NASA ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT 3

RICHARD KOOS
INTERVIEWED BY JENNIFER ROSS-NAZZAL
HOUSTON, TEXAS – AUGUST 29, 2023

ROSS-NAZZAL: Today is August 29, 2023. This interview with Dick Koos is being conducted for the NASA Oral History Project. The interviewer is Jennifer Ross-Nazzal. Thank you again for joining me and bearing with me with technical issues. Last time we were chatting, and you were talking a bit about Skylab, so I wonder if you would talk about the console you were on and some of the challenges that you faced.

KOOS: Yes. I didn't know anything about what planning was previous planning was going on with Skylab. We were just busy with Apollo. For us in the Lunar Surface Experiments Room, every flight was a different flight, so it just kept us busy, quite busy. After Apollo 17, I came back to Davenport with Beverly and our kids for the holidays and came back to Houston.

We immediately started with a three-day simulation, I think. It was a long simulation, which nobody liked. They lasted for about three days. It had to be done that way for Skylab, because it was a long-term mission. It was a rush to figure out what was going on.

In EREP [Earth Resources Experiment Package] there was no downlink; there were just some lights on some of the experiments. We had some indicators on it, and there was nothing to say what to do if the lights showed something wrong. I'm not sure what the problem might have been. What happened as to why actions weren't worked out beforehand, because that's what we always had done. I don't remember ever hearing that during the three flights we had. I don't remember ever hearing what you do about those indicator lights. Maybe it was just me and I

missed something, but I don't think so. That was one of the frustrating things about Skylab, but we enjoyed a lot of aspects of Skylab beside the scheduling stuff.

The military showed us a map of sensitive sites not to take pictures of. Military security people had us sign these releases, that we had reviewed the map, and stated that we would not take photos over those sites. Actually, I can't remember everything in detail and in the busy work of planning an EREP pass over the USA several months later it was easy to forget them. One of the later flights, there was a great big clear sky across the whole country, and the orbital path was going from southwest to northeast. I was on the duty at the time, and we said, "Oh, wow, look at all the pictures we can take." So we just took many pictures across the United States. Went right over those places that we said we wouldn't take pictures.

It was sometime after that. They brought the film back, and it was reviewed by the military. They found out that we'd taken those forbidden pictures that day, so they visited us. I don't know who it was, but they said, "Did you plan that pass?" I said, "Yes, I guess I did." There was no consequence to it except that it was a reprimand, I guess. There were three flights, a one-month, a two-month, and a three-month flight. It was about a year later when we did that, so I wasn't thinking. I was just thinking, like, "Wow, this is a nice sunny day all across the U.S." That didn't amount to anything.

ROSS-NAZZAL: You were directing the crews to take photos, or were you taking photos from here at JSC [Johnson Space Center, Houston, Texas]?

KOOS: EREP guys would plan passes and send instructions to the crew. If the science people wanted a global altimeter pass, to measure the earth's altitude around the Earth, the EREP team,

would take the details, what camera or what instrument from the science people and send them up to the crew. That's basically what we did.

Skylab was complicated, because its attitude, orientation, was controlled by the control-moment gyros (CMGs) for attitude stability. For an EREP pass, the vehicle would have to roll over so that they could point to the Earth, because its main function was to look at the sun. I can't remember the experiments, but there was a whole package of experiments for EREP: cameras, microwave sensors, etc. We would send up a schedule for running the instrument to the crew. On one pass over the USA, Jerry [Gerald P.] Carr was operating an infrared sensor using a viewfinder for pointing. One of the CMGs failed. The vehicle rotated off the area where he was taking data. With perfect timing my headset became very noisy for some reason. Gerry couldn't take the data, and I couldn't talk to the flight director who was Don [Donald R.] Puddy about it. Not a good day.

ROSS-NAZZAL: How did you communicate with the crew? You were giving instructions to CapCom [capsule communicator], and CapCom was verbalizing your orders, or was there another method?

KOOS: We sent up the plans via TTY [teletype]. We'd transmit them to their printer. I think it was an electrostatic printer. We gave them the flight plan that way. We didn't put the daily plan together and physically send it, but we gave instructions to the flight plan people. I think that's the way it worked, if I remember correctly.

Jerry Carr had a problem with the frenetic scheduling that was given them. The flight plan was sent up, and they were falling behind on things. That was a big issue. I remember Dick

[Richard H.] Truly was the CapCom, and [Christopher C.] Kraft was over listening in, of course. They sorted things out. They just had an understanding after that. EREP wasn't involved though.

I was going to talk about one shift. On my shift Bill [William R.] Pogue was activating the S190 camera. It's a nine-camera experiment, with filters for each of the cameras. He was taking pictures with different filters installed. The bottom line on the checklist said, "Install the filters." I was listening to him tell us what he was doing, and that it was finished. I remember seeing that line on the bottom of the checklist. They should have put that in red on the checklist, so someone wouldn't just miss the bottom line, which is exactly what happened. It wasn't found until the filter was developed, I think. There were a whole bunch of pictures with the filters off.

I did entertain, very quickly, in a flash, "Should I say something just to be sure?" We were told, pretty much, "Don't bother the crew, because they're busy. Don't disturb them while busy." So I didn't say anything. I always felt kind of bad about that. I never have spoken about it. Those two incidents are the only ones I can really recall. I never heard too much about what science was found, but they were some early versions of spectrometers that that were used, radiometers, really their early use.

ROSS-NAZZAL: There were a lot of experiments on board, not just EREP, but you mentioned studying the sun. How did you work it so the crew was able to get to your experiments but also to all the other experiments on board? Was that a challenge to have to figure all those details out?

KOOS: Yes. The crew didn't have time to plan, or they felt like they didn't have enough time to go over the day plan. I didn't get into the details about that at all.

When Skylab was over, Charlie [Charles R.] Haines, who was the deputy division chief for Charlie [Charles E.] Harlan at the time, came in and talked to me while on shift. This was, I think, probably on of the last shifts that I pulled. They wanted to know if I wanted to join their division. Charlie Haines ran the Shuttle Training Aircraft, the STA Project, for Charlie Harlan. By the time I got to working on that, I took Harold [M.] Draughn's place.

I don't remember the name of the section, but it was about the avionics of the aircraft that had been augmented by computer to train the Shuttle crew on the descent and landing. They needed it for the approach and landing test [ALT] which was coming soon, and it was having trouble representing the landing well enough for training. The crew was anxious to get started in the training runs for the ALT. The STA was a Grumman Gulfstream II with the windshield masked to duplicate the pilot's vision from the Shuttle. It has a twin pod of engines on the fuselage, like many of our planes do now, but it was a corporate aircraft. It was modified for NASA. It would start at about 40,000 feet and put on the reverse thrust to duplicate the descent, the feel of it, the vertical G profile through descent. It was modified with a special computer to duplicate that profile. The involved unique flight control software.

They were having weekly meetings, Black Friday meetings, with George [W.S.] Abbey, and Joe [H.] Engle who was the crew's rep. They were about where things stood and how it was going toward delivery to NASA. I collected a list of a number software changes to review that Grumman wanted to add to the software, some big and some small. Grumman was—I guess you can say—they were dragging their feet. They wanted a continuation of the contract after it was accepted for a maintenance contract. I don't know who decided it, but Joe [Joseph S.] Algranti

and the Aircraft Division in Flight Ops maintained of all the [Northrop] T-38s. They chose not to use Grumman for that contract. I gathered the list of each proposed change so everyone involved could review it. Then Charlie and I sat down, and we went through them. I remember his asking, "Do we really need to do that?" I said, "You know, from what I had learned from everyone, you don't need it. It's not essential to accept the aircraft." He would say, "Well, if it's good enough without it, it's perfect."

ROSS-NAZZAL: What sort of things did they want?

KOOS: Just little onboard changes. They didn't involve the actual main work of the computer. That's basically what it was. It wasn't going to affect the flight control part of the aircraft. Somewhere in that time, I would go to these Friday meetings, and I took up a chart. I talked about it with Charlie Harlan beforehand, and he said, "Put some ideas down about what needs to be done for getting it accepted." After the meeting, George called me over to his chair at the end of the table. I went through a couple pages—that's all it was—and showed them to George Abbey. It was Sperry Flight Control Systems out in Phoenix. It was their computer, and they were building the flight control part of it. He said, "I want you to go out there and stay out there and don't come back until you see the schedule they will guarantee they're going to satisfy." I said, "Okay."

So, I and Fred [Frederick] Peters—he was in the projects office at JSC supporting the contract—we called them bean counters. That's for schedule and cost. So I went out there with him, and we stayed about a week. He and I stayed in this one room at Sperry by ourselves. Throughout the week the Sperry people would come to talk. "Why are you here?" We said,

"We just want to come back with a schedule that you can stand up and perform, because we need to get the plane accepted." They would come into the room, and I remember they said, "What is it you want?" We would say, "We want the aircraft to work in the timeframe that you can commit to." That's all I wanted. I didn't want to get into, "What do you want?" Because it's their responsibility spelled out in the contract. The responsibility was left with them. It took about a week, and we took the schedule back to JSC.

We went through the rest of the flight test. They got the model following the Shuttle profile duplicated. Later we went up to Grumman, Bethpage [New York], and I was sitting off to the side. George Abbey was the chair of the meeting. It came to whether the model following the Shuttle worked, and I knew that the tests had all been successfully run. He looked over at me, which I was surprised at. Just looked over at me like, "Well?" And I just nodded my head yes, and that was that. Then they brought the plane down to Ellington Air Force Base and started flying it.

It wasn't long after that that Charlie Harlan asked me to be the section head for the Spacelab/Attached Payload Section. The Spacelab was an inhabited space for crew working on experiments that fit into the Shuttle payload bay. It also had a version of pallets to house instruments in the Shuttle payload bay. I and Earl [W.] Thompson—he had been working on it already while we were busy with other stuff. So we started in on the experiment computer. The Spacelab had an experiment computer and a systems computer. Our section work went well through all that, doing the usual flight control thing for it. But there wasn't any simulation for it, which is interesting. I said, "If that's the case, we'll just have to dig in and understand exactly how the computer works down to as detailed as we can possibly get." It was a challenging task to do all that what-iffing and not really be tested in simulations. We did have testing of the

Spacelab at KSC [Kennedy Space Center, Florida] to monitor that gave us confidence in what data from the systems we saw on the telemetry downlink from KSC.

Part of it was not just the experiment and the system computers, but it was the Instrument Pointing System [IPS]. It was mounted on the payload bay. It was a pointing system used to point instruments using two configurations: the stars and the sun. To use it, you had to raise it up above the payload bay doors, outside the volume of the Shuttle. It had to be raised up to use. It was, of course, clamped in for launch. Jimmy [James M.] Bodmer began our section's work on the IPS preparing MCC [Mission Control Center] displays of telemetry data by going through the instrumentation of the IPS systems. He and Karl [G.] Heinze, who was the astronaut assigned to the IPS, drew up the onboard displays. We then gave them to the Marshall Space Flight Center [MSFC, Huntsville, Alabama], which was responsible for integrating the Spacelab into the Shuttle working with the European Space Agency [ESA]. We went over to Dornier [Flugzeugwerke] in Friedrichshafen, Germany a couple of times for design reviews.

We had this review coming up, a preliminary design review. Jimmy was going through everything, drawings mostly, and he came to me. He said, "If you have a single component failure, you can't bring it down into the payload bay. You have to go EVA [extravehicular activity] to cut the thing loose and discard it into space to get the Shuttle payload doors closed for reentry." I'm not sure how that could be, just for one single failure, going EVA. I heard Kraft say that going EVA is dangerous. So we brought that all up at a meeting when ESA came over to meet us.

Not long after that, I think we went over to this design review. Jimmy went with us with John [C.] O'Loughlin from the Payload Project Office, which Glynn [S.] Lunney was the manager of. We found all these other things were happening, too. Marshall found out that the

structure that mounted the IPS into the payload bay, after doing a structural analysis on the IPS mount, wasn't strong enough for launch. They had to redesign it.

Then they found out the things that Jimmy's was talking about. They said, "We want Jim to stay with us after the review and work with us on fixing it, redesigning it." What happened was that the meeting was over—let's see. We flew in and out of Switzerland. Jim had already driven over there to catch the plane, was actually on the plane, and the engines were running. The request for Jim to stay had to go through management at MSFC and JSC through John McLoughlin. Lunney got it to the plane. They said, "we want you to get Mr. Bodmer off the plane and stay with us."

ROSS-NAZZAL: That's unusual.

KOOS: Yes. The pilot said, "Mr. Bodmer," you know, in the old German way. "This has to be very important, I hope," or something like that. He came back to Dorrnier, and he stayed over there for quite a while, as they worked out the problem. I thought that was interesting, that they would want him to be there. Jimmy was meticulous, and he was like a bulldog. He stayed with the problem. He was persistent as well as consistent.

ROSS-NAZZAL: He must have been.

KOOS: Yes. That's the way he was, though. He was good.

ROSS-NAZZAL: How long did it take to resolve that issue?

KOOS: I don't know how they finally completed it, but he was there for three weeks, I think. I don't remember exactly. We just went on and went through all our usual work back in Houston. That was the IPS. Let's see.

We were about to fly, and our flight was going to be the next one or two shuttle flights, and the [*Space Shuttle*] *Challenger* exploded. I was in my branch chief's office. I can't remember. Was that Jack Knight? I believe it was Jack Knight. Or it was Dave [David W.] Whittle. I don't know. They all run together. Anyway, I was in his office. We were just standing there talking, and the secretary came in and said, "It exploded." That was a shock, of course. We tried to figure out, "What's exploded?" We heard about the ice and all that stuff. So I walked down to the section. Cindy Major was in tears. Everybody was just at their desks, keeping to themselves together, in their own thoughts.

I think at some time—not right away, I let them be until the next day—I got them all together, and I said, "We don't know what's going to happen or how this is going to work out, but very likely, there's going to be a delay. It's a chance for us to go through everything," because we weren't very far from flight, "go through all the things that we think need to do that we would we feel are important to do for the Spacelab IPS, including our work. We'll have more time to go into everything, maybe make sure we've covered everything we need to do before flight." We did that, but we did it for about two or three years. Wasn't it two years or so before the Shuttle investigation was finished?

We weren't the first flight to fly, but eventually we did fly. The IPS had some other problems on the first flight. It was supposed to point to the sun, very much like the Skylab ATM [Apollo Telescope Mount]. I'm not sure what the science experiments on the IPS were, but it

was supposed to track the sun. The problem was that the optics were—if you point to the sun, you're going to get sun into the optics of the experiments and the tracking of the IPS was distorted; it didn't work very well. We had to do a lot of backup work by ground command. It was tough to get that, and it didn't work for Karl Henize at all.

ROSS-NAZZAL: That's a problem.

KOOS: Well, we made it through that flight. I think we did get a lot of information somehow, but it was not the normal way it was supposed to work. In fact, Karl Henize told them—this is early in the program, "Take that thing to a mountain where the atmosphere is thin and actually test it pointing at the sun. Do that, because otherwise, it's going to fool the system and it's not going to work." Of course, ESA wouldn't back us up, and Marshall, I'm not sure what their position on that might have been, because I wasn't involved with those discussions. Karl was, and he told us he had tried to warn them, but they didn't want to pay for it. That's such a common thing when costs are overrun.

Fact is, Kraft once said, "There are no accidents." They are mistakes of the past coming to pass. You can go back, and that's what happened to the *Challenger*. You can go back to the IPS case and others that there's been a mistake made or a wrong decision made. It might have been years earlier, but you can usually go back to find out when you're really do an investigation. That's what he meant.

ROSS-NAZZAL: What was your role in preparing for missions and during a mission? Were you involved at all?

KOOS: Yes. For that, I was a section head, and I think for the first Spacelab flight without the IPS, I was in the SPAN [Spacecraft Analysis] Network. They were there to support with analysis, when problems come about, take questions for MSFC that our flight control guys had. The SPAN was the connection between them and Marshall. They had the HOSC [Huntsville Operations Support Center] which was the equivalent of the SPAN at MSFC.

ROSS-NAZZAL: I was just going to ask. I didn't recognize the acronym.

KOOS: It was like the MER, Mission Evaluation Room, over in building 45. I'm trying to think of what else I did after that. Steve [Stephen G.] Bales was the division chief. I talked with him one day, and I said, "I've been thinking about this. We have the IPS, and that's a control system type device. Then we have the Spacelab computers in this same section. We could pull those apart, and then put them in with"— what is it? Was it Shuttle DPS [data processing systems]? Anyway, it's the computer systems for the orbiter. The IPS, we could put that in with the guidance navigation control people. That move was made then we put some other people together, and we started thinking about space station, because we wanted to know something about space station as it developed, and that got us started thinking about how the MCC would look like to support the station. So there's a group in place that did develop some thinking about the station for a while. That's about when I retired.

We put together what I would call a very first look at the concept of how you'd build a Control Center. It was a top-level thing and very premature. I do know it was going to be complicated, because there were so many modules, and how do you support the operation with

an end-to-end system approach? That was the real question, and I think we put our first thoughts together, and then was about that time I retired.

Something I should say about the people who were in that section with me. We hired new people mostly through the co-op program NASA used. I had one person hired as an undergraduate student who was very active and smart. He quickly caught on to what we were doing. After I retired, he advanced in the organization and eventually became a flight director. He has since retired I understand. Another individual was irregular in attendance, so I had to make sure he understood that in our work in operations we were to fill MCC positions. I told him we couldn't accept that sort of behavior. He did straighten out his behavior and eventually took a position in the front room of the MCC. It. Was gratifying to hear about them both.

ROSS-NAZZAL: Why did you decide to retire at that point?

KOOS: I don't know. I think I was just tired of walking in and out of the parking lot in the heat and humidity. As soon as we did—Beverly, she worked up at [University of Texas] MD Anderson [Cancer Center]. As soon as she retired and I retired, we moved out to Colorado. I was there for seven years and came back here to Iowa.

ROSS-NAZZAL: What did you do in Colorado? Were you working, or just enjoying the cooler weather?

KOOS: Beverly went to school.

ROSS-NAZZAL: Oh, okay.

KOOS: While we were raising four kids, she didn't have a chance to do that sort of thing. So, we just gave her the chance to get a second degree. She had been wanting to do that sort of thing. She went to the Iliff School of Theology, which is in Denver. It's a Methodist seminary. She went there, and she got a Master of Theological Studies, a more general course she selected for her own edification, not the ministry. A Master of Divinity is required to preach or basically to be a pastor of a church. Anyway, she went for that for a few years. While she did that, I had some friends, and we went out and hiked around. We lived east of Boulder, and we went hiking a lot in the hills behind Boulder. That was the healthiest thing I could have done. It was very good for my health.

ROSS-NAZZAL: Quite the change from living in the urban sprawl of Houston, I imagine.

KOOS: Oh, yes.

ROSS-NAZZAL: Were you doing any contract work? I know there's some aerospace companies up in that area, like Ball Aerospace.

KOOS: No. I sensed some people, friends outside of work that would ask, "Why do you want to leave this area?" When we left, there was a little bit of—I don't know what you'd call it—a little bit of resentment of leaving, like I should have stayed around Houston and the JSC. Some guys went over to lead tours through Johnson Space Center and Space Center Houston. I know Stan

[Stanley] Faber was doing that. But no, I just left. I don't think there was any deep reason. I just wanted a change. It took a while. I guess you could say it took a while to decompress, and it helped me, hiking around the mountains. Had a really great time. Climbed a couple 14ers [a mountain peak that's at least 14,000 feet above sea level].

ROSS-NAZZAL: It's beautiful up there.

KOOS: We climbed a couple—Beverly didn't. She wasn't into that. But some friends I had from our church and I climbed. They had some real technical climbers, so they took us up. Once a year, they'd take a group from the church up, and we'd climb a couple 14ers. Even at 70 years old, I think I was at the second time.

ROSS-NAZZAL: Oh, my goodness. You were in great shape.

KOOS: I was a little slow. I'd get up there. After 12,000 feet, the 10-year-olds were coming down from the top while I was still going up.

ROSS-NAZZAL: Looking back over your career, what do you think was your greatest challenge working at NASA?

KOOS: Boy, that's a good question. I don't know. It was all challenge after challenge with the changing technology. Yes, it was through the whole period of being there, which is some 30-some years. It was always a new thing; it was never a dull moment. Every time we did

something different, it was a new challenge. We talked about that when we were working on the lunar surface experiments. Every EVA was different, had different things to explore in a different place. It wasn't like the Command and Service Module or the Lunar Module, where it's the same systems were pretty much the same every time, maybe a little bit different but essentially the same. I liked that, but then it was nice to get out of it, too, after a while.

ROSS-NAZZAL: Nice to have a change, yes.

KOOS: Yes, sure. It took a while. I'm surprised at that, looking back on it. There's the energy or something that's required. I guess maybe it's that you just get tired of it. Get tired, not tired of it.

ROSS-NAZZAL: What do you think was your greatest accomplishment?

KOOS: I think getting the simulation working and doing it for the Apollo period. The other thing is, for the Shuttle Training Aircraft, Ron [Ronald K.] Blilie and I were given a Superior Achievement Award by George Abbey when STA was accepted, although I really wasn't doing that for very long.

ROSS-NAZZAL: But you made it possible for that to finally be delivered.

KOOS: Put some emphasis on the contractor for it to be delivered. I don't know. I think we pretty much covered the things I thought of. I wrote some notes on here.

ROSS-NAZZAL: Yes, I wondered if there was something else that you wanted to chat about that we didn't talk about in previous sessions, or something that you didn't share that you'd like to put on the record.

KOOS: No, I can't think of anything off hand. I tell you what. Why don't I just read what your draft or whatever you guys call it, read through it, and see if it brings up anything? If there was something I skipped. When we came back from the Mercury Control Center and [President John F.] Kennedy announced our going to the Moon, Hal [Harold G.] Miller asked me, "What would you like to work on Apollo or Gemini?" I immediately said "Apollo." I think it was my thinking long term, looking forward as I did when first hired.

ROSS-NAZZAL: Absolutely, yes. Like I said, you'll get a chance to edit them.

KOOS: Yes, that's fine. I enjoyed it.

ROSS-NAZZAL: I enjoyed chatting with you, and I hope you enjoyed thinking about your career and your time at NASA. You had a great career.

KOOS: I've been away for a while, so it's nice to go back and recall it.

ROSS-NAZZAL: Yes. Well, I hope you enjoy the rest of your day, and hopefully the weather is a little cooler up there. This morning as I walked in, it was actually—I thought it felt cool here in Houston, but maybe it's because we've been so warm lately.

KOOS: The other day it was 79 degrees.

ROSS-NAZZAL: Oh, I love that. That would be wonderful.

KOOS: Yes, I'll bet.

ROSS-NAZZAL: It hasn't hit 79 since I don't know when. Even our lows at night are in the low 80s, maybe.

KOOS: I have to say—I don't think I said anything about this before, but when I came on board, that was, like I said, the first real full-time job I had, and I didn't know what to expect. I was also very naïve. My folks—my mom grew up on a farm, and she went to one of these little white schoolhouses, rural schoolhouses. There were a lot of them in Iowa. My dad, he had to leave the sixth grade when his dad died. That was in 1898. He was 10 years old. At that time, that was—1898, that's when, if you were old enough, you got out to work to help the rest of the family. So, he and his brother had to do that. There were other kids that their mother had to take care of. He didn't get the education that he wanted. They knew that going to college was a good thing, and they didn't really understand the significance of it except that it was a good thing. Then when I went, I guess they were pleased. I was really happy. They came down to Houston

to visit, and I took them to Galveston and places like that, the Manned Spacecraft Center. At least they knew sort of what it was. He was getting pretty along in age, but at least he got to know what I was doing, or some idea of what I was doing.

If you look at the census—I've done a little bit of research. He worked as a farmhand, and then the war came, First World War, and he was over in France. He was wounded but wasn't really that significant a permanent wound or anything. Then he got a job over here in one of the farm equipment factories. In Iowa there were many. The Quad Cities Area was a real center for that. John Deere's the only one left right now. That was his story. I remember when I was still small during World War II, of course, he knew what it meant, so he worked late at night. They were building tanks over here instead of tractors. Because he had a lot of overtime, he collected and bought a lot of war bonds. Now they call them savings bonds. Those are probably what put me through college. I owe a lot to him, that's for sure.

ROSS-NAZZAL: That's wonderful. Was he still alive when we landed on the Moon in '69?

KOOS: My dad wasn't, but my mom was. She died about a month or two later. They got some idea.

ROSS-NAZZAL: Did your community in Iowa know that you were working at NASA? What did they think about, you know, local boy works at NASA, trying to send man to the Moon?

KOOS: When Beverly and I were engaged, the announcement in the newspaper says, "Engaged to space employee," or something like that, so yes, they knew about that.

ROSS-NAZZAL: That's wonderful. Did you have any siblings?

KOOS: I had an older sister. She was 12 years older than I was. She was married and out of the house before I was very old at all. It's sort of like we were separate.

ROSS-NAZZAL: Children?

KOOS: Yes. We had four. Our youngest daughter passed away a little over a year ago. She was 50. She had a glioblastoma, which you can't do anything about. That was a bad time.

ROSS-NAZZAL: I'm sorry to hear that. Do your children still live in Houston, or did they move up to Iowa with you?

KOOS: Let's see. Rebecca [Koos] was living in Georgia when she died. Carrie [Brazil], she lives in Georgia, northwest of Atlanta, up there. Our daughter Deborah [Camp] lives near Rochester [New York], a little place within walking distance of Lake Ontario. They just moved there from Indianapolis or are in the process of moving. Tim [Koos] is with us. He had an accident and broke his back. He does pretty good, actually, but he works only part time, so we subsidize him.

ROSS-NAZZAL: That's wonderful. Sounds like family means a lot to you.

KOOS: Yes, yes.

ROSS-NAZZAL: That's great. Unless you have anything else to share?

KOOS: No, that's okay. I think I'm about talked out.

ROSS-NAZZAL: I understand that. All right. Like I said, I will send you copies of the transcripts.

KOOS: You've got a lot of people now that you're talking with.

ROSS-NAZZAL: A lot of folks. My colleague has another project that she's working on, so there's a lot of interviews being captured.

KOOS: That's good. You know, I don't know if there's another place that has all that, as much of that oral history kind of thing.

ROSS-NAZZAL: Yes, JSC leads the way. Yes. Although now we're part of the whole agency-wide effort, since we've transitioned to be part of this enterprise contract.

KOOS: I thought it was interesting. I've seen a couple of these programs. They're old ones. I don't know where we found them. It was KSC that put the one that says, "We Are Shuttle." Is that right? And Marshall had one that said, "We Are"—I don't remember what vehicle or

program they were talking about, but they said, "We are, impressing." Like what do you mean? You're not the only ones. That whole Marshall and JSC thing, you know?

ROSS-NAZZAL: Oh, yes, butting heads, for sure.

KOOS: Boy, we did. In Spacelab, we sure did a lot. Jimmy Bodmer brought some of those problems up, and we just talked about some of it with Glynn Lunney, because he was this payload program manager. He said, "Well, you just got a lot of work to do."

ROSS-NAZZAL: What were some of the issues that you were butting heads over?

KOOS: It was about the IPS.

ROSS-NAZZAL: Anything in particular?

KOOS: Well, those things about the pointing, and the payload clamps, and keeping it safely in the payload bay during flight, those kinds of things. Some things I can't remember specifically, but they didn't want to do them. Fact is, for the experiment's computer, Cindy Major found out at a certain component in the Spacelab would have a problem, it would put out a lot of errors signals. It would be on the keyboard of the computer, on the flight deck. We tried to bring these things up to Marshall, and Lunney went through it with us, and he said, "You just have a lot of work to do." That was to convince MSFC to make our suggested change. In other words, work it out. The problem that Cindy Major brought up, we couldn't convince them to do anything

about it. And sure enough, the very thing happened in flight. We just couldn't do anything about it then. It blocked any other error messages or anything else coming up on the keyboard to the crew. It made the doggone thing almost useless for that flight. It was stuff like that. And the thing about optics of the IPS. Karl Henize—I think that was earlier in the program when he tried to get them to do that testing, but they wouldn't do it. I've always wondered if the same sort of thing didn't happen on the Hubble [Space Telescope], when they had the mirror that was not—there was some testing they omitted. That's why I say, I really remember Kraft saying, to this day, "Accidents don't happen."

ROSS-NAZZAL: Were there any lessons learned that you want to share about your relationship with Marshall? Were there things that improved your working relationship that you found that were helpful?

KOOS: No. It's just that they have the money, the control of the money. It's harder.

ROSS-NAZZAL: Got you.

KOOS: Well, that's it, I guess.

ROSS-NAZZAL: All right. I will let you go. I hope that you have a wonderful afternoon.

KOOS: Yes. Yes, it's going to be 86 today.

ROSS-NAZZAL: Oh, my gosh. I would love—I mean, that will probably be around Thanksgiving that we'll see 80s, at this point.

KOOS: Yes, I'm just giving you a hard time.

ROSS-NAZZAL: Yes. Well, still, that would be lovely. I would love that.

KOOS: Yes, I bet.

ROSS-NAZZAL: It's too hot. Like you mentioned, walking to the parking lot. I walk quite a way to my car. Anyway, all right. I will be in touch. Thank you so much for your time. I really appreciate it.

KOOS: Yes. Thank you. Appreciate it, too.

ROSS-NAZZAL: All right. Have a nice day.

KOOS: Yes, you, too.

ROSS-NAZZAL: All right. Bye-bye.

[End of interview]