NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

HAROLD JOSEPH MCMANN, JR.
INTERVIEWED BY KEVIN M. RUSNAK
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RUSNAK: Today is January 25th, 2002. This interview with Joe McMann is being conducted in the offices of the Signal Corporation in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Carol Butler and Sandra Johnson.

I'd like to thank you again for coming by this afternoon.

MCMANN: Thank you for having me.

RUSNAK: It's our pleasure.

If we could start with: tell us a little bit about your life before you came to NASA, some of the interests that you may have had in engineering or chemistry as you were growing up and then going into college, and how you ended up working for the space program.

MCMANN: Okay. Well, I come from Oklahoma. I was born and raised there and probably got really interested in science about the ninth grade. A friend of mine introduced me to Ray Bradbury, a science fiction writer, and *The Martian Chronicles* and all that stuff, and I guess I started getting interested in science then.

I was interested in chemistry, so I was going to go away to college. My father never went to college, but he was a real subway alumnus of [the University of] Notre Dame [South Bend, Indiana]. He had come from Pennsylvania. My mother had come from Oklahoma. So he always had this dream of having a son go to Notre Dame. I was the oldest, so I was elected, and

I never really had a choice. My dad was typical authoritarian Catholic, and you always did what Dad said.

So came time to go to college, I was going to go. He wanted me to go into business, and he had a friend on the Board of Regents. I took my SATs [Scholastic Aptitude Tests] and made a good enough score to get in, but he had also told this guy on the Board of Regents that he had a son that wanted to get in. So I think his feeling was that he wanted me to go into business, something that I would have a good chance of not disgracing him in and his business relationship which he also had with his friend.

I did not want to go into business at all. I wanted to go into engineering, chemical engineering. He didn't want me to go into that. He was afraid I'd flunk out. So that was probably the only time in my life I really stood up to my father, and we finally compromised on a five-year program, arts and letters [in] engineering.

So I got up there to school, got into engineering, and my dad was almost right. The first semester was like I hit a wall. I mean, it was really tough. I tied for valedictorian in my high school. I just thought I'd cruise through college—wrong. Hit a wall in chemistry and calculus, things like this.

But I managed to get through, and it turned though that they had screwed up my curriculum somehow, and they didn't have room in the five-year program, so they stuck me in arts and letters. But I had insisted I was in engineering, so essentially for about three years I was a semester out of bed. They had me with a semester less credits than I really had, and I was really sweating it. But then I ended up graduating fine. I was seventeenth out of thirty-four chemical engineers, I mean, right in the middle.

Took a bunch of job interviews and didn't get any offers. I still have my letters. You got to where you took these job interviews of the guys who'd come on campus and interview you, and then they'd send you a letter. You got to where you could look at the length of the letter and tell exactly whether you were going to get a plant trip, because that was really the next step. If

they liked you, they'd give you a plant trip, and then they might or might not give you an offer. You could tell by the length of the letter whether or not you were going to get a plant trip, even.

Well, I didn't get anything. So I went into Chicago and stayed with a friend of mine. He was a chem major and I was a chem E. So I finally got a job with Liquid Carbonic, a division of General Dynamics, compressed oxygen, nitrogen, medical gasses, liquid oxygen, liquid nitrogen, in the sales engineering.

Actually, what my job boiled down to was making the second visit with the salesman, following the first visit that he'd made during which he had sold a potential customer the idea that, hey, we could solve his problem. My job then, after looking at the technical feasibility of what the salesman had said, was to let the guy down easily and not make him so mad at the company he'd never have us back. So a couple years of that.

One day one of the guys at work said, "Hey, NASA's coming through and interviewing. They got a suite rented down at the Hotel Umptyump down in downtown Chicago." That's where I was working, was out of Chicago. "A bunch of us are going down. We're going to interview NASA."

I said, well, been there a couple years, single, so talked to my chem buddy, and he and I went down. Well, we were the only ones that I knew. These other guys for some reason or another chickened out.

We get up in this room, and it's a room a little bit smaller than this, and they had a desk with a guy behind it from Lewis Research Center [Cleveland, Ohio] and the chairs where the interviewees sat. There was none of this nice, private interview. The guy sat there and essentially wire-brushed you in front of everybody. I mean, he was ruthless. He wanted research guys, research scientists. Of course, I'd work some with liquid oxygen, so I tried to blow up what I'd done, kind of embellish it a little bit. I'd taken this liquid oxygen pump apart.

He said, "Well, what did you publish? Where are your papers?"

I said, "Well, I don't really have any," I'm mumbling.

He said, "Well, I can tell you right now we're not going to be interested in you, but we take all the people that we're not interested in and we send their files to Langley Field [Langley Research Center, Hampton, Virginia]."

All I wanted to do was get out of there, so I got out of there, wrote that off.

At that time I was also deciding, well, I want to do something different. I don't like my job any more. So I was looking into the Peace Corps. So I had settled it. I was going to go down and take the Peace Corps exam.

One day at work I get this call from a guy named Jack Cairl at Langley Field, who was calling to tell me that they were going to make me an offer. I couldn't believe it. So they offered me about $1,100 a year less than I was making. I was making $7,500 a year, and they offered me 6,435. But I took it, because like I said, I was young, single, and hated where I was.

So I took off for Virginia. The Peace Corps, I had missed the entrance exam for the Peace Corps, and so I went on. I'd made up my mind whichever one came through first I was going to go.

So anyway, I went to Langley, Virginia, right after the James River had flooded, stayed in the downtown sumptuous Hotel Langley, laid there on the bed, and tried to make sense out of the stains on the ceiling. They formed sort of interesting, kind of like a Rorschach test overhead. Went down into the lobby and the old-timers were there watching Norm Snead, quarterback the inept [Philadelphia] Eagles [football team] of those days, quite a different shake than the Eagles of today, on a black-and-white TV that if you looked just right, you could just about make out the picture, it was so, so bad. So that was my introduction.

I came out, rode the bus out to Langley Field, and got introduced to a guy named Ted [Edward L.] Hays, who if you've talked to any of the other old-timers, Ted Hays was the first one I met of what I would call the wild men of NASA in those days. We had the wild men, and Ted was one of them. He was kind of a tall, skinny guy, kind of buck-toothed a little bit, terrific

sense of humor, and wearing a gray suit and a bright red vest. I never will forget that bright red vest.

So I was real nervous. We started talking about, of all things, not science, not space, not the glory of Project Mercury, but *Mad* magazine. We were both fans of *Mad* magazine, so we were comparing stories out of *Mad* magazine. That was my introduction to NASA, and I didn't know what to think of this place.

My boss at the time was a guy name Frank [H.] Samonski [Jr.]. Frank was gone; he was at the Bermuda tracking station. So there I was, not knowing what to do. So they gave me the Apollo General Electric proposal to read. They had just awarded the contract for the Apollo Program to North American [Aviation, Inc.] Space and Information Systems [Division]. GE was one of the unsuccessful bidders, so naturally with true governmental sense, they gave me the GE proposal to read, which I think the reason they gave it to me, it was by far the largest and would keep me busy the longest. I mean, it was about as tall as I was. So there I was reading that, waiting for my boss to get back to tell me what in the world I was supposed to do.

RUSNAK: Did you learn anything from it?

MCMANN: As I started reading, the words were totally foreign to me. So I started with the As in the glossary: atelectasis, alveoli. I couldn't get past the As, hardly. There I was, a graduate engineer, and I didn't know what in the world I was doing. But I was going to be working in the environmental and life support system area. I started work on Project Mercury.

RUSNAK: Why did they put you there?

MCMANN: When I applied, they were filling spots. They were just taking about anybody. So that's where somebody, I guess, it was the turn for what was then Life Systems Division,

previously been Life Systems Branch of Flight Systems Division, and the division chief, in fact, I think the branch chief of the Flight Systems Branch was Max [Maxime A.] Faget at that time, if you remember Max Faget. Then we were a section of that and finally became our own division, Life Systems Division, and Dr. Stanley [C.] White was the division chief back in those days.

So there we were up at Langley, and the rumors started coming. We're going to be moving. Where are we going to be moving? Well, they're going to form something called the Manned Spacecraft Center [MSC]. So the odds-on favorite, all the hall talk and everything, was going to be in Maryland, Greenbelt, Maryland. We were going to be located there. Then all at once they set up a place called the Relocation Center, and then signs started cropping up over Langley, "Houston is a good place to live. Average temperature, 72 degrees." I said, "Houston? Houston?"

So they chartered a little airline called East Coast Air Transport. They flew Martin 404s and something a little bigger than a DC-3, I think Convair 440s. You could take a free trip down to Houston and look around. So guys were coming down and looking around for places to live, and they came, and one guy said—it was Jim [James V.] Correale, another one of the wild men, he said, "It's so flat, you can see tomorrow."

Everybody was wondering, "What's it's like down there?"

The guy said, "Well, I pulled up to a stoplight. We were waiting for the stoplight to change. I looked over in the next car, and while we were waiting for the light, a guy picked up his guitar and started to strum while he was waiting for the light." So that was our idea of Houston.

I talked to my folks about it, talked to my mom. I said, "Mom, going to be moving to Houston."

Her first words were, "Your clothes will mildew in the closets." That's all she knew about Houston, was the humidity.

So I started in October of '61 with the Space Task Group. I was only there a couple of months, but I had time to find me a girlfriend, who, I think she was going to do this before she met me, but you can draw your own conclusions. She became an Episcopal nun. I don't think I had anything to do with that, but I could have. She might have been on the fence about men and decided that's it after dating me for a couple of months.

Anyway, I came down to Houston in December, and we were in the Lane Wells Building over on Wayside [Drive]. In that building there was Life, Life Systems Division—I think we had changed to Crew Systems Division [CSD] by then—security, personnel, and what was to become, I guess, Crew Systems also had what ultimately became Life, Life Sciences. All the medical people were also part of Crew Systems. So we were over in the Lane Wells Building.

That was in 1962, and people started coming in. I was a GS-9. I roomed with a guy named Joe [Joseph J.] Kosmo. Maybe you've talked to Joe.

RUSNAK: Yes.

MCMANN: He and I roomed together about three and a half years. He came in as a GS-7, top of the grade. I came in as a 9, near the bottom of the grade. I was making 6,435 a year. He made 6,345.

So Joe and I had a great time, Joe and I, both bachelors. The average age at that time of the Manned Spacecraft Center was twenty-nine, so I was considerably under it. So we had some old guys from [Navy] Bureau of Weapons, Wright-Patterson [Air Force Base, Dayton, Ohio], places like that, that kind of came down and kind of filled out the top end, but there we were from everywhere. I went into Gulf Gate State Bank to open a bank account, didn't even say who I was, whatever, and as she was getting the card out, she says, "What do you do for NASA?"

I was telling her I was wondering how did she know. I said, "How did you know I worked for NASA?"

She says, "All our new accounts are from NASA." So it was just—we just inundated the city with people from everywhere.

Let's see. Mercury, they sent me down to the Cape for Mercury, for John [H.] Glenn's flight. Well, I didn't know what I was going to be doing down there. Why did my boss send me down there? He said, "Well, I want you to help reduce the data, get the data back from the flight." In those days, you got data, huge rolls of strip chart data, and the voice transcripts were typed out. They had the ladies typing. They'd take the tape recorders, and they'd type, and you'd get a transcript maybe that thick. Every word that was said between the crew and the ground was typed out.

The Cape had terrifically tight security. You had to have a badge, show a badge every time you went into a building. You go from within building to the next, you showed a badge. One day I was going from one building to the next, got there, started to walk through, and the guard said, "Quick. Stop."

I looked, my badge was gone. It had fallen off. I said, "Well, it must have dropped off. I'll go back and get it."

"No. You can't move. You don't have a badge, you shouldn't be here." So I had to finally call somebody, and he, one of the other guys I worked with, traced my steps and had found my badge and brought it in.

The day of John Glenn's flight was Atlas Number 109-D. I went down there. It was dark. Everything was lit up, though. There was the Atlas there. I went down, and they were checking your name. You had to be on the access list. So I went down there, and the guy looked at my badge, and okay. Oh, man. So I went on in. I went down to the launch pad, walked up there, and there was B.G. [Byron G.] MacNabb, who headed up the Convair [Division of General Dynamics] group. There was Mr. [James S.] McDonnell [Jr.] of McDonnell Aircraft [Corp.] was there, everybody except me wearing a hardhat. I'm walking around. I'm as close to the booster as maybe from here to that wall. This is great, all these guys, I'm seeing this Atlas, they're

fueling it. There's liquid oxygen. The fumes are coming off, the condensation. This is it. The light shining up on everything.

Then I get hungry, and there was what we called a "roach coach" outside, so I go back out. By then it's starting to get a little light. I go out, and I get me some coffee and a doughnut. Then I said, "I'll go back in again." So I come back. The guy stops me. He looks, says, "You're not on the list."

I said, "Well, you just let me through a minute a go." Well, it turned out there was a guy named Bob [Robert R.] McCann that was on the list, and the guy in the dark and in looking at my badge and all that, thought I was that guy.

Later on a friend of mine that I used to work with at Liquid Carbonic said, "Were you down on launch pad for John Glenn's flight?"

I said, "Yeah. How do you know?"

He said, "Well, I saw this movie, *Friendship Seven*, made about that, and they had a flash of the launch pad. There was one guy down there," he said, "I recognized your red hair," it was red then, "and you were the only one that didn't have a hardhat on." My red hair saved me.

RUSNAK: Easy way to pick you out there, huh?

MCMANN: Yes.

RUSNAK: During his flight, what were your actual responsibilities then?

MCMANN: Not really much, because they had what they called a blockhouse down there where all the data came in. I got to sit in with my boss. He was one of the flight controllers. All the flight control was done from the Cape then. There wasn't any flight control facility at Houston. All the gauges, I remember, were drum-type gauges with an indicator, and occasionally these

would stick. Guys would tap these gauges to make sure the needle was free. So all through the Mercury Program it was like that. When they moved into the control center in Houston, in order, I guess, to ease the transition from the old gauges to CRT-type [cathode ray tubes] displays, they had still the same type of drum-type display on the tube, and damned if you didn't see some people tapping the TV tube. The habits were so deep.

But in the Gemini Program, I was involved in some of the back room operations. We were in the aeromed [aeromedical] Staff Support Room [SSR] alongside the doctors during the Gemini Program. I remember there I wasn't just sitting and watching, I was actually part of the team. This was prior to doing any of the extracurricular activity. But one of the great treats was watching the doctors. These guys were not too adept at operating some of the Brush recorders and the com [communication] systems and all that. I remember one guy, they always dressed real well. A guy had a nice tie there, and he got ready to take data over one of the passes, started the recorder, bent over it and was measuring the little pulses on the ECG [electrocardiogram] , and his tie got caught in the roller and rolled up and stopped it. I mean, there was no way to get it out. They had to finally call a technician in to partially dismantle the thing and get his tie out.

Another time a guy had his arms down there, and there were two rollers that came together. The guy actually got a fold of flesh of his arm caught in the roller. It was always a treat to sit next to the doctors.

We got ready for the Gemini IV EVA [extravehicular activity]. It was very hush-hush. On March 26th, Jim Correale called a bunch of us into his office. He was my branch chief at the time. So they want to go EVA on Gemini IV, which was in March. The flight was in June. So we talked about what could we do, and he said, "Talk about it over the weekend. Let's get together Monday, put together a plan." So we put together a plan.

RUSNAK: Do you remember who else was in that first group?

MCMANN: Larry [E.] Bell, Roger [N.] Tanner. One of the guys that got involved in it right after that was Wayne [L.] Draper, who's over on site or at least he was, if he wasn't retired. He was a comptroller. I put together a sixty bubble PERT [Program Evaluation and Review Technique] chart. I'd been to PERT school, which is a scheduling tool technique in 1963, and I used that to come up with this PERT chart, and then Wayne took that chart and broke it out into subcharts. We scheduled the whole thing out, how we were going to get the thing, designed and built and certified and tested and everything in time to support the EVA.

So we had to disguise it, so we called it the chamber vent system [CVS]. We said we were building a system to use in the vacuum chamber to keep the guy alive in a spacesuit during testing. So came the day, though, that we had to go over and see Dr. [Robert R.] Gilruth, the center director, and show him the hardware, he and his senior staff.

So Larry Bell, who was leader of our team, got in there, and we brought the hardware and laid it on the table, all this stuff. So I'm just kind of sitting in the back of the room, right just behind, behind and off to the side a little bit of Dr. Gilruth. So Larry's up there talking. He's got the viewgraphs going. He's pointing out this and that and explaining things, and they're passing the hardware around.

Part of the hardware was what we call a T-connector. It plugged into the suit, and it had two outlets. What would happen is, you could come in from the spacecraft with one hose, and you'd have your life support system on the other connector. When you got ready to go outside for EVA, you'd pop out the life support hose. This thing had to seal then or else you'd lose pressure in the suit. So they had a springloaded, when you pop this thing out, this poppet came back and sealed. If it didn't seal, you were dead.

So while Larry's up there talking, Dr. Gilruth is sitting there. He's got this T-connector in his hand, and he pokes that poppet and sees it goes back and forth. In those days everybody smoked. He smoked a pipe. So he had an ashtray there, his pipe, some paper matches. So while Larry's up there talking, explaining all how this thing's going to be safe and all that, Dr. Gilruth

takes one of these paper matches and folds it, and he's trying to jam that poppet open. Now, he wasn't able to do it, thank God, because if he would have jammed it open, whether or not we'd been able to go or not. But we got through it, and the rest is history.

RUSNAK: So tell us about the part that you were actually responsible for in these approximately sixty, I guess, days between there.

MCMANN: I was kind of responsible for doing the planning and getting the umbilical, the twenty-five-foot umbilical. At that time I was in charge of the life support system we were going to use after Gemini IV. We had another system we were going to use for the rest of the Gemini Program. That system had an umbilical, so we were going to take one and get it early and use it on Ed [Edward H.] White's [II] flight.

What we wanted to do for these other flights, they were going to be outside longer. We wanted to have a multi-layer, multi-wrap insulation on these umbilicals. But for Ed White's flight, we didn't have time to build all that. We just put a gold coating on it, and that's where the famous gold umbilical came from. It was a gold-colored cloth. The gold surface gave enough thermal control for the short period of time he was going to be out.

Later on we were going to go ahead and use the multi-layer umbilicals, multi-insulation wrap umbilicals. So I was running the contract for that, and after Ed White's flight we had to get back to normal. We were going to do an EVA on Gemini VI. So in talking to my contractor out there, I said, "Okay, what about the umbilical?"

He said, "Well, we already gave you the umbilical."

I said, "No, no, no. That was for Ed White's flight. You need to give us another one."

"Well, you didn't tell us that."

I said, "No, no. Yes, we talked about it." I mean, everything was done word-of-mouth fast.

He said, "Well, the long and short of it is I don't have another umbilical."

I said, "Well, you've got to go get one. We can't show up short."

I guess what had happened just prior to him going back then to his vendor for the umbilical, his vendor had seen Ed White's flight, and he called up his purchasing contact and said, "Hey, was that our umbilical that they used?"

The purchasing contractor said, "No, it was our umbilical."

The guy said, "Oh, okay."

So now we go back to this guy and say, "Oh, we need you to work overtime. We need you to work weekends. We've got to have this umbilical."

He says, "Oh, I'm too busy. I think not. I have a lot of other business."

"What do you need? We'll pay you overtime."

He says, "No, it really isn't a question of that." He says, "I just don't need the business."

We said, "What will it take? Whatever you want."

The guy said, "Just one thing. I want a letter from your purchasing agent thanking us for providing the umbilical that Ed White used."

Then he says, "You got it," and he got it. See, you don't want to make people mad like that when you've got to come back to them.

So I was responsible for this life support system. I had picked it up, really. The whole idea or EVA on Gemini as we had started out with was a lot different than the Ed White thing and the thing we actually did. The idea at first was take a couple of old Mercury environmental control system [ECS] bottles and regulators and give them to a contractor and have him put them in a sling and put a relief valve on the suit and let them just dump flow into the suit and let it vent overboard fifteen minutes. So we said, "Okay. We'll do that."

"Well, how much is that going to cost?"

So we let a contract for it, $135,000. Okay. That was in January of 1964. In February of 1964, they let the first contract change, did away from the Mercury bottles, went to a semi-closed loop system with an umbilical and raised the value to $700,000.

Then in April, I came in to manage it. This thing was already getting people's attention. Well, we ended up spending three and a half million dollars on it by the time it was done, just by reason of the fact, our ideas of what we wanted just kept growing. It was also some of the Ed White stuff in there also. So it was my first lesson in economics. It's always going the cost more, and never trust an engineer, because that's what I was, and I knew later I couldn't be trusted.

Dick [Richard S.] Johnston, who was my boss at the time, had made it kind of a policy that his people, he wanted his people that were running projects to be test subjects on those. That sounded like a pretty good idea to me. So I was the first one that took an altitude chamber run on this system we ended up using on Gemini IX through XII. We tried it on VI, but we didn't fly on VI because they had the stuck thruster problem.

Dick Johnston, he did not delude himself that he was a technical guy. When he was trying to explain something technical to somebody, he'd call in you or whoever the expert was. I was always a little bit nervous going up to the division chief's office, because I was below a section chief, and I was just one of the troops.

So one day he was trying to explain how this chest pack worked with the ejector and all that to this guy, and he couldn't remember how it worked. So he called on me to come up there quickly and draw him a little sketch on the board and show this guy how it worked. At that time I was smoking cigars, Dutch Masters. I was just getting ready to light one up when he called. So I went down in his office, a little bit nervous. So he explained to me what he wanted, and I lit that cigar, put it down. "Okay, yes, okay." I picked it up and stuck the wrong end in my mouth. Now, trying to maintain your cool as you hear the sizzle and you watch both of them go kind of [McMann grimaces], they're thinking, "That must have hurt," and you're trying to talk, spit, bits

of your lip blistered, and bits of ash and still keep talking and maintain. "Oh, yes. Yes. I meant to do that."

I managed to explain it and still kept my job. Now I'd have to write a safety report. It'd be a close call. I'd be called up before Safety Committee or something like that. I just went back, tried to eat my lunch and keep the hot coffee away from my burn.

RUSNAK: You probably didn't do that again.

MCMANN: No. No, probably not. It was one of ways that will help you to stop smoking. In fact, I should have brought it. They got a picture of this guy and I over at the control console, and I got a big old Dutch Master cigar right there as I'm going away.

Some of the testing, those days. Nowadays to get metabolic rate up when you're in the spacesuit and you want to tax it a little bit, they have these fancy built-in treadmills. None of that stuff for us. Back in the old days, you'd have like a step test. You'd step up and down to get your metabolic rate up. In order the simulate the cold, we had a thing about the size of a phone booth with liquid nitrogen circulating through the walls, and you were inside this thing, and they put a clock up on the outside of the chamber. Through a window you could see this clock. Every so many seconds, you'd step up and down based on work you'd done outside of the chamber in a pressurized suit to determine at this many steps for this many seconds you'll get this rate, so we were doing that.

So one day we had a guy in there. It was a friend of mine, Norm [R. Norman] Prince. Norm is also retired. He's living in up in Colorado now. But he was in the phone booth with liquid nitrogen, 320 degrees below zero, circulating through this wall.

So workmen were out working on a line they were putting in between this chamber that Norm was in and another smaller chamber. What they wanted to do was have a way to bring both systems up to vacuum. Well, there was about a pipe about this damn big [gestures], a huge

pipe, that connected these two chambers with a valve right there in the middle. Here we were running this test with this valve shut, but the workmen were working on it. So there was vacuum on one side of this valve, air on the other side. They came to this chamber, which had a full opening door, a door like a refrigerator door, if you will, and guys working in it. Well, something happened. They swore it couldn't happen, but it did. That valve opened while the test was on.

Well, what happened was you started sucking air from the outside, not only air, dirt, papers, bugs, dead cats, everything up through this thing, and that door on that chamber start to swing shut, just like a door will do if you got a lot of breeze on it. Well, they managed to hold it open, and the poor guys in there got out, and they were diving the chamber down, helping it come down. A filter then came out of this. This thing was never meant for this sort of a rush of air. Threw this huge filter out, crashed it into the phone booth that Norm was in. Lucky it didn't rupture it and spray liquid nitrogen or it might have fractured the suit and brought Norm down. So, again, we just sort of, "Oh, well, gee, we shouldn't have done that. We promise never to do that again."

Another time we had a test going on with a, we had a Gemini spacecraft mockup, and it was just the size of a Gemini. We were practicing, again, another run. We had a test subject. Vern Dugan was his name. Vern was in there. We were running this test. He'd been in there quite a while, and things were getting a little bit cold. So we started adding on some things at the end of the test. Guys wanted to check some com modes. They wanted to check this and that. So we started extending the test.

We had a measurement of his flow rate. Well, that measurement had been coming down all the time. Now, you need enough flow rate or the carbon dioxide won't get washed out of your helmet. So we kept going and going and going, and it's getting cold. It's probably just the flow meter's just showing a lower flow than it really is, because it's getting cold. I'm sure we have plenty of flow. We kept telling ourselves that.

So then we went into these other modes. I won't bore you with the details, but we ended up stopping flow altogether, and then we had a thing that was supposed to bypass for emergencies. Well, what had happened was we had been freezing up ice inside around this nozzle, and pretty soon the ice choked up almost all the flow, and our bypass flow came in upstream of that, so it didn't do us any good, our bypass flow, because we were already plugged.

So here he was, and all at once—we measuring his CO_2—his CO_2 spiked up. So we were diving the chamber, bringing it up to sea level, and he's screaming, "Get me out of here." He starts to pop his—in those days you had a face plate on the helmet. He wanted to open his face plate so he could breathe. Well, there was nothing to breathe. We were screaming at him, "Don't open your face plate. Don't open your face." So we finally got him down. Some hairy moments.

RUSNAK: Yes. I heard another one about they were testing, I think, the backpack for Apollo where one of hoses became disconnected.

MCMANN: Yes. Jim [James] Le Blanc, who's over in the EA [Engineering and Development Directorate office] now. In fact, he's on old roomie of mine. We roomed together a while. In fact, it was sort of ironic. He was on the suit, an Apollo suit, and he had even made the corrections himself. We had two pipes coming out of the facility environmental control system. Now, anytime you have a pipe that's going to have a hose on it, it has a little bead on it. So you put the hose over it and put a clamp on it, and if you try to pull it off, the clamp will get stopped by this little bead that's on the hose. Didn't have it in those days, it was a smooth bore. So he was moving around in the chamber and pulled the hose off. He said he could feel the saliva bubbling in his mouth. Either it was air coming out or it could have been even blood before he passed out.

RUSNAK: Definitely a scary moment.

MCMANN: Oh, yes. But it was kind of ironic. He was the one that put on the clamps anyway, so he kind of did it to himself. But it was something that if you can survive your lessons, you can learn.

RUSNAK: Yes. Well, fortunately there weren't any fatalities.

MCMANN: No, not that we had. We had some close calls. We had a guy get burned pretty severely in April of 1980.

RUSNAK: I don't think I've heard that one.

MCMANN: It was April, April of '80, about 1:25 in the afternoon. I heard the alarm going off out in Building Seven. Well, they had fire alarms. They'd empty the building, fire drills, all that. So we go out there. No fire drill, there's some white smoke and some people milling around. By the time I got down there, I guess the guy that had been burned, they had already taken him.

What had happened, we were getting ready for a chamber run on the Shuttle EMU [extravehicular mobility unit]. This was the first time we were going to run a manned test, manned chamber run test on it. The subject was going to be a guy named John [W.] Samouce, "Dusty" Samouce. Dusty was one of our prime subjects. I was the backup subject. What had happened was the EMU was laying on this table. It was fully pressurized. We had 6,000 psi oxygen in the emergency system, 1,000 psi oxygen in the normal system, and we had a control box that is mounted on the front of the crewman. Of course, laying on the table it was laying like this.

Part of the test procedure, the technician, Bob [Robert] Mayfield, was supposed to turn this emergency system on. When he turned it on, there was a fire instantly that totally burned through the suit, burned him over about a third of his body. Totally wiped out the suit, but the fire went out quickly. We ended up totally redesigning the oxygen system, in fact, came up with new design standards for oxygen systems. From that fire came a whole new way of designing and testing and building oxygen systems. We're still using that stuff to this day.

To go down and see him in the hospital, burned, and know that this was a system that I had participated and a lot of other people had participated in designing, testing, and all that, and also knowing that I was the backup subject the next time somebody would have been in the suit, the next time that valve was open, either Dusty or myself would have been in the suit, and you would have been cut in half. There was a jet of flame that came through, there was no way you could have survived.

I think people forget what we're dealing with. The thing that struck me over my forty years of experience—actually, I think what I really had is two years of experience repeated about nineteen times. People say I've had fifty years' experience, twenty years' experience. You really have only a few years of experience, and you repeat that over and over. Hopefully you get better at it as you go along, but not always.

I think we were always subject to the laws of physics. Hardware always does what you tell it to do. Sometimes you don't realize what you told it to do. The *Challenger* did exactly what it was supposed to do with that design. With the temperature conditions and all that, it did exactly what it was supposed to do.

RUSNAK: I guess that's the purpose of testing before you're actually using these in an operational environment, is to find out exactly if you have designed it to do what you think you've designed it to do.

MCMANN: But you know what? The three most important words that I've found over the years are: integrity is one. You've got to have integrity.

Margin is another one. You put margin in what you think it's going to do and you add something over it. Well, what if I want it to do more? What if someday I want it to do more? You've got to have that margin in there, because you're always going to be short in what the heck you predict. A test, by its very nature, is a compromise. You're not doing the thing that you're going to do. You're doing something that you hope approximates or is greater than what you ask it to, but not always. Not always.

I can't remember what the third one is, but I'll remember it in a minute.

RUSNAK: Okay. Well, we can come back to that when you do remember.

MCMANN: Yes. Running tests is an art. I think I've still got probably the record for running dumb tests. I mean, you can run a dumb test.

One time we were going to have to build, again, for the Apollo Program, we called the PEAP, Pad Emergency Air Pack, a little five-minute air supply that the astronauts would use. They'd get out of the Apollo command module in the midst of a fire or smoke, grab this system, throw it over their head, plug it into the suit, get some ventilation started, jump on the slide wire, and come on down. The way you tested this thing was—remember I was one of the test subjects—you get in the suit, and you were on a treadmill walking. They also had a bag over your head so you couldn't see, to simulate a condition where you had a lot of smoke. So you'd be walking along on the treadmill. All at once they'd stop flow. So you'd have to pop the hoses out of your suit, find this pad emergency airpack, put it on, plug it into the suit, and do that within thirty seconds. You had to plug it into the suit and then plug in a relief valve to the other side. In fact, you plug in the relief valve first, plug in the PEAP, and turn it on, and then the test ended.

So in order to get bottles for this thing, somebody said, "Well, look, there's these other little bottles. We want to run it 3,000 psi, but we got these bottles. They're supposed to be rated only 1,800, but they're so good, we can run these things at 300[0]."

I said, "Yes, but what if they break? What if you get a scratch in them?"

"We'll prove to you that even if this bottle breaks, the case we'll put it in will contain the fragments."

"Oh, okay. Let's design and test it." So we test this test article. We had one bottle empty, normal, another bottle next to it that we put a big scratch in it, made sure it was going to break. Then I think it had five bottles total. We had two live bottles and then three dummy, just turned pieces of aluminum, and then we had the fiberglass case.

We went over to the Thermochemical Test Area. We had this 9,000 psi accumulator, fast-opening valve inside this test cell. What we were going to do, we were going to pressurize this bottle, make sure it broke, and show that the case would contain the fragments. Then we had to send this report to Dr. Kurt [H.] Debus, who was center director at KSC [Kennedy Space Center, Florida], show him that this thing was going to be safe. Even though these were only 1,800 psi bottles, they would be safe.

While we were designing this test and getting it ready, we found out we didn't have enough of these 1,800 psi bottles, so we have to buy new bottles. Well, as long as we're buying new bottles, let's just buy some that are designed for 3,000. So we did that, but we didn't turn off the test. We kept going. Because the test was going, we had other things on our mind and forgot. "Oh, yeah, this test is going."

So the day came for the test. We open up, had a fast-ex [exposure] camera on it, popped open that accumulator. I remember seeing the pressure gauge go off scale. They had lights on this thing. All at once the lights are down, the room was practically dark. One light is still on. We can see little fibers floating down. We found seventeen pieces of the bottle. The case was dust. Then we realized, we had that 9,000 psi accumulator. Even if they would have contained

the fragments from a bottle, we'd put so much gas in there, there was no way that little case could hold all that gas. We blew that thing to smithereens.

So now I have to write a letter, "Oh, Dr. Debus, you know this test we ran that showed we'd blow up and wipe out half a city block? Don't worry. The same guys that ran that test are the guys telling you now it's a system they're building you can believe in." Those are difficult letters to write and keep a straight face. I think I got the world record for dumb tests.

We had some great times. The Skylab emergency was another great time. Two weeks of unbelievable activity. Here we'd launched this thing. We lost the solar wing, ripped off the insulation. There it was up there cooking, toxic fumes coming off all the insulation inside. Well, a lot of us were saying, "Well, that's it. It's done. Skylab Program is done." We had another vehicle, but it would cost $40 million to get it outfitted and a year. I mean, there was no way. There was no way anybody is going to let us go up there and breathe that stuff. Even if we vent it out, no one is going to let us do that. Well, sure enough, decided we would do it.

So we got together, putting together the parasol, all these things. We had the whole center working 24/7. I mean, it was amazing. We set up this thing in Building Seven called Action Central, and we were the key place where T-3[8]s were scheduled to carry bolts of cloth from up in Massachusetts down to Houston to look at building the parasol. Everybody was going through us. We were the key place that all actions came into and went out of. People were working just unbelievable hours.

I remember Charlie [Charles C.] Lutz came from Wright-Pat, his son [Glenn C. Lutz] now is in the Project Office having the job that I used to have. I think when Glenn's kids start to work. I'm definitely going to have to retire. That's just too long. But anyway, Charlie had been going I don't know how many days. One night I happened to be behind him, he was going out of Building Seven. He walked out that back door, and he just collapsed. His body just gave up. He was able to keep going as long as he was in the building. Once he got outside the building, that's it. He just collapsed. So people were doing that all over the place.

We had a meeting over in Building One with [Charles "Pete"] Conrad, I forget, Conrad, [Paul J.] Weitz, and [Joseph P.] Kerwin, I think they were one of crews. They were going to go up, so we had this big meeting on what they were going to do up there, how we were going to let this parasol go and all that. So they were already in quarantine. So you've got to get this picture. You have the ninth floor conference room, carpeted, mahogany, the big table, the chairs, the soft lighting, the suits, everybody there, everybody wears these white masks. Everybody. It was outlandishly funny. The people put up their viewgraphs. They're talking through the masks with the viewgraphs going and showing all this. Well, if you've worn one of these things for a while, painter's mask, whatever, when they get a little wet, you can't hardly breathe through them. Well, after about an hour, everybody's mask started getting a little wet. So pretty soon you saw people kind of moving them off to the side so they could breathe. Well, pretty soon, Pete Conrad has got a cigar. He's smoking a cigar. Pretty soon they're wearing their masks like hats, one of them up over his ear. Everybody just blows it off. But nobody took the little mask off. They always had it around your neck, around your ear, over your eye. [Laughter] It was great.

We had guys going out at Ellington [Field, Houston, Texas] putting this stuff together. I had a guy work for me, Roger, Roger Tanner, I mentioned him before. Roger was the kind of guy if you wanted a complete job done and you didn't care who he made mad, then Roger was the guy to give it to. He could do anything.

Well, Roger was out working on this thing. He was working with another division chief. Roger wasn't even a section chief. Here was this guy who was a division chief, Caldwell [C.] Johnson. We were out there. Roger was working essentially for Caldwell. I was there. I was Roger's boss at the time. It was about three a.m. We were practicing packing this stuff up and unpacking it, making sure the crew was going to be able to do it, all these tools and things they were going to use.

So we had it all done. So finally Caldwell says, "Well, it's about three o'clock. I think we've done enough. I think we're ready to go."

So everybody, "Oh, good. Man."

Roger said, "Well, I really think we need to do it one more time."

Caldwell says, "Roger, we've done it about six times now. I think we've done it about as good as we can do it. I don't think we need to do it again. We're going to pack up and go home."

Roger said, "No, I really think we need to do it one more time."

Caldwell says, "No, Roger. We're not going to do it again. We've already done it." I mean his voice is starting to go up, maybe an octave and a half.

I thought it was settled, and Roger says, "No, Caldwell, I think we need to do it one more time."

Caldwell just—I won't even go into the profanity. All at once it dawns on me, this is a division chief chewing out a guy that works for me and I'm letting him get crucified here, so I finally jumped in and told Roger, "Roger, we're going to do it this way." But I mean, he's a guy that'd never hold any hard feelings or anything against Roger.

But Roger was also one of the key people working on Ed White's gun, the zip gun, the little maneuvering unit [hand-held maneuvering unit] that he used.

RUSNAK: Well, while we're still on the subject of Skylab, you had done a couple of specific things like to figure out how to recharge the cooling loop, for instance.

MCMANN: Oh, yes. We had a leak in the coolant loop. This is one I wouldn't have told, but now since you brought it up, I'll tell it. So the idea was we're going to send up a coolant loop repair kit. We're going to pierce, just like you do an air-conditioning system. We've got this

valve. You put it on the line and seal it and then screw it in, and you'll puncture it and then you'll let flow come in from another way. So we'll replenish the coolant loop.

Here is my contribution: I said, "Well, wait a minute. What if this recharge kit leaks?"

The guy says, "Well, we don't think it's going to."

"Yes, we need something to check it." So we came up with the coolant loop recharge kit leakage test fixture, which was my brainchild, my contribution. Somebody else asks the question, "Well, what if your leakage fixture leaks?"

"Well, no, we don't think it's going to."

Anyway, make a long story short, we come up with the coolant loop recharge fixture, the coolant loop recharge fixture leakage kit, send them up there. They put it on, and, sure enough, when they check for leakage, it shows that somehow this assembly leaks.

Somebody say, "Well, let's try it without the coolant loop fixture leakage test fixture." So they did, and it worked. They recharged it. So I ended up getting an award for the coolant loop recharge kit. Somebody forgot that, no, his was the test fixture, his was the piece that didn't work. But I very graciously, I didn't want to make look bad, so I accepted the award.

RUSNAK: I don't recall coming across that.

MCMANN: A little-known fact. You can see why I didn't want to bring that up, but thank you so much –

RUSNAK: Sorry.

MCMANN: —for enriching this oral history with that.

RUSNAK: Maybe we can change that part to some ellipses.

MCMANN: As long as we're on that, if you want to know another contribution I made, see, being a chemical engineer, my secret desire has always been to make some unique chemical engineering contribution to space hardware design, and I found my chance in the Shuttle EMU Program. We had a problem. We had something called a sublimator, which is a heat-rejection device. It needs very pure water to work. Water is stored in these bladders. Well, it turns out that the bladders were made out of Neoprene. In the making of the Neoprene, you use some chemicals that essentially leach out into the water, and these chemicals, there's one called abietic acid, present in only a few parts per billion. It essentially, when it gets to the sublimator, the porous plate, very fine mesh, fine grained pore, it causes it to lose its capacity to form a nice ice block in there. Anyway, the performance goes to hell. So we were having this problem.

So we said, "We don't know how we're going to do this. How are we going to fix this?"

I said, "An ion exchange bed." Deep from my chemical engineering roots comes the answer, as if by magic, an ion exchange bed. I was running the program at that time, so it was pretty easy to make my will felt. You will design an ion exchange bed, and it was a good idea, seemingly. They designed the ion exchange bed. It works. I'm a hero for about two seconds.

Then they said, "Oh, that's good. Well, unfortunately, the bladders we tried it with are ones we're not going to use anymore. We've got a new batch that we're going to use. These old ones are about out of life. We've got a new batch we just got from the vendor. Let's try it with them."

Worse than before, worse performance with the ion exchange bed than they'd ever had. Try it without the ion exchange bed, it still cratered, but it was much better. Turned out the guy had varied the formulation just a little bit. So what you'd have to have is essentially an infinite number of ion exchange beds to cover all the possible different kinds of chemicals you might have in this thing. We ended up going to a different bladder material.

The ion exchange bed, we put it in a little pocket on the thermal cover. It kind of stuck out, so we had to build a little pocket on the thermal cover. That's now useful as a holder for some batteries. So my ion exchange bed was nothing. The a little pocket that it created is now being used for batteries. So that was my big contribution.

RUSNAK: Clearing some empty space.

MCMANN: Clearing some empty space out.

RUSNAK: We'll note that one as a primary contribution.

MCMANN: That's right. When I retired from NASA, my friends at Hamilton [Sunstrand] gave me a nice big picture, and on that they've got part of the drawings from the ion exchange bed, just as kind of a reminder.

RUSNAK: Make sure your ego doesn't get too big.

MCMANN: That's right, yes.

RUSNAK: Yes, I understand it works like that a lot over there.

We've kind of moved around a little bit from Mercury to Gemini to Skylab to Shuttle. We didn't talk a whole lot about Apollo, though.

MCMANN: I didn't have a lot to do with Apollo. You see, Apollo and Gemini were rivals. We had both programs going on at once. When I moved over and got the Gemini life support system, we had the Gemini Support Office and the Apollo Support Office. They had their suit,

we had our suit. They had their primary life support system [PLSS], I had the ELSS, what we called the ELSS, extravehicular life support system.

We hated Apollo. They got all the money. Their secretaries were prettier. They got better office space. We were just the poor—in fact, the Gemini Program contract was let after Apollo. Its number was NAS9-170 and Apollo was NAS9-150. It was actually let after Apollo. The reason they let it was because the first concept for Apollo was direct launch. They were going to build this huge booster called the Nova and go direct for the Moon. They found out it didn't look like it was feasible, so they needed to develop orbital rendezvous, and that was kind of the mission of Gemini really, was to prove out that you could do rendezvous and docking and things like that. EVA was sort of an add-on to Gemini because of the doors, the full opening doors. It was easy, then, to get out.

Apollo, I did have something to do with the little clothesline they used to haul up the box of rocks off the lunar surface, "Mrs. Murphy's clothesline." It was a continuous clothesline that they used to hook on the rocks and bring it up. We came up with this concept, and Max Faget, consummate engineer, who headed up Engineering and Development Directorate, he saw our concept, and he said, "You better make sure that when that box gets to the middle you're not going to pull the guy across the lunar surface." Because if you remember, like you can pull a car out of the mud. You tie a rope to the car and to a tree, pull in the middle of the rope, and you can pull the car up. It's physics, it's geometry, and it actually works. He could see that same thing happening as you got to the middle of that line, the force on each end of that would be such that you pull that guy across the lunar surface if the coefficient of friction wasn't high enough.

So we went over, had to go over, counterweighted the guy to one-sixth his weight and proved that for the weight that we could get in the box it wouldn't happen. But I always really, really respected Max Faget for seeing that instantly and none of us saw it.

So we built that. In fact, a guy named Bob [Robert M.] Bernardin built that tether on a big old brown table over in Building Seven. We still have that brown table. We use it now for

teleconferences and all that, but I always think that as the tether table, Bob's tether table. He built all the tethers on it.

He was a story. He was a technician, non-degreed. He finally got to be a GS-13, which is unheard of anymore. You can't do it without a degree, but Bob was such a class guy. He was not only good technically, he could deal with people. He could write. He could talk. He was really valuable. He was like the perfect bridge between a pure engineer and a pure tech, one that couldn't do the other job. He could do everything. Great guy. Dead now, along with some of these other guys.

Well, I was mentioning some of the wild men in the early days. Jim Correale ended up being a division chief. Jim came from South Philly. He came down to Houston, and Joe Kosmo and I went out, go out to eat with him and all. His wife was still back in Philly. She wasn't coming down till he had the house ready. So he rented this house. One of the things that amazed everybody, including me, was the size of the roaches down here in Houston. Unbelievable. His wife was deathly afraid of bugs. She'd heard about the roaches.

So apparently this house had been vacant for a while, and it was a roach condo for everybody's roaches that they had chased off. So he called out an exterminator, had him go through the place, I mean really blast it. So he got Kosmo and I, and he said, "Okay. Got to clean this place up. Make sure you get all the roaches out of here. My wife will freak if she sees any of them."

So we went in. Roaches, we swept up roaches. We went in the closet, pulled up roaches. Into kitchen, there was a box of detergent under the sink. I remember opening it up, there was roaches in that. We pulled them out. Out of the cabinets, out of the closets, everywhere. We got the roaches out, just waste basketful after waste basketful. Got all of the roaches.

He says, "You got all the roaches?"

I said, "Yes, Jim, we've got them. They're everywhere. They're gone."

"Are you sure?"

"Yes. Jim, I'm telling you, we got them everywhere."

So the way he tells the story, of course, you know we didn't them, obviously, or I wouldn't be telling the story, right? Gets his wife down. She comes in and says, "Did you do exterminating?"

He says, "Yes, Joyce. The roaches are gone."

"Are you sure?"

"Yes, I'm positive."

"Oh, good. Well, we can get rid of these drapes." She rips down the drapes, and there on back of the drapes are 10,000 dead roaches. We forgot to look on back of them.

RUSNAK: Well, at least you guys still had your jobs after that.

MCMANN: Yes. Well, we were good slaves. They still needed slaves.

RUSNAK: So dare I ask how the wild men got their name?

MCMANN: Okay. I'll give you another story about Correale. When he became division chief, he decided, "This place is filthy. I'm going to have a safety walk-through." So he called all the branch chiefs together, unannounced. He's going from office to office. Now, you've got to realize in those days there were a lot of people, got 180 people or so in Crew and Thermal Systems [Division], co-ops, people that had never maybe even seen the division chief, much less met him or anything.

Jim comes through. Nothing on file cabinets. Instead of saying, "Take your stuff off the file cabinets," he just took his arm and just wiped it off. Ashtrays, stacks of computer cards, back in those days, like the leaves off the trees in the fall falling down. Goes through the room.

Doesn't say a word, just sweeps the tops and all that. Guys are, "Who was that masked man? Who was that guy?"

He goes down. Everybody is taking notes and all that. He's going from office to office. He's having a field day. He's loving it. So he goes out to the lab, out to the high bay area. He goes down, and he's walking along. All of a sudden he looks up, and he sees one of these deluge showers. You get something in your eyes or anything like that, you've got this shower. The shower head's about that big. Holes, gigantic holes in it. Huge pipe coming from that. He says, "I'll bet that thing doesn't even work." What happens, you pull these things on, it just stays on. You don't let it up and it stops. It just stays on. You've got to shut it off. He steps under that thing and pulls it, and I mean instantly he is deluged. Of course, everybody thought that was the greatest thing in the world. When he retired, we gave him one of those shower heads mounted on a walnut plaque.

Ted Hays, talking about him, he was always joking. You've got to remember, girls, sexual harassment had not been invented yet back these days. We had a division secretary. She's a terrific person, Ginny [Virginia B.] Hughes. In fact, I think she has an award or something named for her now. She was traffic. She ended up on the ninth floor, but Ginny was great. Ted was always teasing her. He'd come around and say, "All I want for Easter is to grab you by the keister." She didn't think anything of it, but Ted was always joking with people like that.

One day he went off on a trip. His office was right at the end of the hall. If you went down to the end of the hall, you could look straight into his office. They were redoing offices. What they were going to do was instead of coming directly to his office from the hall, you went in through a secretary, and they put a doorway in here, so they put that across. So what they did was they put the panel in, totally closed off his door. They found a little half desk and put it out there and a chair and his name on it. So when he came back from the trip, he walks down the hall and sees there's no door to his office, yet there's this little thing sitting out in the hallway.

Oh, yes. Matt [Matthew I.] Radnofsky, another one of the wild men. Matt had been in the Second World War. He was shot down in a plane, had been machine-gunned by Germans as he was floating down on the parachute. Being of Jewish extraction and having that, he was not really fond of Germans. Matt was our materials expert, and you just have to know him to know how wild he was. I remember he used to wear a yellow knit tie with a knot about as big as a fist on that. He was always yelling, always yelling. If he wanted this guy to come over to his office, the guy's office was about twelve, fifteen feet away, he wouldn't call for him. The guy usually had his guy door shut. He wouldn't call for him, wouldn't pick up the intercom. He had these letter-openers. He'd throw a letter-opener at him and hit the door. That was the guy's signal that Matt wanted to see him.

So a guy came to work for Matt, Franz Reineker [phonetic]. Franz had been in the Wehrmacht. So they're out there. So Franz, knowing who Matt was, knowing his history, is very careful what he says and all that, except one day they're out there. We got in this special—it was, honest to God, I'm not making this up, it was a Frankenstein suit. That was the name of the guy that invented it. It was Frankenstein. It was a special suit. It was a prototype pressure suit. I think it was a positive pressure suit, real tight-fitting thing.

So we were trying to put it on this test subject. Matt and Franz were working there together, trying to put it on this guy. All at once, I never know what possessed Franz after all this time of keeping himself straight, he says [mimicking German accent], "This suit is terrible. We should have used it on the Jews." So Franz was not with us for very long after that. Matt said, "That's not funny." Matt, he didn't let him get away with it. Oh, yes. Matt was a character.

You had concepts that you would essentially sell to your management. You'd have a Change Board. You get in there. You'd have the official decision on whether or not you were going to go with this approach, now, all very orderly, all very honest and up-to-date. Then you had what I call the CPCB, the Carpool Change Board. You get these branch chiefs who are all

riding home with Dick Johnston in the evening. They'd talk him out of the change you just talked him into, so you were never safe as long at CPCB was operating.

RUSNAK: Can you recall any specific instances where that happened?

MCMANN: No, I don't. I don't remember any. But I remember one of the guys, Bill [William L.] Gill was one of the guys that used to work on Dick Johnston in the damn car.

The cars were great thing, too. We had a lot of great car stories. We had Norm Prince, a guy I mentioned before. Norm drove a '52 black and yellow Oldsmobile. Norm did a lot of engine work himself, but he did not bother with frills like floors. Norm drank a lot of beer in those days. So what he would do, Norm would drink beer while he was driving, and you don't want a bunch of beer cans clattering around in your car. So he would put the beer can down and stomp it through the floor so that it would end up on the road. It would not be rattling around in his car.

We had one of guys, Dick [Richard E.] Mayo, drove a little Fiat, really little Fiat, real tiny Fiat. Over at the Lane Wells Building, we'd take that Fiat and get it rolling, and then we would pick it up and put it in, they had some little stall-like things. I don't know what in the world they had had at that building, but we'd that Fiat in there, and I mean it was firmly wedged front to back in the side of that stall. So Dick'd come out looking for his car, and there it was. No idea how in the world it got in there. So we'd eventually take it out and let him go home. He eventually got himself a bigger car just for self-protection.

Then there was the guard, the security guards. They had not too strict screening for some of these guys, I don't think. Anyway, they used to let them patrol with loaded guns, and then one night one of those guys ended up discharging a weapon. After that, I don't know whether this is true or not, they swear it was, they had only one bullet, and when a guy would come on with his gun, they would have the ceremonial changing of guard and the bullet. So they'd pass

the bullet on. They had one bullet. I guess they let them have one. They wouldn't let them have more than one.

RUSNAK: I hadn't heard about that one, but I think we have some security people on our list to interview, so maybe we'll ask them.

MCMANN: The Lane Wells Building, yes. They had a guard called Iron Horse. We called Iron Horse. He rode a motorcycle. He was famous, too.

RUSNAK: So what do you think are some of the stories that people would be telling about you if we had them say any?

MCMANN: Oh, there are no stories about me. I got into, being part of this test subject, started running. A bunch of us started running out there. I guess my thing was we ran in Building 29, which is a round building, and the idea was you ran two and a half miles three days a week, a mile and three-eighths the other two days of the week. I don't know where we came up with those numbers, but that was it. So to get two and a half miles, you ran fifteen laps one way and fourteen laps the other way. You had to have twenty-nine laps in that centrifuge building. You talk about boring.

So one day, somebody said, "Well, why don't we run outside?"

"Well, it's kind of cold outside," happened to be that time of year. So this one guy, Wiley [P.] Beal, Wiley ran outside.

We all dressed out over in Building 29. So we asked him, "Sort of chilly out there. How is it out there, Wiley?"

"Oh, it's nice," he says, "Nice." Might be thirty-five degrees blowing rain, for Wiley it was nice. So pretty soon we don't even ask him anymore. So pretty soon we started running

outside. I was always slower than everybody, and every day about the same place I'd start losing out. The idea was run as hard as you could as long as you could to get two and a half miles out.

So one of these days I started running longer, just away from the rest of the crowd, just started running longer and longer and much, much slower, and I found out I liked it. Then I started running, I wonder if you really need a shirt all the time, so I started running without a shirt. I started wondering, does it ever get really too cold to run without a shirt or is it mostly mental? So I determined it was mostly mental, that if you get past it, the thought of it, you could run without a shirt in any weather. I would put like socks on my hands, but I ran in shorts and no shirt. So I started do that.

I remember one time at JSC, we had an ice storm. I remember my chest hair, I had ice on my chest hair, but still no shirt. Running up at Windsor Locks, up in Connecticut in the winter, one time I went out, and I don't know how cold it was for sure. I found out later it was either five or seven degrees. What happens, it's kind of interesting. When you do that, I found out later that when your skin temperature gets down to about fifty-nine degrees, the blood shuts off in order to start conserving heat to your core. Okay.

You go out there and run in that cold weather. You come back in, take a shower, what happens? Your skin, when it warms up above fifty-nine degrees, the blood starts coming out. Well, the blood is hitting sixty, sixty-five degree skin, it's getting chilled. You get the damndest case of shivers sometimes fifteen or twenty minutes after you run, even after the shower sometimes. So I learned to stay in the shower for a long time until I got past the shiver stage. But that was an interesting phenomenon.

But only thing that stopped me from running without my shirt on was I looked at myself. I started putting on some weight. I looked at myself in a shop window one time when I was running by and I was so fat and ugly I decided that's why I need a shirt, to cover up the fat.

RUSNAK: Only an engineer would regard running in these extreme temperatures without a shirt as an interesting experiment.

MCMANN: Well, it was. We had other experiments. [F.] Story Musgrave, one of the astronauts, had a program going along—this was running in the summer—on the effect of heat on running. So we would go out there. Here was the way you'd do this. You had your thermometer. You would go in and weigh before you ran, take your pulse rate, take your core temperature. I don't need to tell you ladies how to take your core temperature, right? Okay.

You'd go out and run. We ran like six miles at noon. He was measuring the sweat rates. I could lose almost five pounds in six miles of just water coming off. So the idea was you do these measurements right as you start, go out and run, right as you stop running, take your pulse rate and your core temperature. Now, again, this is a lesson in how to be cool casually inserting a thermometer to take your core temperature out there without acting like you're doing anything special. So we did that for a year. We took data for a year. It was about six of us.

Another time I got involved with an experiment, same type of thing. This time, though, they wanted to keep the core temperature going all the time you were running, so they had this special harness that you wore and a little belt and an RF [radio frequency] transmitter. I'm sorry, we didn't have the RF transmitter. That was the problem. They had to have a hard wire to the data recorder. So we got on the back roads. He was in his car, and I'm running alongside. The problem was he was running in the good part of the road. I was running in the ruts. So he was driving his car in the good part of the road, I'm having to skip across the ruts. So we did about three miles that way, running with this wire coming out of my shorts into the car.

RUSNAK: You know, I bet the Mercury astronauts felt some vindication there to getting back with the –

MCMANN: Oh, being a test subject was really something. I was a test subject for every piece of hardware I was responsible for. I mentioned the ELSS and PEAP, the Skylab system, I was test subject for that, and also the Shuttle spacesuit. I've been in the Russian spacesuit also.

But getting in the old Apollo spacesuit one time, the guys that suited you up, a lot of times they didn't think much of these test subjects. So I was getting in the Apollo suit, and it was quite a chore to get in. It had a rear-opening zipper, so you opened that up and stuck your leg in, had to work it down, and get it into the boot. So I putting the other leg on and I hit something hard. I said, "I've got something on here."

The technician was getting kind of exasperated. He says, "Oh, you've probably just got one of the vent ducts tangled up."

I said, "No. I think it's something else."

He reaches down there and he pulls out this big chrome hanger that they hang the suits on. It worked itself down into the leg.

Another time I was getting into a suit, and I managed to get the thing on, and it felt kind of funny. As they started to pressurize it, my foot started turning. The damn thing was twisted. It was going to twist my foot around unless I stopped them.

The other thing was, even if a suit was made for you—and of course they weren't for test subjects. You were wearing someone else's suit. Particularly in Apollo, every suit was custom-made, and even in Shuttle, you're doing testing, a lot of times you wouldn't have a perfect fit. You'd get chafe points if you weren't careful, so you put moleskin on. You'd do a little walk in the suit, see where you thought it was going to rub you, and you'd put on moleskin. Well, that was great, except when it came time to take the moleskin off. Sometimes you took the moleskin off, you took off more hide than if you'd just left it off and let the suit wear you out.

RUSNAK: Did you find this was a good experience for you as an engineer to be testing some of this stuff?

MCMANN: Oh, definitely. I recommended to anybody who ever worked for me. Take a ride on your own hardware. You get the user viewpoint. I've been in meetings before. I remember this big board and people were talking about the liquid cooling and ventilation garment. Well, how do you know if you get a leak? I said, "It's instantly obvious, because I've been in one that leaked."

Somebody said, "Are you talking about the fan flow rate? How do you know if the fan flow rate is cut off? Can you feel it?"

"Oh, yes. You can feel it and you can hear it." Nothing takes the place of having been there.

I've even had the bends. I was on a research project where they were developing the pre-breathe protocol that they're using in Shuttle. A bunch of us guys were test subjects for that. A third of us got the bends. I got them right in the knees. So I wouldn't necessarily recommend that for everybody, because it is dangerous. But having done it, it is a valuable thing.

RUSNAK: Actually, Joe Kosmo told me pretty much exactly the same thing there, which is why I asked.

MCMANN: Yes. Joe tell you about—we used to entertain the ladies over at our apartment, and one night we had these two ladies over, decided we'd grill steaks. We hadn't had a grill, but somebody gave us this old grill. It was pretty good, except it had two wheels on it, but it didn't have really a third support. So we had kind of a stick to prop it up. Out back of the apartments was a walk, and there was kind of a slope down there. We'd had a little bit of the grape, and so I decided it's time to go out and check the steaks.

So Joe was entertaining the ladies, and I went outside. I started to turn them over, and I knocked that stick off, and that damn thing took off down the slope and fell over. So there

was—Joe's still got the girls in there. That sobered me up a little bit. So I got the grill turned over, got the coals back in, got the grill on, got the steaks covered with grass and things, put it on the grill, got it good and hot, and it burned it off. I think that's how mesquite cooking was invented. I think Joe and I actually invented it.

RUSNAK: Did you ever come clean to Joe what happened?

MCMANN: Oh, yes. Yes. He and I have often talked about it. Joe tell you about his trick shoulder?

RUSNAK: No.

MCMANN: Joe, he was a test subject also, but he had this shoulder that he'd throw it out if he moved just wrong, so he threw it out once in the suit, so after that it washed him out as a test subject. So he and I were rooming together. Joe was in love with his car. He had a Triumph TR4. I said, "Oh, God. It's Saturday morning. Joe's going to go out and wax his car, make love to his car again."

So one morning he goes out there, got his shorts on. All at once he comes back in about ten minutes, he's got this bulge in his shoulder. It's called skinned up. He'd been pushing his car or something and slipped and threw his shoulder out, fell down, cut his knees up, but he was in real bad pain. He really threw his shoulder out.

So, "What can I do?"

"Get me to the doctor. It's an anterior dislocation."

"I know what it is." So we get into my car. We're driving over there.

"Oh, God, do you have to hit every bump?"

I was going, "Okay, Joe. Okay, I'm sorry." Get over to the doctor's office, take him in. I'm sitting down there waiting.

The doctor's office is air-conditioned. I mean, it's nice and cool in there. The doctor comes out, he is covered in sweat. He says, "Could you give us a hand here?"

So I go back. He's giving Joe a shot. Joe is half out of it. Got a nurse, got a sheet wrapped around him, she's pulling one way, I'm going to pull him the other way, and the doctor is going to honk down on that shoulder and try to get it in. So he honks down on his shoulder. Joe's groaning.

He says, "We're going to have to take him over to the hospital. I'm going to have to work on him a little better there."

So I get him out into the car. He's mumbling, "It's an anterior dislocation. It's an anterior dislocation." So I get him in the car. We race over to the hospital. Every bump, "Oh, it's an anterior dislocation."

They have a gurney waiting for us, put him on the gurney. He's waiting there, waiting to go back, right there by the information desk. All at once over the intercom, you hear this voice says, "Maintenance man, come to the information desk, please. Maintenance man, information desk."

So guy comes up, got his Tim Allen tool belt on. He said, "What is it?"

Joe says, "It's an anterior dislocation." I can just see the guy pull out his dikes and cut something on Joe. I think he finally had an operation that fixed it.

RUSNAK: He left that story out.

MCMANN: I roomed with Joe three and a half years. Towards the end of the three and a half, and the reason for the end of the three and a half, was one day—well, see, Joe—let me go back a little bit. Joe's theory of dating was kind of unique. If Joe wanted to go out Saturday night, then

around Saturday morning, he would start calling from his little black book. Sometimes he'd get a taker and sometimes not, but there was this one girl, Laura, that would go out with him. Well, pretty soon Joe got kind of lazy and his circle kind of dwindled, so I could see Laura just reeling him in, just reeling him in.

So one day I'm at work. Somebody says, "Hey, what about Joe?"

I said, "What about Joe? He's Joe."

He said, "No, no, I mean about him getting married."

I said, "Getting married?"

He says, "Yes. He's getting married to Laura on such and such."

So I got home that night. I said, "Hey, Joe. There something you want to tell me?"

He said, "Oh, yes. Yes, I'm getting married." Now, who else do you know who, on his honeymoon, he and his bride were out hunting petrified sharks' teeth on a North Carolina beach. Joe didn't tell you that, did he?

RUSNAK: No.

MCMANN: See? All right.

RUSNAK: He did tell me about one time he was participating in some sort of experiment where he had to save his urine in a big jar.

MCMANN: Yes. Yes. We went out, he and I had, again, with the ladies. So we had our ice chest with the beer in it and our ice chest with Joe's urine jug. [Laughter] Again, the stress of remaining cool under all these circumstances, I'm telling you, project this image of coolness like "I've got it under control. This is normal for me," it's tough.

RUSNAK: It's nice to see that you managed to keep a lot of composure during these events. But we're actually about out of tape on our first tape, so if we can pause for a minute just to swap that out.

MCMANN: Okay.

RUSNAK: —principles and still have as much fun and as much color and the personalities.

MCMANN: Oh, but, see, that's what the fun. To me, I never forget that it's a game. The "it" is your life, your job, whatever. You're lucky if you know what the rules are and you're lucky if knowing what the rules are, that they don't change on you. But you can make a game out of anything.

For example, I used to be the head of the Award Fee Board for the Extracurricular Mobility Unit. Every six months you evaluate the contractor on how well he's doing, you write this huge, big report. It goes up to the center director. You've got to go up and present to the center director.

I'm a wordsmith. I live by words. So when I write these reports, I like to use appropriate words, but I like to maybe stretch it just a little bit, maybe use one that's not quite usual. My boss, Clay [E.] McCullough, who is also retired now, Clay used to read these reports pretty close. One day he called me on this word. "I don't think this is appropriate."

I said, "Well, let's look it up." We looked it up, it turns out I knew I was right, and I was.

"Well, okay," he says, "well, good, I learned something."

Well, that's all it took. After that I went out of my way. Sometimes I would go to the dictionary and find a word and then find a way to use it in the report in an appropriate fashion. Now, that took some creativity sometimes. He got to looking for "the word." It was always

there. But this same report would go all the way up the chain, so you're running a little bit of a risk that somebody else is going to read it. But I knew nobody else read it.

In fact, when you went up to the ninth floor and you gave this report, you sent up the report early. You went up to George [W. S.] Abbey, in those days, and what he did was he looked at the pitch you put together, the presentation, and he listened to what you said. So he was thumbing through the pitch, listening to what you said, and then nail you from that, either something you had in here or something you said or something he kind of knew. So that's what you had to watch out for, not really what was in the report, what you put on the presentation.

One time we had rated the contractor, gave them a certain score in a certain area. It was cost savings or whatever. We gave them a certain score. The next time he saved even more money, and they gave him less of a score. I said, "Wait a minute. That's not consistent. You guys gave him this much last time. He deserves more than that this time."

So the difference was about two points, which was about $8,000 worth of fee, about $4,000 a point. So I didn't like that. So I essentially put together a minority position. So I went up to present to George Abbey and presented what the board recommended, and I said, "I have a white paper. I have a counter recommendation. I have a minority report, if you will. I think they need to be two points higher because," and I outlined it.

So George's first take was, "Well, we rated too high last time." I wasn't getting any more money. So I argued and argued. He ended up giving me a point, $4,000.

Another time, this was after I was getting ready to leave. This was about October of '96, and I retired in January of '97. We had a new boss, Don [Donald R.] McMonagle. He was an astronaut heading up the office. I think it was the first time he had gone up there for one of these award fee presentations.

Well, it turned out that at that time Brian Duffy, one of the astronauts, was George's deputy. Brian had also been a commander on STS-72. During STS-72, the crew screwed up some special temperature measurements . They were wearing these little packs on their legs.

They were supposed to pull this little lanyard. Well, they ended up pulling the leads on the instrumentation on one of the packs, so they destroyed that measurement. So we didn't get some data that we wanted. So I got warned beforehand, the guy that was the Award Fee Board presenter for the USA [United Space Alliance] contract said, "Hey, George is on the warpath about that STS-72," they called them HOBO recorders, "those HOBOs. He asked if we were responsible, and we really didn't have anything to do with it, so look out. You're the only one that's left."

I said, "Oh, okay. Well, thanks for the warning." So I did a little research. There wasn't really a good answer. So I just wondered if Brian Duffy was going to be there.

Well, I get up there. I'm making my presentation. I notice he's not there. Great. Going to make it through. So I'm going through this, doing that, and I get to the field portion, which was the area of where it had happened. Just as I'm getting to that, Brian Duffy walks in. Well, maybe he won't notice. I said, "We supported STS-72 in the field, successful EVAs."

All at once George says, "STS-72. Brian, wasn't that your flight?"

He said, "Yes. Oh, yes." Then I can see, oh, damn, here it comes. They remember. "Yes. What happened on those temperature recorders?"

I said, "Well, the crew didn't have enough training to know to pull these lanyards instead of the leads. They just were not well trained enough."

So George said, "Whose fault was that?"

I started thinking, if I say it's MOD's fault, then Sue [Susan B.] Rainwater, who was the one we worked with over there, hell hath no fury like Sue. It won't bother me, because I'll be gone, but the rest of these guys. So I said, "Well, if you've got to blame anybody, it's probably me. I didn't allow enough time to leave the hardware with the crew long enough where they could get adequately trained. So if you've got to blame anybody, it's probably me."

So George looked at one of the other guys, he laughed, and he says, "Is there any way we can get some of his salary?" They laughed.

So as we were leaving the room—he ended up agreeing with the grade—my boss looked at me and he said, "You kind of fell on your sword, didn't you?"

I said, "Think, Don. What's he going to do? I'm leaving. Why leave a mess?"

But it's all a game. It's a game. If you can't have some fun with it and skirt the edge a little bit and take some risk, it's just I like to have a little fun with it.

RUSNAK: Well, it certainly makes for a more enjoyable forty years, as you've been.

MCMANN: Oh, yes. Yes. Being a test subject and doing those things, stepping out of the box a little bit, trying your own hardware, doing stuff like that, it gives you more of a perspective. It puts more of a texture into your job, I think, rather than just I went in there, I put in my eight hours, and I came back and all that.

RUSNAK: I don't know, perhaps you haven't had enough exposure to other areas to really answer this, but how would you really compare that environment within Crew Systems to other places in Engineering or even in Operations?

MCMANN: Well, operations, pure operations, is a different world. Even though some of the people in Crew Systems do participate in some of the ops things, you have to put on a different hat when you're in ops. I've seen people that couldn't deal with an operational environment. You always have to make decisions on insufficient data. You never have enough data.

In fact, a pure engineer or somebody that's really sunk in to having nice, orderly, sequenced answers to things, you go with the data you have at the time you have it and you make a decision based on that. A lot of people, I've had guys work for me that could not operate in that environment. You could not get an answer out of them.

But there's never enough data, so you're just going to have to at some point say, "Okay, that's it. I'm going to go with this. I'm going to make my decision." Sometimes you make a decision to go, sometimes you make a decision not.

But a lot of times there's some conflict between the Crew Systems people and other people, the more of the engineering side and all, because the ops world is so different. I think it's valuable, though, that people like some of the guys in Crew Systems, if you take a turn in the ops world, you start to appreciate that viewpoint.

I'm happy now I've got a daughter working for Wyle Labs that's head BME, biomedical engineer, for the [International Space Station] Increment Four crew. It's really neat to trade acronyms with one of your kids. In fact, she knows a lot of acronyms I don't know anymore. So that's really fun. But her world is ops, and it's a real strain. You don't have regular hours. That's one of the first things that gets you. It's unpredictable. A lot of people can't really handle that. That's not a flaw, it's just a difference in people. It takes both kinds.

RUSNAK: Well, you've had some operations experience like in the latter part of the Gemini Program.

MCMANN: Yes.

RUSNAK: Can you tell us something about that, working the Staff Support Room?

MCMANN: Oh, yes. We got involved not just in EVA, we were also worrying the environmental control system. In Gemini VII, it was a fourteen-day mission, and the coverage was such you could go hour after hour without the spacecraft ever going over one of the tracking stations. So you're essentially there with nothing to do, except when Gene Kranz was flight director. Gene would think up these exercises. How much is the CG [center of gravity] going to shift in the

vehicle if the metabolic rate of—you had to worry about how much water was absorbed by the lithium hydroxide fourteen-day cartridge, where that water would likely be absorbed, how much that would influence the CG. I mean, he would put you through these agonizing calculations and all. You'd be glad when your shift ended, just to get away from it. No problem you could have during flight came anywhere close to the problems that Gene Kranz would give you. Oh, it was really something.

Then, of course, occasionally you'd get called out to the front room. One time we had a problem with the cryo [cryogenic] system aboard a Gemini spacecraft. The heaters had failed. It was, they call, a supercritical storage, which means you had a pressure and temperature combination such that you had a very dense substance, say, it was almost as dense as a liquid, but it was single phase. In other words, I didn't have a liquid and then a gas phase; I had all one phase. So that meant anytime you draw stuff out, you can be sure you were drawing only gas, you wouldn't get slugs of liquid out. However, if you drew it out too fast without a heater, then if you drew it out too fast you'd cause some of the liquid to condense, then I'd get shot of liquid. So you wanted to draw it out just fast enough to satisfy your need, but not so fast you would cause a condensation.

So you had to keep looking to the pressure and temperature readings and call for them to cut down on the usage or whatever to keep this thing, so we were plotting it. There was a line you can plot on a certain diagram, which they called a pressure enthalpy diagram that will show you if you're dipping into the liquid dome, what they call the liquid dome. Under this line is liquid.

So we were wondering at some point when this thing was going to do something. I can't remember exactly what the circumstances were, but it called for a time prediction. At some time some event was going to happen. So I got called into the front room to talk to one of the flight directors or talk to, I guess, the flight director, the head flight director, on when was this tank going to do this thing, either vent or not vent or whatever.

I said, "By my calculations," again to kind of lighten the mood a little bit," I said, "I think it's going to happen about 6:15 tomorrow morning." "Six-fifteen," he says. "Why do you think it's going to be 6:15?"

I said, "Because I'll be off shift at six o'clock." I thought that was so funny.

He did not think it was funny at all. He said, "There's a place for humor, and this isn't it."

So I went back, sharpened my pencil, called my boss at home, who was in bed, and asked him to help me figure out when it was going to vent or stop venting, whatever it was. There's a time for humor and not. That was not, not one of the times.

RUSNAK: Did this happen to be the instance where they were taking on bets on when it was actually going to go?

MCMANN: Yes.

RUSNAK: Okay.

MCMANN: Yes, it was. I think it was when it was going to stop venting or start venting or something. Yes. If you get a hold of Larry Bell –

RUSNAK: He was telling us that story, yes.

MCMANN: Did Larry tell you some of his own stories?

RUSNAK: I don't think he told anything about on himself, anyway.

MCMANN: Tell you about our thing we put together for Brooks Air Force Base [San Antonio, Texas]?

RUSNAK: Oh, where they had the fire?

MCMANN: Had the fire?

RUSNAK: Yes, he did mention that.

MCMANN: We were going through, building that thing up we were going to automobile junkyards and getting heater cores.

RUSNAK: Oh, no, he left this part of the story out.

MCMANN: We finally ended up with what was a Big Joe heat exchanger out of one of the rockets, but at first we were putting something together, we were going and getting junk radiator cores or heater cores out of junkyards, putting that together.

Oh, Larry was something. He was the greatest storyteller. He had more stories about his days back as a farm boy, all that. You'll have to get him back.

He was my boss on the Gemini, on the Ed White system, and then after that, too, before he moved over into the Project Office. Actually, that Gemini IV, being leader of that really started him up in his career. He did so well on that, it gave people an idea of what he could do, and I think it really paved the way for his career advancement.

RUSNAK: Well, I'm hoping to get him back to get talk to me a little bit, so we can ask him some more about this.

MCMANN: Talk about his golf game. Larry and I would go play golf occasionally. We'd go out to this one place, Brock Park, called "the ravines." I mean, you have to tee off across these damn ravines, and neither of us are very good golfers at all. So we go out there one morning, decide we're going to play. So we go out. We didn't figure there'd be many people out there. Well, I don't know what the deal was, but we go into the pro shop to play, "Can we get a tee time?"

They said, "See that crowd out there? You go out and there see if the starter can work you in."

So we go out there carrying our golf bags, went up on the starter. He's got his clipboard there, and people are out there gathered around. We said, "Say, any way we can get on?"

He said, "You see that?" People are looking around laughing at us, all that. "Yes, maybe by about eight, eight-thirty. It was about six then."

I said, "Well, okay." So we walk over, kind of standing off to the side.

Larry looks down in his bag. He said, "oh, I wondered what the hell was making that so heavy," pulls out a shotgun. He'd stuck a shotgun in his bag. He kind of clears it once like that. I mean, all at once we realized there is dead silence. Hey, this is Houston. You shoot people for a lot less than not getting on tee time you want. You know, we got on pretty damn soon after that. He locked it in his car. But ask Larry to tell you how he gets a good tee time.

RUSNAK: I will definitely do that.

So you were around when they had that incident at Brooks?

MCMANN: Oh, yes. I've still got it in written down in my notebook. Not in this one, one of the other ones. It was a Sunday, a Sunday morning. We were thirteen days into a fourteen-day test. What had happened was they had this chamber, no ports or anything in it except one port on the door where they had what they call a torpedo tube. They had this long tube, and you could slide

stuff in. I guess you could—whether it fit a person or not, but you would equalize pressure in that and they could reach in and get food and stuff like that. But the only way you could see in was a TV camera.

They had this thing called a psychomotor, which was a little thing to judge your visual and manual acuity after so many days in this system. We were having what we call partial-don suits, suits with detachable arms and legs. They were trying those out for the Gemini program. The guys are going to be fourteen days inside the Gemini spacecraft, wanted to make sure they wouldn't too much water. So we were measuring water intake and output and ventilation. So we had these ventilation fans that we'd taken, old Mercury spacecraft suit compressors and put them together in this kluge that we made, covered with yellow tape. I never will forget that. That was our contribution to it.

Then they had a fire in that psychomotor thing, flash fire, and started this insulation burning. That really was the problem. These guys breathing that insulation, it almost killed them. It was the fumes, cyanide-based-type fumes coming off the insulation. So they managed to get in to them and rescue them. I've got pictures of that thing. It's really scary.

We looked at our system. There it was that yellow tape burned. These heat exchangers were a magnesium alloy. If they'd ever gotten lit, no telling how hot they would have gotten. But the fire was over so fast, nothing else much burned except that insulation.

Well, that's when we started worrying about oxygen compatibility with materials. In fact, Larry was one of the people involved in that. And during the Gemini Program after this happened, Larry was kind of hosting a meeting, and McDonnell came in. "We've got this insulation. It is great." So he threw it out on the table, samples of it. "It won't burn in oxygen" and all that kind of stuff.

So they pass it around. Larry was a smoker at that time. While this guy is talking, Larry has one of these things, and he lights it. It burns in air. So while this guy is talking, extolling the

virtues of this stuff, Larry holds this thing up with this thing burning. Ever watch somebody just kind of crumple and die? Larry was great.

RUSNAK: I guess on a related subject, did you have any involvement after the Apollo 1 fire with any of the changes going on there, either in materials or to the environmental control system, cabin atmosphere, whatever?

MCMANN: Not really. I was around. Again, our chief guy for materials control was the aforementioned Matt Radnofsky. So we had what we called the material of the week. Every week it seemed Matt would have a new material that was the answer to everything. I remember one week it was carboxynitroso rubber. This was it. Use it for O-rings, use it for everything. This was it, the absolute living end, and next week there was a new material, and he didn't say a word about the carboxynitroso rubber. Found out later that, true, it wouldn't burn, but it gave off cyanide. So, yes, you won't burn, but you'll be just as dead. Matt would get really mad if you would mention that, CNR.

But in all fairness, he was the one that, through his efforts, developed all the materials that we used for the suits and stuff, the Teflon-coated beta fabric and all the stuff that we used. But even the greatest guys have a few foul-ups.

RUSNAK: Yourself included, I'm sure, right?

MCMANN: Oh, yes. Oh, yes.

RUSNAK: When you were working for the Gemini Program as CSD support to that, what sense did you have of the actual Program Office's interest in your help?

MCMANN: We essentially worked for the Program Office, as far as I was concerned. If you looked at the organization chart, it should have been you had the Project Office or the Program Office. You had the Engineering Development Directorate. You'd have Crew and Thermal Systems Division, and you'd have a branch and you'd have a section.

In reality, I consider myself working directly for Chuck [Charles W.] Mathews, head of the Gemini Program Office. That usually worked. Chuck, he was a phenomenal guy, phenomenal. He had his Black Saturday meetings. He'd come over and go your schedules on Saturday. I remember early in the Gemini Program, we went over there and I was having trouble. Luckily I wasn't going to be flying until Gemini VI with this chest pack, but other people were flying on Gemini III, and they were in trouble getting ready. So Chuck would really drag them over the coals every Saturday morning. So one day, I think Jim [James W.] McBarron, who was running the suit—have you talked to Jim, by with way?

RUSNAK: Yes.

MCMANN: Yes. Good. He was talking about the suits. The way you showed your slips [on PERT charts] were little diamonds on the card. You have a little bar you were supposed to be. Well, you weren't ready yet, so you showed a diamond. That was a slip. I'm not going to be able to start here, I'm going to have to start over here. When Jim finished, Chuck gave us a lecture. He could not tolerate these slips. There would be no more slips tolerated. He must have made that clear in however many ways you can do it.

The next guy to get up was Wayne Holt, T. Wayne Holt, an operator from the word go. He gets up there and throws his first chart up. It was like you were looking in the window at Cartier's. There were more diamonds up there than you could believe. Didn't stop him in the least. I never will forget how he started his speech. "We're currently enjoying a three-week slip

in the delivery. We're currently enjoying a three-week slip." Mathews just—he was just overwhelmed. It was just too much.

RUSNAK: Had you worked at all with Jim [James A.] Chamberlin when he was in charge of the Gemini Program?

MCMANN: Not much, but I remember one story about Jim and Correale. Jim Chamberlin had a problem. He had a number of problems. One of his problems was he wouldn't cash his paychecks. The government would come to him and ask him, "Please cash your paychecks." I don't know, he must have had money or something. He'd go around, his shoes would be untied. He'd have money stuck in his shirt. He wore those nylon shirts with the see-through pockets. You can see money stuffed in his pockets and all that.

One day Jim was telling this story, he was eating lunch with Jim Chamberlin. They were over there in the JSC cafeteria eating lunch. Chamberlin was eating a bowl of soup. As he was bent over and eating, his nose start bleeding, and he kept eating. Jim looked at it, and he said, "Jim, your nose is bleeding in your soup!"

"Oh. Oh, okay."

That's the only story I remember about Chamberlin except dropping at Headquarters there would be an eighteen-month slip in the Gemini Program. I remember that was something he did early in his career, and it kind of ended his tenure as head of the Gemini Program. He just kind of dropped that on the table at Headquarters, an eighteen-month slip.

RUSNAK: Who were some of the other guys from the Crew Systems end who were working on Gemini with you that you remember?

MCMANN: Elton [M.] Tucker.

RUSNAK: Is he still around?

MCMANN: No. He left and went with Metal Bellows, up in Massachusetts, I think, years and years ago. Bill [Willerie M.] Beeson, Tommy [Thomas R.] Turner. Tommy Turner was a fellow Okie. Came from Jones, Oklahoma, came down there and was working. He was running the Gemini ejection seat program. They had tests out at China Lake, California. Sometimes I ended up riding out on the plane. I'd be going out to [Garrett] AiResearch in Torrance, California. He'd be going out to China Lake, so we'd ride out there together to Los Angeles, and he'd rent a car and drive 150 miles.

I'd meet him sometimes coming back. I said, "Well, how did it go, John?"

He said, "Well, you go out there. They had the seats on a rail. Fire it off, augured into the ground." Get back in his car, drive back, go back to Houston. Few months later, be ready again. This time take off at an angle. Finally got a successful test.

I remember one time he brought back a rattlesnake from out there. Caught a little baby rattlesnake, put it in a jar, and brought it back with him. John was a character.

He went up to Tinker Field in Midwest City, Oklahoma, which is where they did the maintenance on the KC-135. Tinker Air Force Base was a SAC [Strategic Air Command] maintenance base. We did the zero-G flights in the KC-135. It's supposed to be good for 2,500 parabolas, and then that was it.

Well, we run them to 2,500, and then they took it, X-rayed it, oh, they were good for 5,000. So we went up to 7,500. One time I remember John came down to visit us, and he kind of said, "Whatever happened to the old KC-135 you guys were flying?"

We said, "Oh, we're still flying it. They say it's good for 10,000."

He says, "Oh, you're not serious, are you?"

"Oh, yes. Yes, we still fly it."

"You still fly that?"

Then we started wondering, what does he know that we don't know?

But that was an experience, flying zero-G. They always told you, if you're going to fly zero-G, sit down in the chair, take the first few parabolas kind of easy, kind of get used to it. Worst advice you could possibly get. The thing I found was you needed to have your mind occupied on something else other than, hey, I'm weighing two and a half Gs and then I'm weighing zero, then I'm weighing two and a half again. It was a really funny experience.

You go up there. First of all, you get up there at altitude. The plane is cold. It's cold. It's covered with Insulite, this material so if you're bouncing off the walls you wouldn't get hurt. They had these big lights that would come on when they were going to film. Well, the sequence would go something like this: You're up there. You're on a level flight. It's very, very cold. So you're going to then climb up. So you get two and a half Gs as you're climbing up. As you hit zero-G, the lights come on, the cabin heats up instantly. As it's heating up, all the old odors of vomit and everything that's accumulated for years along with the plasticizer in the Insulite is coming out. It's getting hot as hell in there. You're going to go into zero-G. Then you're going to go to—lights go off—two and a half Gs as you're pulling out again, plus the place is getting cold again. So you're going through this hot, cold, smell, oh, my God, stomach, two and a half Gs to nothing, all this time, for forty times or so.

One time I was there with a guy. We were both floating around in zero-G, and he's talking to me like I'm talking to you, and he starts vomiting as he's talking. I'm thinking, here, it is out there. In a few seconds, two and a half Gs' of vomit is going to come down on me, and here I am floating free, trying to think of how am I going to get—finally was able to get out of the way. Of course, as we pulled out, it hit, along with me, but I managed to stay out of it. Oh, yes.

RUSNAK: I assume you were supposed to be testing some hardware or something like that?

MCMANN: Yes. We also had a little fun along with it.

RUSNAK: Tell me a little bit about working with the astronauts, either in training or in developing hardware, something like that.

MCMANN: Well, let's see. I worked a lot with Story Musgrave in the early Shuttle EMU days.

Oh, my first recollection of working with an astronaut was with Gus [Virgil I.] Grissom back in the Gemini days. The concept of a dry run seems so basic. I mean, who would ever go into an exercise without a dry run? I think I invented the reason why you have dry runs. We went into this big, big exercise with the astronauts with our mockup of what was going to be the chest pack with John [W.] Young and Gus Grissom. We had cameras there. We had everybody there, had never even practiced it. Got in there, of course, they couldn't do anything. The pack was long. Gus Grissom, he had the damndest eyes. They were almost clear gray. The thing I noticed about certain astronauts are their eyes. They never learn how to blink. They don't blink. They just pierce you. Gus looked at me and he said, "It's too goddamned big." We ended up shortening it. So he was definitely an influence.

Story Musgrave, he was definitely an influence. I got a tremendous compliment from him one time. I never have forgotten it. We were putting together the latching mechanism for the service and cooling umbilical. It plugs into the front of the shuttle EMU. It was a concept for a lock, and we'd been working with it and all that. I had gotten in the suit and tried it out and was finally happy with it. I said, "Story, we've got this locking mechanism done now." I said, "I want you to come over and try it and see if you like it."

He said, "Have you tried it?"

I said, "Yes."

He said, "What do you think of it?"

I said, "Well, I think it's fine. I think it will work."

He said, "That's good enough for me." I felt great.

Another time, though, I didn't feel so great. This was [STS] 61-B. I think we're getting ready to fly. We were doing the checkout of the EMUs with the orbiter, and we had a problem between the power supply in the orbiter and our electrical system. We kept getting indications we were having a power dropout. It turned out it just happened something we found out then and later that we had certain electrical systems of our system and the orbiter's that would not get along. It's kind of like me and my ex-wife. Both of us separate are good people, and we're fine. You put us together, and we don't work.

So we ended up shipping a spare one down there. Well, another one had a switch knocked off. You could work around that, but it was a real nuisance. So I was trying to explain to Brewster [H.] Shaw [Jr.] at two a.m. why it was okay to go ahead and fly with these units. So I was talking to him, much like I'm talking to you, and he's sitting there. Again, his eyes are not clear gray, they're a darker color, but he don't know how to blink either. He also doesn't know how to talk. He just watches me, and I'm talking, and I'm talking, and I talk for about ten minutes and then stop. He doesn't shake his head, doesn't do anything. If he shook his head or something, then I would have stopped. He just looked at me and waited and waited. Silence like that at two a.m. when you got something crucial going on, each second drags like a minute.

So I figured, well, I've got to do so more talking. So I talk again. I talk till I'm talked out again, and he has never blinked. He has never wavered. He's looking at me into the depths of my soul. Well, I better say some more. So I babble some more. I finally got through, I said, "Well, that that's really it."

He waited about another two minutes and said, "Okay."

I wondered how sooner could I have done that. But I mean it's that ability to look not at you, but through you that set some of them apart. Astronauts vary, just like other people.

RUSNAK: Maybe it's those fighter pilot eyes or something.

MCMANN: I don't know what it is. It's different.

But they also—a couple of astronauts, Bill [William B.] Lenoir and Jack [R.] Lousma, one time we were having one of these intercenter runs, a little two-mile run. So everybody's getting out there ready, and so they're standing there talking to each other. Bill says, "Well, how you doing, Jack?"

Jack says, "Oh, I'm pretty stiff. I hurt my back last week."

Then Bill coughs, very envious cough. He says, "Yeah, I've had the flu. I really shouldn't be out there." Both of them sandbagging just terribly. Now, Bill was quite a bit smaller and faster, but they both ran under thirteen minutes for two miles, which is not shabby by anyone's standards. I think, in fact, Bill ran under twelve. Jack, who was quite a bit bigger guy, ran under a thirteen. Both of them sandbagging each other, just like a couple of kids. Just "I really shouldn't be here. I don't know, my knee's been kicking up a little bit. I really shouldn't. I'm just going to go out and jog it." Yeah, right.

RUSNAK: Still a little bit of competitiveness there, I think

MCMANN: Just a bit. That's what I call the test-subject mentality. That's the problem they had in the early Apollo, what I call the test-subject mentality. They decided in early Apollo, we got a fourteen-day mission here, so we're going to have to really figure out how long it takes the crew to do each and every operation they're going to have to do. So we're going to do part tasks and the investigations and everything, changing lithium canisters, opening lockers, closing lockers, all this stuff. So they got zero-G flights scheduled so they would do each one of these tasks in zero-G. Well, you've got thirty seconds to do it. If you didn't get through, you had to wait until the next parabola and finish it.

So they couldn't get crew to do all this, it'd take too much crew time. So we're going to plot it out. So they got these test subjects. Well, between the natural competitiveness of the test subjects and the fact that you only had thirty seconds, these guys got to where they could change a lithium canister out in twenty-five seconds. So they put together these times. When you get the real crew in to do it, they can't do it anywhere near that good. So you have that competitiveness.

Every year we'd go for physicals over at the JSC clinic, and if you haven't heard of her, I'll tell you about her, and you can ask other people about her, Johnny, Nurse Johnny. She'd know you from year after year. So she got me in there one time. Get on the treadmill, we had a protocol, you start out level, a certain speed, and they start raising the treadmill, raising the speed, raising the treadmill, taking your blood pressure as you're going and try and get to the end of the protocol. Nobody hardly ever made it to the end. I think it was a fifteen-minute total. Nobody ever made it to the end. You'd just get exhausted and have to quit.

So I worked for a guy named Maurice [A.] Carson. Maurice was also a runner like I was. He was quite a bit leaner than me, though. She got there and said, "Well, Mr. Carson did thirteen and a half minutes. What do you think you're going to do?"

I said, "I don't know." Well, there it is, thirteen thirty-one is my goal. I don't know whether he did it or not, but she worked on that, the test subject, test-subject mentality.

RUSNAK: Did you get past it?

MCMANN: No. No.

RUSNAK: Well, before we came back on tape, you said you were going to tell us about the "great exposure?"

MCMANN: Oh, yes. After 51-L when we had the two-year standdown, everybody went back and took a really detailed look at your systems, all the levels of redundancy you had, just any kind of design weakness that you thought, "Gee, I wish I had time to fix that," now you had time to fix it.

So we went in, and we looked at the suits. Where are we vulnerable in the suits? Well, all the rotating seals at the wrist, at the shoulder and the arm and the waist, we just had single seals in those. We said, "We're going to go to redundant seals in those. Any dynamic seal we're going to make redundant. But we also don't have to have the torque get real high, where the crew is not going to be able to move as well." So we came up with a new design, actually went back to something close to an Apollo-era design, and we said, "We're going to get those in."

So we were going to have a demonstration by the fact that this torque on these bearings was equal to or less than the torque on the previous ones. So we had these little fixtures put up where you had this bearing in there and you had a little hand pump so you could pump it up to the right pressure, and you'd rotate it, and you could just feel how easy it was to do. Well, these fixtures are pretty heavy. So I was going to demonstrate these things over to a huge room full of people, I mean packed, astronauts, technical people, my boss, boss' boss, everybody.

So chance number one, I'm over in Building 7. We're loading this stuff up. My chance number one was a technician said, "You want me to go over with you and do this?"

I said, "No. That's okay. I'll do it."

Go over there, go up on the elevator, get out there, getting ready to talk, somebody else says, "Do you want me to do that for you while you're talking? I can do it."

"No. I'll go ahead and do it."

My boss comes over. "You're going to be awful busy doing this. Why don't you do the talking and let me do that."

"No, I'll go ahead and do it."

So I had my three chances. So I'm there talking this stuff, getting kind of wound into it, showing the viewgraphs up on the wall. I'm going to get this thing out. I bend over and get it, and as I strained to lift it, I popped a seam of my pants from the belt all under to the crotch instantly. I meant, it sounded like a sail ripped in a high wind. I jumped up. Only the first few people had noticed it. My boss was there, and I said, "Could you take over?"

So I backed out of room, and he picked it up. He knew the stuff as well as I did. I backed out of the room. A guy followed me out. He had a coat on. He said, "Let me give you my coat."

Well, his coat came down only to about here, but I think it's covered enough, walking down the hall, all of a sudden a secretary passed and says, "Oh, ripped your pants, huh?"

Go down, I call a guy to come over and get me. One of my guys comes over, picks me up, takes me over to Building 7. We go up in the survival shop. I take my pants off. They sew them up. This guy puts them on the machine because they had all kinds of sewing machines there, sews them up. Get back in the car, come back, come in, my boss is still on, so I come up and finish up the pitch.

So I got through, and I said, "I want to thank you all. I just want to say if I do have to show my ass, there's no group I'd rather do it in front of than this one." The guys in front laughed. The guys in the back didn't even know what was going on. In fact, a woman said she just found out about it a month later and came up to me and talked to me, she said didn't realize it had happened.

RUSNAK: Again, keeping your composure.

MCMANN: That's right. It's hard to be cool, but you've got to do it.

RUSNAK: Well, I'm glad you volunteered that story.

MCMANN: Better me tell it than someone else.

RUSNAK: That's right. Well, see, now, we can ask other people about these and see what their recollections are, right?

MCMANN: Yes. I don't remember who was there. I can't remember who was there. Walt [Walter W.] Guy, he was there, in fact. He's somebody you ought to talk to. He's been around longer than I have.

RUSNAK: As part of that, I guess I'm just thinking of the time period that you were just talking about, part of the post-*Challenger* standdown, one of the things they did was stop use of the manned maneuvering unit [MMU], which I think it was something you had some involvement with.

MCMANN: Oh, yes. The MMU, that was great. The story of the MMU started with a guy named Ed [Charles E.] Whitsett [Jr.]. One of the most phenomenal people I've ever met. It's just unfortunate that's he gone.

RUSNAK: Didn't he just recently pass away?

MCMANN: In the last few years. It's not real recent.

But Ed was in the Air Force and came to work for me and started working on maneuvering units. Well, the Skylab, we had an experiment. It was M-486, was the name of it, and we decided to have an A and a B part. M-486A was going to be this task board that they would use to, kind of like that psychomotor had done that I talked about earlier. I remember one

of them had a zigzag slot in it, and the idea was to take a wand and move it through that slot as fast as you could without touching the sides. You touch the side, it gave a signal or something. The crew hated this thing. It was like giving a banana pellet at the end or something if I'd do it, and they hated that. But that was one experiment, and then 486B was the maneuvering unit.

So it turned out that the [NASA] Headquarters, the computer couldn't handle the alphanumerics of that number. In other words, the 486A was too much. So they became M-508 and M-509. So it M-509 was the maneuvering unit experiment that Ed was the principal investigator on. It was a cold gas maneuvering unit that we used inside the workshop to prove out the principles which eventually led us to the MMU, the manned maneuvering unit.

But anyway, there's a story that goes along with this other one. The M-508, the crew finally succeeded in killing. John Jackson was the principal investigator. The crew said, "I hate it. I'm not going to do it," so M-508 died.

M-509 made it on board. Well, they also had a number of student experiments they were going to fly. One of these student experiments was this board, and it had a zigzag slot in it, and it had these knobs and things that the crew would pull. It made it onboard. The principal investigator was John Jackson's daughter. So he got it onboard, even though it had been killed.

Ed was trying to find a home for the maneuvering unit, for the manned maneuvering unit on Shuttle. We had the MUWG, the Maneuvering Unit Working Group. We'd meet after hours, Ed Whitsett and me and Bruce McCandless and a guy named Lou [Louis V.] Ramon, and I forget who else, and tried to find out a way, how are we going get this thing on? This was prior to the fact they even ever put it onboard Shuttle. We finally got it onboard Shuttle, and I think the maneuvering unit, it did everything it was supposed to do and more. It was tremendously successful and yet never found its place on Station. We never found a real use for it on Station, but next to Ed White's photo, I think the photo of Bruce McCandless, being the first human satellite, is probably at least as famous even if not more famous than that. But that was a great system.

It was great to go up to Denver [Colorado], too, up to Martin in Denver. I used to go running in Denver. I'd go out from the motel room. One night I went out again in my shirt and shoes, I mean my shorts and shoes, went out running and I got lost. I went up to this high place, and I said, "Well, I'll run back now." Well, it was starting to get dark. Temperature was dropping. I'm running through the city streets just in my shorts and shoes looking for my hotel. I finally found it before I froze.

That was always fun, too, go to different places and run.

RUSNAK: It guess it gives you a little bit of an excuse to see some of these places.

MCMANN: Oh, yes. Yes.

RUSNAK: Well, the MMU they tried or they were planning on something similar for Gemini, but because of the –

MCMANN: Oh, the AMU.

RUSNAK: Yes, the AMU.

MCMANN: The astronaut maneuvering unit. The hydrogen peroxide jets. It was a little bit different design. They had to put what they called the iron pants on the suit, chromel-R cloth on the suit because when the jets impinged on the suit, they'd just erode away the material. So they had that metal cloth on there to keep that from happening.

That was a sad day when we couldn't get that thing donned. Jim [James J.] Griffin was the project manager for LTV [Ling-Temco-Vought] who made it, and I remember the thing you worried about on the AMU was the peroxide decomposing into water and oxygen. So the

indication that that was happening would be a rise in pressure. So any sort of contamination would have caused that to happen. So they monitored the peroxide pressure. That was the thing. They'd had all kind of problems with it. On that flight it was rock solid. I remember Jim Griffin watching that as the adapter reentered and it burned up. Peroxide pressure was rock solid up until the time they lost telemetry. That was a sad day.

RUSNAK: Yes.

MCMANN: Then we had to essentially after that and Gemini XI, which was a disastrous mission as far as the EVA was concerned. Dick [Richard F.] Gordon was supposed to attach a collar onto the front of the Gemini spacecraft onto an antenna boom, and then they were going to spin a satellite. They were going to spin up with a satellite. Well, he couldn't get it attached. He didn't have good enough restraints. So between Gemini IX and Gemini XI, we realized we got to do something for a better simulation of zero-G and do something better as far as providing a crewman with adequate work stations and restraints.

So Gemini XII came along. Gemini XII, the original plans were you'd be flying the astronaut maneuvering unit untethered. I mean, that was the whole goal for Gemini XII. We scaled back to we're going evaluate foot restraints and Velcro patches and all these types of things. I remember in the flight readiness review for Gemini XII, [Edwin E. "Buzz"] Aldrin was the prime and [Eugene F.] Cernan was the backup. Cernan had been the prime for IX.

So Gene Cernan had in his head that the thing we needed was stainless steel Velcro. Stainless steel Velcro. This was the greatest stuff. So he had a sample of this Velcro hook and pile. He started passing it around the room. Somebody said, "Isn't that kind of sharp?"

"Oh, this is the greatest stuff. It'll hold everything."

So he passed it around the room, and he's extolling the virtues. It gets up to Chuck Mathews. Chuck takes that Velcro hook, stainless steel stuff, and wipes it on his pants. Totally

ripped his pants. He said, "We're not using this at all." Gene started arguing about it, and he said, "We're not using it, and this is one meeting if you can't stay in this meeting, leave." There he was with a pair of ruined pants. That's always the danger of passing around hardware in a room.

RUSNAK: Someone might try to stuff paper in it.

MCMANN: Yes. I remember they were worried about the guys being able to close the hatch in Gemini after they did the EVA. Tom [Thomas P.] Stafford never could go EVA. His torso was so long that when he tried to get back in, and they had this helmet tie-down thing where you could pull. You had a pulley arrangement where you could ratchet yourself down and then reach down and pull the door closed. He could never get down far enough in any time maybe like more than three out of five times to get the door closed. So he could never go EVA.

So they had all these concepts for how are we going to get this door closed. So I remember up at Headquarters. I was up there about this time. The guys had all these different concepts. One guy had this series of pulleys and lines. You got this terrific mechanical advantage. You'd hook this thing up and you'd pull it, and, boy, it would ratchet that door shut. But he made the error of taking off the covers over these lines. So he passed this thing around. These managers proceeded to snarl this thing up. When he got it back, it was just this gob of stuff, and that concept died right there. It might have been a good concept, but he passed the hardware around.

RUSNAK: They ended up using some sort of bar, I think.

MCMANN: Yes, they built it in. It was a pawl and then it was kind of a ratchet-type arrangement, but you had to get it hooked first and then ratchet it shut. That was the thing Tom

couldn't do. He couldn't repeatedly get it down far enough to get it hooked and then you could ratchet it shut.

RUSNAK: Well, did you as someone who had involvement with the environmental control system, the life support stuff, take any heat because of the problems they were having with the EVA, the overheating, the fogging of the visor, that sort of thing?

MCMANN: Oh, yes. Yes. In the Gemini EVAs?

RUSNAK: Yes.

MCMANN: Yes, that was my system. What it was, what we found out was that the actual rates, the metabolic rates that the guys were experiencing were up in the neighborhood of 3,000 BTUs [British Thermal Units] an hour. We were sized for about a thousand an hour, max. Just due to the fact that they were working so much harder, the suit was not really designed for that type of stuff. They were working so much harder. It was taking out a lot of heat, but it just wasn't taking out enough. That's what really told us, hey, we need some sort of more aggressive cooling system, and that's where the liquid cooling garment really proved its worth. You're just limited in the amount of heat you can take off with a gas-cooling-type system.

RUSNAK: So would you attribute that to just not understanding how much heat they were going to be producing or inadequate training or just the hardware wasn't good enough?

MCMANN: I think that the lead time for the hardware is such you make some assumptions early on. Our earliest assumptions about what they were going to be doing were pretty simplistic, more of Ed White-type stuff. As we got on, we made our missions more aggressive. We were

going to do more. The system was already designed, and the fact that you weren't going to change the suit and you weren't really going to change the life support system, and we probably didn't have as good—obviously didn't have as good simulation technique, didn't know what some of these rates were going to be till late in the program. By that time, the system was designed.

By Gemini XII, by restricting activity and making the mission fairly well modest and having a lot better simulation and training techniques, we didn't have any problems on Gemini XII. That sort of redeemed us.

I remember after Gemini XI, it was kind of the low point. I was in the elevator over in the Mission Control Center, and Chuck Mathews got on. He and I were the only ones on there. We were riding down, and I just sort of said, "Well, you sure don't luck out, do you, Mr. Mathews?" just sort of a little offhand comment.

Again, one of these guys with the eyes, he pierced me, and he said, "No, Joe, you don't just luck out." That was you don't luck out. The most luck you have is bad. If you're going to have luck, it's bad.

RUSNAK: After either of their flights, did Cernan or Gordon come to you and say, "What happened here?" Did they give you a rundown of their experiences personally?

MCMANN: I don't remember that, if it happened. It was pretty well obvious what had happened and having the voice transcripts and seeing what data we had, and running tests later, we could pretty well prove what happened. It wasn't any mystery.

So we said, "Hey, for this system, we're just going to have to keep a lower level of activity and we definitely need water cooling." In fact, our plans at one point in the Gemini program in some of the later phases was to put in water cooling, but we didn't really have the

money, and the big push then was to get Apollo going. Gemini essentially served its purpose when we proved out rendezvous and docking. EVA was kind of an extra.

RUSNAK: You had mentioned earlier running in these different places at different facilities you visited. That got me thinking about the different contractors you had a chance to work with. Could you tell me a little bit about some of those companies, maybe some of the people there and what it was like working with them?

MCMANN: I started my career working with AiResearch. Allied Signal got bought out by Honeywell, got bought out by GE, so you wouldn't really recognize, but it was AiResearch in those days. They had built the Mercury environmental control system, the Gemini environmental control system, the Apollo command module environmental control system, and then Hamilton [Standard] came in and got the lunar module environmental control system and the EMU, the spacesuit.

So I spent my early years working with AiResearch and hating Hamilton, because they were part of that Apollo group. They had a sublimator instead of a water boiler. We don't like their hardware, all that. Then as I got into some advanced work and then into the Shuttle arena, I started working with Hamilton and then later on found myself, even as NASA saying why we were sticking with Hamilton, explaining to the Allied Signal guys then why we weren't going with them. So it's sort of done a complete turnaround.

Companies change their makeup and their profile, if you will, over the years, I think. In those days when I was working with AiResearch, the knock on AiResearch was they were essentially tin benders. They could crank out hardware, but their engineering depth wasn't that great. Hamilton, the rap was, oh, Hamilton could engineer stuff, they couldn't build anything. So I remember thinking at the time, boy, if I could take AiResearch's manufacturing technique and marry it with Hamilton's engineering technique, I'd have the perfect company. But people

change over the years. The people in the company change over the years. The company's product lines change and all that. All those things change. But at that time that was the impression I had.

There was a guy that we worked with in Gemini, he's got a little company called Air Lock [Corp.]. Jim Edwards was president. I guess he's still affiliated with them, but I guess he's semi-retired. But Jim, he was not a real strong technical guy but he had a technique. He had a little plane. He'd jump in his plane, and he'd fly down, and he'd come around and see you and talk to you and say, "What are you working on? What are your problems?" and all that. You'd whine about something that was going wrong.

One time on our chest pack, the hose connections needed to have a double lock on them. We'd been flying up in this zero-G aircraft and "killed" our astronauts a couple of times because the hose popped out. Somehow our locks were getting disengaged. I was so frustrated with AiResearch and their inability to design something, and I was talking about it to Jim.

He said, "Let me look at that." He went back and had his shop make up a double-locking connector. He brought it back down to me and tossed it on my desk. Jim had this ability. His hardware looked so beautiful. He has this anodize process. I mean, it's beautiful stuff, and he's got great, great machinists and all that. Here was this thing, and it worked great.

So I just directed AiResearch to buy it from him. But that was the thing. I often tell that to people when they're whining about, "How can I get into this business" and all that. Risk a little bit. Go in to a guy, ask him what his problem is, solve his first problem for free, and then maybe he'll come back to you and he'll pay you for solving the second one.

I could have taken that thing and thrown it across the room and said, "Get out of here. This is lousy." So he took the risk, went out on his own, built this thing, and solved my problem. That's what we ended up using in flight.

David Clark [Company] did the same thing. I talked about the Brooks tests we were flying. We were looking at Arrowhead and B.F. Goodrich suits. Those were the two. It was

going to be an Arrowhead or a B.F. Goodrich suit. Well, all at once here comes David Clark off the street, built a suit with their own money, and said, "Hey, we think this will work." They ended up winning it, but they invested. They risked. People nowadays are so risk-averse. You really don't see that anymore. They're interested in the bottom line. Show me the money.

RUSNAK: Do you think there's a way NASA can encourage more of that sort of risk-taking?

MCMANN: NASA doesn't like risk-taking itself. Now, the companies, it seems to be a thread throughout the country, I think, is that they're so interested in next quarter and what do I have to do to get something back to the stockholders right now. People like Amazon.com, I mean, they're one of the few people that have made it through the big die-off of the dot-coms [internet companies]. They're finally showing a profit, I guess. But that type of risk-taking in our area seems to be rare.

Some people are taking it in the hydrogen fuel cell arena, some companies, and they're losing their shirts now. Hopefully they'll outlast it. We don't seem to be, at least my association right now, seems to be don't take risks. Safety above all. You can't knock safety. But it seems to get to the point of almost killing motivation.

Because the down side is so great, if I have a problem, everything will be shut down. As far as the contractor is concerned, if I have a big problem, if I take a risk and I have a big problem, something happens, man, NASA will be down on me. I'm showing I'm not safe and all that. So I don't know where that balance is.

I say in the old days, we were definitely unsafe in a lot of the things that we did. Probably we didn't know. Probably we didn't care. I think maybe we're too far the other way now, and we're not necessarily being safe, we're just being overly cautious. But who's to tell?

RUSNAK: How easy do you think it is to find that balance in something that is as critical as like a spacesuit or the life support system for that, where if there's a significant failure, then it's not really –

MCMANN: Yes, it's easy to go back after the fact and say, "Well, you should have done this or that." At the time you do what you think is the right thing to do. We've had failures here recently where, looking back, we should have done more work in our development phase. We maybe made some assumptions that maybe the vendors knew more than they did. We were using their product a little bit different than they designed it for, that they and us didn't think it was a big swinger, and we ended up having problems. You look back and you say, "Gee, if I'd only done these other tests."

But then NASA a lot of times doesn't want to pay for a lot of stuff. They say, "Well, gosh, you don't need to go test all that. We don't have the money to test all that."

So the contractor ends up saying, "Well, okay. It's probably not necessary."

Then NASA says, "You told me it wasn't necessary." So it's difficult. It's difficult to know how much is enough. You only know that you didn't do enough after you have a problem. You never know what to leave off a lot of times.

People talk about, well, thinking out of the box, get out of the box, think out of the box. I caution you, a box represents structure, and you can't really operate without a structure. So if you go out of your structured box, to me you go into another box. Maybe you go out off a square box into a triangular box, but eventually you've got to have a box. You've got to have something that's predictable and repeatable. You can't just have anarchy. So you can change the way you're doing it, but the change itself leads to new rules, new ways of doing things. That learning period as to what that new box looks like is the risky part.

Change for itself is not necessarily good. I always say every change has a bad side. Hopefully the bad side is less than the good side you get out of it, but not always.

We had an example. We had a glove design. The gloves were great. They only had one problem: they only had a forty-two-hour pressurized life. In other words, you could stay in them for forty-two pressurized hours. So we went, okay. We're going to go to a different material. We got this new material. It's good for 468 hours of pressurized life. So your obvious thought would be, well, good, I'll just take this new material and put it into the old glove. This new bladder, put it into the old glove. What we said was, yes, we'll do that, but while we're at it we'll make these other changes. We'll add a little extra easement, we'll do this, we'll do that.

What happened was, we came out with a glove that had 468 hours. It also caused Jerry [L.] Ross numb thumbs for two weeks after he got back off his flight. So we changed things we didn't have to change. We made it better. It was changed. It was going to do good, right? Ended up that the thing we got, the problem we got, was much worse than the problem that we solved.

So change always has a down side. You've got to know what that down side is, and a lot of times you only find that out by using something over and over. Then you find out the down side. You do testing. That's going to give you some sort of indication. The only test really is using it.

RUSNAK: Thinking along that line with regards to testing, one of the people we were talking to recently, he put it such that sometimes you can save the wrong money in terms of, well, we won't run this test but it turns out that is the test you should have run to discover this problem.

MCMANN: Well, I think there's two kinds of money. There's real money, and there's viewgraph money. Real money is what you have to pay right now. Viewgraph money is what people will promise you you're going to save. Now, it's really tough to get people to part with real money on the promise they're going to get viewgraph money.

Also, when you test, three things can happen: you get the answer you want; you get the answer you don't want; you get an answer you don't understand. Now, you don't have to be a math major to figure two out of three ain't very good odds. So the thing to do when you test is figure out what am I going to do if I get one of those two bad answers? Where am I going then? What if I never find out what's caused this problem? So then you've got the backup. What's my backup plan?

I was walking in the hall one day. This guy walks by me and says, "Oh, Joe, by the way, we're getting ready to ship the EMU to the Cape, and somehow we forgot to do the calibration on the CO_2 sensor. We're going to go ahead and run a quick, quick check on it and send it." He started walking.

I said, "Wait. Wait. Wait. Wait. What happens if you don't pass it?"

He said, "Oh, I'm sure we're going to pass it. It's a good sensor. It's passed all its tests."

"I understand. What happens if you don't pass it?"

"Oh, I'm positive we're going to pass it."

"What happens if you don't pass it?"

"Well, I guess we'll have to put in a spare."

"Do you have a spare?"

"Well, I think there's one in Bond [bonded storage]."

"Do you know it's in Bond? Is it in calibration? Is it okay?"

In other words, you go run a test. Before you run the test, be prepared to go down the road less traveled. What happens if it ain't any good? That's the question the manager asks.

The most difficult question I ever had to answer was on Tuesday explaining to my boss why the answer I gave him on Monday was no good. His question was very simple. "You lied to me before. Why should I believe you now?"

That's why remodeling is harder than building. You've got to rip out the story you sold before you can build the story that you now want to sell him. So the obvious answer is be damn

sure when you go in the first time. That's where the integrity comes in and the discipline, the discipline of doing what needs to be done to find that answer.

RUSNAK: You've had a chance to see things from the contractor's side after you left NASA. Can you tell us a little bit about that and maybe now what you've learned being on the private side rather than the government side?

MCMANN: Well, I started on the private side and went to the government and then back on the contractor's side. Well, one thing is the universality of people and hardware. People are always people. Hardware is always hardware. Software I don't know about. Software is hardware in drag, as far as I'm concerned. I mean, really don't know software.

But anyway, hardware, like I said before, always does what you tell it to do. Sometimes you don't know what you told it to do. People seldom do what you tell them to do. So people are going to be the same. People have their own agendas. They have home lives. They have lives at work. They're driven by different things. Government, I mean NASA, and the contractors, I think, are convergent on technical excellence. They both want that. They're divergent on how much it ought to cost. The contractor is bound and determined to not only get sales, but to get return on sales. That turns out to be important also from the stock standpoint and all. So that's something the government doesn't really care about. Government wants what it wants when it wants it.

The government looks at the contractor as an infinite source of resources. In other words, if I have a job to do, I flick on a switch, and a thousand contractors come on and do it. They're all equally capable. They're all going to do it. I flick that switch off, and they die. They're gone instantly. I don't care where they go. I want them off my contract.

The contractor looks at things and he knows I have limited resources. I have priorities. Maybe this job for NASA is not my number one priority, but I don't dare tell them that it isn't

my number one priority. But somehow I've got to satisfy the customer and satisfy my internal and my external customers.

So I always say that you have the NASA upper-management brain. It's extremely tiny. Particle physicists haven't even found it yet. But the characteristics are very well known. It only sees in two colors: black and white. Its knowledge of mathematics is limited to zero and a one. It either is or it isn't. The only temperature it likes is warm. It gets a warm temperature, not from just the words you're saying, but what's behind those words. It's memory is extremely long, and the strength of the memory of the NASA memory is inversely proportional to the amount of time you put into coming up with a number.

If you throw a number out on the table, "I think it's going to cost about 10K, but that's just a rough guess," doesn't matter. You've said 10K. That 10K is etched in stone, on your tombstone. You'll be whipped with that number from now on out. "I think we can do it in about a week." One week. Not eight days, not two weeks for sure. "I think it will weigh, it's probably somewhere around, now this is just a raw now, around a pound." One pound, 1.00 pounds. So anytime you come up with a number, that's it.

That's where my other word comes in: the margin. Margin. But see, there's two rules of budgeting that I used to give people, budgeting for technical performance, schedule, costs and all that. Rule number one, put in plenty of margin. Rule number two, I better not be able to find it. As a manager, if I find it, I have to take it out.

Now, the Shuttle EMU was supposed be to a fifteen-year system. They started buying hardware in about 1978. For those without math degrees, that's about 1993. It's 2002.

"How the hell can we fly? Have we bought all new hardware?"

"No."

"We're still flying some of the same hardware?"

"Yes."

"How can we do that?"

"Margin." It's better than it had to be. We didn't know that at the time. Shuttle EMU was supposed to be good for three EVAs before you did some ground servicing. We tested it, and it's good for twenty-five EVAs between ground servicings. It's a damn good thing, because that's what we're stuck with. We have to leave it up for a year up on Station. How can we do that? Margin.

Supposed to be good for seven hours EVA. We've got fourteen EVAs so far, eight hours or more. How can we do that? Margin. But if I'd have known they were building that in at the time, "You can't put all that in. It's extra weight and cost. I'm not going to pay for that." Yet I'd be the same guy beating on them now, "Why can't we go longer?" It's part of the game. You say, "Well, wait a minute. That's not your integrity, then if you're sneaking that stuff in."

No. I'm answering the question they should have asked, not will it go seven hours, how long can you make it go? Part of the game.

RUSNAK: Sure. Well, now you're working for Hamilton Sundstrand, is that right?

MCMANN: Yes. Through this June.

RUSNAK: Then you're going to retire again?

MCMANN: Then I'm going to hang it up. Yes.

RUSNAK: For good or are you going somewhere else?

MCMANN: Well, I may do a little consulting or insulting, whatever. Whatever is around.

RUSNAK: Well, they've had quit a history themselves through both the environmental control system, as you've mentioned, and with the suits as well.

MCMANN: Yes.

RUSNAK: I don't know how much involvement you had with them when they were the prime contractor for the Apollo suit.

MCMANN: Not really much with them, except, as I say, they were the bad guys. I really didn't get associated with them until after Apollo. I got associated with some advanced work and then since 1977 with the Shuttle.

RUSNAK: What kind of advanced work was that?

MCMANN: We had a lithium peroxide system which was a system which would absorb CO_2 and give off oxygen. It was a fun little program, but it was something that probably not too practical from a system standpoint. It worked good, but you had to have certain pretty well prescribed conditions for it to work under, temperatures, thermal-type conditions. You also had to precondition it with some CO_2. In other words, if you started trying to use it, it would starve you of oxygen before it would start giving off enough. So you'd have to have another oxygen tank to supplement it, so that starts making the system complicated. So we ended up passing it up. But it was fun. It was a fun system.

RUSNAK: Did you have any involvement in choosing the shuttle EMU?

MCMANN: Oh, yes. I was part of the source board on that.

RUSNAK: Can you tell us about that?

MCMANN: I can tell you about the train chart.

RUSNAK: Okay.

MCMANN: You to have get the pictures. Ellington Air Force Base, the old wooden barracks, built in the forties or so, creaky wooden floors, inadequate air-conditioning, Houston summer, and interminable meetings on evaluating the AiResearch proposal and the Hamilton proposal.

We had two source boards going on at the same time, for the Shuttle EMU and for the portable oxygen system. Both contractors were bidding on them, had the same contractors bidding on both. I was working on both source boards, so going back and forth.

There was railroad tracks run out in front of Ellington, as you probably know. Be in some of these meetings and I mean it would be so hot we finally had a fan going and just have the windows open. Guys would notice the train going by and then maybe another train going by. So one guy off in one of the rooms started keeping a chart of trains going south and trains going north, keeping count of them. So it got to be sort of a real game with us, to keep track of the trains. So I can remember being there one day in a meeting. We were all sort of just dying. It was real hot, and this guy was droning on and on. All at once a train. Everybody perked up. North or south? Everybody was worried about getting that train on the chart. Nobody worried about what the guy was saying. We finally came to the conclusion after gathering data for several months they're making trains in Galveston and shipping them north. That was our conclusion.

RUSNAK: You certainly had the evidence to support that, I guess.

MCMANN: The other thing was you kept all your stuff in locked safes, these combination locks. You've seen your *Matlock*s, your shows on TV where the guy opens the safe, three left, twenty right. Oh, no, no, no, not these safes. These safes, these combination locks, you have to spin it about four times to clear the tumblers. You have this complicated system and you end up on a zero. You always want to end up on a zero. That way nobody could come up and see the last number, as if anybody is going to come out to that godforsaken Ellington and go through these godforsaken files of this boring documentation.

But anyway, I had this cabinet. I was chairman of the management committee for the portable oxygen system procurement. My particular cabinet, I didn't know where it came from. It was a reject, I guess, but it was lower than the others, and the dial, it was just so sensitive. It was just, you could almost breathe near it and it would move. I got to where I got so rattled, I could not open that lock. I would get so nervous, I couldn't make it stop on a number. My hand, just the lightest tremor, and this thing was off. I had to have somebody else open my safe for me. I couldn't open it. Every morning I'd come in, "Today I'm going to do it. Today I'm going to open my own safe." I could never do it.

The chairman of our source board, Frank Samonski, a guy I mentioned before, he's retired and living in Oregon now, we were evaluating these two proposals one day. They came in there, and we were all going to put our scores. So we all went off and evaluated and came back with our scores. So our scores—there were about five of us—like Frank was 72. I had like 94, 92, 89, 91. We're all looking at those scores. All at once Frank is attacking all of us for our scores. So we're all on the defensive defending our nineties, and he's got his 72 down there. All of a sudden somebody says, "Wait a minute. You're the only one that's out of step. How come your score is so low?"

He started laughing. He said, "I wondered when somebody would tumble to that." [Laughter]

RUSNAK: Obviously the Shuttle's need for an EMU is based on the fact that you're going to do EVAs from the Shuttle. But from what I understand, it wasn't necessarily a given at the very beginning of the Shuttle Program that it was even going to have an EVA capability.

MCMANN: Oh, no. Oh, no. Right.

RUSNAK: What do you remember about that discussion?

MCMANN: Very much. It was very much on the fence back in the early days. In fact, the way they were going to do EVA, they were going to have a kit, an airlock kit. On missions where they wanted to have EVA, you'd fly the airlock kit, put it in the payload bay. On those other missions, you wouldn't.

One day I saw a viewgraph a guy put together at Headquarters that showed on one side of the viewgraph the Skylab module with the parasol and the other stuff. On the other side it said, "EVA, would you want to fly without it?" So EVA, after they really assessed the impact of that, it was really in the baseline Shuttle design. But the early designs of the Shuttle back in the mid-seventies or so was not to have EVA as a given.

Then they put the airlock inside and put it firmly inside so you flew it on every mission, and they decided we'll fly EVAs on every mission or we'll have EVA capability on every mission for payload bay door closure, if nothing else. So it was onboard after that. I guess recently they've come to be able to fly an outside airlock to take advantage of being able to dock to the Station.

Some of the other stuff about the early days of EVA, I mean, the STS-5, when we had two unrelated failures on the same mission. Anytime people talk about not coincidence, well, you can have coincidence. We had two totally unrelated failures that totally wiped out EVA for

that mission. The fallout of that, I mean careers were ended. One guy had a nervous breakdown, one of the contractors. I mean, it was really, really bad.

It's funny that when we found out for the regulator, the fact that it had been assembled wrong and then stamped off as assembled right, the first inclination of my old boss at the time when he found out that the regulator had been assembled wrong was "Fire the guy."

Wait. Wait. The guy that assembled the regulator is one of only two people in the world who can assemble them, and he's the best guy, and he feels worse about it than anybody. So you don't fire him. That guy is your most valuable employee now. He's been hurt. His pride, everything has been hurt. So he's absolutely the best of the best now.

So I mean that thinking, though, in those days was take him out and shoot him rather than learn from the experience. That's one thing I think we've changed in our attitudes, is figure out what's wrong with the process, not what's wrong with the person. If there's something wrong with the person, that may be also the process, the process of selection, the process of training, whatever. Because if you start blaming people, pretty soon people start hiding stuff. So you end up in a much worse state than if you figured out, well, let's take this guy and let's find out what the heck happened.

The fan that went bad on that mission, it's funny about that fan. We had an altitude chamber run with Jack Lousma with one of those same fans in it. During the altitude chamber run, the fan just quit. It just died. Well, he cycled it off and then back on, and it came up, but it didn't quite come up to the same speed it had before. It was still in spec, but it was different. So we got all through, so we had a failure.

So I went in to my boss and said, "Harley [L. Stutesman], what do we want to do? Bill [William L.] Burton [Jr.]," who was our electrical guy, "said he wants to take the Hall [effect] sensor out," which is the speed sensor. "He wants to take it out and cut it open."

Harley said, "How much does it cost?"

I said, "Well, Hamilton estimates about 30K to analyze."

"Too much money. We'll probably ruin it anyway taking it apart. No, we're not going to do it. It was just a random thing. Close it out. What do you think?"

I said, "Yes. Yes. Yes, you're probably right."

So we closed it out. Well, later on in the STS-5 mission when that happened, we got that fan back, cut into the Hall sensor, all corroded. Then we went back to the Lousma fan motor, cut it open. It was corroded. Not as badly, but we had an early indication of that failure only we ignored it. When we had this problem on STS-5, Harley said, "Where's Burton? By God, we ought to fire him."

I said, "Wait a minute, Harley. You and I stood right here in your office and agreed over Burton's recommendation not to tear into that thing. So don't blame Burton."

"Well, he shouldn't have let us convince him. He should have tried harder."

That same fan, that was Lenoir's fan. Later on when he was flying, he got on a later mission, Harley said, "Out of curiosity, what fan have we got in there?" We'd modified the fans, and we had an interim-type configuration, which fixed this problem for a while on the way to our ultimate solution. So we had an interim fix in there, and everything looked good.

I said, "I don't know. I'll check and see." It was the same serial-number fan.

Harley said, "Is there any way we can change that?"

I said, "Not now. It's too late."

He said, "Think of it. If that goes wrong, if something goes wrong with that fan, wouldn't even have to be a Hall sensor, and that gets out, can't you see the headlines? 'NASA Uses Faulty Fan Again.'"

But it worked fine. Just one of those things that happens. Coincidence happens.

RUSNAK: Right. Well, we're almost out of tape again. I don't know if you want to stop here for the afternoon? It's almost five o'clock.

MCMANN: Probably ought to stop.

[End of interview]