do the electric power system or the environmental control system, and run through operations, guided operations or scripted operations. Just to learn switches; learn what it would do. Another way to get familiar. There were, of course, the simulations in the Control Center.

There was also more and more test information available. As the LMs were being built and tested, the other set of stuff that we were interested in and needed to know was how the equipment actually performed. It's kind of like a car. You can build a car. You put the thing together, and everything fits and it's where it's supposed to be, but once you start it, cars have quirks, and each of the vehicles also could have had quirks. So as test data was accumulated, that was made available to us, and we would incorporate a power profile, power information, for example, for the electrical power; and the environmental control guys would incorporate any characteristics of their systems into our handbook, into our system briefs, into our consumables calculations. So the test data was very important. But that was our life during that time, getting up to speed on the vehicle and learning how to operate in the Control Center.

Oh, the other big thing that we did is to design a console, the console layout. What is it in the back rooms and in the front rooms? How did we want the information presented to us? On the console itself, there were panels that were events, binary kinds of indications. There were indicators that could be driven by limits on analog kinds of events. The CRT [cathode ray tube] display, each one of those had to be designed, the telemetry data laid out on the CRT, and there

were layers of those. In the front room there was one for the combination of electrical and pyrotechnic and telemetry and that kind of thing, and then in the back room there would be different displays dedicated to each one of those systems. That took a lot of time and effort to get all of the controllers to agree on the optimum way to get the information presented to us.

The communications panel. There were lots of requirements on what loops we need to have, how to lay them out. A lot of that also had to do with the fact that the telemetry, the various parameters were sampled at different rates, most of those one sample a second; but there were some that were ten. So we needed to figure out how we wanted to display that and make sure that we knew what we were looking at, because it could make a difference, knowing that you're looking at something with one sample a second versus ten.

In the back rooms there were strip chart recorders, which were flatbed—do you know what strip chart recorders are?

JOHNSON: Go ahead and explain it to us.

HESELMEYER: It's a flat bed with paper that is lined paper, and then these—I think they were 8-pin, and each pin was driven by a telemetry point, and it was like you see nowadays for hurricane seismic stuff. That's a good analogy. During the flight the paper would roll and the needles would wiggle, and we would have all this analog data on the strip chart recorders, and we'd mark significant events. Ended up with lots of paper. But deciding what to put on those recorders was another—and for what mission phase—was another set of stuff that needed to be done. So that's what we did in terms of figuring out how to design the Control Center stuff, how to learn the

vehicle, how to get our console tools built, our handbooks, incorporating the test data, working with the crews.

JOHNSON: You mentioned that the controllers would get together and decide what they wanted to see on these. How did that process work? How did you agree on what you wanted? Was it a specific process that happened for each one of these, or did one person start and—

HESELMEYER: There wasn't a specific process that I remember. Somebody might have the responsibility to do a proposal, do a layout, and then we'd gather around the table and talk about it and get everybody's comments and come to a consensus. We worked together very well. Everybody was into what was going on and wanting to do the best they could, and we worked together very well.

It's interesting, because during that time it was a mixture. Some of us were NASA employees; some were contractors. Bob Legler, I mentioned on the *CSQ*, worked for Philco-Ford [Corporation]. Lots of other—at that time—Philco-Ford people doing the flight control work in the LM Systems Branch or in the Command and Service Module. Some Air Force people were also assigned to NASA. You couldn't tell us apart; we all did the same things. The organizational responsibility was up through NASA, of course, the management was NASA, but we sat in the same room with contractors and Air Force people, and you wouldn't know the difference. We all did the same work, and it worked out fine. That was a good arrangement.

JOHNSON: You mentioned working with the crews. Was that something that you worked closely with them? How much input did they have on checklists and that sort of thing in the LM?

HESELMEYER: Yes, we did work closely and often, in terms of making sure that we got together with them on making the checklist right and that they understood what was going on in the checklist. It was back and forth. There wasn't all that much room to negotiate in terms of preferences. It wasn't a preference kind of thing. It was, "Here is activation checklist. We're going to activate some part of the equipment," and there's very few ways to do that. There's probably some variations on it, but to get from here to there, you've got to do these steps, and there they are. Now, you could maybe vary the sequence a little bit. I don't remember that was a big deal. The crews had their opinion about some things, but by and large, my impression is they went along with and understood what we were doing with those checklists and bought into it.

JOHNSON: Apollo 6 happened in April of [19]'68 on the same day that Martin Luther King [Jr.] was assassinated, and also Robert [F.] Kennedy was assassinated shortly after that. There was a lot going on in the country, and you mentioned Vietnam earlier. How did that influence the way you worked and felt about your job, if at all?

HESELMEYER: It didn't affect what we did, or what I did, much at all. I was very much aware of those events, but we were into our work. It was the same thing for me in college. Vietnam War, all kinds of controversy about that thing, and me in particular, the student body in general, were not involved in that. Where I went to school, there weren't demonstrations. We didn't even talk about it much. We were doing our thing. Working for NASA during that period of time, we

were very much focused on our thing, and the rest of the world kind of went on without us, really. At least that was my view of it. So I was doing the NASA deal.

JOHNSON: Actually, today is the anniversary of when it was first announced that they were going to the Moon on Apollo 8.

HESELMEYER: Is that right?

JOHNSON: That's right. In '68. Part of that announcement, from what I've read, was influenced by the LM not quite being ready to go on, and they wanted to move this up for a lot of reasons. When did you first learn that Apollo 8 was going to happen, and how did that affect what you were doing?

HESELMEYER: I don't remember specifically when I heard. I assume I heard it when it got announced. We may have known that before, but that was Program Office policy-level kinds of things, and I was a flight controller doing very focused flight controller things, so I just listened and learned what was going to happen next. My opinion of that was that that was a drastic decision. I know there was a lot of talk about doing it without a LM, without having some kind of backup, originally. So that was a bold move, and worked out very well. I was just down there trying to get going, trying to get ready for a LM flight, which was coming up.

JOHNSON: Were you in the Control Center during Apollo 8?

HESELMEYER: Not that I remember, no. It was not a Lunar Module thing.

JOHNSON: So talk to us about the next one, Apollo 9.

HESELMEYER: Apollo 9, I have a very distinct recollection of Apollo 9 being a sense of risk. Just like Apollo 8 going to the Moon, Apollo 9 was detaching—the LM being all by itself, and no way to get home without re-rendezvousing and docking. I was very impressed with that being a risky thing to do. New, new spacecraft, first time people ever been flying in it, and to be in a situation where you didn't have any backup if you couldn't get it back together was dangerous.

It impressed upon me one more time that this is a risky business, and you' got to take some chances. So that flight, I worried about it, because I was confident enough in the LM, but it was a first time. Apollo 9 was test-flight kind of very fast. It had to behave. The LM had to work right on [Apollo] 9. From the standpoint of our systems, it did. I was trying to remember if there are any significant things to talk about on 9.

JOHNSON: What about some of the simulations getting ready for 9? Do you have any specific memories about any of those or how well they ran?

HESELMEYER: I remember a lot of them. I remember lots of simulations, and an overall impression of they did fine. They accomplished what they were supposed to do. Sims are always—you just sit there waiting for something to happen, and it was a good test of your—

sharpened not only your knowledge, but your ability to use the tools that you had to figure out what was going on.

I don't remember if it was an Apollo 9 sim or not; I do remember one specific sim, probably because it was unpleasant. I was in the back room. I was an SSR [Staff Support Room] guy, electrical system; electrical and pyro and also the communications, instrumentation and communications stuff. There was a failure. We lost some telemetry parameters. They were just gone, and I couldn't figure out why. I think Don Puddy was the guy in the front room. The sim was going on, and we had lost these telemetry parameters, and he was wanting to know from me why we lost them. I never did figure it out.

After the sim, it turned out that what was simulated was that one of the umbilicals that runs between the ascent and descent stages was inadvertently cut by the pyro device, and so the signal, the signals from those transducers were lost. But it was a mixed bag of stuff. So I remember not figuring that one out, and I felt bad about it, which is probably why I remember it. But by and large, the sims were very helpful and ran well. I liked sims, and there's folks used to like to tell sim stories, but I don't have any of those.

JOHNSON: How are the shifts determined in the different positions in the different teams with the Flight Directors?

HESELMEYER: How they were determined is that my management would work with the Flight Directors and Flight Control Division, and they would put together how the shifting would go. It was some combination of—there wasn't just teams of people who worked together; we would be assigned for various flights to the various shifts. I don't remember any specific guidelines. I'm

sure there was some account taken for newer people working with older people. A "newbie"; when I was a new guy, I would be paired with an older, a more veteran person. But other than that, I didn't have a lot of insight into how that—or I didn't pay any attention to it. I did my shifts.

JOHNSON: As you mentioned for this flight, Don Puddy, for the simulation, he was in the front room. How did that relationship work between the back room and the MOCR [Mission Operations Control Room]?

HESELMEYER: The MOCR position for our part of the LM Systems Branch was responsible for a certain number of systems on the Lunar Module, and as I said earlier on, we had electrical, environmental, pyrotechnic, instrumentation systems, and so that was our whole realm of responsibility. In the back rooms, in the SSR, were divided up into a couple of consoles, and it was essentially split in half. It was the electrical, pyro, instrumentation guys on console, and then separate consoles for the environmental. Thinking back on it, they're really two different kinds of disciplines. The electrical and pyro and that kind of thing is wiring and electrons and signals and stuff like that. With the environmental control systems, there was a lot of pressures and temperatures and pipes, and that's a different deal.

So the guy in the front room had to know all of that; had to be familiar with those two different kinds of disciplines and all those systems. In the [front] room, Don Puddy having to worry about all of it, and then in the back room, the electrical guys could concentrate on their systems, and there was a regimen of events to report, prescribed, how things are going at

different stages, and then anything that looked funny or was off nominal would also get reported. It was pretty straightforward.

We also had access to the SPAN [Spacecraft Analysis] in the front room normally, but the back room could also ask questions of the Spacecraft Analysis room, I think it was, where the Program Office folks and representatives from the contractors were either in residence or could be contacted.

JOHNSON: Rusty [Russell L.] Schweickart actually had an illness during that flight. How did that affect—since he was the LM pilot?

HESELMEYER: We didn't learn about that till after the flight. I didn't. Now, maybe some of the other folks knew about it. It did not affect what we did in that flight in any significant way at all. I remember being surprised when I heard about it, because it sounded like it could have been a problem, and it was for him. But in terms of the flight itself and meeting those flight objectives, as I recall, the Lunar Module met all of its objectives. Rusty had a rough time.

JOHNSON: Before we move on to Apollo 10, I think we're going to take a break.

[pause]

JOHNSON: Let's go on and move on to Apollo 10. What are your memories of that flight and some of the simulations, maybe, getting ready for that?

HESELMEYER: I have no specific memories of Apollo 10 in terms of significant events associated with it.

JOHNSON: In my notes I have that the LM began some wild gyrations as they were getting ready to separate, but that doesn't ring a bell?

HESELMEYER: Vaguely it does, but that's not an electrical, environmental, pyrotechnic, instrumentation thing.

JOHNSON: So nothing specific that you needed to deal with.

HESELMEYER: Right.

JOHNSON: You want to move on, then, and we'll talk about Apollo 11 and maybe some of the simulations getting ready for that?

HESELMEYER: Okay. With respect to Apollo 11 and even 10, though, there is a little background that maybe I ought to mention. With the electrical power system, one of the things that I had worked on with a man named [F. R.] Fred Wentland, who was an Air Force officer, was to develop an analogy of the electrical power system in the Lunar Module in a drawing that was an analogy of it, with resistances and capacitants and what have you. It was an equivalent network.

We took that to TRW [Inc.], and TRW converted it to a software model, and that software model became the model that we used to predict LM electrical consumables. It was

called SEENA, and it stood for Spacecraft Electrical Equivalent Node Analysis or something like that. I made the last part of that up, but it was something like that. But it was important because it was a model that then—I mentioned test data earlier. When testing was done and we saw how much electricity the various components used, we could put that into this model, and it became the tool—we gave it to MPAD, Mission Planning and Analysis Division. They did a lot of the consumables work. It was the Lunar Module electrical consumables tool. That's the one that was used to do predictions on various flight profiles on consumables, and we used it to track actuals during flights, and it was the tool that was used by the LM EPS consumables position, which was one of the positions in the Control Center for—it was a separate position, I think, for only two or three flights, [Apollo] 11 being one of them. That's what I was for Apollo 11, and that's kind of the reason, is because I'd done all this work on the consumables and that tool.

So Apollo 11 was, of course, a significant event. I was a consumables guy, so I did not do a lot of the normal different flight-phase simulations in terms of monitoring the system and the system performance and looking for anomalies and having to deal with, during simulations, the problems that were thrown in and needing to solve the problems or recommend the alternate approaches or whatever. So that was not, for me for Apollo 11, a major role, because I was worrying about consumables for the LM.

For that flight, because it went okay for the LM and the LM consumables and the lunar module in general, I wasn't so much in a tunnel, so I got to be a little more aware of what all was going on with that flight, and I was really getting the landing done with the computer alarm and then with the consumables, the low-level consumables. That was dicey. That was a most impressive performance by those guys, [Neil A.] Armstrong, and [Buzz] Aldrin. They did good.

JOHNSON: Can you walk us through your memories of that actual landing and getting through that and what you remember about that moment?

HESELMEYER: Not a lot. I was listening to it and worried about the—I didn't know anything about the computer and the computer alarms, and wondered, just like everybody else, how serious that was. Then the consumables, the low level, that was just a matter of hanging on and hoping that they could get it on the ground before they had to punch out. It worked. So I was just sitting there rooting for them.

When what happened, while they were on the Moon and even after the flight, I kept trying to get in touch with the reality of that. It was, for me, mind-bending in terms of connecting with it really happened. They really got there, really got back. I concluded that it was probably going to be some time before that really sunk in, and it was. Still is. Still think about that. Of course, it's been some time now, but you think about that and think, "Man, amazing." And done on the fast track, in terms of the vehicles; in terms of the limited, by today's standard, computing capacity; the ability of the Flight Control organization—the whole organization, not just Flight Control, the Program Office—to make hard decisions without having to convince [United States] Congress that it was the right thing to do at the time and have it debated back and forth, but to get on with doing something pretty amazing in an efficient way, and as safely as we all knew how to do it.

Of course, everybody knew it was fraught with opportunity to have serious problems, and the fire proved that. But everybody was so aware of—the safety part was built into us. That was just part of our culture, and maybe I guess that's what NASA is trying to—it's always been part of NASA's culture.

JOHNSON: There was a problem right after they landed. I don't think it was something that was well known at the time, but the pressure and temperature rose in the descent-stage fuel lines in the LM. Do you have any memory of that issue at all? There was a blockage that occurred, I think.

HESELMEYER: When you said it, it sounds familiar, but that wasn't my part of the thing, so it wasn't something that I would help with, no.

JOHNSON: Are there any other memories about that mission that you'd like to share?

HESELMEYER: Other than it was just such a milestone. It's hard to state adequately being able to accomplish that and then look forward to doing it again and again. I can remember during that time, though, walking from the Control Center back to my office and looking up at the Moon and saying, you know, "That's where those guys are." It was across where the ponds are on the JSC campus, and back then the deer would show up by the ponds, and so there you are at night with the deer around the ponds and the Moon up there and thinking, "This is really kind of surreal." For a guy who was trained as an engineer for technical stuff to start thinking surreal thoughts was a breakthrough.

JOHNSON: You were very young at that time, also.

HESELMEYER: Yes, yes. We were all young at that time, many of us. I think back sometimes, too, on how young we were and what all we did. Of course, now all the folks in the Control Center look so young, and I have to remind myself that, hey, that's the age where you do that stuff.

JOHNSON: It's probably the best age to do that stuff.

HESELMEYER: It certainly is helpful from the standpoint of not only the enthusiasm, but also the endurance, because it took endurance. Between simulations and trips and some of the stress level associated with that activity, it took somebody who had the energy to stay with it, yes.

JOHNSON: Very long hours and lots of time spent up there.

HESELMEYER: Yes, long hours. Of course, the flights were events. The Apollo flights were events, and then you get back to regular hours for the most part. Long days, but regular hours. It wasn't quite the same thing as Skylab later on, where you actually did a lot of around-the-clock stuff for a long time. We'll talk about that later.

JOHNSON: Let's move on to Apollo 12, then. Did you have the same sort of position for Apollo 12?

HESELMEYER: On [Apollo] 12 I think I was in the SSR as the system monitoring guy. I don't have a lot of distinct memories of 12 other than 12 was the lightning strike. Did not do anything

to us, so in the performance of the lunar module, I have no specific recollections of events on 12 that gave us undue trouble.

JOHNSON: I wasn't sure how involved you were or if you had any memories.

HESELMEYER: I was a Staff Support Room systems monitoring guy. Of course, that was a second landing, so there was a lot of getting ready, lot of simulating, a lot of making sure that we would do it as well as the first time. It is always tense, and maybe I sound like I'm underrating that, but I should not.

The flights were—you're always on edge a little bit because of what's going on, and the whole operation of getting the LM, getting the Command and Service Module turned around, dock to it, getting it extracted, checking the thing out, coasting, keeping temperatures where they ought to be. Then the whole lunar orbit get—well, getting inserted, but we didn't do that, but then the whole lunar orbit exercise and landing is a tense environment. So all of us are very alert and very on the edge of our chairs, looking at what we're responsible for and ready to try to do what we needed to in case something went wrong, but by and large, for our part of the LM system, things behaved.

There were always quirky things. I mentioned earlier about how vehicles perform. Each of the vehicles perform a little differently, and so we were very attuned to what nominal performance was. But that was a theoretical nominal, and each vehicle might—the batteries would share the load a little differently. Some of the equipment took more or less power. The telemetry would change a little bit, and we would have to adjust for that between flights. We always watched all that very closely and stayed very much in touch with exactly what was going

on. So we were engaged up to our eyeballs in all of this, but once the flight happened, and you're going along with it and concentrating on it, when things go well, then that's a good thing, but it doesn't leave you a lot to talk about afterwards, other than it was a success.

JOHNSON: In the research I've read that part of the controller's job was, as you mentioned when things were nominal, you knew what that looked like, and it was looking for numbers that weren't right and picking those out, and then the communications between and knowing when to actually assume that something was wrong or to make those statements. As far as the relationship between the back room, since you were in the back room up until this point, and the ones on console, were there times when you saw things and you had to make that decision whether you brought it to the attention of the person on console? How was that decision made, and what were the criteria as far as making those types of decisions?

HESELMEYER: Communication was very free between the back room and the front room, and we could talk about anything that we needed to at all. There was no danger of the back room guy calling the front room and saying, "Hey, this looks funny," and the front room guy saying, "Don't bother me. No, it doesn't." We knew the measurements, the analog measurements, to the extent that we knew when there was noise or the bits were just flipping by one, and the amperage on a battery would just flip a couple of tenths of a volt.

For example, the four descent batteries on a lunar module, we could sit there and watch those and know that the telemetry on this one is steady and it's good; the telemetry on this one is fine; this one over here, for some reason it's bouncing around a little bit, and that could be the battery, that could be the instrumentation, it could be something in the processing. It was

perfectly all right for the back room to call the front room and say, "Look at battery number three. Looks like might be some goofiness going on there, and I'm going to watch it."

That's when maybe the controller would go look at their system brief on the batteries and see if there was some condition that, through testing or through information from Grumman, had been uncovered that that's a battery characteristic, because during a flight phase, where it's being cold-soaked more than normal. Something like that. As that condition that didn't look quite right was being worked through, the front room and the back room would communicate with each other about it, yes.

It was, in general, not too tough a call to know when something was probably just off-nominal performance, but not bad performance, just not exactly what you thought you were going to see, versus something that looked like it might start trending toward being a problem. We worried as much about trends as we did about events. A battery normally doesn't just stop, but batteries can get sick and start to not work as well as they are supposed to, for a number of reasons, and we would watch the batteries over time.

We knew how much each battery was loaded to, to begin with, what the amp hours were, and then as the flight went on, how much power was being drawn from each of those batteries and what was expected from each battery as it was being depleted. There were curves. We had exact curves on the battery and what the voltage should look like for the load and at what point in the life of the battery we could expect it to start trailing off. All that came from a lot of test data with the batteries. So we were in tune with how our batteries were doing, and we knew exactly where they were on their curve, and it was easy to see if something—it took some time, but it would become obvious when things weren't quite what they were predicted to be.

Same thing with some of the equipment. There were inverters on the LM to convert the DC [direct current] to AC [alternating current], and we knew how those things worked and how they responded to various fluctuations in voltage, so we could watch those things pretty closely. So it was not a matter of sitting there during, for example, translunar coast, when things are pretty benign. Oh, that's not good; we didn't have much telemetry. But when things were benign, and we were just watching telemetry, waiting for something to break—not true. We were looking at performance of various kinds all the time.

JOHNSON: The procedures and the mission rules that you mentioned early on that you were working on, were those updated with each flight? Were you continuously adding to that?

HESELMEYER: Yes. If there was any significant change in the configuration, and I don't remember any of those, but as performance changed, it may affect a flight rule. Simulations affected flight rules quite a bit; the simulation experience. The sim guys, of course, were out to—and that's where a lot of the stories come from—the sim guys were out to get the flight controllers, and it was a friendly competition, but it was a serious thing. So the sim guys would study our systems handbook drawings, and they would listen in on our discussions of various things. They'd read our system briefs. So they were armed with all kinds of information on how to see if we really knew what we were talking about, having produced these things.

Flight rules was probably the best example, because we would sit around a table and postulate a failure and then talk our way through—based on when it happened, of course, and a lot of other factors—okay, what should we do about it? What is our decision? Sometimes that wasn't always absolutely straightforward, but we could get pretty convinced that we were right,

and then the sim guys would run a sim and they'd fail something, and then we'd try to invoke our rule, and we'd find out later on that probably there were some other things we could have done.

It's different when you're sitting around, the same group with the same mind-set, figuring it out, and then when somebody's got to go explain it to the Flight Director, who may or may not think that's the best thing to do or something that you want to do or maybe it's logical, but it's not right for some other reason. So the flight rules did get changed as time went on, as necessary, as experience taught us.

I mentioned earlier about flight rules rationale. I don't remember when we first started doing those, but the flight rules document started having a rationale section for the very reason that there were cases where a flight rule was written and then because of a sim or some other discussion, we'd start trying to remember why we decided that. Sometimes it wasn't always clear, and so we started writing down our rationale, and that helped a lot.

JOHNSON: With Apollo 13, you moved from the back room into the MOCR. If you would, describe that position and when you were first assigned, and some of the preparations that you were making for that flight.

HESELMEYER: The preparations were for MOCR duty and expanding my base from being the SSR person for the limited number of systems to the MOCR person for the whole vehicle, and that was not trivial, because the environmental control systems are a whole different kind of thing. That's gases and pipe. Trends are different. Gases act different than electrons. The systems are used differently. There are relief valves and all kind of things that took a lot of

learning. Of course, we all knew the basics, but getting familiar with the system in the same manner as the ones you've always lived with, in terms of how the equipment performs, what the quirks are, what the trends are.

Gases are trickier, because pressures change with temperatures, and you've got to know what your temperatures are. You need to understand during what phases, what the temperatures are driving the pressure to and what variations you can expect. So it was a very large learning process to get proficient in all the systems. That was number one.

Number two was the difference between being in the back room and reporting to the MOCR operator, who was the person you work with all the time—friends with, went out and drank with, and very comfortable, although very disciplined when the time came—to being in the front room. It was a little bit like getting into a management position. You now have people who are reporting to you, their responsibility is to report to you, and you are now depending on their expertise in some areas, and so you have to look after that.

At the same time, you are now reporting up and out from LM to the Flight Director, and that's a whole different deal. The Flight Director is expecting crisper communications. I had mentioned earlier that between the back room and the MOCR you could say, "Hey, this is looking a little goofy, and I'm going to think about it, and I'll let you know." You don't normally do that with the Flight Director. There's, of course, the protocol kinds of calls that you make, but then in terms of how your vehicle is performing, it needs to be a little more defined, like, "Everything is okay," or, "Something isn't, and here's why." It would be fair to say. "There's something funny going on here." But it's a businesslike discussion. It's not a casual, you know, "I'll talk to you in twenty minutes and see how this is looking."

So the atmosphere is all different, all different. The weight of responsibility shifted a whole lot more than the distance from the [back] room to the MOCR. You're out there and you're responsible for more things at a higher level, yes. I felt that, yes.

So there I am on [Apollo] 13, on my very first shift. They're doing a housekeeping. That's the only reason I was there. Normally, no LM people there anyway, but they were doing a housekeeping. I was on the white team; I was on [Eugene F.] Kranz's team. My guess is that that was no accident. You asked earlier about how staffing is determined. It's speculation on my part, because I don't know that I knew that at the time, but I was the new guy, and so my guess is Kranz said, "I'll take him and keep an eye on him," kind of thing. So that's probably why that happened, although I don't know it for sure.

So a translunar coast and they're going to the LM, and I'm sitting there and did not have any specific things to do. Could watch the current being fed to the heaters, but I was thinking, "They're going to get in there and they're going to see something funny, and they're going to ask about it, and then I'm going to have to figure out." Because the prelaunch configuration is what it should be, and they're going to say, "Why is this switch like this?" And that thing's going to come down, and I'm going to have to deal with it. I'm thinking, "I don't know why it would be like that," but had ways to find out. It was kind of the nervousness of being there, first, and wondering what was going to happen.

Then, of course, the accident happened. The tank blew. I am right next to Sy [Seymour Liebergot]. I'm here; Sy is here [gestures]. So I had a bird's-eye view of Sy's console lighting up like a Christmas tree. The consoles have all these indicators, and there's reds and greens and yellows. His console just glows, and it happened very rapidly. A lot of things not right very quickly, and Sy's trying to deal with that, and I'm sitting there looking at that, thinking, "Sy

really has a problem." But his problem initially was just too much data too fast. There's no good way to reconstruct when all the result is right there in front of you. It's so much easier, obviously, if it's simpler, but also if it's sequential, and that didn't happen.

So Sy was struggling with that, and initially, of course, thinking it was instrumentation, which is kind of logical, because our training did not prepare us or lend us to expect catastrophic things. We were single failure, double failure kind of mentality. So he's thinking it must be an instrumentation hit, and it's another one of those deals—I don't remember the exact time sequence, but it wasn't all that long a time before it did become obvious that there were serious problems. The crew helped, of course, with their calls. So it evolved. What appeared to be slowly was actually pretty crisply—it was probably within ten or fifteen minutes—that there was a serious problem, and people pretty much knew what it was and that the LM was going to get involved.

I made the call to Kranz when the current to the LM went to zero, and I did that simply because it happened, and I wanted him to know everything that was going on. Of course, he was worlds away in the other problem, but he acknowledged it and said, "Okay. Yeah, thanks," and then went on with his serious problems.

I alerted the back rooms to the fact that it was looking like we were going to have to get the LM, that the LM was going to be used, and that we needed to start thinking about what that meant to us. And it meant several things. The immediate thing was getting the LM powered up, which wasn't complicated, but it was unique, and it was one of our little procedural things. We knew how to do that; that was not hard. Having the crew in the LM for some extended period of time meant that we had to worry about consumables, and so the guys started looking at what

consumable usage could be expected. It was also obvious, without looking at any detail, that we were going to have to conserve, and we were going to have to do some powering down.

I can remember sitting on the console, thinking that we had lifeboat procedures, but I couldn't find them. So I called around, called SPAN—everybody was on alert—about what we needed to do, and it turns out that after—this is after the flight. The thing about lifeboat procedures, there was some things written up about why didn't you have them, what were they, who had them, who wrote them. Jim Hannigan shed a lot of light on that for us, because he took some umbrage with the fact that there are other folks taking credit for developing lifeboat procedures, and so he and Bob Legler did some research, looking back on how the lifeboat procedures came about.

What they determined is that back on Apollo 10, there was a simulation that had a service module—helium tank, hydrogen?—one of the tanks, massive leak, and it looked like it was going to disable that vehicle enough to where the LM was going to have to be used for an extended period of time. The sim itself didn't run long enough to get the LM real involved, but as a result of that, the discussion was, within the LM organization, within those of us, we needed some lifeboat procedures. There was a set of those kind of started to get put together. It was a skeleton of lifeboat procedures. But as time went on, it became more and more obvious that there wasn't going to be a crying need to include those in our regular console set of tools, because it was such a far-out failure that would cause us to need them. So they didn't get fully developed and just were kind of hip pocket.

For my part, I must have been aware that that was going on. I don't know that I was a principal, one of the people in the branch who was going a lot of work on that, because as I sat there during Apollo 13, I had memories of there being procedures, but I didn't have them, and I

didn't stop to worry about it that much at the time, about where they were and all. So it has been determined for the record that the LM Systems Branch people did put together the first set of lifeboat procedures.

So during 13 they were getting themselves to open the hatch, getting into the LM, and amongst all of that, shift change happened, and I turned the console over to Merlin Merritt, who was the TELMU [LM Telemetry, Electrical, EVA, Mobility Unit Officer] guy. I need to tell you about TELCOMs [Telemetry and Communications Officer] and TELMUs, too. The TELMU coming on after me, and then Kranz and the rest of the team retired to one of the SSRs to deal with where we were going to go from there.

So Kranz got us back there. I had called in all the help I could get, so there were TELMUs there. What ended up happening is that Bill Peters, who was the lead TELMU, was there, and Gene decided that in terms of supporting his white team, tiger team, offline, develop the checklists to conserve LM consumables and to get the guidance, all that kind of business taken care of, that he wanted Bill there to support that, because Bill was much more experienced in the MOCR, and I was the new guy in the Control Center. I think I was only there for that initial meeting, and then Bill took on the responsibilities of negotiating the checklist and what would be powered down and when and why and all that. Then I was reassigned back to the console, so I went back to systems duty for Apollo 13.

I remember that that shifting had me back on console within a fairly short period of time, like eight hours or something like that, so I didn't even bother to go home. In the Control Center there was a dorm, a small dorm with some bunks where people could go rest. So I just went up and sacked out in the dorm room. I woke up sometime during that night absolutely soaked. I think that's where the stress of this thing must have first come out. I slept in my clothes, and I'm

soaking wet. Went back to sleep; got up. That was five or six or seven hours, something like that, and then had to go back down and sit on the console for another whole shift, not having changed or washed or anything. I was probably not the most popular guy. But I have a distinct memory of having tried to get myself cleaned up and going again and then going back and sitting on the console, and watching those now very critical LM systems and making sure that vehicle was still doing its job.

The whole flight was nerve-racking. Later on that flight, one of the descent batteries gave us some trouble. It was venting. From the telemetry, it was not obvious. It's one of those deals where you couldn't tell the battery performance from the telemetry uncertainties, and so we couldn't find it. We didn't know at the time it was a battery problem. I think it was something causing the vehicle to drift a little bit, and people were looking for what it was. Then there was this bang and snowflakes or something like that, after the initial accident, and it turned out that it was one of the descent battery cells had shorted, and it had been working up to it for a while, but it didn't show up in the telemetry enough to be able to find it. In that situation, you're worrying about everything all the time, and that battery performance was not welcome, but it turned out that it also wasn't critical, so we got through that.

Me, personally, I was always of the firm opinion that those guys were going to get back. Maybe I never allowed myself to think that they wouldn't, but I just knew they were going to make it. That also may have been from the standpoint of—although I don't think so—of not understanding how complicated it was, especially, especially to get the CSM [Command and Service Module] back up and separated and the Command Module powered up and the guidance system aligned and all that. I just knew it was going to work, and between the flight controllers and the crew and all that, we had done enough of this together to know what we were capable of

doing, and this was within the realm of getting it done, unless something else happened to the vehicles. So I thought it was going to be okay.

I also remember, when I finally did get out of the Control Center and went home to get cleaned up between shifts and turned on the television, I was amazed and impressed and touched by the world attention to that problem. I was in awe of how many people in how many places, friend or not, who were paying attention to this drama that was playing out. For that little period of time, it brought the world kind of closer together. Unfortunate what it was, but that was a byproduct that was positive in my mind, that people were coming together on this thing. So I'm impressed by that.

What else about 13?

JOHNSON: How many times did you end up working on console?

HESELMEYER: Oh, a bunch. Yes, from the accident till the end of the flight, I was doing a shift. I was one of the three twenty-four-hour shifts.

JOHNSON: Sort of an initiation by fire.

HESELMEYER: Oh yes, it certainly was. But then getting back on console, thinking about it now, it was probably made a little easier because there was so much stuff not on, and so there was less to do. There was a lot more to worry about, but there was less to watch. That's what I trained to do; I was system guy and I could watch this stuff, and I had help in the back room, and so that was not a problem at all, keeping an eye on what was happening with those systems. Then by

the time it came time to transfer back, get powered up and all that, then Bill came back and I was not on the console for the power-up and the entry and all that.

JOHNSON: Were you in the Control Room?

HESELMEYER: Oh yes, but I didn't have the specific responsibility, so I could help. But, yes, it was an exciting first flight in the MOCR.

JOHNSON: When they actually did splash down, can you describe what it was like inside the MOCR?

HESELMEYER: I knew they were going to be okay, so I was deliriously happy for them, and, yes, the Control Center, I mean, it went wild. It was the Hollywood end to that sequence of events, with everybody clapping and cheering. But it was a real-world deal. Everybody was very relieved and ecstatic that they'd pulled it off. The hardware held up, the people held up, and they got back.

Speaking of the people holding up, it is hard to overemphasize the hardships that the crew endured in those vehicles during that flight. I think of it as living in a refrigerator in a t-shirt for four or five days. It had to be awful. Not being able to sleep, always being cold, and then needing to summon the concentration, under those conditions, to generate new and complicated checklists. They're hard enough to do when you're in the comfort of your own office and conference room, but to have to copy it down and to understand it and to be able to do some very

specific and unique kind of operations you've never done before, it was amazing. Those guys are just amazing, that under those conditions they could do it.

Of course, all the ground support was huge. We had to take care of the LM, but the simulators were up and running, and there were people running scenarios on how to make the transition back happen, and, of course, the crew systems guys did the lithium hydroxide gizmo, and that was a piece of nice work. There was an earlier version of that that we'd kicked around—not me, Jack Knight had thought it—about trying to use a suit, trying to hook things up to a suit and get a canister in there, but that was just a preliminary kind of thought.

JOHNSON: You mentioned, when you were talking, that you needed to tell us more about TELMU and TELCOM.

HESELMEYER: The call signs. The call signs changed. It's not a big thing, but the front room for our part of the LM started off being TELCOMs, and that's what it was for the early flights, [Apollo] 9 and 10 and 11, I think. It's supposed to reflect the systems we're responsible for, telemetry and electrical and the EMU was the—I don't remember. It was not an exact acronym, but it tried to reflect the systems. TELCOM was telemetry, electrical, and communications, I think.

Then with the lunar surface operations and the backpacks and that kind of thing, that was in the branch and reported through that console position, or part of it did, then we changed it to TELMU to reflect the EMU [Extravehicular Mobility Unit] kind of thing, and then the console position was TELMU from, I believe, [Apollo] 12 on. TELCOM always had a better ring to it to me than TELMU. TELMU always sounds a little—I don't know, but—

JOHNSON: Since you lived through Apollo 13 and you were there, how well do you think the movie captured that experience?

HESELMEYER: You know, there are two movies on Apollo 13. The most recent movie I thought did a nice job. Ron Howard—that was a Ron Howard movie, and he did pretty well. I thought that movie was a good reflection of what happened. You have to get past the Hollywoodisms and the dramatic this and that and the other, but in terms of following the scenario and like that, it was good.

There was an Apollo 13 movie made a few years after the flight. That was back when *ABC Monday*—y'all may not remember—*ABC Monday Night Movies.* ABC made a movie called *Thirteen, We Have a Problem*, [*Houston, We've Got a Problem*, 1974] something like that. It was an *ABC Monday Night Movie*. It starred names. There were some names in that movie, Robert Culp and Sandra Dee and Clu Gulager, people like that, so it wasn't people with no names.

For extras, there was a call for flight controllers who wanted to be in this movie could be in the movie. So I had my first movie experience. I decided along with some of the other flight control guys to be in this movie, and what we were were extras. We were crowd-scene people. But in the process we got to see how the movie was made, and a lot of it was filmed in the Control Center. So we would sit around. We'd need to go over there, and we'd sit around and we'd watch them set up the lighting, and set up the lighting, and reset up the lighting. Then the sound had to get done right, so the sound had to be adjusted, and then people had to get their cues, and the cameras need to be positioned. It was long periods of intense boredom.

I only remember being in one scene in that movie, and it was when Kranz, after the accident, takes the white team into the SSR and charges us with what we've got to do to get the spacecraft powered down and all this. So I am one of the flight controllers who's behind one of the consoles listening to the actor give us this pep talk. So we listened to him give this pep talk, and then we're all charged up and we walk out of the room. For me, it was not a pleasant experience. I didn't like it. All the waiting and then all the prepping, and then all the do the take and then you do another take, and then you reposition that, and you do another take. To this day, when I watch a movie, I am aware of all of the rigamarole that goes on into making five seconds of screen time as perfect as you can make it.

And to boot, the movie was awful. The whole story was a soap opera built around the Apollo 13 accident. One of the characters—I forget who he was playing—has a heart attack in the hall outside the Control Center. Somebody else is having marital problems, and they're going into all that. I saved the clipping; I have it at home somewhere. When the movie ran on ABC Monday night, it received the lowest ratings of any Monday night movie to date. So that was the first 13 movie.

There is an excellent book on Apollo 13. A lot of books have been written. Henry [S. F.] Cooper [Jr.] wrote a book called *Thirteen: The [Apollo] Flight That Failed*. It's probably not in print anymore. I believe it came out in [19]'72; it was not long afterwards. '72, '73, something like that. It was serialized in *The New Yorker* [magazine] and published as a book. He interviewed all of us at the time and got us while our memories were a whole lot better then than they are now, in terms of what happened from the Flight Control standpoint, and he put together a book, and that's the best narrative of the story of Apollo 13 from a flight controller's

standpoint. If people want to read about that flight and see what happened in the Control Center, that's the one I recommend to them.

JOHNSON: After that flight—

HESELMEYER: After that flight, things were peachy. Not altogether peachy, but then the follow-on flights were obviously successful, and I stayed in the MOCR and was a MOCR operator, same position, same responsibilities, through Apollo 16. Those flights, again, by and large, they went just fine.

On I believe it was [Apollo] 14, there was a period of time on the lunar surface when the LM was losing cabin pressure, and it was very slow. It was one of these trend deals, and it was slowly going down, another thing that I probably remember because I couldn't figure out what would be doing it. The back room guy, who was supporting me, we were talking about where can this be going, and we were looking at switch positions and what could be leaking. Crew was asleep. That was the other thing. The crew was asleep, and so we couldn't get them to verify things without waking them up.

[M. P.] Pete Frank [III] was the Flight Director, and Pete kept saying, "What do you want to do?" We only had a certain amount of time, because as the pressure went down, the master alarm was going to go off and wake the crew up. He didn't want the crew to wake up with the master alarm. If we needed to get them up, he wanted to call them.

I couldn't find it, so I told Pete, "We can't see enough to know what it is, and we haven't been able to figure it out."

So they called the crew, woke them up, and said, "There's a little bit of a leak," and the crew knew exactly what it was right off the bat, because it was a valve that they left open that had to do with the urine system, and you open the switch and it creates a little bit of a vacuum. They closed it. So there's this teeny tiny little leak that the crew had to get up to shut off the valve. I would like to have been able to have figured that one out, but I didn't.

JOHNSON: Are there any other memories about [Apollo] 15 and 16 that you're aware of?

HESELMEYER: Not pertaining to my responsibilities. It was more of the same. It was a wonderful experience being in the MOCR and supporting those flights.

There is one impression. It's not a specific system-related or LM-related. Lunar surface operations were very deliberate, were very slow, and I noticed how quickly the public seemed to lose interest in this fascinating thing because it was so slow, people walk slowly, and get down the steps slowly. Even with the [Lunar] Rovers, which put some more mobility into it. It was my impression that there was something going on here, and what was going on is that the public was getting used to it. It's kind of the standard thing. Same thing happened with the Shuttle Program. You've done an amazing thing. You've done it twice; you've done it three times, and after a few more times, even though you've had a wakeup call with the accident, can't help it, it starts becoming a little routine, and people drift. I was sorry to see that.

I remember being a little disappointed when I was asked to transfer after 16 and not support 17, to go start working on Skylab.

JOHNSON: I think we're going to stop for a second and change the tape out again.

[pause]

JOHNSON: Speaking about those last Apollo missions and the Rover—you mentioned the Rover—the LM had to be somewhat adjusted to accommodate different weights and everything with those last flights. Did that affect your job at all?

HESELMEYER: Not in any drastic way. I don't remember any changes that we needed to make that significantly changed our operation. There were some adjustments over time. I think maybe after [Apollo] 15 it was noticed that the descent batteries operated better if they were cooled, a little cooler than they had been, and so there was a mod done to get some cooling to those batteries to help their performance. Tweaks, not major changes.

JOHNSON: While the crews were actually on the surface of the Moon and out and about, your job was monitoring the LM, the systems, just to make sure everything was nominal during that?

HESELMEYER: Right. That's correct. There was a separate group of people who did the EVA [extravehicular activities] activities and the backpacks. That was like a different vehicle, and not all of the same systems, but a lot of the same systems going on in the backpacks, and there were separate folks that did that. That's right.

JOHNSON: We talked about Apollo 11 and Apollo 13 and how relieved everyone was back, and after all the early flights, especially, we've heard different stories about splashdown parties and

that sort of thing. I wondered if you wanted to share some details about any of that you remember or anything, the reaction even of the whole community after Apollo 11 and 13.

HESELMEYER: [Apollo] 11 and 13, of course, were special. After all of the flights, the splashdown parties were a celebration. It was a gathering of the people who had worked extremely hard and had spent lots of intense time and concentration and some amount of stress making sure that these flights happened to the best of their ability, our ability. Then celebrating the fact that they came off, and the celebrations tended to be as intense as the work. Some of them were memorable occasions. They happened in various places over time, but they were kind of raucous and a lot of carrying-on and a lot of fun, a lot of fun. Thinking back on it, it was great therapy for all of us to be able to turn loose of what we'd been through and get ready for the next one. But, yes, lots of fun. Camaraderie, the morale boost, it was excellent.

The whole Flight Control organization got along extremely well. To my knowledge, there wasn't jealousies and infighting or any of that kind of thing. At least at my level when I was a Staff Support Room guy and then in the MOCR, we were working together as best we could to make this stuff happen, and the parties were part of the process.

The beer hall in Dickinson was one place; the Hofbrau Garden, I think, probably has been mentioned. I had never been a huge beer drinker. I made an exception sometimes at some of the parties, but I was really impressed at some of the folks' chugging ability. You know, that was the first time—even in college—but that was the first time I had seen a mug of beer consumed in probably a second. Amazing.

JOHNSON: A real talent. [Laughs]

HESELMEYER: Yes, it is. It is. It is a special talent.

JOHNSON: When you first moved to this area in 1966, what were your impressions of the Center as it was being built?

HESELMEYER: My overall impression was hot.

When I graduated from college, I bought myself a new car. I bought a 1966 Pontiac GTO convertible, muscle car at the time, and people who I knew or knew my family said, "If you're going to buy a car and you're going to move to Houston, get it air-conditioned." I thought that was silly to air-condition a convertible, which, by the way, had a black interior. So I came tootling down here in that vehicle. In October it was still warm enough to make somewhat of an impression, but by the next summer, I knew I had made a mistake because of the heat.

The area itself was fine. I'm not real susceptible to scenery, so flat was okay. Out in the country was okay. It has been distressing over the years to see the place built—well, it's not fair exactly, but it used to be much more relaxed and quaint, and now, of course, it's very, very metropolitan around here. I ended up finding a place to live in a little efficiency apartment up the freeway, up by Broadway. I had to go that far in to find a place I could afford. But the area was fine. I liked it when I got here, and I've liked it ever since.

By the way, I got here after the Center was put together. There were a lot of folks who got here before then and have stories to tell about how, before the Center opened, they were in the Stahl & Meyers Building and in hotels and various places around, before they could even have a common campus. My experience was that JSC was here. My experience also was that

Ellington [Field, Houston] was an active Air Force base, and there was an Officers' club, and there was a nice place to go eat, and there was a little golf course up there, so there were some amenities just right up the road at that time, too.

JOHNSON: Did you move down to this area at some point?

HESELMEYER: Yes. After a year or less, three of us got together and shared an apartment in Nassau Bay across the street. We got a two-bedroom apartment, and it was Jack Knight and a guy named Gary [C.] Watros [phonetic], who left after Apollo 11, I think, and went up and started working for the Department of Transportation in Boston [Massachusetts] or somewhere. Three of us shared an apartment for a year or two, something like that.

JOHNSON: You worked with a number of different Flight Directors during Apollo. Can you share some thoughts about the different management types or the different personalities that they brought to their job and what you might have learned from them?

HESELMEYER: Kranz was very disciplined, fair, but had expectations of what flight controllers should be and should do and motivated us to strive to be, and so Kranz was your best friend because you were a flight controller, but he could let you know when you needed to maybe improve here and there. But he was a great esprit de corps guy and a great manager.

Glynn [S.] Lunney was a Flight Director, and Glynn was very, very professional. Had a little bit of a softer edge to him in terms of working with the controllers, but also was always very focused and very intent on making sure all the right things happened. Of course, all those

guys were very smart and knew what they were about. Lunney went on to be a lot of things, Shuttle Program Manager; headed up the SFOC [Space Flight Operations Contract]. But he was extremely organized about what he did, but he could do it in a softer kind of fashion.

Pete Frank was easy to get along with, easy to talk to, businesslike, I would say.

[Gerald D.] Gerry Griffin was kind of the optimist, a little more of a joker, of the bunch, willing to laugh a little easier. He became [JSC] Center Director, of course.

I guess [Milton L.] Milt Windler was Flight Director back then, and he was more the businesslike kind of guy that was ready to get on with doing the things that needed doing. Some of the other Flight Directors I did not have that much exposure to. [Clifford E.] Cliff Charlesworth. Of course, [Christopher C.] Kraft was not doing that by the time I got there. That was the Apollo era guys I remember. Have I left somebody out?

JOHNSON: John [D.] Hodge.

HESELMEYER: Hodge was not a Flight Director when I got there. There were some other guys became Flight Directors later.

JOHNSON: After 13, you, along with the people you worked with, were awarded the Presidential Medal of Freedom.

HESELMEYER: Yes, we were.

JOHNSON: Do you want to talk about that for a minute, and how that was awarded and that experience?

HESELMEYER: Let's see if I remember how it was awarded. Is that when [President Richard M.] Nixon came down to the center and did the speech and awarded the medal? It was very impressive. Appreciated it. A big event. There was a platform set up. Was it beside Building 1? Don't remember exactly where it was on the Center, but there was a platform set up, and then the Flight Directors were up there, and speeches were made, and the rest of us were out in this huge crowd, watching all the festivities. So it was very nice, but from most of our standpoint, it was a crowd deal; we got to see it from a little bit of a distance. But it was still—I mean, we were still in the glow of having gotten that flight done, and so we appreciated it very much.

JOHNSON: Looking back over the Apollo years, is there anything that stands out as being your most challenging moment of your career up to that point?

HESELMEYER: During Apollo, I think the most challenging thing for me was making sure that I became the best flight controller I could be. I always wanted to be better than I thought I was, and there were a lot of my management and aspects of the program that depended on the flight controllers doing what they needed to do, and especially doing it in the right way if there was a serious problem. I can't think of a specific event. [Apollo] 13 was scary, but from a challenge standpoint, I would say it was getting myself up to my expectations on being the best flight controller that I was capable of being. That's what it would have been.

JOHNSON: What about your proudest moment or favorite memory?

HESELMEYER: Of course, [Apollo] 11 and 13, there's always those. Having gotten it done, I think, in general. Just for a specific instance, having gone through that whole period of time and having accomplished what we did, I was proud of that. I was happy, thrilled to be part of that experience. Especially now, looking back on it and the efficiency of the organization and the freedom of being able to get things done without some amount of overhead and advice was really a nice thing. We had our little area of the world, our part of the LM, and we could do what we needed to do to make that work and make sure it kept on working.

JOHNSON: If you don't mind, I'm going to ask Rebecca and Jennifer if they have any questions about this Apollo part of your career.

HESELMEYER: That would be fine.

JOHNSON: Okay. I guess we'll finish for today, unless there's something else you want to add that we haven't talked about.

HESELMEYER: I don't think so.

JOHNSON: We appreciate you being here.

HESELMEYER: Thank you very much.

[End of interview]