NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

RICHARD N. RICHARDS
INTERVIEWED BY JENNIFER ROSS-NAZZAL
HOUSTON, TEXAS – 26 JANUARY 2006

ROSS-NAZZAL: Today is January 26th, 2006. This oral history with Richard N. Richards is being conducted for the Johnson Space Center Oral History Project in Houston, Texas. Jennifer Ross-Nazzal is the interviewer, and she is assisted by Rebecca Wright.

Thanks again for joining us this morning. We appreciate it.

RICHARDS: Good morning.

ROSS-NAZZAL: I'd like to begin by asking you to briefly describe your career with the Navy before you came to NASA.

RICHARDS: Well, it starts back at the University of Missouri in Columbia, Missouri, where I did my undergraduate work. I had an ROTC [Reserve Officers' Training Corps] scholarship there, and so at the end of my—when I arrived at the University of Missouri in whatever year that was, 1965, I'd already sort of committed that I was going to do four years in the Navy. And at the time, that was the Vietnam War going on, so the draft was in vogue, so any young male at that point knew he had to deal with that. So I just decided to deal with it upfront and get some part of my college paid for. And my dad was a Navy guy as well, too, so I was sort of predisposed to joining the service.

It was a good exposure, because during that four years the ROTC unit, although I was in civilian clothes 99 percent of the time, during the summertime I got to spend a couple months out on what they call cruises. Sometimes they were cruises, really cruises. Sometimes they were not. They were just deployments to land-based facilities. But it gave me a broad cross-section of the Navy, the Marine Corps, the Navy nuclear program, naval aviation, so it was kind of a shopping list of what the military's disciplines were so that when you graduate it wasn't guaranteed that you would get to choose what you wanted, but at least you knew what to apply for.

So I graduated in 1969, and my dad was a submariner all of his life, and so I had to rebel a little bit, so even though I was going back in the Navy, I decided that this aviation thing looked like a fun thing. I'd never flown an airplane before in my life and so decided to go do that. So when I was commissioned as an ensign, I immediately got shipped off to Naval Air Station Pensacola [Florida] to start the standard U.S. naval officer flight training program, which lasted about a year and a half going through Pensacola and then later on to Corpus Christi, and I got my wings in Corpus Christi, Texas.

After that, my first assignment was with a shore-based squadron. Crazy thing as it was, the Vietnam War was raging, and planes were being shot down all over the place, but we had a glut of pilots at that particular time. And so even though I did well with all my flight training and wanted to go fly the most challenging missions, I couldn't do it, so went off to the shore-based squadron called VAQ-33. The only good thing about it was the fact that the airplane they were flying was the airplane I wanted to fly, which was then at the time McDonnell Douglas Phantom F-4 airplane. And so I did that for about a year until year and a half, and then I finally

managed to land what they called a fleet spot, which meant that I get to fly that airplane aboard aircraft carriers and deploy it overseas, which at the time I wanted to do that.

So joined, went through the replacement air group, which is the formal advanced training for that particular airplane in a Naval Air Station in Oceana in Virginia Beach [Virginia], and then joined fighter squadron 103 or VF-103, as it's called, was called at that time, and deployed aboard the USS *America* and the USS *Saratoga*. Didn't go to Vietnam because we had two carriers in the Mediterranean at that time. Even though all that was going on over in Southeast Asia, we had to maintain because of our NATO [North Atlantic Treaty Organization] commitments two aircraft carriers in the Mediterranean all of that time because of the perceived Russian threat over there. So spent a cruise doing that and left, finally got to the end of my tour. Along the way there, during that tour, I got married to my wife and still married to her, thankfully, and she put up with all that. But so for her first year and a half, I was gone.

Then finally, we got a shore-based assignment, and I applied for the U.S. naval test pilot school training and, because of my engineering background, I graduated with a B.S. in chemical engineering out of the University of Missouri. Even though the Navy didn't have too much to do with chemical engineers, they did like the engineering background, so that fit in well with the test pilot school background, which was an engineering oriented school. Graduated from there, and you'll have to look at my résumé about what year that was, I can't remember, but graduated from there and then went on to assignment with, I think it's called, Strike Aircraft Test Directorate at Patuxent River [Maryland]. It's long since had its name changed, I'm sure, and was assigned to the F-18 project, which the F-18 was just coming out at that particular time, and I got reassigned to do the first air carrier qualifications of the F-18 at that point. I got assigned to that office about 1978, and that was when John [W.] Young came.

I think John Young showed up at the naval air test pilot school at about ’78, somewhere in that range, saying that NASA was, after a long delay, was going to start interviewing for a new cadre of astronauts called Shuttle astronauts, and they’d be interested in anybody interested in it that’s got test piloting background to apply for it. So I applied for that. That was probably more like ’77. I applied for that and came down here to Houston to interview in 1978 and went through all the process and so forth, got fairly close, I was told, but was not selected in the ’78 group but got enough encouragement to try to reapply.

Along that way, between that and the next time I came down here, which was the late 1979, we finally got the F-18 flying and did the first [carrier] trials, and in fact, that’s the first landing right there [points] when we were aboard the USS *America*. So that went well, and I was then posted to go back to another shore-based squadron, VF-102, aboard, I can’t even remember, I think it was the USS *Independence*. About that time, I’d already applied to the second round of the astronaut selection, come down here, repeated the whole thing. George [W.S.] Abbey was running all that business then. And managed to get selected, and just as I was about ready to step foot on the USS *Independence*, George called and rescued me from another year and a half overseas and said, “How would you like to come to Houston, go fly the Space Shuttle,” and that was a fairly easy decision.

So off we went in 1980 and sold our house in Virginia Beach and moved to Houston in 1980, was here, and that was sort of the—I stayed a naval officer, to answer your question specifically. I stayed a naval officer all the time I was here at the Johnson Space Center and as an active duty astronaut. That was the way we were organized at that point. I can’t remember exactly why that was, but the military allowed us to retain our rank even though effectively I

don't think I put on a uniform more than four or five times after I arrived here in 1980. That was effectively the end of my Navy career and the start of my NASA career.

ROSS-NAZZAL: Let me go back and ask you just a couple of questions. Had you been interested in the space program while you were going to high school and in college? Had you followed the program at all?

RICHARDS: Well, yeah, I sort of skipped over that. Of course the Apollo landings caught everybody's attention, and I will admit when I was in high school—I graduated from high school in 1964—of course, all that was starting to ramp up at that point. I was trying to remember the other day, and I don't think I remember a thing about it in high school. I was too involved with being a high school student at that point to pay much attention to that. And then even the first few years of even with the ROTC commitment, I was—my thought process, as I recall, was more the Navy and aircraft carriers or submarines or ships at sea, that sort of thing. But space, I had made the connection that the Navy and the space program were somehow interrelated at that point, and so I sort of, yeah, I remember seeing some of the Walter Cronkite broadcasts and Wally [Walter M.] Schirra [Jr.] of some of the Gemini and Apollo stuff. But it was not until the buildup for the first flight to the Moon, Apollo 11, that I have any conscious recollection of remembering about the space program, and I was at the University of Missouri at that time, again trying to figure out what I wanted to do after I left there. I knew I was going into the Navy, but I didn't know what I was going to do in there, and I didn't know if I was going to stay in the Navy. My dad was pressuring me to come back to St. Louis [Missouri]. He wasn't pressuring me, but

he was hoping that I would come back and join him in the insurance business in St. Louis, at which he had a successful small operation there with State Farm.

Then I remember as the buildup to all that, I watched the Apollo 11 landings take place, or maybe it was Apollo 8—and then they had that photograph come back of Apollo 8 of the Earthrise, and I never forget seeing that in the paper. Excuse me, this is my—

ROSS-NAZZAL: Sure.

RICHARDS: Yeah, I should have remembered that, because that was quite an event. I know when that photograph came out of Earthrise, and I'm almost sure it was Apollo 8 that took that photograph, I just, like the rest of the world, I was just stunned by that. And that's when I first all of a sudden started connecting about the fact that, wow, this is really something we're doing, going to the Moon.

So I started following it more closely, and I can't recall when it was, but sometime between that point and the actual Apollo 11 landings, I actually did something I had never done before, which was wrote off to NASA and asked them about the astronauts and the space program and so forth. And they do like they're doing right now, they sent me a packet of stuff, and of which was in there a compilation of all of the short summary of the biographies of all of the astronauts that they had. So I read through the thing, just scanned through it. But I picked up on the fact that almost all of the current astronauts they had there were either current active duty military officers or former military officers and all of them, for the most part, were pilots, which was, I said, "Hey, that's sort of where I'm heading as well, too." So I just sort of filed it away as I said, "Boy, that would be really fun to do if later on I got myself into a position to do that."

I also noticed that they had enough information in there that all these guys were pilots and all of them test pilots as well, too. And the Navy at that point, I'd just come back from my summer cruise or either I was just going to it where they gave us an aviation oriented two months, and part of the two months was a little visit to Edwards Air Force Base [California], the test pilot school out there as well as Patuxent River. So I just sort of filed that away, saying if that ever happened to me, I'd be interested in doing that sort of thing.

Of course, Apollo landings came and went, Skylab started, and for the most part, though, I was busy being a naval officer at that particular point, and it wasn't until John Young showed up at the naval air test pilot school that all of a sudden I said, "Hey, this connection that I thought of many years ago, it's still here and it looks like my timing is just lucky enough to be right that they're starting a new phase and maybe I can get into it." So that's how I got involved, yeah.

ROSS-NAZZAL: Why don't you tell us about the interview process for '78 and '80 and give us a sort of comparison. Did they differ at all?

RICHARDS: From my perspective, they didn't. I got selected in '80 and didn't get selected in '78, that was a big difference. But you know, I can't tell you that they changed all that much. Maybe that's why I did so much better in '80, is the fact that it looked so much like it was in '78. I mean the interview board was the same group of characters they had in '78. It was George, who I had figured out by this time was the 800-pound gorilla out of this whole thing, and the rest of the people around the board were very nice important people, but for the most part it was George that mattered. And the rest of these guys, I'm sure, had an influence, but it was George who decided.

But, no, it looked almost a carbon copy to me. My memory was it was, other than the people I spent the week with down here for the interview process, no, it was identical. It was even the same time of the year as I recall, so I'd never been to Houston before, but it looked familiar to me. Maybe that's why I did so much better then, I was so relaxed because it was all more routine. The first time I came down here, I said, "Wow, the NASA," like a lot of us, we were—all of us said, "Wow, this is the tops right here." And so some of us were, I know I was uncomfortable. I don't think anybody would be, not uncomfortable having—walking around NASA and so forth at that time. But the second trip was just better, and maybe that's why I did better.

ROSS-NAZZAL: Did you make any special contacts with any of the Navy guys in the office?

RICHARDS: You know, I don't recall ever even—John Young was in the astronaut interview. Maybe we had contact with those guys, but I don't remember any of them, in both groups. The first time I remember having contact with those people was when I arrived here as an astronaut.

ROSS-NAZZAL: Can you tell us about those first few days after arriving here and the first meeting in the Astronaut Office?

RICHARDS: Oh, yeah. Oh, you mean after I was selected? Yeah. I'm fond of saying it, the first seven months I was here, I didn't understand a word they were saying, honestly. I came from a Navy background and aviation background, fairly intense flying, both from a test pilot and operational thing, and I thought, "Okay, this is just going to space. It's going to be the same

deal." And I got in here in my first meeting. We have our standard, they're still doing it, I think, eight o'clock in the morning meeting on Monday where they go over everything that is going on. And these guys stood up, and, of course, they were in the middle of getting ready to go fly STS-1 at that point.

But I remember a guy by the name of Dale [A.] Gardner, he was in the '78 group, he'd have been there for two years. He stood up to start talking. I can't even remember the topic. He did not, other than prepositions and verbs, those are the only words I understood. He talked completely in acronyms and stuff that I couldn't understand. So we laughed when we walked out of there. Charlie [Charles F.] Bolden [Jr.] was part of my group, and I said, "Did you understand a word that guy said?"

And he said, "I didn't understand anything the guy said."

We sat there for six months like that, not understanding a word they said. It was only in our classes, in our lectures, where we controlled what was being said, that the instructors when they came in, of which were all for the most part JSC engineers or astronauts themselves. When they came in that room, we started to feel like, "Well, we've got control over this space," and so we would start stopping the guy. We'd all made a deal that it's not stupid to ask some guy to repeat what he said, only thing in English. So we started the slow process of trying to understand, but that was one of the hardest things I ever did. I don't think NASA to this day knows how hard their vernacular is to understand to somebody from the outside. And that's something I remember when I go in to talk in public, because you can't do that in public, you'll lose people in a heartbeat. So I try to de-acronym myself, and it's still hard to do. Even NASA's an acronym, for that matter.

ROSS-NAZZAL: Besides classroom lectures, what other sort of training did you participate in?

RICHARDS: Well, we had a gamut of it. I recall scuba training. That's something I'd never done before, but we had to do that, and so that led to a scuba training and doing all that activity. And it turned out to get our NAUI [National Association of Underwater Instructors] certification. I still remember the guy. His name is Bill [William F.] Moran. He was our instructor over there. He's long since gone from the Johnson Space Center, but he was our instructor, really, really quite a character. And so he organized this dive trip afterwards so that he could then give us our NAUI certification.

So there was about eight or nine of us who decided that would be a good thing to do. So he organized this dive trip, which I guess he could have probably done a dive trip here off the Texas coast somewhere, but for some reason we ended up in Florida. I still remember a guy by the name of Ron [Ronald J.] Grabe, who was in my group, Mary [L.] Cleave, in my group, we all piled on this bus at six-thirty in the morning, or something like that, and drove—or maybe it was that evening. I can't remember. All I can remember is Grabe ended up sleeping in, you know, where you put your bags in the overhead compartment of the bus. That's where he slept, because somehow we'd maxed out this bus with all of our equipment and dive gear and all that sort of stuff. [Laughter] I remember Mary Cleave was all the way in the back, and she was piled under something or other so that she could get a little bit of protection there, because she wanted to take off some of her clothes but she didn't—obviously, this is not a private setting, so we made this little cocoon back there for her.

And that was a wild, wild dive. We didn't lose anybody, but I still remember that, how uncomfortable and unpleasant that dive trip was.

ROSS-NAZZAL: You mentioned STS-1. What were your duties for that mission?

RICHARDS: What were my duties for STS-1? My duties for STS-1 were nothing. I was the support crew for—at that time they had support crew, which basically you're a gopher for the flight crew that's getting ready to go for STS-2, Joe [H.] Engle and Dick [Richard H.] Truly. And so my job was to go do whatever the hell Joe Engle and Dick Truly wanted me to do, which was generally just go chase down a bunch of stuff. They were very nice guys. They realized that was kind of a tough position, to have a naval officer that was used to flying airplanes off of aircraft carriers and flight test work, and now all of a sudden, you're a gopher for a bunch of astronauts.

But they were wonderful people, and they had me involved in as much things as I was interested in, and for instance, they had this experiment, I remember, on their flight where they were going to go—they thought that they would be able to see sunken ship vessels to something of a depth, and so they were looking for interesting sunken ships for targets, and so they asked me to go research some of the sunken ships to go find. So I ended up, we ended up, picking the USS *Houston* of all things, which was sunk in the battle of the Java Sea in World War II, and so I spent a lot of time researching that and so forth just in case Dick Truly was able to see it using this device that he was supposed to look at.

We got the latitude and longitude of it, which in those days of no GPS [Global Positioning System], it's not a trivial matter, traveling in space looking down a hundred and sixty miles above the Earth, trying to find a particular spot in the ocean where you're supposed to train and look for where this ship might be below the way. So he never found it. Whether or not he

was looking in the right spot, I never know; whether or not our experiments didn't work, I didn't know. But we had fun doing that.

ROSS-NAZZAL: That sounds like a fun task.

RICHARDS: Yeah.

ROSS-NAZZAL: What are your memories of STS-1?

RICHARDS: I was just in awe of how such a complicated vehicle like that—from a flight test perspective, I thought it was the most complicated and successful flight test I've ever seen. I couldn't believe that for the first flight test, we were going to actually do the whole mission from beginning to end. Although it was obvious that that was the right thing to do, it still had a tremendous amount of risk associated with it because if there's nothing, that if I was a test pilot, and I controlled it and there was any other way around it, nobody would have ever flown that flight the way we flew it. But just due to the physics of it all and you just couldn't do it any other way, other than the way NASA pulled it off with minimum crew and so forth, then it just all worked. So I was just dazzled by that fact that we could take such a complicated thing and make it work for the first time. And that feeling hasn't left me.

And when we launched the next one here, I still think it's the most complicated thing that human beings can ever undertake, and for the most part, we do it very, very well, but it's just fraught with risk, and I held my breath every time. In STS-1, I held my breath, and I stayed up or I don't think I slept much. I didn't have much to do, but I just wanted to be over listening so

that basically I could understand, because I knew I'd have to fly it one day. Still there was a lot about it that I didn't understand. I wanted to understand what the crew was going through and what and how the systems were performing on orbit. I didn't sleep a lot during that three or four-day flight, but then I was just happy when it got back. I [was] just in awe. That was my feeling that I remember.

ROSS-NAZZAL: Were you here in Houston during that flight?

RICHARDS: Yes. Yeah.

ROSS-NAZZAL: Besides working as a member of the support group for STS-2, what were some of your other assignments?

RICHARDS: Oh, George had little assignments for you all, and because I was a naval officer, George knew that a Navy officer isn't just a pilot, a naval aviator, but you're a naval officer first. Distinction: you're a naval aviator, then you're a naval officer. First you're a naval officer, then you're an aviator, and what that meant was that you had to take care of your people. Aboard a ship, my primary duty, as my captain and squadron commander used to tell me, is, "Okay, your primary duty is to get these multi-million dollar airplanes off and back on safely, and to keep yourself alive. But as equal of importance is you've got to take care of your enlisted guys that are doing various functions aboard the ship."

That was a given in the Navy. George knew that, and so he had this position out at aircraft operations. There's a guy by the name of Joe [Joseph S.] Algranti, who was running it at

that particular time. Joe Algranti was a lot like George. He was more or less the up and out guy as I've described. He was out thinking the big picture about what his airplanes were doing and the larger role of what their missions they were accomplishing. All the hundred and fifty people underneath him who've actually turned the crank and made the thing happen, Joe, it's unfair to say, could have cared less, but he just wished that that would all just take care of itself so he could focus on this other stuff. And George knew that, so he always would put somebody out there who could become, as he would say, the naval officer, and it was always astronauts, their first tour, and naval officers that went out there and did that tour. And I went out there for a year and a half as I recall, and like I was beginning to think I was going to stay out there forever.

But George, that's where all of his assets were, other than his people assets in the astronaut corps, his hardware assets were all out there, and he wanted them taken care of. So I guess that after a while it started to dawn on me that this was a good thing, because he obviously thought enough of me that he put me out there in that position and he appreciated, he knew, that that had nothing to do with flying in space, because I was out there doing the mundane union things. And a guy—his wife's sick, he can't come in, you have to go take care of that, but meanwhile you have to worry about, okay, who's going to take care of his role and we've got airplanes to deploy and airplanes break and all that sort of thing. And largely, I was also out there to make sure George knew what was going on so in case something happened out there. George wanted to know because he knew Joe would never call him. [Laughter]

So I still recall Hurricane—I don't know if you were here for Alicia when it came through, but that did a lot of damage here in the Houston area, and it did a lot of damage out at Ellington Field [Houston, Texas]. It ripped the roof off of one of our hangars out there, and, of course, the Center Ops [Operations] people and I came in that day. We escaped and went north,

and I came back the day after there because I knew no one was at Ellington, and Center Ops was already at work trying to upright trees out here at the Johnson Space Center. If you've noticed, those trees are still bent over from that storm. You look along NASA Road One, and that's one I remember. They were vertical prior to Alicia, and all those oak trees in front of the lunar planetary museum. If you drive down and look for them, they're all just bent in the same direction, and that's from Alicia, because they were vertical prior to that.

So I drove out to Ellington, got in there. Security had it all closed down. I was the first guy in there and found out the roof had been blown off, and it was still raining at the time. And we had parked some of our airplanes we couldn't fly out inside there, fortunately, and they had debris on them and so forth. So I looked around to start to get to work and to get the crew in there, realized I had no equipment because Center Ops had parked it in one of our hangars and then come out and grabbed it to go work on trees back here at the Johnson Space Center and other buildings. But for the most part, the Johnson Space Center came through pretty good. Ellington had the most damage because of the hangar facilities we had out there.

So marshal George Abbey and as soon as he found out about it, all of a sudden within thirty minutes there was a stream of equipment coming down Highway 3, and we spent the next week and a half trying to clean that place out. That's one of my AOD [Aircraft Operations Division] experience[s] I remember is trying to recover from Hurricane Alicia out there.

ROSS-NAZZAL: What were some of your other assignments besides working out at Aircraft Ops?

RICHARDS: Let's see. I know I spent a tour down as a Cape Crusader. I can't remember if it was prior to—yeah, it had to be prior to my first flight, yeah. So I did that, went down there, and

I would describe that as unremarkable, except that it was the first time that you could get in the vehicle and actually start to—that was period of time where I actually learned where all the switches were in the cockpit, all five hundred of them. So that was valuable to me because I could actually get out there and I was the guy inside there for any tests I wanted to be. So I ended up pulling a lot of test time out there. You just throw a technician out who was either standing in there or who would–to throw switches in case they needed it. I used to volunteer for all that because it was great, because if they'd call up and say go to this panel and throw this switch, before I'd never know where it was. But I got done with that tour, and I knew where everything was, backwards, and that turned out to be wonderful training. Sort of like learning to type, you can sit there and it's rote and mechanical, just like this was, but you find out where all the letters were and used it a lot later in your life. This thing worked well for me.

Then we had our interesting share of incidents down there. There was one I recall. *Challenger* was just coming back from— it had just been built, and it arrived. And it was down in [Kennedy Space Center] Florida, and about two in the morning I was down there, and I was asleep in this condo [condominium] we had. And this guy called me, one of our technicians called me, and he said, "You've got to come down here and see this."

I said, "Okay." So I got my astronaut suit in and drove in and walked down on the floor of the Orbiter Processing Facility, and there was good old *Challenger* sitting there. And what they were trying to do was do some brake work, and they were trying to—I can't remember what the reason was, they were installing an anti-skid box or something like that. But it's like three in the morning, so you'd be surprised then and there. You walk in and you had a lot of autonomy on the floor, as far as doing things, and the technician's down there and he's on a radio talking to the—they had hydraulic power in the vehicle. I was up inside the wheel well, and there's a lot of

aluminum tubing and so forth up there like you'd expect. The guy said, "Now look right there at that brake line."

I said, "Okay."

He called up there and said, "Okay, press the brakes," [to] the guy up in the cockpit. So he pressed the brakes. And, all of a sudden, I heard this huge noise, and the brake line that I was looking at disappeared. And the stun. And he said, "Okay, let out the brakes." And he let out the brakes, and the brake line came back.

I said, "Holy cow." There was a vibration in the brake line where it was moving about like this in distance [demonstrates] and was moving so fast that you couldn't see it any time the brake lines were replaced. Now, I looked at that and I said, "I can't believe that."

He said, "Isn't that something?"

And I said, "Yeah, let's get out of here, first of all. If that thing breaks, it's 3,000 psi [pounds per square inch] of hydraulic pressure, and we're all going to be sprayed with this stuff." So they shut down the vehicle at that point and I, quite frankly, called it back to the Astronaut Office, and we didn't quite think too much about it at that point. This is not a good story for NASA, because we thought, "Well, that will be fixed."

Well, they were under a lot of schedule pressure at the time, and incredibly, the proposal was that we go fly as is with that condition and that we just try not to use the brakes all that much on landing. And we said, "Well, what about aborts and things where you had to have heavy braking?"

And they said, "Oh, well, you know, we're not really going to abort. It's the end of the mission that's going to." We spent a week and a half with the Orbiter Project Office at that point trying to say that we should [not] fly as is. Finally, myself and "Ox" [James D.A.] van Hoften,

after about day two of this, realizing this was heading horribly in the wrong direction, got a hold of John Young, something you very rarely ever did, and said, "You've got to understand."

First he didn't believe it. We had to ship him the videotape of them showing of—they put a strobe on the thing so that you could actually see the brake line with the static, because you couldn't see it when it was moving, so you had to put a strobe on it at the right frequency so that you actually could see the brake. And there it was going through all these contortions, and John just about came unglued from his chair. He went over to see Arnie [Arnold D.] Aldrich, who was the Program Director at that time, and Arnie almost came down and took of the head of the guy running the Orbiter Project Office at that point, and we ended up getting it fixed.

But as an astronaut at that point—new, budding—we spent a week before we finally had the right thing done, and that's when I started realizing we might be in trouble, as far as our engineering approach to things and how we look at things, and we say, "Well, it's not that bad, let's look for operational work-arounds," or the fact that, "Well, we figure that if he only uses the brakes for thirty seconds, the line has enough life in it that we can design an engineering change for it later and get it in later."

In 1985 or whatever, whenever that was, '83, '84, that was the first time I'd ever been put in a situation where I saw something so obvious that needed to be fixed that I had to spend a week arguing to get it fixed. Fortunately, it's lesser so nowadays, but back then that was an eye-opener for me, one I still remember. I probably still have the videotape of that thing somewhere around here.

ROSS-NAZZAL: That would be an interesting piece of history.

RICHARDS: Yeah. But in the end the right thing got done. It was just awfully hard to do that, and it took a while. From my perspective, it took about six or seven years of bad things happening at NASA before they started coming around saying instead of "Prove to me it's unsafe," it took us about six or seven years to get it more into saying that "You've got to prove to me it is safe."

ROSS-NAZZAL: That speaks to the pre-*Challenger* culture.

RICHARDS: Yeah, right. Yes, exactly right. Yeah. And it's unfair to the *Challenger* guys. There was a lot of people that didn't agree with that particular thought, including the Orbiter Representative that wasn't an astronaut down there. He and I had dinner the night before out there, and I just was wailing about how horrible this thing was, and he quite frankly agreed with me, just he was having trouble with the schedule pressures as they were. And if you go ask an engineer, "Well, how bad is it?" he'll run out and do a calculation for you, and you give him a percent of assumptions and ground rules for it, he can likely come up with a mechanical answer that is okay to you, and that's a lot of what we were doing. We were trying to achieve a set solution, but it was a set of assumptions going in that we were having trouble with, and that got us into trouble later, obviously.

ROSS-NAZZAL: One of your other tasks that I saw on your biosheet was you were CapCom [Capsule Communicator] for several missions.

RICHARDS: Yes. I think that was after I got done with the Florida where they give you that exposure, again, another great training opportunity there, just to be able to know the checklist. Like I went down and knew where the switches were in Florida, it was just being able to handle all the huge sixty pounds' worth of documentation. As a CapCom, you had to be able to know all the books, where they were, what the pages were, what the procedures were, because when this guy calls out, "Go to this book at this point and so forth," so this was great training for me to be able to do this. And all the emergencies that we went through, even though I wasn't doing them in the vehicle, I started to—that's when it all started to come together, for me at least, after that, that tour.

And of course, I was the CapCom for when we lost our very first engine there, hopefully our last engine, that was Gordon [Charles G.] Fullerton's flight when he lost—a sensor shut down one of his engines, and hopefully I will be the only CapCom ever to say, "Abort," the word "abort." At that point, it wasn't abort Spain or anything like that, it was abort to orbit at that point, but that was an interesting eight minutes there. It was.

[T.] Cleon Lacefield was the Flight Director at that particular—ascent Flight Director, Cleon, great guy. We had worked on that flight for like six months, and, of course, the CapCom sits right next to him, and I can't say anything without the Flight Director being okay with it, and there were interesting ways to communicate. I'd just sit there and look at him. I wouldn't wait for him to tell me. I'd look at him, because I'd hear a request come up from one of the flight controllers, and I could sit there, Cleon thinking about it, whether or not he wanted to do it. Of course, I already knew what to tell the crew in the event Cleon wanted to do this. I just needed his okay. And we had developed this sort of silent communication there, and he'd just turn to me

and nod his head like this [demonstrates], and I'd, boom, out it would go. And it worked very well, because it was very quick.

That paid off in spades on that particular flight, the only time in ascent where we really had a time-critical emergency that the Mission Control Center actually could do something about, unlike *Challenger* and almost any other flight we did. Everything the Mission Control Center could have take time, you know; that eight-minutes of ascent, you don't have time.

And we're sitting there, in fact, somewhere around four minutes, and we'd just given them the ATO [Abort to Orbit] call, which meant that if they lose an engine, they could go right after that. And maybe somebody knew something back somewhere in the Mission Control Center. I had heard no talk at this particular point anything was wrong. And all of a sudden I heard Gordon Fullerton say, just seconds after I'd given, "You're ATO," at this point, he said, "Houston, the left engine's out." It was like automatic clockwork at that point. It was like Gordon made that call. Gordon made that call just like on the simulator.

And I said, "Roger, left engine's out." Turned to Cleon, and all of a sudden, we had this traffic. And the Flight Dynamics Officer called up, "He's ATO flight."

Cleon nodded his head, and I said, "Abort ATO." And as I recall, I said it twice, "Abort, abort ATO." I ended up getting Marie Fullerton all upset, because she didn't know. She was sitting in the gallery at this point, and she didn't know what that meant at that point. And I can't recall if I—no, she was down in Florida. That's right. She was down in Florida. But she told me afterwards that, because I'd said it twice, it got her upset. And I said, "I just wanted to make sure he heard me." [Laughs] I probably had a little gain in my voice at that particular point, too, but I knew that it wasn't really anything bad. We were still going into orbit, it's just it had the word "abort" in front of it.

And so off we were going to orbit, and we were dumping fuel like we were planned. Everything looked nominal. All the normal calls were coming up. And then, I'm trying to remember her name. Her name was Jenny [M. Howard]. She was the main propulsion system officer. I can't remember her name. I think it was Jenny [M. Howard]. She was our main propulsion system officer, flight control officer. And I could tell some uncertainty was in her voice. About six and a half minutes, she was saying, "Flight, we think an erratic set of sensors shut down the first engine, and I'm watching, in the right engine, one of the two sensors is already disqualified, and the other sensor is starting to move around," which meant if the second engine had gone down, we would have had to end up trying to land at Crete. That would have not been a good experience. With two engines out, that's something NASA just refused to accept was even possible, and we had cooked these, made these, procedures, come up with these procedures, that if two engines went out, this is where they were supposed to go because they had no place to go at this point. They couldn't go to orbit. They were past the point that they could get—they were too fast to go to Spain, and there was this gray zone of where they go, so they would have ended up going to Crete.

I heard the fact that the second engine might go down, and my heart just—that's when I started getting excited. And Jenny was sitting there saying, "Flight, I'm thinking about taking the limits to inhibit," which would have meant that the engine would have ignored those sensor readings and just continue running. It didn't care what those sensors told it, it would have continued to run.

So just like classic Cleon, Cleon was listening to all this, and Jenny didn't even request it, I recall. He said, "I was just thinking—I'm just thinking about doing it." That's a big deal in the engine community. The engine community never wants to run with limits inhibits, because they

think they don't—because if you run and something bad happens, and the sensors tell you that, the whole engine could blow up, and so they'd rather have it shut down. But if the sensors are bad, and we were in such an extremist situation for the second engine failure of where we were going to end up. Cleon understand all this, that that was the right thing to do. So Cleon very calmly said, "Well, I think you ought to take the limits to inhibit."

She said, "Okay, Flight, limits to inhibit."

And I went, "Limits to inhibit" to Gordo.

And of course, he didn't understand that, because he didn't have any data, but he said, "Limits to inhibit."

It turned out that sensor wandered around, but it never did. It would have never tripped, but it was wandering around bad enough where we had three sensors fail on one flight at that particular point. It was still the right call. Then we went to orbit and we had a successful mission after that, flew almost all nine, ten days.

But I'll still never forget that ascent. I was really proud with how the whole ascent team worked together. Gene [Eugene F.] Kranz had some—he was still at NASA at that point. He had some good comments for us afterwards. He just thought the ascent team just did so wonderfully, and I remember his words in the press were they crackled, was the word he said. "I love it when I hear a flight control team crackle like that." I think it was a good thing he said, but I was really proud of it, proud of us for that.

And then, thereafter, we spent ten days during and after that period of time, because we dumped so much propellant trying to get us to orbit, we didn't have enough RCS or reaction control system jets to be able to protect—initially, we couldn't fly the full ten-day mission, so we were only going to fly six or seven. Then somehow we kept chipping away at our flight rules for

entry in case we have more failures on entry, they said, "Well, we don't need that prop, so we can bring it back a little bit. And you're too conservative, bring it back," and we got this thing out to about eight or nine days now, as I recall.

Of course, poor Cleon Lacefield was also running entry, so he just had this potentially horrific thing happen to him in ascent. The last thing he's going to do is give up his margin for entry. And keep in mind, we'd only flown the vehicle about nine, ten times at this particular point. He was not about to give up any of this margin. He had to defend and fight, and he looked—as we came in, as we got closer to entry, he looked more and more tired to me. And of course, in the paper, the [NASA] Headquarter's Administrator at that time [James M. Beggs], all he could think about was defend himself from the word "abort." We called it an abort to orbit, and so I had said abort. And so he was being quoted in the press, "Well, that's a lousy terminology. It wasn't an abort. In fact, I'm going to change this; they're never going to get to say this." This is the crazy stuff we were doing at that particular point.

And Cleon, poor Cleon, finally we did entry and everything worked great. But afterwards Cleon decided to leave NASA, and I was just—that was personally a really tough thing for me, because I thought he ought to be a friggin' hero, and he wasn't because he was too conservative for this thing. He was on the outside of NASA, but inside he was getting eaten up, and he left NASA shortly after that sort of thing.

So, we had a bad thing happen to us that could have been turned into something heroic, but we ended up, in my opinion, picking the wrong priorities for things. So sorry to pick on these negative things, but they just were the things that stuck in my mind at that point.

ROSS-NAZZAL: Well, and they're part of the history, too, so, and history's not always positive.

RICHARDS: Yeah, that's right. That's right.

ROSS-NAZZAL: Any other memories that you have from any of the missions from where you were CapCom that stand out?

RICHARDS: Of course my first CapCom flight was the repair on Solar Max. That wasn't an ascent. I was their basically to backup Jerry [L.] Ross and start learning this CapCom, and that was when we went to try to repair Solar Max, and we'd come up with this tool that Pinky [George D.] Nelson was supposed to put this thing and extend it from his belly like a big cylindrical box, and he was supposed to fly up there in the Manned Maneuvering Unit [to] Solar Max and there's this little thing sticking out. Of course Solar Max was never designed to be rescued, but they had this little pin sticking out, and they had designed this thing such that Pinky would fly in there, get close, and then get close but not touch it, because if he touches it, the satellite's going to go spinning off.

He's going to get close, fly in close, and then throw this device. And I don't understand how it worked, but essentially clamp down on this thing, then he and satellite would be as one, and he'd fly this thing back into the payload bay and we would grab it and then go fix it. Well, that was the flight where he got in close, tried to do his little clamping mechanism, and it didn't work. He'd clamp it, and for whatever reason, it wouldn't clamp.

Meanwhile, the spacecraft would bounce off of him and go spinning off, so he had to back out. So we spent, oh, I don't know how long. We spent two days trying to figure out what the heck was going wrong, and it took us about two days before we realized using closeout

photos of the spacecraft, which was launched about a year and a half earlier, that there was little tiny grommet sticking out about this far [demonstrates] just adjacent to where this pin is, and it just happened to be at the right location such that if you get this thing close enough, the thing had to get flush within maybe a quarter of an inch. And Pinky was capable of flying it that close, but he'd get to within half an inch, and the device he had would contact that grommet and then the spacecraft would get pushed off to the side like this and just enough at a bad-enough angle that when he did the clamping mechanism, it wouldn't grab. Meanwhile, it was bouncing off, and off it would go.

First history of that building spacecraft and you're trying to do this close quarter operation, little details like that are extremely important because all of the design documentation we had said there was nothing supposed to be there. We called it, in Boeing, as designed and as built. We design things, and we'll put out drawings, but how they actually end up being built is sometimes considerably different. We have a task where there's not a contract where we try to match up the difference between as designed and as built.

This was a case where the little spacecraft had this little grommet on there that was used to house a blanket, and all the drawings said was put the blanket on and use these grommets, but it doesn't say—the technician had a wide degree of latitude about where he could put these grommets and where he could put these things, and it never dawned on anybody this grommet could be right there at the wrong spot. So we spent two days doing that and finally gave up on this method and ended up grappling it with the arm directly.

And that was a real eye-opener to me. Nobody's fault, but it was just this new spacewalk business that we're doing. [It] had to be really important. The devil's in the details here, and we keep learning that lesson over and over again. But one thing that to me has come a long way in

the last twenty years is that EVA [Extravehicular Activity] group across the street at the Johnson Space Center, they know all this stuff. And later on, when I was Mission Director for the second Hubble servicing mission, I worked with our Goddard [Space Flight Center, Greenbelt, Maryland] friends on that one, and this was the same group of people that built Solar Max, so we didn't have to spend a lot of time communicating about these sorts of little things, particularly when something is EVA intensive as repair of the Hubble telescope. We spent a lot of time worrying about as designed and built. We put a lot of money into it to make sure we didn't have any surprises in that thing, but that was our first one. Great, great victory, by the way, too, when we overcame that.

I'm trying to think what other CapCom. I can't think of any other ones.

ROSS-NAZZAL: Let's talk about your first mission, which was cancelled.

RICHARDS: Twenty-eight.

ROSS-NAZZAL: Sixty-one-E.

RICHARDS: Sixty-one-E, right.

ROSS-NAZZAL: When did you find out that you were selected for this mission?

RICHARDS: I don't remember when that was. Let me see. We were supposed to fly in '86, so it seemed like '85, maybe late '84. Can't remember there. I knew I was up for a mission. George

never says anything; of course John Young is a sphinx, so you never knew what the heck you were—how bad or good you were doing, but I thought I was just because of where I was assigned, I thought, "Well, I'm progressing here." And we'd performed enough flights that I thought my group was about ready to start being assigned there.

I knew the other Navy guy is my group was Mike [Michael J.] Smith, so he and I were talking back and forth about where we'd end up. At the time, we were going to fly out on the West Coast. We were going to have the first flight out—Bob [Robert L.] Crippen was going to have that flight out there, and so for a while there, Mike Smith was going out there with him, because they thought they were going to do the first launch from Vandenberg [Air Force Base, California].

Then I started getting all these simulation flights with Dick [Francis R.] Scobee. I thought, "Oh, oh, something's up here," because I'd go in there at two in the morning for simulate, and there'd be Dick Scobee. And so it happened three times in a row, and I said, "This is something beyond coincidence here." So that's where I thought I was headed was whatever flight Dick was assigned to.

Then the Vandenberg thing all came apart, or it was delayed. It hadn't come apart at that point. I think it was just delayed. And so Mike all of a sudden showed up, and he started doing simulations with Dick Scobee, and I started showing up with Jon [A.] McBride. And so I said, "Okay, that's how it must be working." Then in like '85, all of a sudden they announced that Mike was going to be paired with Dick Scobee for 51-F, and I was going to do the 61-E with Jon McBride.

ROSS-NAZZAL: Can you talk to us about the training regiment that you and your crew were working on at that point?

RICHARDS: You know, I'd done so much training as a CapCom, I'd been there by now four and a half years, and I'd scarfed up so many simulation flights, it was just more or less getting to know my crew and working and doing. I already knew the ascent and entry stuff fairly well at that point. It was the on-orbit stuff that I had to spend a lot of time with, that I can't talk about. Oh, excuse me, 61-E, I can talk about that, yeah.

And we had a couple of payload specialists, and we had this new instrument pointing system. Our mission was that we were going to go get, go out there and track Haley's Comet when it came around. So we had this instrument pointing system, which was the Shuttle could point at it, but we weren't—the Shuttle, in cosmic turns, wasn't stable enough, so they'd have this more fine-tuning device, which is really supposed to focus in on Haley's Comet and sort of view it with a wide array of sensors, trying to get this sensor to work for the very first time. It was basically an Orbiter subsystem, and so we had two payload specialists onboard that flight that were trained to use that thing. Trying to get that thing to work was a real challenge. The Orbiter was mature compared to this thing.

So we spent a lot of time worrying about contingencies. It was the first flight of this, and we spent a lot of time trying to figure out how we were going to work around this thing once we got up there, in the event of its failure modes. Of course, there were EVAs involved because this thing moved around, and so it was a lot of on-orbit operations, and we weren't very mature. But Haley's Comet was coming and going, so but we looked at it as a standpoint of, "Well, we're going to go up there and do the best we can with this thing."

So I spent a lot of time going over to [Marshall Space Flight Center] Huntsville [Alabama], I remember that. But for the most part, I just, Jon McBride and I would just sit there and try to do our pilot commander thing. I don't remember too much else about it, other than the fact we had a good time and we really thought we were ready to go in March of '86 until *Challenger* happened.

ROSS-NAZZAL: Where were you when the *Challenger* accident occurred?

RICHARDS: We were in the simulator and they were getting ready to go and they decided to stop. And of course, we'd come down and watched the launch, so that's when we saw it all happen when we were sitting down there in the Building 5, in one of the simulators. And when it happened, we knew what happened, and so it wasn't much point in doing much else at that particular point, so I went home.

ROSS-NAZZAL: After you went home, what were some of your assignments related to the *Challenger* accident?

RICHARDS: I got called like that day by Mike [Michael L.] Coats, as a matter of fact. He was down in Florida. Of course the spouses down there were basket cases, and they wanted—we needed to do something called a Casualty Assistance Officer. NASA was way behind at this point. All of a sudden, they had this national event in front of them, and of course, the spouses were all of a sudden had just become the focus of the entire country because they were the ones that were left, the widows of that crew, and they wanted Mike—from the military when

something like that happens, you assign what they call a Casualty Assistance Officer, who is a guy that comes and shows up and basically does whatever the hell the spouse wants to have done. But largely you help them. Depending on who the spouse is, sometimes they know what's going on with—sometimes spouses don't have a clue. Their husband took care of all that. Of course, there's the Navy paperwork and insurance and all that sort of stuff.

And Mike Smith was a naval officer, and so I got assigned to be the Casualty Assistance Officer for Jane at that point, and that was supposed to be a three-month assignment that turned into almost a year and a half, not because of the paperwork stuff but just for the fact that they had all these speaking engagements around the country, and they had to go from spouse, homemaker, basically in the shadows, to be out front there. So we spent a lot of time there helping them out trying as best we could. So I did that for about a year and a half.

At the same time, we still had a mission that came and went, Haley's Comet kept right on coming and left. But our crew stayed together. Obviously, our mission had gone. We had thought that maybe they would reoutfit *Columbia*, which at the time was the vehicle, with another target, because we were lobbying that we should be—of course, we were lobbying that we ought to go fly this thing because there was other opportunities for it for later on. Haley's Comet would be back, but we ought to go fly it anyway and flight-test it and so forth. That sort of fell on deaf ears in NASA. They basically said, "No, that was designed for this. We're not. There's no scientific return. We're not going to do it."

But we were still there, and we spent for a year and a half had no mission, but we were still together. But we knew we were not going to be together for very much longer, and it wasn't until, oh, gosh, it seemed like a year and a half, maybe '87, '88, before I got assigned to 28.

ROSS-NAZZAL: Let's talk about 28 then. What sort of changes were made to flight training that you noticed after the *Challenger* accident?

RICHARDS: Well, we had more time. The thing I remember most though was the fact that in between there I was—another assignment that I picked up. I didn't mean to imply that I was a Casualty Assistance Officer and that's all I did. I also picked up the SS, the Space Shuttle main engine requirements. I was the astronaut representative to the main engine project. All of sudden, Huntsville, the project offices over there, all of a sudden they wanted us along for everything if we could. Before, they didn't. You know, all we did was create problems. We'd just say, "We don't like what you're doing."

They'd say, "Go away." But now all of a sudden we were their friend, so I ended up becoming the representative to the Space Shuttle main engine project mainly because Space Shuttle main engine, those guys, the Rocketdyne people, they spent forty-eight hours after the *Challenger* accident thinking that they'd caused it, because of the way the vehicle came apart, you couldn't tell if it was a breakup or an explosion. Engine exploding could have been the same thing, and even though they didn't have any data to support it, those engine failures happen so fast that they hadn't ruled out that they were the cause of it. It took about forty-eight hours before the finger got pointed at the field joint, and they all breathed a sign of relief.

But in that intervening period between '86 and '89 that we flew between 51-L and STS-26, the Space Shuttle main engine project used that to get well. They put in thirty safety-flight modifications, as I recall, to that engine. I briefly followed the engine program, because there was a lot of explosions over the test sands there, and each time an explosion happened, we would go through and go through this process where everybody would try to figure out why it is that it

was okay to go fly on the next flight, even though we just had a meltdown of an engine on a test stand over there. And they'd had a lot of them, and so I'd gotten involved in that process.

Fortunately, all the testing they had done, they had gotten better, but really they needed about thirty fixes in that engine. In that intervening three years, they had the time to do it and they did it. Most of it was engineering work. All I could sit there and nod my head and say, "I understand why you're doing it." But there were some areas, particularly with respects to limits and the sensors and so forth and that we got heavily involved in and ended up, I think, positively influencing how the engine responds in the event a pair of sensors starts not working properly.

I felt really good in walking out to *Columbia* in 1989, just because I knew about those thirty changes, and I tried to communicate that back to the Astronaut Office that we are—I can't quantify it but there's probably some probabilistic person that would argue that this number, but as far as I was concerned, the engine was ten times safer than what it was in 1986 and we would have eventually gotten all those things in but we would have had to fly a lot of flights before we would have got them all in. So I told them I thought we had used the three years well. We made the program whole as far as I was concerned and we were ready to start finally flying this thing at approaching the flight rates starting in 1989 that I thought that we'd hoped to do in 1984 and '85 and now people were marching, I won't say blindly, but way too fast trying to get us out to flight rates when the vehicle wasn't ready to do that. So in '89 I felt a lot better about that.

And your question was about training?

ROSS-NAZZAL: About training, yeah.

RICHARDS: Yeah. And so training was kind of routine. I'd already done all that stuff. We had a payload, classified payload, can't talk about that, but the ascent/entry stuff was pretty much—I'd now been at the Johnson Space Center for seven, eight years. Probably a year of that or nine months of that, I lived in a simulator, so I was getting to be pretty bulletproof as far as the simulator was concerned, so it was just the real experience I was lacking. So I can't recall too much about it. It was, again, getting used to a new commander, Brewster [H.] Shaw [Jr.], and then the three compatriots out there, which was a good crew. We had a good flight.

ROSS-NAZZAL: Can you talk about that crew relationship? You were an all-military crew. Was there any sort of military rivalry?

RICHARDS: We didn't have to communicate. No, we didn't have to communicate a lot. We were all cut from the same cloth. There wasn't too much that we needed to talk about. We all understood each other, and so from that sense it was probably boring to the outsiders but it was comfortable for us because we all knew each other.

ROSS-NAZZAL: What were some of the challenges associated with flying a classified mission?

RICHARDS: Keeping it classified and not getting into trouble, yeah. We had some weird stuff we had to do as far as what we could tell our wife, what we couldn't. Some of it's pretty complicated. I usually approach those things, "Well I'll do what makes sense." But when I got into it, this thing was so classified that we had to do things that were, in my mind, crazy. But I knew I had to do them, so it was just a question of remembering and trying to do that. That was

the hardest thing, was to make sure that you didn't inadvertently have a security leak or a security breakdown there that you could not only jeopardize your mission and your payload, but also yourself personally.

ROSS-NAZZAL: I wonder if you could take us back to that day of launch and sort of walk us through the beginning of that day up until you actually launched in the Orbiter.

RICHARDS: Let's see. As I recall, we were one of the few crews—I've got four flights. I'm one of the few crewmembers who I think can say that the day they flew down to Florida, they actually launched three days later. I did all four of my flights, and this was one of those. This was one of those.

Columbia was a vehicle. It was the first flight of *Columbia* after *Challenger*. We all felt good about the vehicle. I can't recall anything specific, other than the fact of just going down there, we—the wives were there, of course, and they had gotten along really well with each other. In fact, my wife and Kathy Shaw, Brewster Shaw's wife, started [as] volunteers down at the Museum Fine Arts in Houston. They still, in fact, they're out together today. So they got to be good friends, and so we had a really tight-knit crew.

I recall the first time going out to the beach house, which is a famous place down there, which is where we go and relax down at the beach and just had a ball out there, as much as you can have, and so all of that was routine and I felt pretty relaxed going out to the vehicle. Then launch came around and, you know, we counted down. The weather was just drop-dead gorgeous. I remember one instance we got down to T-minus twenty minutes, and they started the clock, and everything was going pretty much routine. And we had a software transition

where they take it out of the ground mode and put it in a flight mode about T-minus seventeen minutes or something like that, and all that, we were sitting there watching the displays.

Normally in a simulator, all you see is the display change and that's it. Well, when the display changed, we heard this huge bang that shook the whole vehicle, and so I turned to Brewster, and I said, "That wasn't in the simulator," like [demonstrates] and "What the heck was that?"

He said, "Ah, those guys in the ground, if there's something wrong, they'll have seen that sort of thing."

And I said, "Okay." So we sat there for the next ten or eleven minutes, got down to T-minus nine, sat there and waited for ten minutes. Nobody said anything, and I said, "They going to say anything about this, about this big bang we had?" I mean it was a big bang. It wasn't just a little thunk. It was a big bang. And we sat there and waited, and they came out of the T-minute nine-minute hold and started counting.

So we're having a lot of debate inside the cockpit at this time, because Brewster's got to give the go to come out of the hold. We're having a lot of debate inside. "Well, do we say anything?" And finally it was his call. He finally decided, well, there's enough data on the ground. If this thing would really hurt something, they'd know about it. So he didn't. He elected to not say anything.

And so we came out of the T-minus nine-minute hold and we launched and everything was just wonderful. And we flew to space and came back. Now when we came back, we got into the debrief process and sat down and we started saying, "Okay, hey, did you guys see anything at T-minus seventeen?"

And so the whole Mission Control Center group is sitting there looking at us, incredulous faces, and said, "We had this really loud bang at T-minus seventeen minutes." And that prompted this big investigation. They had never seen anything. They were clueless that any of this had ever happened, didn't know what it was, didn't know what it could be. And so we did this huge investigation trying to find out, went back and looked at all the data, all the strip charts, everything, could not find anything at all. In the end, we concluded that—well, let me fast forward then for about two years later.

I can't remember if it was *Columbia* or something else, but this technician is standing there in the aft compartment. They were getting ready to throw some valves on the main propulsion system. And all of a sudden, he heard this huge bang, and he reported it. Everybody remembered from our incident. Okay. So they went back again. It turns out we have these little, we have these huge seventeen-inch lines that come up. They had come together like bellows, and there's this complicated bellows where they give and relieve and they move around, and this bellow can actually get cocked. And it can sit there, and as it moves around, it can actually get off center, and it turns out it can ride. The way this thing is bent, it can ride up on a little bit of a ridge of a piece of material, and then when it's supposed to relieve and come back, it's supposed to come back down, sometimes it hangs up, and then it will sit there and sit there and sit there until something thermally happens that the thing will contract just a little bit. And then all of a sudden, it will just give and go boom. So when the seventeen-inch line does that, we finally figured it out that that's what it was, but interesting story, interesting story.

In the end, I was convinced, and Brewster would, if he was here, he'd know this story, so I don't care. If he reads this, he will know. And I was never sure he had made the right decision on that. In the end, two years later, we made the right decision, because it turned out it was just

this bellows relieving, and so it was okay. But, boy, the sound was just—the sound sure didn't sound like it was a bellows relieving. And if we'd done that, we would have put *Columbia* down for six months, because NASA would have come and after *Challenger* come and broke that thing apart, and maybe we would have found it after that period of time, but we would lose six months for something that really turned out to be not all that bad. But that was my one experience there.

Then in the flight, I can't tell you about what happened, but we had our first fire in the flight. Turned out a little piece of GSE cable for a nonclassified experiment built over here somewhere by some either Warren. I'll never forget. Dave [David C.] Leestma was sitting there in the cockpit, sitting there doing something. I was sitting in the seat about day three or four. All of a sudden, I hear Dave go, "Whoa, whoa, whoa," and he actually got to see a fire in flight. It actually started, it melted down; they had a short and started burning all the wire material. There a little ball of flames, a sphere of flame, about this big occurred [demonstrates], and so that was our one exciting moment there, and we took care of it ourselves, turned off the switch, like you would do if you had a fire, electrical fire on your flight, and the fire went away and never did trip the smoke detector. But that was the other interesting, interesting part of the flight. That's about it.

ROSS-NAZZAL: What are your memories of your first landing of the Space Shuttle?

RICHARDS: Brewster had this technique that we were landing at Edwards and everything was fine in entry. The thing that surprised me so much was on entry I kept seeing stuff come off; things would fly by me at mach 17, and you just go by—it would go by the window and I'd turn to Brewster and I said, "What was that?"

And he said, "Well, just hope it isn't important." [Laughs]

ROSS-NAZZAL: Oh, that makes you feel good, huh?

RICHARDS: Finally, a similar about mach 10, something came off and just splattered my right window, and it looked like a giant bird poop, is what it looked like, and it just splattered the right side of the window. Again, I had this stuff coming back, and little fiery things would come off and they'd go by, and I was just surprised by that. I didn't think anything was supposed to come off, but there was more stuff coming off than I had been led to believe. And this thing hit the window.

So we got out and we landed. Should get on the landing. Brewster had this technique where he really—his last landing, he'd had the lowest sync rate ever by a Shuttle pilot, which pilots like to have that happen. See, he had this technique and he'd get down close to the ground and he'd just tweak back, pull back on the stick a little bit, and then relieve and then we'd float a little bit longer and he'd pull back some more and float a little bit longer, float a little bit longer. And that worked pretty well the first landing.

The second landing, he kept doing that; we never landed. We even got to a foot. I called a foot for what seemed like thirty seconds. We were in landing, I said, "One foot. One foot. One foot. One foot. One foot. One foot. One foot." Finally the nose came up. We landed at something like a hundred and seventy-five knots, which is really slow. We were supposed to land on like a hundred and ninety-five knots. And the problem is, you see, that he got the vehicle cocked up so much that when the vehicle comes over, it actually goes in a negative angle of attack and about here it loses all authority to keep the nose up, so the nose just goes right through [demonstrates].

And so the higher you are and the slower you are, you lose authority even sooner and nose ends up coming forward even faster, and you can get so slow you worry about breaking the nose gear off.

Finally about a hundred seventy, I think I recall saying something, "We've got to land here." And when we finally landed, I said, "Get the nose down." And Brewster quickly flew the nose down. He didn't let it fall through. He flew the nose down, and it just landed. Oh, it felt like that friggin' nose gear just collapsed, because we're on—it wasn't, but it just was a horrible sound. And so I remember that, and Brewster will remember that as well, too. But we gave him a lot of pilot grief for that. Afterwards I said, "Brewster, I'm not going to be using that technique if I get to land." [Laughter]

Then so we get out on the ground, and the first guy to meet us was Don [Donald R.] Puddy, who was running Flight Crew Operations at the time, and I told Don, I said, "Hey, something came off at mach 10, splattered my right window, and it's still there, didn't ever burn off. You ought to go get it." And so they told the ground crew about that, and so the ground crew went out there, scraped this stuff up. It was still in liquid format somewhat. And they scraped this stuff off the window, and he didn't have anything to put it in, so he took a coffee cup out there and put it in.

So about three days later, I see Don at one of our startup debrief, and we had to go through our flight, and I said, "What's Orbiter say about what the material is."

And Don goes like this [demonstrates] and he says, "You're not going to believe this." This guy took this thing back, puts in on a counter, guy comes up, pours coffee in it, and drinks it. [Laughs] And he said, "This is the worst tasting coffee I've ever had," and throws it away. So we never found out what that was, other than the— [Laughs]

ROSS-NAZZAL: Oh, my gosh.

RICHARDS: So that's what I remember about landing. [Laughter]

ROSS-NAZZAL: Did you have any PR [Public Relations] duties after this flight?

RICHARDS: We had PR duties before that flight and after the flight, and most of them were classified in nature, going out to whatever it was we had onboard and talking to the people that helped make it. That's all.

ROSS-NAZZAL: No hometown tours or anything like that?

RICHARDS: I think I did that, too, yeah, I did that, but I don't remember much of them.

ROSS-NAZZAL: What were your duties after this flight until you were named to your second flight?

RICHARDS: As I recall, I didn't spend a lot of time on the ground. I don't recall a duty because I almost got immediately assigned to STS-41. I'd been told beforehand since I had been—that was nine years between the time I reported to the Astronaut Office to the time that I flew for the first time. And I remember in the Astronaut Office, we'd had a whole bunch of people being selected to the astronaut office at this point. They were up to the class of '85 or maybe even '87

at this point. So we had a whole bunch of astronauts that had not flown, and so when we did our debrief when them, I said, "I was the plank holder. I was the longest guy that had waited at that particular point, nine years." And I remember making the speech. I said, "Well, I hope I'm the last guy that has to spend nine and a half years here between the time he walks in the door and he flies." And I guess management felt like they owed it to me to make it up to me, so they had turned me around and got me ready for my first command on STS-41 right away. And so I don't recall spending a lot of time before I was announced that I'd be the commander of STS-41, and we weren't that far from flight at that point. So I think my memory was we went right back into training at that point. NASA was pretty good to me about that, Don Puddy in particular. I know Don was post-George there, and Don took a lot of guff from a lot of people, but I've got nothing but good things to say about Don Puddy.

ROSS-NAZZAL: Could you compare and contrast your role as pilot on STS-28 with your role as commander on this mission?

RICHARDS: Yeah. It was more I was more in charge of making sure the crew was trained and trying to think about the big picture rather than just my role there. Also mentoring the pilot at that time. The pilot I had was Bob [Robert D.] Cabana, who was a new guy. It was going to be his first flight, so I'd just gone through that so I was interested to try to make Bob as comfortable as possible. And we also had two other. We had a crew of five. Two of the mission specialists, Bruce [E.] Melnick and Tom [Thomas D.] Akers had never flown before. And the only other seasoned guy I had, he had only flown one flight, was Bill [William M.] Shepherd. So Bill and I

had, with our one great one-flight experience, were the veterans, and the rest of us were rookies, so we had a—I was struck by how new this particular crew was.

I had had the luxury of nine years getting ready to go fly. They didn't have that much time. And so I decided to do a little crash course in systems knowledge, and I sort of came out and decided that they would start giving lectures on systems from their perspective. So we'd do that once a week, that sort of thing. Popular with some people, not so popular with others. [Laughs]

So we spent a lot of time, I spent a lot of time, worrying about their systems knowledge and ship basics because of the lack of their shelf life. Turned out to be they were great. By the time we got done on that crew, we knew that vehicle backwards and forwards. My contribution to that was probably small. It was just that they were—I had a very smart, capable bunch of people who were just—and they were all military background, just like I was so, so we didn't have to spend a lot of time talking to each other, because we could look at each other and we'd understand where we wanted to go with things. So we were pretty good, and that's what I spent most of my time worrying about.

Then that was the summer of hydrogen leaks. I don't know if you recall, but as I call it, *Discovery* was doing, as I recall, a major modification, and so it spent a lot of time in down period because it was going through a major mod [modification] period, and we were going to get it to go fly in October after that with this Ulysses mission. And *Columbia* and, I guess it was, [*Atlantis*], I can't recall, were going to try and launch all throughout the summer, and couldn't ever get off the ground because they'd get down to T-minus nine minutes and all started picking up hydrogen leaks in the aft compartments, and it was on two vehicles. NASA was tearing its hair out trying to figure out. We spent like six months.

In our heart, we thought *Discovery* was just going to be just fine, didn't know why, but it'd just come through major mod, they'd done a lot of leak inspections on the aft plumbing, and so we felt like we had the best chance of anything to go out to the launch pad. And when they finally tanked and fueled the thing, which is where we could only pick these things up, when the cold hydrogen got in there, turned out our vehicle was tight like we thought it was, and so we launched.

ROSS-NAZZAL: What sort of knowledge did you pass along to Bob Cabana from your own previous experience?

RICHARDS: Just a lot of it personal. You know, I told him in a simulator, you're going to be able to move around a lot more than you're going to be in this spaceflight. I got on him pretty hard that that's fine, maybe you've got more flexibility than I've got, but have two ways to be able to get to a switch. If you're behind it, don't count on the simulator being able to look like he was doing. Start training yourself to be able to look in your mirror, because on launch day you might find you can't turn around. So I don't want that to upset you. So be able to look in a mirror and find that switch and throw it, which is, you know, in mirrors things are backwards. So he had to train himself to be able to do that.

You know, checklists, insist that it's right. We've got this huge army of flight data file people out there, make them earn their pay. And so Bob is basically one of the nicest guys I've ever run across, still one of the nicest guys over there. I think the Johnson Space Center people probably love him. I just got on him more to be hard, be more of a hard-ass than what he was doing, because Bob was, "Well, this is okay. This is okay."

And I said, "No, it's not. We've got all these contractors out there. We pay them a lot of money. Make them go do it right." So those little things, that's all.

ROSS-NAZZAL: How closely were you and the crew working with ESA [European Space Agency], who built Ulysses and with JPL [Jet Propulsion Laboratory, Pasadena, California] who was managing?

RICHARDS: Pretty good. Well, that was one of our first things, to go over to Europe and meet the European Space Agency people that were building the Ulysses spacecraft, and so we did that, and they were a great bunch, German contractors, as I recall, with a lot of Dutch project management there. So our first exposure to ESA and we were—it was a small thing. I don't know if I still have it or not. Yeah. It's back here in the corner, that little gold thing [points]. It's really tiny. It was really tiny. You could literally go out there and pick it up and put it in the back of your pickup truck and drive off with it if you wanted to. It was really small. The only thing about it was heavy because that RTG [Radioisotope Thermoelectric Generator], radio nuclear powered power source they had for electricity for it.

So it was not a lot of staff in there. It was maybe about fifteen, twenty people that maintained that, and I was just—it was my first with European culture. At four-thirty, end of the day, they have one shift working on this thing. Of course, they'd been waiting for a long time to go fly it. Well, post-*Challenger*, so they had it ready to go. So at four-thirty, end of the day, the German crew would sit there and say, "Is it four-thirty yet?" Said, [speaks German], and they would all of sudden, they would open up their cooler and there they'd have kegs of beer, German beer there, and we'd all sit around there and sit next to Ulysses, toasting Ulysses and having

beer. We didn't do that here in the United States, and so that culture was different. I kind of liked it, but. [Laughter] And we got along great with them.

ROSS-NAZZAL: What are your memories of the deployment once you were up in space?

RICHARDS: Never forget Tom Akers, quite a guy. He was my prime go-to guy for deployment of Ulysses, and there was a time critical bunch of steps where we had to purge the RTG of all of the coolant in there and a bunch of switches. Tom had to get down on this switch panel, which was, for some reason, located in this obscure corner of the flight deck. And he was down there, and we were counting down, and once you start this process, it's an automatic process and you have to get it done. We were at like T-minus deploy minus maybe four or five minutes, and Tom was down there doing his thing.

And, of course, everybody's nervous. This flight had a lot of pressure on us because we'd finally gotten off the ground. It was the summer of hydrogen leaks, first time NASA had flown in like about six or seven months, a lot riding on this, the Space Shuttle's reputation, that this thing work. And so four minutes, I had not bothered Tom, not asked him one thing the entire sequence, and he'd thrown all these switches, configured the vehicle. But by now it was up to him, because the Mission Control Center had very little insight into what we were doing. We'd cut the electricity off from the Ulysses spacecraft, and the only people that could see anything that was going on was Tom, and he was doing all these switch throws down there.

A couple times in the simulations, he had been late, and so we just said, "Tom, you know that's a big deal."

He said, "I know. Okay, don't worry."

So finally about four minutes, I'll never forget, I had to ask him, said, "Tom, how you doing?"

And he just turned to me and he looked up at me and smiled and said, "Never had so much time." [Laughter] And I relaxed and everybody relaxed and so we said, "Okay, we're okay." And the spacecraft came out, came out beautifully, and it was thereafter we were done with it at that particular point because everything was automatic thereafter and it had this complicated IUS [Inertial Upper Stage] burn followed by a—it would jettison and then it had this solid rocket motor section on it that it would automatically fire three minutes later and then it would separate. And then this little tiny thing that you could fit in the back of a pickup truck would come out the other end, no data, nobody knew what the heck was going on. And literally the ESA had their deep-space network, or maybe our deep-space [network], pointed at this one spot in the sky, hoping this thing came out. If it had blown up, nobody would have known. All they would have known was it didn't show up, and I'm sure everybody held their breath. And twenty minutes later, beep, beep, beep, beep, beep, there it comes on its way to Saturn to get spun out in ecliptic and the thing's still going around.

It came back. It came back here, I think, three or four years ago, still working. That RTG on it just kept giving power, and it was going to come back eight years later, and as far as I know, I think ESA's shut down now, but I wouldn't be surprised if they tried to get back in operation, because I'll bet it's still working at that point.

ROSS-NAZZAL: What were some of the experiments that you worked on onboard the flight, if any?

RICHARDS: They were close-circuit. We had the first, our first, introduction of voice-activated commands for closing; Bruce Melnick did that, was controlling the cameras out in the payload bay. That was kind of cool. Let me see. What else did we do? Flew the first Macintosh in space, I remember that. Bill Shepherd liked that a lot. Macintosh had their first version of a portable. I'd always joked that space was the only thing, only place worthy for this portable because the portable weighed thirteen pounds.

Let me see. After Ulysses was deployed, we did cats and dogs experiments, and those are the ones I remember, mainly because they were a lot of fun to deal with. And then the few exercise equipment. Actually, that was the time when NASA said, "We've got to launch, and we've got to get back." That's the part that never made any sense to me. We go to all this trouble to launch, and then they wanted to get back as soon as possible, and so we had a four-day flight and then we had to come back and land at that particular point. And always just frosted me that we spent all this time and effort getting up there and then we couldn't find something to keep us going for longer out there, but that was the way NASA was oriented at that particular point.

ROSS-NAZZAL: Let's take a break here for a second. We need to change our tape.

RICHARDS: Okay.

[Tape change]

RICHARDS: Still on this let's be nice to Dick plan, which was I thought was pretty good, that Don Puddy had, I don't think George had made his comeback at this particular point, because we got done with 41 and then it seemed like I walked into—I can't recall who the Chief of the Astronaut Office was at this point, [Daniel G.] Brandenstein, or maybe it was Brandenstein, I can't remember. I think it was. And he said, "Yeah, we've got this mission coming up here that Bonnie [J.] Dunbar has more or less gotten funding or helped NASA get funding for. It's called—." Because I'd complained a lot about the four-day flight, and they said okay. I said, "Four days." I just raved to NASA about the fact that I can't believe we're going up there and only spending four days here when you do this. So they said, "Okay. We've got this flight coming off called United States Microgravity Laboratory [I], and you're going to be up there with it. We're going to give you an extra set of oxygen and hydrogen tanks, and you're going to get to go fourteen days in space with it."

Great. And my memory was I didn't spend a lot of time. I probably did some things as far as assignments, but I can't remember what they were. It seemed like I went right into STS-50 is how my memory of it went, because it was they had a payload specialist, two shifts, and as I recall the training for that starts like two years ahead of time. Bonnie was already assigned at that particular point and payload specialists were already assigned, so it was just adding myself and Ken [Kenneth D.] Bowersox to the complement. So, yeah, that started that process.

ROSS-NAZZAL: Let's go back and just talk a little bit more about STS-41. There are a couple things that I wanted to ask you about.

RICHARDS: Yeah, sure.

ROSS-NAZZAL: Were there any challenges that you had to face on that mission, that you can talk about?

RICHARDS: I don't recall any, other than getting Ulysses out, and I don't recall any. And the other challenge was this was my first landing. It was going to be at Edwards Air Force Base, and I didn't want to land at a hundred and seventy-five knots, I knew that, and the landing turned out to be—I decided to use a different technique that the rest of the Astronaut Office was using at that point, and that turned out to work wonderfully. And for the most part, a lot of guys have adapted that technique.

ROSS-NAZZAL: And what was that technique?

RICHARDS: Basically, fly the vehicle down to about five feet, and then don't touch it anymore because ground effect, the vehicle's got so much wingspan that once it gets down to ground effect, there's a natural cushioning. In fact, you'll end up landing at maybe about one foot per second. You won't be the world record touchdown. You won't go .001 and then be able to say you did point, but you'll land consistently at one foot per second. And so that was my technique for that sort of thing, and it turned out to work just like I hoped it. So I think the Astronaut Office liked that. I think there's a lot of people that—I think I've always said, "This thing flies very well without pilot inputs." [Laughs] "It just occasionally needs to be guided, so just guide it, don't fly it." So that worked out well.

ROSS-NAZZAL: Anything end up on your windshield?

RICHARDS: Not that I recall. Not—more debris comes off, but now I was—now, my second flight, Bob made the same comment. He said, "Here comes some more stuff."

I said, "I know. It did that on my flight, too."

And after *Columbia* was lost, you sit there and start wracking yourself for that, about maybe. I'm sure they must have been seeing the same stuff on *Columbia* come off, and you start saying, "Maybe I should have complained more about that."

Of course, we came back and we reported all these things, but when we lost *Columbia*, I started thinking, "You know, it was pretty lucky, pretty lucky. Maybe we were more lucky than good," on those sort of things.

It turned out STS-50 on launch, we lost the same section of that ET [External Tank] that ended up coming off *Columbia* on this last flight and hitting the leading edge of the wing. Instead of hitting the leading edge of the wing, it went about a foot below the leading edge of the wing. It ended up hitting the lower surface of the wing and knocking off a section of tile back there. Of course, we launched through an overcast, so we never knew on 50 that it even happened. We took photographs of the tank, but the photographs weren't down-linked to anybody. They were just sat up there. So we didn't know that the section had—the first thing we found out about it was when our post-flight walk-around after landing, Ken Bowersox and I went out, and we said, "Oh, look at that," big long section of white showing. Turned out to be not—the tile are fairly resilient, surprisingly, even though you can take one of these things and knock a hole in it pretty easy. But as long as the last little bit of it's there, it can put up with entry. It can look bad, but it turned out to be not a big deal.

It wasn't the first time that section came off, but it wasn't until *Columbia*, we lost *Columbia*, that we realized how lucky we were because a foot higher it would have hit the leading edge of the wing and then we would have been the first recipients of that thing. So no, other than 41 no I don't remember anything more about that.

ROSS-NAZZAL: You mentioned there were two shifts on STS-50. What shift did you work on?

RICHARDS: The commander shift, which was the one oriented to be ready to—I went to bed as soon as we got up on orbit, which was fine with me, about two or three hours after we got on orbit. And then they shifted me. The whole mission was oriented around keeping me shifted so that when landing time come, I was full up ready. Ken Bowersox, my pilot, was the on the other shift, and although he had to be ready to go as well, they biased the daylight hours to me, and then Ken would—is that right?

No. Ken and I were on the same shift. I'm sorry. Yes. That's right. That makes sense. And Ellen [S.] Baker, who was our MS [Mission Specialist]-2 or our flight engineer, she was on the other shift. That's right. So, yeah, shifting was fine. We got these little sleep compartments that I've never had before, and I thought it was wonderful.

ROSS-NAZZAL: How much contact did you have with the other crewmembers on the different shift?

RICHARDS: A lot. But for the most part, you know, we'd had a lot of trouble on other twenty-four hour shift two-shift flights from previous flights where the crew is their own worst enemy

sometimes. They work too hard. And there was some science flights where the mission specialist and the payload specialist, because of problems they were having in the laboratory, and they were the anointed expert on this thing, they would stay up beyond their time of going to bed, and you start doing that very much, and it's a slow spiral to about day ten or eleven, you're a basket case.

So we made a hard rule, about the only rule I had for the entire flight, was that everybody was going to go to bed on time. "I don't care if the lab is coming unglued, you better train the guy that's going to relieve you, because even if that's your experiment, you're going to bed. The other guy has got to be able to do it, got to be able to take your place. And you've got an hour to hand over, and then you're going to bed." For the most part, our guys did that. They all went to bed on time, so I was happy about that. And for the most part, I think we came through it, came through it pretty well.

I had one payload specialist who was—I won't say who— was really into his experiment and ended up working this glovebox really hard. He ended up injuring his shoulder sometime in the middle of the flight because he was trying to work against some resistance. Just like almost like working on, what is it called, carpal tunnel or whatever it is? He got it in his shoulder, and rather than tell anybody about it, he kept working, and he ended up aggravating such that on day ten he was in so much pain that he finally had to confess that he was in so much pain he couldn't do it. Fortunately, he was on my shift, and so I said, "Okay." We had to get the docs involved.

The poor guy, he was laid up. I moved some priorities around so that somebody else would work that stuff. Turned out the other person onboard the flight could do it just fine, but he wanted to do it because that was his experiment, and I understood that, but it ended up close to

damaging his shoulder. I think he ended up having surgery, so it was that bad, you know. If you work something and keep doing something like this, you can really hurt yourself after a while.

ROSS-NAZZAL: What sort of experiments were you involved in as the commander?

RICHARDS: The only experiment that they would let me do—Bonnie was in charge, the payload commander, and Bonnie would have been happy if I never came in the lab. [Laughter] And so I tried to say, "Okay, I won't." And in fact, the only time I did go back in there, I came back in the lab maybe two times, and on my second trip, I brought some coffee back there, and I hadn't realized that Bonnie had made a rule that there'd be no coffee in the lab. So I went floating back there with my coffee thing, and Bonnie was looking at me, and I didn't know this was a rule or else I wouldn't have done it.

And it turned out that the reason she didn't write a rule is because people spill, and I hadn't spilled coffee in seven days. I went back in that lab and spilled coffee. I think she gave me a look like, "Will you please go back up on the flight deck and go do your Shuttle stuff." You know, that's the last time I went in the lab. [Laughter] I'll never forget the look she had.

That's when Ellen Baker told me, "Bonnie has a rule that says nobody brings anything in here." Oh, shit! [Laughter]

WRIGHT: Oops.

RICHARDS: And so I stayed up on the flight deck for the most part, and it was—I had this SAREX, which is the [Shuttle] Amateur Radio Experiment. First time I'd ever used it, but I was

going to be up there for fourteen days, and I thought *Columbia* was going to work great, and it did. So there were going to be no emergencies to work. It was just going to be routine stuff, and all the action was going to be in the lab. And I was just going to be up in the flight deck waiting for alarms to go off and I assumed no alarms were going, so I had this SAREX experiment, and I had a ball with that.

I found the conversation between the Mission Control Center and yourself is nice, but because everybody listens to it, it's what I would call microwaved. It's any little colorful comments are usually expunged in that. In SAREX, it ain't that way. It's direct to the ground, and whoever you got down there, they'll talk. They're going to say whatever the hell they want to say, and I enjoyed. After fourteen days, I enjoyed that.

I had some, what I would call—they were guys, but I used to have an expression called "girlfriends." Girlfriends talk, you know, I said. The crew would laugh and say, "Well, you got any girlfriends today?"

And I says, "Yeah, I got my girlfriend in New Zealand, who I'm going to be looking for." Turns out it's a guy, but it's just an expression we had. And so I'd be sitting there when he'd be sitting there at two in the morning over in New Zealand, waiting for me, and it turned out to be a spot in the—never did meet the guy, but he and I shared the news. I'd get to find out what was going on in New Zealand, about the all-black rugby team and all that. Then in California there was another guy who had the biggest transmitter. In all of Southern California, he had the biggest transmitter, so if he wanted to talk, he'd drown out everybody else around him.

So this guy would always have photographs to send up, and I had a way of getting photographs on our monitors. And he would send up news clips about the mission in color and pictures and things like that. And then another guy in South Africa did the same thing. Another

guy in Argentina, actually patched us through to our—he had a way to take your transmission and patch it through the phone system to the public phone system. So by the time I figured this thing out on day eight, I was about one rev [revolution] away from having him patch me through to my wife, which I thought would be kind of cool, because she'd be on her mobile phone driving around town. And he tried to do it, but she had her cell phone turned off, so it was going to be surprise. [Laughs]

Of course I couldn't call Houston and tell them, "Tell my wife to turn her cell phone on." They'd wonder, "Well, what's going on?" [Laughter]

ROSS-NAZZAL: What are you doing?

RICHARDS: So I said, "My next flight if I do this, don't turn your cell phone off." [Laughter] So that was a lot of fun for me.

And I ended up on day nine, I got a call. Of course the ground, Mission Control Center, was about as bored as I was because all the action was in the payload community. So SAREX was the only thing, and I was always telling them, "Okay, I've got this contact," and so forth. So finally they called me about day nine and said, "Hey, there's this Polynesian sailing vessel that's out trying to recreate the navigational techniques of the Polynesian sailing from Hawaii to French Polynesia, and they've got their own amateur radio equipment on board that they use for emergency purposes, and they'd be glad to talk to you."

I said, "Great. Where is it?"

So they said, "It's here and here." So, okay. So I look and I had this little program where I'd sit there and know when they were within range. So up they'd pop, and we're out on the

middle of the South Pacific. There's no one around; even in space, there's no one around. I made a call, and sure enough, got the guy. Turned out he was the captain of a vessel called the *Hokolea* [phonetic], which was out of Hawaii. We got the small talk out of the way, and then said, "How are you going?"

He said, "Well, not too good. We've been becalmed here for a day, and so people are getting bored." He said, "You can't see any weather around you, can you?"

I said, "Well, I'm not sure where you are." I made a best guess as to where he was, and I looked out to the north there, and I said, "Well, where I think you are, yeah, it looks like you're calm, because I don't see any whitecaps. But out to the north of you, I think about a hundred miles, I see lots of whitecaps."

He knew the weather in the area a lot better than I did. That made him really excited, because apparently there was a front coming down, and that gave him confirmation that their weather was about to change. He said, "Oh, great. Thanks."

Sure enough, a day later when I went over it. I called him again, and he was under sail at that point. So he was just so happy, and he said, "We want to invite you to the Pacific Asian Arts Festival in the Cook Islands."

I said, "Great. Sure, I'll be glad to come." Sure enough, these guys were serious. When we got back a week later I got a message from them. They were in French Polynesia outfitting for their trip to the Cook Islands, and so a month later my wife and I were in the Cook Islands sailing aboard this vessel. So I thought that was one of the cooler trips I've ever had, yes.

ROSS-NAZZAL: What was your call sign?

RICHARDS: KB5SIW.

ROSS-NAZZAL: Did everyone have a chance to experiment with the SAREX or was it just—

RICHARDS: Ken Bowersox didn't. I don't think Ken was particularly enamored with it. He wasn't interested in it, and so it was myself and Ellen Baker, for the most part. Ellen thought it was as much fun as I did, because she was on the other shift, and she was worried she wouldn't have anything to do. So as soon as I got done, she would get on, and she said she'd go over her list of girlfriends that she had collected on her side of the world that she flies over when we're asleep. So she had a ball, too. Ellen and I still have fun recalling that experience.

ROSS-NAZZAL: I noticed your crew was up during the Fourth of July. Did you have any sort of celebration?

RICHARDS: Not a lot. Not a lot. No, we took out a moment to honor America and tried to do the best we could with that sort of thing, but there wasn't really much about that sort of thing.

ROSS-NAZZAL: Any other interesting anecdotes from this flight or landing?

RICHARDS: No, not that I can talk about. No, everything else, it was a great flight, and we had some physical problems brought about by that much time in space. None of it affected the crew that mattered in entry. We were all in good shape, but we learned a lot during that flight, let me put it like that, that help people fly those long-duration flights. Again, that's you have to do the

unique thing we do, which is land the vehicle after that. But, yes. No, everything else was routine.

ROSS-NAZZAL: Okay. Do you want to talk about your last flight, or should we wait until next time?

RICHARDS: What time is it here? Well, let's see here. Let me see what I got going on here, see what the next event is. We'll see.

ROSS-NAZZAL: I just have one more question about this flight. Did you have any sort of PR tours after this flight? Did you go to Europe?

RICHARDS: Let's see. Europe, yes, I think. I'm trying to remember, where did we go? It was the United States Microgravity Laboratories. So no, we didn't go to Europe. We went back up to Washington, D.C., to thank the congressional people that supported that particular flight. Then my recollection is the Cook Islands was—that sort of overpowered all the other events. I'm sure we did other things, but I just don't remember them.

ROSS-NAZZAL: Do you want to talk about STS-64?

RICHARDS: Yes. Let's see. I'm trying to remember what I did on—it seemed like it was maybe a little while. I must have done something in the Astronaut Office between 50 and 64, but I know I went in as we normally did after the last flight, and I told the chief that I thought maybe

my next one, or whatever it was going to be, was going to be my last one, and I would like the rendezvous flight, that was all, if I had a chance. So Dan Brandenstein or "Hoot" [Robert L.] Gibson—I can't remember who was in charge at that point—offered up this hodge-podge flight that they had on the books called STS-64. Unlike any of my other flights, there was not going to be a major payload. This was going to be a bunch of different things. He put me on that flight. I can't recall what I did in between there and then; maybe I'll remember and tell you, but I can't remember what it is. Seemed like between 50 and 64, I was off doing—maybe it was—I know I spent somewhere about six months up in [NASA Headquarters] Washington, D.C., as a flunky for the Legislative Affairs people.

One second. I'm on this particular flight.

[Tape recorder turned off.]

ROSS-NAZZAL: What are your recollections of testing the SAFER [Simplified Aid for EVA Rescue] on this flight?

RICHARDS: I was nervous as hell. That thing, Mark [C.] Lee and Carl [J.] Meade were out there doing that thing, and I think that the things built by the Johnson Space Center Engineering Department are wonderful, but this one didn't have necessarily the controls, safeguards in it that I would have liked to have had, so we made some very conservative ground rules—but nevertheless—for what they could and could not do, so that they could keep them, so I could keep my eyes on them in case they got into trouble. Because I was convinced if something went wrong and somebody made the wrong move with their hand or arm, we would have a human

spacecraft out there, and, of course, I was going to go get them. So for the entire time of that three- or four-hour thing, I was glued to my window back there. Turned out it went perfectly well; Carl and Mark just did a wonderful job flying that thing, and it worked out. The piece of equipment was wonderful, and it worked out very, very well. So it was just the nervous commander, that's all, but I was glad when it was over with.

ROSS-NAZZAL: What are your memories of deploying the SPARTAN spacecraft?

RICHARDS: I remember it all went routine, and the fact that later, a later flight turned out to be they ended up deploying SPARTAN the same like we did, and ended up misconfiguring it and almost losing the spacecraft. It made me very thankful for the crew I had, because Sue [Susan J.] Helms was the—now General Helms—was the mission specialist in charge of SPARTAN, along with some help from Carl Meade on that thing, and they made it go routine. In fact, I don't remember being worried about it at all. Later, watching that later flight, I said, "Boy, I should have been a lot more worried about that thing." But I wasn't, and they did a wonderful job with it, both on the deployment and then the rendezvous itself, all went just like I hoped it was, routine, and brought that thing in and hovered it over the payload bay and turned it over to Susan, who just maneuvered the arm right over, grabbed it, and we stuck it in the bay, and it was all very satisfying, because it worked very, very well.

ROSS-NAZZAL: There was a volcano that exploded in New Guinea.

RICHARDS: Yes, there was. There was.

ROSS-NAZZAL: Can you talk about that?

RICHARDS: Yes, it just sort of showed up. All of a sudden the ground, Earth Ops people, said, "There's a volcano that might go. Take a look for it on your next rev." And literally, we'd flown over it the previous rev and not seen anything, and the next rev we came back over and it was obvious. We could see this smoke and ash cloud streaming almost maybe seven, eight hundred miles away, and then flew over it, and it was very present. Made us glad we were there, and not down there where those poor people were having to deal with that thing. But it was a very impressive act of nature.

ROSS-NAZZAL: Any other recollections from this mission?

RICHARDS: No, but I'll go back to STS-50. I'll go back and tell you about the only time I was scared in space. You're apprehensive. Now, there's a difference between being scared and then apprehensive, and this is somewhere between—not scared, but this is more apprehensive than normal, let me put it like that.

STS-50 ascent, there was a landing. We ended up landing in Florida, but our primary landing site was Edwards, and of all things, we had a summertime hurricane come up from [Cabo San Lucas], in that area, come up, and it was hugging the coast of California. The clouds were spilling in over the Edwards complex. A little bit gusty, the high clouds and so forth. Not bad, but we thought we were going to land there, and it was dark. It was going to be a daylight landing, so Ken Bowersox and I were sitting there in the vehicle, and it was about three revs

prior to our deorbit. We came up over this huge hurricane, which was just off the coast of California, and it's dark. We're sitting there, and we know two and a half hours from now we're going to be coming back down this same track; only thing, we're going to be a lot lower. Well, this hurricane must have had probably more than—this number is probably grossly inflated, but it seemed like it—sixty thunderstorms going on, and there was cloud-to-cloud lightning. Every once in a while, we'd see what we thought was lightning come out of one cloud, go across the top of the clouds, and go enter into another cloud.

You made me recall about what things I worked on in STS-2. There was an experiment on STS-2 called NOSL, [Night/Daytime Optical Survey of Lightning]. A little tiny experiment. It had, you know, maybe three people behind it, and Dick Truly was supposed to get up there and take a look at thunderstorms and try to photograph them. Because this guy had a theory that lightning hit the ground, but that's just because that was where the ground was and that's where the neutral point was, but lightning doesn't care. If there's a path, an electrical path that goes up, it's happy to go up as it is down, and he had had airline reports of lightning actually going up. Airliners would report that they would somehow see something in the atmosphere, so they would go up and then come back down.

So I'm sitting there watching these sixty thunderstorms, and all of a sudden I think of this guy I was having this conversation with back in STS-2 about the fact that lightning can go up just as well, and I'm starting to think, "Let's see. We're going to be coming back right over the top of this thing, and instead of being at 160 miles, literally, I'm going to be at 160,000 feet, which is going to be real close to streaming this plasma trail behind me, which is nothing but electrically charged atmosphere." And I'm starting to think, "Now, I don't think we've ever done an entry before over this much electrical energy, spewing a plasma stream." I didn't tell

Ken Bowersox that, because I didn't want him to get upset. There's no way you can tell the ground of your concern, but I started going over the physics of this thing in my mind and said, "Boy, I—gosh, if this landing didn't occur, I'd be really happy."

So then the next rev we came on, and they were getting ready to go. They were getting ready to go to Edwards, and we had one more rev and came across, and it was worse. There must have been seventy, eighty thunderstorms, and it was just the most horraceous [phonetic] lightning show I've ever seen. So I said, "Well, next rev, we're just going to have to suck it up and say, 'Well, we'll see what happens.'" And then, all of a sudden, about ten minutes later they decided that the clouds at Edwards and the gusty winds were just such that they just didn't like it, and so they were going to go land in Florida, which the weather was beautiful. So we didn't have to do it, and they had one relieved commander. [Laughter] Don't know if that will ever happen again, but I know that was—all I could think about was what was going to happen to us when we flew over those sets of hurricanes. I don't know if it's real or not, to tell you the truth.

So, back to 64. What was your question here?

ROSS-NAZZAL: Well, any other anecdotes or memories?

RICHARDS: Let's see. Yes, this was a mistake on my part. Mission control never—they sort of saw it, but they didn't know what happened. The EVA got done, and a mistake, we allowed them to put a lot of science, all the other science aboard the Shuttle at that time. As I mentioned, we had a lot of little things. All the other science couldn't do anything while the EVA was going on, so as soon as we got the two people back in the hatch and closed the door, we were ready to maneuver and start doing other things.

We were having trouble getting Carl and Mark out of the hatch because of some equipment problems, and so I had a couple of people down there, Jerry [M.] Linenger and Susan down there helping them. Normally I would put one person down there, but Susan—Susan or Jerry, one of the two—had to go down and lend a hand. So it was left to me as the commander to go pick up Susan's duties, and I'd done it, but there's a lot of switch throws that you do. A lot of switch throws that you do, and I went through and very careful to do them all, and I did them all. One of the switch throws you have to do is you have to go down to the bathroom. We end up sucking wastewater out of the suits and putting it in the waste tank that the toilet also goes to the same waste tank. So you have to configure the bathroom so that you say, "Don't use this thing now."

There's this little guard. It doesn't do anything; it's just a guard, and it's got a little sign on it that says, "Don't use this thing." Well, I went down there and configured the valves underneath there, but I neglected to take the little guard and put it over this thing. Well, not that would have done any good. We finally got Jerry or Carl—I can't remember if it was Carl or Mark, but they got out of their suit, and they had to go use the restroom. I didn't even think twice about it; I said, "Yeah, go ahead." They didn't ask me; they just went.

They got in there and saw that all these valves were not configured properly, and Mark says that, "Well, if the lever had been down, I would have known not to do that."

So I said, "Okay, I didn't do that."

He got in there and just undid it all and used the bathroom—and all went well—and then left it in that configuration. So we're sitting there maybe about forty-five minutes later, and nobody had used it. We keep a screen across the vent so you can't see in there. So it so

happened that I think it was Susan who decided she wanted to go use the restroom, so she went and opened the curtain. I'll never forget her, or whoever it was, who went, "Aaaaah!" [Laughs]

I float down there, and there in the end of the urinal hose, it turned out the water has to go into the tank, and instead, the way we configured the valves, we closed it off. So the water was now, from the EMU [Extravehicular Mobility Unit], wastewater was coming up through the urinal hose, and I had this ball of water that was this big and perfectly round, and it was just sitting there, undulating back and forth, just attached with surface tension to the end of the hose. So we had this huge ball of water sitting there that you couldn't—we didn't have enough towels, clothing, to mop this thing up. If it had gotten loose, it would have been a disaster.

And so, "What do we do?"

I said, "Well," and we'd been told not to do this, turn on the fans inside of the toilet so that it would suck all the water down in the urinal tube, because sometimes you can stall the fans and ruin the fans, and then you won't have a toilet to work anymore. But we didn't have a choice, because one jet firing, and this thing was going to fly into a thousand pieces. So I went over there and said, "Okay, guys, hold your breath." I went [imitates sucking sound], turned this thing on, and it was amazing to watch this thing go [imitates sound]. [Laughs] We could hear that little fan going around [imitates sound] as it sucked this huge ball of water. It just got smaller and smaller and smaller, and it finally just [imitates sound] disappeared like a little ghost or something you see in *Ghostbusters* where they vacuum up ghosts.

And it was just fine. We waited until the fan finally went [imitates sound] and it returned to a normal sound, and then configured everything and put it back in the right configuration for all the rest of the EMU water. And the ground control, mission control, never said anything. So

in the debrief, we laughed about that thing. God, we laughed about it. In the debrief, we asked them, "Did you guys notice anything peculiar going on?"

And the guy that was in charge of the toilet said, "Yeah, I saw some currents that I couldn't quite understand. We spent a day talking about that, but again, everything returned to normal, so we didn't ask."

I said, "Well, that's what it was."

The other incident I remember most was [L.] Blaine Hammond [Jr.]. What a great guy. Blaine thought that after this flight he was going to end up going to Russia as part of our contingent of people that were starting to go over there. So prior to the flight he had been taking Russian lessons. Well, while we were waiting to deorbit, we'd spent—I think it was like we'd spent two attempts trying to land at Edwards before they finally, the third day, landed us at Edwards. We spent two attempts trying to land there, and so we spent a lot of time sitting there going around and around, waiting for NASA to decide if the weather was good enough to land in Florida. For the most part, we were all dressed up, sitting in our seats, so we had a lot of time to kill in those two days.

So we were going around, and it so happened every time we fly over this particular portion of Russia, all of a sudden our frigging audio system would just light up with extraneous noise, and we knew what it was. There was an old Russian ground site down there that was radiating us with electrical energy, and they were just radiating us. It would shut down our FM trans—mission control knew what was going on, because all their data would stop. They knew this was going on, and they would always tell us, "We're about to lose data, because you're going over this site."

And said, "We understand." We would just stop, and we would keep going and get on the other side, and the data would start again. Well, the thing they didn't know about it was the fact that it made this horrible noise in our headsets as well, too.

So finally after going over that spot about eight times, we were sitting there on day two—no, this is the third day. The first time we sat there, we went over this site. Sure enough, there it comes again. We'd hear—and even you could hear people talking in Russian; we'd hear all this stuff. They'd intentionally get on our UHF frequency just to be irritable. So finally I said, "Blaine, you speak Russian, don't you?"

He says, "Yeah."

I said, "Why don't you just reconfigure that headset and just tell these guys to get the hell off our frequency." [Laughs]

Susan Helms is behind us, saying, "Yeah, Blaine, tell them."

And the rest of the crew is sitting there, "Yeah, Blaine, tell them."

So Blaine configures the thing so that mission control can't hear this, and it just talks into UHF, which is just line of sight. So he said something in Russian, and as Blaine says, "All I did was very nicely tell them to please not—this is the Space Shuttle *Discovery* and would you please not use this frequency, as we're conducting critical operations." Probably in the nicest words you can, but he probably also—I don't know what he said. But he got on there and he started speaking in Russian, and next thing we knew—we thought that this was irritable—they turned on their superjammers, and just radiated us with all this electrical energy, and it was so loud that we had to turn off UHF by how much they were radiating us. They started yelling at us in Russian, you know and all that. We were laughing so hard. We gave Blaine Hammond so much crap over that thing. "What the hell did you say, Blaine?"

He said, "I didn't say—." [Laughs] I still talk about that. Blaine never did go to Russia, but we were laughing. We were getting punchy at this point, we were laughing so hard about these Russians and their reactions to it, and of course, we all blamed Blaine for this thing. But that was a funny story.

ROSS-NAZZAL: So what did you do after this mission?

RICHARDS: After this mission? They asked me to go to Russia and be the Director of Operations over there. This was the first time I told the chief of the Astronaut Office that I didn't want to do something, the first time I told him no in my fourteen years there. I told him, "No, I'm going to leave the Astronaut Office." Didn't know what I was going to do, but I was done flying. At the time that was an unaccompanied flight, an unaccompanied experience over there. George was the Center Director of this thing, and so I knew as soon as I said this, George was going to find out about it, and so he wouldn't be happy with that. So I knew that I was going to leave the Astronaut Office.

Fortunately, at the time Brewster Shaw was the head of the Shuttle Program and wanted some help over there. So I decided to go work for him and offered that up, and I think that made George happy. Don't know; George never talked to me about it. But at least George knew I was doing something else. I just told him I couldn't go to Russia and leave my wife for a year and a half. I didn't want to do that. Later they changed it so that she could have come. Whether or not she would have or not, that's another matter, but at the time it was unaccompanied, and I just wasn't interested in doing it. So that's when I decided to leave the Astronaut Office and went to

the Shuttle Program to work in the Flight Management Office under Ron [Ronald D.] Dittemore over there, and Brewster was the Shuttle Program Manager at the time.

ROSS-NAZZAL: And you became a Mission Director?

RICHARDS: Yes. I was what they call a Flight Manager first. That was a new office that Ron Dittemore started over there, Flight Manager. But I also, part of my Flight Manager duties was Randy Brinkley had just completed the Mission Director role for the first servicing mission for Hubble. They liked the Mission Director concept, they just wanted to bring that person into the Shuttle Program, whereas Randy was outside the Shuttle Program, and they wanted to bring the next one inside, so Ron and Brewster asked me to do that. I said, "That will be good," so I went ahead and did that.

ROSS-NAZZAL: What were the basic duties of the Flight Manager?

RICHARDS: I had a small amount of budget that Ron gave me that I could go spend as to however I deemed fit. Our largest issue was making sure that we were all working together; we didn't get any silos going where the Goddard Space Flight Center does it this way, and you, Johnson Space Center, you need to change your ways and vice versa. We had to work together as a team. Largely, I didn't have to spend too much time in that area, because we had some great people at Goddard and great people at the Johnson Space Center.

One thing I may have done is had some influence on who the people were at the Johnson Space Center that were assigned and got some great people assigned to that thing that were

proven team players, and so we worked together. I was very, very fortunate. I never had to spend much time arguing about personalities. Had a great crowd of people that you don't have to do much, just point them in the right direction, generally tell them where you want them to go, put the few things that are out of bounds, out of bounds, and then just listen and watch them work, and that's what happened here. Jeff [Jeffrey W.] Bantle was the Lead Flight Director for that, and John Campbell was the head of the Hubble Project at Goddard. Just great people; can't say enough about them.

The only issue we had was that Hubble's solar arrays were bent. Apparently it was a manufacturing problem, combined with the unknowns of space. The arrays, the last time they visited and they deployed them, turned out they had a curve in them, and what that meant was they were weaker than normal. We spent a lot of time worrying about not breaking those arrays just by the process of docking, rendezvous docking, and the crew working in or around that thing. So we spent a lot of time worrying about particular area, and that was the biggest thing was investing our money wisely to try to come up with preventative measures to make sure we didn't break Hubble in the process of trying to fix it.

ROSS-NAZZAL: What were some of those preventive measures you came up with?

RICHARDS: Oh, largely just foot restraints. We invested in some foot restraints that had some shock absorbers in them, so that when the crew was—literally, the arrays were so fragile, they were worried about the crew literally getting in the foot restraints and then rocking back in there and react against the foot restraints would react against the Orbiter, which would make the arrays move. Theoretically, it's possible that a crew, if he did it fast enough, he could actually break

the arrays. It was hard for me to believe, but we treated it like that would happen, and it turned out the crew at the time was just great. It turned out to be Mark Lee, again, who was my EVA for the SAFER flight. He was my payload commander for that flight, and so again I had a good dialogue with Mark, and so if there was something going on, we found out about it.

ROSS-NAZZAL: What were your duties during the mission itself?

RICHARDS: Largely just to sit there and help come up with the priorities and the payload priorities, in the event that something happened such that Jeff Bantle and his flight team tried to write down as many of the priorities as possible so that if something did happen, they knew where to go. They didn't have to ask the program. So, largely, all these things were agreed upon prior to flight. During the flight, I'm trying to remember. I don't think there was very many things. There was maybe one or two incidences where the payload community wanted to look at something, and they'd made the request to the flight team to do it. The flight team had decided it wasn't worth it to do it, so then they would run around the corner and come to us in the program, and say, "Will you tell those guys we need to do this?"

So then we'd go—I'd have to go out on the floor in the Mission Control Center and, "Okay, Jeff. Let's figure out what's the right thing to do." So we'd always end up at a compromise. But that was very rare.

ROSS-NAZZAL: And the flight went well, in your opinion?

RICHARDS: Yes, it went great. We almost broke the arrays, for a reason we didn't know about. Turned out that was a—they had a modification to the Orbiter. They removed some vent lines for—when they decompress the air lock, the Orbiter had a modification to it that moved the vent for this thing to a new location. We have so many people off doing things, it's hard to keep track, but we in the program are supposed to keep track of this stuff. But they moved this thing, and it wasn't a lot of air, but air escaping, high-pressure air escaping through a little vent, it expands very quickly, and it can be a force in space.

So as soon as the crew started venting the cabin, we looked up, and there went Hubble's arrays, which, at this point, hadn't moved much at all. We saw both arrays literally do this. [Demonstrates] Bent up to ninety degrees. Should have broke them at that point. Should have, but at this point the air, most of the air, was out of the hatch, and it turned out to be this cloud of gas had come up, pushed the arrays up, and then they allowed them to come back. They reacted back down this way and did all this sort of thing. I was sitting in the Payload Control Center at the Mission Control Center. I thought the Goddard people were going to have a friggin' heart attack. I know I almost had a friggin' heart attack, waiting for the arrays to snap off. But we lucked out, and they didn't, and turned out, we didn't break them.

Turned out that this vent was moved by the Orbiter Project. We're supposed to have a control in place whereby when you do that, there's called a systems interface control document that Systems Integration, another part of the Orbiter—not the Orbiter Project, another part of the Shuttle Program—is supposed to pick up on this thing and then change their interface control document to recreate, okay, here's where the plume clouds will be now, and then send it out to all the payload customers, who use it to make sure that they know about it so that they can plan

around it. That second step never got done. Again, people thinking moving this little line can't possibly change anything. It meant a big deal to Hubble.

ROSS-NAZZAL: I also understand you worked on STS-75.

RICHARDS: That's the tethered satellite, yes. Again, that was our more challenging flight. We had some high-energy personalities on that flight, and so I spent more time with that one trying to make sure we were working together as a team, this time from the Marshall Space Flight Center and the Johnson Space Center. We spent a lot of time on that one. It was a big deal. Putting out a spacecraft that had a twelve-mile-long tether attached to the Shuttle was a big deal. Lo and behold, we lost that one due to the fact that the tether had been in the container for so long that, much like the fire we had on STS-28, it was due to the protective material cracking and allowing arcing to occur.

Same type of deal. This tether, which was an electrical conduit, had been wrapped in this container for such a long time that about ten miles down into the wire container, it had a small crack, and when that crack came out in space and then they put electricity through it, it saw a short, arced, snapped the tether off, and then the tether departed the spacecraft at that point, much to the surprise of everybody at Huntsville and the Johnson Space Center. So that was not one of our better moments.

ROSS-NAZZAL: What led to your decision to resign from NASA?

RICHARDS: Brewster. He'd gotten me over in the Shuttle Program, and I hadn't been over there more than two months when he decided to leave and go work for the Boeing Company. Then he got out to California. He knew I wanted to go to California, and he called me up one day and he was laughing about—I remember, we'd just lost the tethered—I had moved on. I had been promoted up to be the Program Integration, which is sort of the deputy to the Shuttle Program Manager at that point, so I was Tommy's—Tommy [Thomas W.] Holloway took Brewster's spot. Let's see, was that right? Yes, that's right. Tommy Holloway took Brewster's spot. Ron Dittemore went down into the Orbiter Office, so Tommy was running the Shuttle Program. So they needed somebody to run the day-to-day operations, so Tommy was nice enough to promote me up into that spot.

So I'd done that for about two or three years, and doing the MMT [Mission Management Team] meetings and so forth. Brewster called up one day and said, "I've got this opportunity in California for you. Would you be interested in leaving NASA and coming to work out there?"

My wife and I had always wanted to live in California, and we went out there, took a trip out there just to see what we thought about it, and decided that was a good time to make a move. So we did. Then we came out, and everything was wonderful. We got out there for three years, and then Boeing decided to move the Shuttle Program back to Houston. [Laughs]

ROSS-NAZZAL: So what have you been doing for Boeing since you left NASA?

RICHARDS: Went out there and worked in several outfits, all of which, those organizations supported NASA in one way or the other. We did a lot of business development work, trying to—at one time point NASA was interested in doing inflatable habitats. You've probably heard

of that one. We were trying to figure out a way if there was some way that we could get involved with our own money and go into it with a partnership with several other industries and some independent people out there—I would call it atypical NASA people—and NASA, and try to form some sort of a partnership where we could build this inflatable thing and put it on station.

We tried. Getting partnerships where money is at risk between industry and NASA, it was a learning experience for me. Everybody talks like they want to do it. Everybody wants to do it. In principle, it's the right thing to do, but the devil's always in the details, and it's the amount of risk the individual companies want to take on. NASA, of course, is interested in shedding as much risk as possible onto the private companies, and private companies are trying to shove all the risk onto the government. We could never get to a position whereby the investors and the government could ever get to the same position. So we eventually walked away from that. I always thought that somebody would walk into it that would be willing to accept more risk, and that, from private industry, just the Boeing Company was not willing to do that. Unfortunately, it never happened.

Then the Shuttle Program came along, and they were looking for some help to interface with the Program Integration people over at NASA, so I picked up that job. Then I was involved with several other—John [F.] Muratore's X-38, I had the Boeing piece of that sort of thing, of which we never got very far in that, either. A similar type of deal, sharing of risk and so forth. We just never could get comfortable with it.

ROSS-NAZZAL: Where were you on February 1st, 2003?

RICHARDS: I'm a volunteer here in the Houston Area, and I was heading for my volunteer duties there on Saturday when Henry [J.] Kunkel, who was my Deputy at that time and assigned to go to the Mission Control Center and watch the entry, called me and said, "They've lost *Columbia*, and they don't know where it is."

I went, "What? You've lost *Columbia*, and mission control doesn't know where it is?" It took me a few seconds before I realized that Henry is talking about—talking about the fact that it broke up. Then it made a lot of sense to me. Then at the same time I was listening to KTRH, and they were already reporting the news articles about people seeing fiery debris up in Lufkin [Texas] and that area. So I obviously canceled my volunteer work and headed in here to do whatever I could.

ROSS-NAZZAL: What did you end up doing those first few days?

RICHARDS: Not a lot. I had Program Integration, so that my people did work the debris transport work during the flight. We knew the piece had come off. We knew it had broken up into two or three pieces. We had to model where it could have hit, and then pass it on to the Orbiter. So we had done all that work, and all we could do was give them a range of probabilities, all the way from the leading edge of the wing to the wheel well area, about where it might have hit. We knew it hit, we just didn't know where, because the photography, it looked like it was under the side of a wing, but we couldn't tell for sure, so we gave them probabilities as far as where it could hit. So we went back over that work; impounded all that data, because we knew, or it didn't take too long to figure out, that that had something to do with it. Got all the people

involved that did the transport analysis, analytical work, locked their desks. We told them to go home; don't talk to anybody, get ready for a long, arduous process. So that's what we did.

ROSS-NAZZAL: So you were primarily involved in the investigation?

RICHARDS: Not really, no. Because I ran Program Integration, I think they thought I was too close to it. I was surprised by that. I would have thought I would have been, but they decided to keep me out of that sort of thing. It was really a NASA show, and our people was just there to support NASA in their investigation, both in the Orbiter side and the integration side. I would have thought I would have done a lot, but I really didn't. I really didn't.

ROSS-NAZZAL: Yes, that's what it sounds like.

RICHARDS: Yes.

ROSS-NAZZAL: So what have you been doing since the *Columbia* accident?

RICHARDS: About a year after the *Columbia* accident, Steve [Stephen S.] Oswald asked me to take over our Shuttle development organization. We had thought at the time the Shuttle was going to be flying out to the year 2020, and we saw a lot of instances where the subsystems aboard the Shuttle were aging and weren't supported. We had anticipated that we'd have to design replacement subsystems for them, so we were putting ourselves in a position to compete for those opportunities. Then when February 1st came along, it was good we set up that

organization. We set it up for the wrong reason. It was clear at that point that there weren't going to—we didn't know it, but we didn't figure now with three Orbiters, we didn't think NASA was going to be flying to 2020 anymore.

But what their real interest was, was going to be to fly the three vehicles they had for as long as possible. Thermal protection systems, and the resilience to thermal protection system debris, was going to be important. Fortunately, we had a number of R&D [Research and Development] projects, internal R&D projects that we'd been working on for over a year. Didn't think we'd ever be able to have an opportunity to sell them to the government, because it takes too long to put them on. Turned out NASA was interested in all of them. So we were able to at least help in that area, bring forward—as well as the rest of industry—bring forward these things for their consideration as far as where they wanted to take the vehicle.

Then when they picked the boom inspection system, that was like adding a whole new subsystem. Our people were critical to integrating that system on the boom. So we had to build all new hardware for it, and that was, as I said, it was a system that normally takes three years; it was done in a year and a half. This last Christmas was the first Christmas my organization didn't have to work in the last three years. I was able to tell them, "Go home." The rest of the time they had all worked over Christmas, trying to get all this hardware and analytical work done.

ROSS-NAZZAL: I just had a couple of general questions for you, and then I was going to ask Rebecca if she had any.

RICHARDS: Sure.

ROSS-NAZZAL: What do you think has been your most significant accomplishment while working for NASA, if you had to go back and look at one thing?

RICHARDS: Probably the most significant accomplishment was I'm not going to take credit for it, but I like to think I'd take credit for it. You've got two guys over there at the Johnson Space Center, and they're both my pilots, Bob Cabana and Ken Bowersox. I was very proud of them after the flight. I think I had maybe somewhat of an influence about how they approached spaceflight and what their—they already had their own instance, and they'll probably deny I had anything to do with it, but I think I influenced them somewhat about how to treat your crew members and how to treat other people and how to conduct yourself such that you don't push people away; they want to come toward you instead. I'm very happy. I think they were naturally inclined for that, anyway, so all I did was reinforce ideas. Maybe my best credit was I could just reinforce something they already had inside of them. But now, seeing them in the positions they're in over there, I feel very good about that, and I feel good that NASA is in pretty good hands over there right now, if those two are any example. So that's probably the best thing I feel about.

ROSS-NAZZAL: What do you think was your most challenging moment while working for NASA?

RICHARDS: Getting the organization to realize that the Shuttle is never going to be an operational vehicle. I spent six years listening to—and I'm going to describe it as bluntly as when I was there—it was bullshit, about how the Shuttle was an operational vehicle, particularly in the pre-

Challenger era. It was like crashing your head into a wall. After *Challenger*, that whole paradigm changed. We were able to do things as we had been doing. Unlike the *Columbia* accident, which NASA got beat up pretty bad for their culture and that sort of thing, from my perspective, it wasn't anything like it was pre-*Challenger*.

I'm less concerned about the culture issue that the Columbia [Accident] Investigation Board brought out; I'm much less concerned about it. I think NASA should be concerned about it and make sure it doesn't creep back in, but I'm as conservative as anyone, and I was involved from the Astronaut Office into the Shuttle Program, running day-to-day operations in the Shuttle. I know what my personal philosophy was on it, and I know what Tommy Holloway's was. I never saw us once get to the point of being so coarse towards people's safety as what was described in the Columbia Accident Investigation Board. They made it appear as if we were horrible, and I think that was a gross unfairness to those people, particularly Ron Dittemore and the rest of that group. As such, NASA has had to spend a lot of money and a lot of energy focused on something which I think is a red herring.

The *Challenger* was—is much, much worse. The cultural change occurred then. Now I'm sure it will occur a little bit more, but I'm just worried maybe it's gone too much. Spaceflight is inherently risky. The question is where do you decide the acceptable amount of risk is, and as we get an aging vehicle, my hat's off to those people that have to be able to still make those decisions over there. But in the end they have to make a decision, because the spacecraft will never be perfect when it lifts off, and you just have to decide where that point is where you don't do something silly. In our culture here, it's very hard to do, because we only have three vehicles, and if you lose an accident, it's so public and so politicized that you're going to be criticized no matter what you do. But in the real world, in my opinion, the poor guys at

NASA got beat up unfairly on *Columbia*. The hardest thing was prior to that, which they changed.

ROSS-NAZZAL: Rebecca, do you have any questions?

WRIGHT: No.

ROSS-NAZZAL: Do you think there's anything that we might have overlooked, or that you want to talk about?

RICHARDS: Oh, I'm sure you probably overlooked something, but I can't think of anything.

ROSS-NAZZAL: Okay. We sure appreciate you taking the time this morning to talk with us.

RICHARDS: Okay. Okay. Very good. Okay.

[End of interview]