

# ORAL HISTORY TRANSCRIPT

GRADY E. MCCRIGHT  
INTERVIEWED BY CAROL BUTLER  
LAS CRUCES, NEW MEXICO – 7 MARCH 2000

BUTLER: Today is March 7, 2000. This oral history with Grady McCright is being conducted at his home in Las Cruces, New Mexico, for the Johnson Space Center Oral History Project. Carol Butler is the interviewer and is assisted by Kevin Rusnak.

Thank you so much for allowing us to come and talk with you today.

MCCRIGHT: Well, you're more than welcome. I will enjoy doing it, I'm sure.

BUTLER: Thank you. To begin with, if maybe you could tell us a little bit about your background and how you became interested in engineering and even the possibilities of becoming involved with the space program.

MCCRIGHT: Well, I think that from the time I was probably eight or nine years old, I knew I wanted to be an engineer. Some of the time I wanted to be an aeronautical engineer, and some of the time I wanted to be a mechanical engineer, and sometimes I wanted to be a civil engineer.

When I was in the eighth grade, I had an uncle who was a ham radio operator and he sent me what was called a progressive education kit. You could build eight different electronic Morse code senders and one-tube receivers, and things like that. I went through that entire eight-project progressive education kit, and decided at that time I wanted to be an electrical engineer. So that was my goal from then on.

Then when I struggled through college, as I was going to college, the space program was just being born. By the time I got out we were in the middle of the Gemini Program,

when I got out of college. By that time, I had decided that if I could, I'd like to be a part of the space program.

So my senior year in college, early in my senior year in college, I started sending applications to—I sent one to Marshall [Space Flight Center, Huntsville, Alabama], one to KSC [Kennedy Space Center, Cape Canaveral, Florida], and one to Johnson Space Center [JSC, Houston, Texas]. I also sent some to the Civil Service Commission in the region of Dallas, and I think in New Orleans I sent one.

In the spring of the year I got out of college, I received an offer from Marshall and one from JSC. The JSC office was for a duty station at White Sands [Test Facility, White Sands, New Mexico]. I got an offer from the Department of Agriculture in New Orleans and several other offers. I had an offer from the phone company, from Southwestern Bell.

I suppose I choose the JSC job because it kept me in Texas, and I was in Texas at the time, although that's the home office, was in Texas, although this would be out in New Mexico. I had been out here, not to Las Cruces, but into this area, while I was in college, and kind of liked it. From the description of the job they had out here, which would be a hands-on rocket engine test facility, data acquisition and control systems kind of a job, I just thought it was the best offer that I had of all of those. I never really seriously considered anything except the Marshall job and the JSC White Sands job, because they were NASA jobs and that's what I really wanted to do.

So I accepted the JSC appointment to a duty station at White Sands in March of 1966, and I reported for duty on the 12th of September 1966 at White Sands. I got out of college in August and got here in September.

For the first three years that I was here, three and a half years that I was at White Sands, it amazed me how quickly I was trusted to do things and to make configuration changes to the systems and to make—we did a lot of troubleshooting. It was a development job. The job had never been done before. I was working principally on the control systems

for the lunar module [LM], ascent and descent engines, and some on the RCS [Reaction Control System] engines, reaction control engines for both the LM and the command service module. I spent about two and a half years of that three and a half years working on the altitude simulation control system.

The Apollo engines, which were designed to fire only in space, never in the atmosphere, so we tested them at a reduced pressure. We'd test them at altitude, in other words, at about 150,000 feet equivalent. We had—and it still exists, it's a huge chemical steam generator that produces super saturated steam, super heated steam, at about 300 psi [pounds per square inch]. It's the equivalent of about a million horsepower and it's three modified X-15 rocket engines that burn alcohol and LOX [liquid oxygen]. You quench that rocket engine flame with large, large quantities of water which is converted to steam, and use the steam to be able to evacuate these large test chambers where the engines were, engine systems were. Then we could fire those engines in a vacuum.

The chemical steam generator was built by Thiokol [Chemical Corporation] and delivered to NASA in a pretty sad state of completion, so we spent a lot of time perfecting that steam generator. The control systems on it were probably as complex as they were on the lunar module, if not more so, because if you happened to lose this steam while the gate valve, a big nine-foot gate valve, was open, you'd get a supersonic shockwave coming up the ejector and when it hit the nozzle of these little light spacecrafts, it'd just scattered them all over the test stand.

So we had a nine-foot shutter valve, which is like a Venetian blind, that set in the ejector of that steam system, and if we sensed a loss of steam pressure at 270 psi decreasing pressure, we triggered this shutter valve, and the shutter valve was then fired with squibs and a fike-valve which opened about an eight-inch valve, it just ruptured the valve is what it did, and opened about 3,000 psi to an actuator that slammed that shutter valve closed and prevent that shockwave from getting to the vehicle. We had to use it several times.

It was a very complicated control system for the altitude simulation system and these shutter valve, and I spent hours and hours and hours and days on end trying to calibrate the shutter valve. We finally redesigned the control circuitry and it finally became very reliable, but it took us probably most of the Apollo era to get that perfected.

So that's principally what I did during Apollo. I spent a lot of time working on engine control systems and facility control, electrical control systems, and the control system for the altitude simulation system.

But the office at White Sands at that time, which was the peak employment at White Sands Test Facility, was about 1,600 people. There were only six electrical engineers in the NASA office, so I worked some power distribution. I worked a lot of engine control systems on lunar module, a little bit on the command service module, which was at the 300 Test Area, and the lunar module was at the 400 Test Area.

Because it was such a small office, it's probably the best thing that ever happened to my career, because I came fresh out of college, green as a gourd, came into White Sands where you had to be able, because of the small number of people in the office, you had to be able to be reasonably competent on power distribution systems, electronic control systems for the facility, and engine control systems, engine system control for the lunar module. So in three and a half years, almost four years that I was here during Apollo, I got a lot of knowledge about a lot of varied activity. I would consider myself at that time an expert at nothing, but a Jack-of-all-trades in the electrical business. I could do a little bit of this, a little bit of that, because that's the way we had to operate out here.

So it probably proved to be the best thing that ever happened in my career, because it forced me to be independent and I got a lot of exposure in a broad variety of subjects very quickly. Of course, you say that sounds a lot for three and a half years. They weren't short days. We were working a lot of long days. When we were trying to calibrate the shutter valve, for example, I can remember one time when I was pretty young, that I would go out

and work twelve hours and I'd get relieved by another engineer, and twelve hours later I'd come back and relieve him. That went on for probably the better part of a week before we got it calibrated. Ultimately we wound up changing the design where it was easier to do, and today it's a reliable device, but it wasn't for a long time.

So that's my background and how I got to the Apollo Program.

BUTLER: That's a good background, good review. While you were working with, during the Apollo Program, and in this area, what were some of the biggest challenges, I guess, on each specific system? You said you worked a lot with the LM and the ascent and descent engines. Were there some primary areas that were problematical?

MCCRIGHT: Well, the altitude simulation system controls was probably my biggest challenge during Apollo. However, we made a number of changes. I can think of a zener [phonetic] diode that we had to change in the LM control systems, it was on board the spacecraft, because it kept shorting out on us. We had to change the design of the circuitry that controlled that valve to prevent that.

So I would say the research and development involved in refining those engine system control. It wasn't just the engine, but it was the entire engine system, the pressurization system, the propellant, both fuel and oxidizer systems, the super critical helium systems, and a number of different systems that make an engine work. So it was the research and development and perfecting the controls for the lunar module engines, principally ascent and descent engines.

On the facility side, we had some great challenges there, too, because this million-horsepower steam generator, chemical steam generator, is a very complex beast. So it probably provided personally the biggest challenge was on the facility side of that system.

Now, I can remember what we called the fire-in-the-hole test that we did. Fire-in-the-hole test was when we built a simulator for the descent stage that from an engine pressurization system it looked like a descent stage, and we put the ascent stage on top of that. Then what we were trying to determine is if we went through an abort, if we ever had to abort while the descent stage was attached to the ascent stage, the way you abort is fire explosive bolts and fire the ascent engine and push the ascent stage, which had the two astronauts in it, away from the descent stage. When that engine first fired, it would be firing right against the descent stage, so the exit pressure at the nozzle would be higher than normal.

We were worried about a rough combustion cutoff, that the engine would cut off because of rough combustion. So we built a mylar diaphragm over the diffuser in Test Stand 403, and put the ascent stage on top of that where the nozzle was probably two inches from that mylar diaphragm. Then we evacuated the chamber mechanically with the pumps. This mylar diaphragm then was the vacuum seal between the chamber and the ejectors. Then we fired up the steam generator and brought it up to pressure and temperature and then we had a vacuum on both sides of that mylar diaphragm. We opened the gate valve and evacuated all of that ejector. We're pulling against this mylar diaphragm and then we fired the lunar module.

I was responsible for the design and operating the console. We fired the shape charge that ruptured that mylar diaphragm. Because what we had to do is simulate that as the ascent engine fired and the chamber exit nozzle pressure was high, which made the chamber pressure high, and then in a few milliseconds later I had to rupture the mylar diaphragm. We had an X cut in it, we had a shape charge and an X-shape on top of it, and we fired them with squibs and ruptured that diaphragm, because as soon as you start a fire in that ascent engine, we wanted to simulate that it was moving away from the descent engine.

The other problem we had was that the pressure inside the chamber was going up rapidly because of the exhaust products from the ascent engine. So we had to get the chemical steam generator to start pumping the chamber. So we did that test about probably four or five times, and it was a pretty exciting test to get all that to come together in a few milliseconds and make it happen right without doing any damage to the engine. What we proved is that the engine is that the engine would continue to run and be able to get the astronauts away from the descent stage.

Another highlight, which I didn't know was going to be a highlight, none of us did, but in about 1968 we ran a lunar module descent engine firing profile which simulated the LM having to act as the service module because something's wrong with the service module. What if we get out in translunar injection and we have a problem with the service module engine, SPS engine? SPS engine is a 22,000-pound engine that did mid-course corrections between the Earth and the Moon, also put the astronauts into orbit around the Moon, and then it fired again to get them out of orbit, headed back to Earth, and did mid-course corrections coming back. If you didn't have it, you wouldn't go into orbit around the Moon. If you were in orbit around the Moon, you couldn't fire it, you couldn't get home, and you needed it for mid-course correction.

So about 1968 we decided we really ought to figure out what would do if we couldn't fire the SPS engine. Well, we'd have to use the LM as a lifeboat. So we ran a firing profile of how would we get around the Moon and get home and make the mid-course correction with the lunar module engine. If you watched the movie *Apollo 13*, [Eugene F.] Gene Kranz calls the Grumman [Aircraft Engineering Corporation] engine representative in, and the Grumman engine representative says, "We've never done this before." That's not true. We did it about 1968.

So we had proved that would work, not necessarily that the astronauts—and they did fire it manually—not that they could do it manually, but that the engine system would work.

So that Apollo 13 catastrophe which turned out to be one of the high points of NASA, getting them home safely, everybody was working awful hard to make that happen. Some of the people you ought to talk to that I can tell you who were actively involved in Houston in Apollo 13, you really ought to interview, if you haven't. But we had done that engine firing profile out here about two years before that event occurred. I had no idea that it would ever be a high point in my career, but it turned out to be.

BUTLER: And it's interesting that you did that in 1968, because at the end of the year Apollo 8 went to the Moon with just the command module, just the service propulsion system.

MCCRIGHT: That's right. If they'd had a problem, they wouldn't have got back.

BUTLER: At the time did you think about that in conjunction with this test that you had completed, or did it even cross your mind?

MCCRIGHT: No, because they didn't have a lunar module with them, so they would not have been able to use it as a lifeboat. It was just the command service module. I do remember thinking during Apollo 8—and Frank Borman lives here in town, by the way—I do remember during Apollo 8 thinking that this is the first time man's ever been outside of the gravitational pull of the Earth, and he does not have a free ride home. Now, they were in a slingshot orbit, so they would have come back toward Earth, but once they went in orbit around the Moon, which they did, they had to be able to fire the SPS engine to get out. I do remember thinking that if it doesn't fire, they're lost in lunar orbit.

I do remember that night when they fired that engine behind the Moon and we couldn't talk to them, and we didn't know for sure if it was successful until they—we knew what time we'd be able to talk to them if it was and what time we'd be able to talk to them if



it wasn't. We could talk to them first if it was successful because of where they were behind the Moon. So they put in a call to them just about the time they should show up around the edge of the Moon and they responded. So it was a good feeling.

BUTLER: I'm sure it was, understandably. Where were you typically during the missions? How did you follow them?

MCCRIGHT: Well, out here we followed them on commercial television mostly. Today we have NASA Select out here that we could see, but in those days it was mostly commercial television and radio. We had some audio links with Houston that we could hear, one way. We could just hear, we couldn't respond.

What we principally at White Sands did during the missions, early missions, we would load the vehicles and leave them at pad pressure. We wouldn't put pressure on the tank. We'd load the fuel oxidizer in both ascent and descent engines. We would make sure we had a load of LOX and a load of alcohol for altitude simulation system and we would be in standby. And we would just be standing by in case they had a problem with an engine and they wanted us to see if we could simulate the problem and maybe tell them what was wrong with it. White Sands still does that for Shuttle. Now, they don't tank the engines every time, but they used to. In the very early days we did, but now we don't.

But when an Orbiter is up and they have a problem with—on the last flight they had a problem with the RCS engine. I would not be surprised if after they got back, White Sands tried to duplicate that failure. I'm not involved anymore, but I suspect they did. That's generally what happens. When they have an engine problem on the Orbiter, once they get back, if they aren't sure what happened to it, White Sands tries to duplicate it. The engines are in standby here for those kinds of problems. During Apollo we were really in standby. We were tanked and loaded then.

A little sidelight to Apollo [13]. I moved to Houston in May of 1970, from here. I had been in Houston probably two weeks, when I went to Eckard's Drugstore one afternoon in Nassau Bay, right across from the center, and just as I came down a parking lot there, Jim [James A.] Lovell [Jr.] came zipping around the corner in his Corvette and went into the parking place that I was headed for. And I thought, you know, just a few weeks ago he was in a crippled spacecraft coming back from the Moon and he successfully got home, and I almost hit him in the parking lot of Eckerd's Drug. [Laughter]

BUTLER: I guess sometimes being on Earth is a little bit more hazardous. [Laughter]

MCCRIGHT: That's right.

BUTLER: Well, luckily you both avoided any incident there.

MCCRIGHT: We're both still alive, yes.

BUTLER: Did you tell him to watch out next time?

MCCRIGHT: No, I didn't say anything to him. I just went on to another parking place.

BUTLER: You worked at White Sands here initially for a few years, as you mentioned, on these various projects. How then did the opportunity arise for you to go to the Johnson Space Center?

MCCRIGHT: Well, I suppose it was an opportunity to serve the nation and the space program in another capacity. At the time I did not look at it as an opportunity at all. You have to

understand that the White Sands Test Facility was built for one specific purpose, and that was to do the research and development of the SPS engine, the lunar module ascent/descent engine, and the RCS engines on both the lunar module and the command service module.

Once that job was done, White Sands was expendable. We knew all along that NASA's intention was, once Apollo was over, they would no longer need White Sands Test Facility, and that White Sands Test Facility would be offered to the United States Army, because they're over at White Sands Missile Range. If they took it, then the Army would own it. If they didn't, NASA would likely abandon it.

So in 1970, [Philip] Whitbeck, who was the director of administration at JSC at the time, came out here and told all of us, got all of us together, all of us civil service people—we had already started sending Grumman and North American [Aviation] home. They were essentially gone by then. There was a few of them left, but not very many. So the population of the site went from about 1,600 down to, the middle of 1970 it was probably down to 600 or so. So when he came out here he told us that, "NASA's intention is to close it, and close it during the summer of 1970. Don't worry, you're all going to be offered jobs in Houston." Most of us weren't very excited about moving to Houston.

People come to this part of the country, there's only two kinds of people that come: they love it or they hate it. Those that hate it don't stay long, and those that love it don't ever want to leave. The vast majority of people are those that don't want to leave. At that time, Las Cruces was a town of about 28,000. It was a nice, comfortable place to live, raise your kids. The job out here was hands-on hardware. It was exciting. We'd been in the mainstream of Apollo, and none of us really wanted to leave, but 1970 was no time to be on the street. The aerospace industry was in really bad shape by 1970. It was in its heyday from '65 to '69 or so, and once we landed on the Moon with Apollo 11, it started downhill rapidly.

So I had one child at the time, and I looked at the situation and said, "Man, I don't want to be on the street, because there are no engineering jobs out there. So I'd better take

the job in Houston," even though I didn't want to go to Houston. I'm from a small town in northeast Texas of 2,800 people, and I never wanted to live in a big town, but the situation was that if you wanted a job, you probably should take it, so I did. I took an appointment in Houston.

Let me continue on with White Sands just for a second. What happened at that time is about half of the NASA staff moved to Houston. Probably more than half. There were also a bunch of quality people that we had borrowed from the U.S. Army for the Apollo Program and we gave them back to the Army, back at White Sands. So another twenty-five or so people went back to White Sands Missile Range. The principal, the primary engine contractors and spacecraft contractors, Grumman, Aerojet [General Corporation], Rocketdyne [Division of], North American, all went home. The only thing we had left was the facilities contractor and a labs contractor, LTV [Ling Temco Vought/ Aerospace Corporation] and Zia [phonetic]. The NASA people got down to about twenty-five people.

Shortly after I left, White Sands dribbled on down to a total of 200 people, NASA and contractors, what we call today our core base. The core base at White Sands has been identified in 1970 as being 200 people. About twenty-five of them were NASA people and 175 or so were contractors. They consolidated the LTV and the Zia contract and Zia won that competition and Zia became the only contractor at White Sands.

Let me take that back. That's not true. When they consolidated those two contracts, Dyna Corp won that contract. So there was Dyna Corp 175 or so people and then 25 or so NASA people. That's still known as the WSTF core base.

So I accepted the appointment to Houston and went down there in 1970. The other twenty-five or so were scheduled to come later, and a couple of groups did after I left. I left in the first group, because the better jobs at Houston are probably now than they will be in three months. I took a job in Environmental Test Division in Houston. A couple of groups came after I did. Then by that time, four or five months later, they had decided, well, let's

keep that core base of 200 out there for a little while and see what happens to Shuttle. The Shuttle was in the thought process at that time. Let's see what happens to Shuttle. So it never went below the 200. So a few of those NASA people never went to Houston, but most of us did, went to Houston or found another job. A few of them found another job.

So I went to Houston in May of 1970 and stayed down there for about three and a half years. I got the opportunity to come back here in 1973 and did. So when I went to Houston working in Space Environmental Test Division, it was working in the largest vacuum chamber in the free world, over in Building 32 in Houston. That's chamber A. There's also chamber B. Then at that time Building 33, next door, had some small, real small, seven-foot chambers and stuff in them. I worked in those two buildings for the next three and a half years.

For the first six months I was down there, I was assigned to an operations branch which was kind of Facility Operations Branch, and I stayed in there about six months. Then I transferred up to the Data Systems Branch, I believe it was called, and I worked for Dave [David G.] Billingsley, who was a branch chief. What we did there, we were responsible for data acquisition off of the test articles and the facility systems in chamber A and chamber B, and did a little work over at 33 in the small chambers.

I guess probably in late '71, early '72, maybe, I was assigned the task of moving an ACE [Apollo Checkout Equipment] control system from Bethpage, New York, to Houston. Bethpage, New York, is where the Grumman Corporation was and they had a NASA-owned system. There were several ace systems. There was two in Building 32 already, and then there was in California and there was one in Bethpage and probably some others.

But we were phasing out of Bethpage, so the government property up there we wanted to move to Houston, so I got the task of moving that system from Bethpage, New York, to Houston. I was representing the government. GE was doing a lot of the work.

General Electric [Corporation] was the contractor that was going to move it, but I was doing the interface for the government.

ACE stands for Apollo Checkout Equipment, and so we used that. It was a 160G, control data system 160G, which was the first—I believe it was the first solid-state computer. It was the first—yes, I'm sure it was. It was the first solid-state discrete components, solid-state computer. And NASA owned most of them that they ever built, I think.

But anyway, I spent probably eighteen months moving that system from Bethpage, New York, installing it in Building 32A, which was an annex to Building 32 on the second floor. After we moved it down here, Apollo released it, so we brought it into Houston to do facility controls with. So we did facility controls and data acquisition through that former ace station that we called Data Acquisition and Control System DACS for the Space Environment Test Division. So I worked on that eighteen months or so, and we got it up and running and it was running pretty well by the spring of 1973.

You're going to ask me how I got back to White Sands, probably. There were several factors in that. My daughter was five years old at the time, my oldest daughter. By then I had a second one, second daughter, and she was six months old. I wanted my children to be raised in a smaller town, if possible. I was living in Friendswood. I was raised in an environment in Texas similar to the Houston environment, a small town, but similar to that environment. But I had discovered there was another way of life in the desert, and I just fell in love with the desert when I came out here. The work at White Sands was closer to an engineer's dream, because you had your hands on it, you were really responsible for it, and you were a Jack-of-all-trades, not an expert in anything. In Houston you tend to get pigeon-holed and be an expert in one subject, and I preferred the other life like you had at White Sands.

I enjoyed my job at the Space Environment Test Division. Bringing that DACS down from Bethpage was a great experience. Doing the vacuum testing on the Apollo telescope

mount for the Skylab was very exciting. When we put Skylab up and the two solar panels did not unfold and we had to figure out a way to go up and put an umbrella over it to keep the sun off, that was done in the high bay. Figured out how to deploy that thing in the high bay of Building 32. That was fun to watch. I wasn't really involved in it, but I was around there when they were doing it. So those were some fun things to do.

Chamber A and chamber B are man-rated chambers, so I was involved in several manned tests in those chambers, where you actually have a person in there in a spacesuit. Anytime you've got a manned system, you've got to have a way to get them out of there in a hurry. So the emergency repress system, I was involved in some redesign on that and some testing of that. If you emergency repress, that big chamber is a very, very volatile activity to repressurize it as fast as you can, because you got a guy dying in there. We actually had one—I believe in chamber B we actually had to go in and get a guy while I was there. Those were exciting things to be involved in, but my heart was still at White Sands, and I wanted, if possible, to have my children out of there by the time they started public school.

So all that to tell you that in March of 1973, the Chief of the Engineering Office [Gene Lundgren] at White Sands Test Facility called me and said, "Hey, Grady, would you like to come back to White Sands?"

I said, "Yes, sir."

He said, "When do you think you could be here?"

I said, "Tomorrow morning."

He said, "Okay. I'll see if I can make it happen."

It took me till September of '73 to get released from JSC, but I did get back out in September of '73. Although I really enjoyed my job in Houston, I was influenced by my children's age and getting them out here. They went to school out here all their public school life.

So I came back out here and accepted a position of being responsible for the data reduction system at White Sands for the build-up of the Shuttle hardware when we were doing Shuttle engine testing.

In those days we acquired the data with a Beckman 210 system at the test stands and put it on tape, put the data on tape. Then we took the tape, the magnetic tape, down to the 200 Area where a Control Data [Corporation, CDC] system 3200 computer was, and we played those tapes back through a Beckman 210 system and reduced the data using that [CDC] computer. So when I came back to White Sands, I was responsible for the data reduction of the engine and facility data off the 400 and 300 Area where we were testing the Shuttle engines.

I also was responsible, when I came back in '73, for the electronic calibration labs and for electrical fabrication, a small shop where we put together prototype electrical control circuits, designed and put them together. One of the biggest challenges I had during that period of time was that computer system, although it will surprise you youngsters, that computer system took up a room nearly as large as this house, and it took 50 tons of air-conditioning to keep it cool. And it had 32,000 words of memory.

In about 1974, we acquired a second CDC [Control Data Corporation] 3200 from another government agency in California, and I went out and looked at that computer. They were ready to excess it, so we picked that up off of excess, brought it to White Sands, so then we had a backup computer. That's what we were really after, so we'd have two computers to be able to reduce this data in case we lost one. At the same time we added magnetic disk to the computer, three of them, I believe, and we doubled the memory. I said 30, didn't I? It was 32, 32,000 words of memory. We doubled that to 64,000 words of memory and installed that second computer we got from another agency, put a magnetic disk on it, and did some other things to enhance it, to get ready for the research and development on the Shuttle engines, because we were going to be acquiring high-speed data, more of it.



By that time CDC 3200s were obsolete, and so we could never find the money to upgrade to a new computer system, so we started picking up excess hardware from other government agencies to keep this one running. We also put into place an agreement with Point Magu, naval installation at Point Magu, who also had a Beckman 210 so if we lost our Beckman 210 we could take those tapes to Point Magu, have them play them back and demodulate them for us.

Then we went to Arden Hills, Minnesota, where Control Data Corporation had a 3200 still working. We cut an agreement with them that if we ever lost these systems catastrophically, we would demodulate the tapes at Point Magu, we'd take them to Arden Hills, Minnesota, and take our software up there and run it on that computer.

So that was one of the early things that we did, is to put into place some backup if Houston no longer had any. The agency didn't have any, the only ones left, CDC had one in Point Magu, the Navy had a Beckman 210. So we tested those and we went to Point Magu, made sure that worked, went and took that tape to Arden Hills, Minnesota, to CDC Corporation, and spent one long night up there making sure we could reduce that data. We took a programmer and an analyst up there with me and we spent all night running on their computer and proved it would work.

We never had to use the Arden Hills backup. We did use Point Magu. We used it a couple of times because we had little hiccups in our Beckman 210, but we principally used it because they were taking data so fast on the test stand, we couldn't reduce it twenty-four hours a day, so we were getting some of it demodulated at Point Magu and bring it back here and do the rest of the work on it. So those were two of the highlights, I guess, of that period of time.

Before I left that job in 1979, we were also beginning to upgrade the cal lab to automated calibration hardware. We made the first step toward automation about 1979, '78, maybe, late '78. The Shuttle engine R&D [research and development] was much like Apollo,

but it was not quite as hectic as Apollo, because we didn't have the national mandate we did on Apollo of getting a man on the Moon and safely returned by the end of the decade. So it was little less demanding, maybe, than Apollo, but it was still a fun program.

While I was doing these, I did several other things, such as I installed some large junction boxes for the data systems up in [test stand] 301. So that was just kind of a side job that I did getting ready for the Shuttle engine testing up there.

So I was relatively happy doing that. I spent six years doing that, from '73 to '79, and in January of '79 I became the Chief of Electrical Data Systems Branch at White Sands. That was my first official supervisor job, although I'd been project engineer and systems engineer on various tasks prior, which is kind of like a supervisor, except you don't have to sign a time card and you don't have to do disciplinary things.

I first became a supervisor in January of '79, and once I became supervisor of that Electrical and Data Systems Branch, I was responsible for all the data acquisition in all of the 300 Area and all of the 400 Area, all the calibration, not just electrical, mechanical calibration as well, electrical fabrication, the data reduction facility, all the power distribution systems, all the facility control systems, all the engine control systems. So I spent only two years doing that. I spent about two years, roughly two years, doing that.

Then was selected for Chief of the Technical Support Office, which was essentially the Chief of Engineering at White Sands. At that time I was responsible for everything I just mentioned, plus all the mechanical systems, altitude simulation system, roads, grounds, utilities, and all of the engineering design work on the test stands and on the facility itself. Essentially I was responsible on a much smaller scale, but essentially responsible for everything that plant engineering is responsible for in Houston and Facility Design Division is responsible for, and most of what engineering directorate was responsible for in Houston, but on a much smaller scale. I did that until I went to Houston in 1984.

At that time, some of the highlights of that was building up Northrup Strip, which is now called White Sands Space Harbor. When we first started going over there to train astronauts, there was nothing over there but two graded runways. I don't remember how long they were, but they were very short. We went over there and put—I remember a big job of putting electrical distribution system into the tower area. We ran on generators for a long time, and we finally put electrical power into the tower area. We put a communications, portable building over there with a communications rack in it, so we could talk to the airplanes and we could interface with the ground radio systems, intercom systems and whatnot.

We put a medical trailer over there so that in case of an emergency we'd have some medical attention, because when the astronauts were training over there with the STAs [Shuttle Training Aircraft] and T-38s, we had to have paramedics over there in case of an accident. They came from Holloman [Air Force Base, New Mexico]. We contracted with the Air Force to provide them from Holloman.

MCCRIGHT: Then we continued to expand the runways until we had two Shuttle-certified runways, which we load-tested them to certify them for Shuttle, make sure they could take the impact of the nose gears. The nose gears were the smallest footprint and the highest density load is on the Shuttle on the ground. So we certified them to be able to take the nose gear loads, and they were 35,000 feet long, which is seven miles. There's two of them in an X over there, two runways 35,000 feet long, 300 feet wide, and they still exist today. Since that time they have added a 15,000-foot runway off to one side, which can reconfigure to simulate various TAL landing sites. So a transatlantic abort landing sites, they'll configure it to look like Dakar, Senegal, or Rota, Spain, or whatever they want it to look like, so the astronauts can practice landing on a runway that's got the same markings on it as they'd see if

they had to go into TAL abort. But this was a big effort over a large number of years. We started that actually when I was Chief of the Electrical Branch, but we got it finished while I was Chief of Tech Support Office.

Then in 1982, March of 1982, I believe that's something you can talk to about with Rob [R. Tillett], but I think it was on March 17th, Rob and I and one other guy went out early, early one morning and listened to a telecon between General Abramson, who was the AA [Associate Administrator] for Office of Space Flight, and his minions, and Dr. [Christopher C.] Kraft [Jr.] and the JSC people and some people at the Cape, because they were ready to launch STS-3. A Shuttle had never landed on concrete. They'd always landed at Edwards [Air Force Base, Edwards, California] on a lakebed, [STS] 1 and 2 had.

They wanted to land on a lakebed, because the first three flights were research flights and they didn't want to land on concrete. This is a gypsum lakebed out here. It's hardpacked gypsum like the sheetrock's made out of, except it's in granular form, but when you compact it, it's almost as hard as concrete. So the lakebed at Edwards was wet. They had standing water on it, so they couldn't land out there. So the decision had to be made, "We go ahead and launch and land at White Sands or we wait until the lakebed's dry and land at Edwards." Most people did not want to wait. They wanted to get on with the flight program, the development program, and they did not want to go to the Cape because they had not at that time landed on concrete. They'd never tested the brakes. They just let it roll to a stop. So they did not feel comfortable doing that.

So the decision was made that morning to land at White Sands, launch and land at White Sands. I remember Rob Tillett looking at me when Kraft recommended to go ahead and launch and Abramson agreed, somewhat reluctantly he agreed. Dr. Kraft asked Tillett, who was the manager at the time, said, "Are you ready, Rob?"

And Rob looked at me and I said, "Well, yes, we've got a few days. We'll be ready."

So Rob responded, "Yes, we're ready, Dr. Kraft."

And He said, "Okay, we're going to launch."

As soon as that telecon was over, Mr. Tillett told me, he said, "You go to Holloman and get"—we had ready looked at this equipment. There are some air bases in boxes at Holloman, landing mat and tent hangars and latrines and kitchens and barracks, just anything you need. They can deploy those air bases anywhere in the world and in a few days they can have an operational air base.

So we had gone over and looked at that stuff. There's generators and there's water bladders and fuel bladders and everything. We had made arrangements with Holloman that if we ever had to take an Orbiter, we needed some help, because all we had, as I said, is a tower and a little probably 20-by-20 foot communications building, portable, and a trailer, medical trailer. That's all we had out there. It's about 68 miles from where we sit, and there was nothing between here and there in those days. There was nothing there.

So I went to Holloman and met with Colonel Chuck [Charles A.] Horner, who was a brigadier general-elect, but didn't have the star yet, but he acted like he did. Anyway, I went over to General Horner and I had to convince him to let me borrow those air bases, and then we had to get approval of the Joint Chiefs of Staff to use them because they're strategic equipment.

So I went over there and met with General-elect Colonel Horner and he gave me a hard time, but he eventually said okay. Then he and NASA Headquarters [Washington, DC] went to the Joint Chiefs of Staff and got permission to use one of them, or part of one of them. We didn't need all, but part of it. So I detailed what I thought we needed and I told him we'd get back to him later with what else we might need, and left Holloman and came back this way.

At the same time, Mr. Tillett was at White Sands Missile Range talking to the general of the Army over there, because we needed a lot of Army help, too. He told me when I got back from Holloman to call Houston and get some money. I said, "Okay."

Just an aside about Colonel Horner. When I last saw him in 1982, he was a colonel general-elect at Holloman Air Force Base, tactical wing commander. The next time I heard of General Horner, he was a three-star general running the air operations in the [Persian] Gulf War. And the next time I heard from him I was in his office at Peterson Air Force Base where he was the Chief of Space Command, four-star general by then. Now he's retired like me. Anyway, Horner went up fast from that point.

Anyway, when I got back from Holloman, probably noonish or so that day, I called Houston and called [Henry E.] Pete Clements, who was the associate director of the center. When he answered the phone, when he got on the phone, he said, "Well, I've been expecting you guys to call me. What can I do for you, Dr. McCright?" He like to call us—he'd call you that when he was joking.

I said, "Pete, we need some money."

He said, "How much?"

I said, "God only knows how much. I do not know."

He said, "Well, I'll tell you what I'll do, I'll have the comptroller put 3 million dollars in your till and I'll check it every few days until this is over and I'll keep the balance at three million." He says, "You don't worry about it. You just go do what you got to do and I'll keep the money flowing."

To this day I can't tell you how much millions of dollars we spent in the next few days, and I doubt if anybody else can. I'm sure they have an official number, but I doubt if it's right, because in the next few days, two dedicated trains, large trains, came from Dryden [Flight Research Center, Edwards, California] to Holloman Air Force Base, where we offloaded trucks and blowers and air-conditioning units and materials and just many, many, many—whatever you'd need to recover an Orbiter all came from Dryden. And about 2,000 people came from the Cape and Dryden.

So in just a few days, here I was in the middle of the desert and we had something like 1,200 or so people on that piece of gypsum lakebed out there. The Air Force was putting up—we had them put up some hangars and we had them put up some barracks buildings we used as offices, and we had them put up a lot of latrines scattered around the place.

The media was coming in here by the droves. They had earth stations they were bringing in so they could record the landing and get it out. We were building an area for PAO [Public Affairs Office] so that we could have visitors out there, VIP visitors, to watch the landing. And it was hectic.

We had about two weeks before the launch, and in that two weeks we built a city out of tents and trailers and trucks. It was an amazing time from the standpoint of the public support we had. These things really happened. We had truck drivers show up at our gate at White Sands Test Facility and say, "I've got a truck and I'll go wherever you want me to and get whatever you want. I'll haul whatever you need."

Now, you say, sure they would for money, but they were just volunteering hoping that we'd get around to paying them, that we could keep it all straight. I don't know that anybody ever said "for so much money." They just said, "We'll do it."

We were working around the clock for these two weeks. I had some people that stayed out there for days on end. I left here every morning about 4:30 or 5:00 and went out there and got home at 10:00 at night, most nights. But it was an exciting time.

I got called here one night at my house, not this house, but another house I had, from an engineer out there and he said, "One of our trucks is broken." It was a 1965 International or something like that, I don't remember, but it was a pretty old truck. He said, "We need a fuel pump and we don't have one."

I said, "Well, I don't know what I'm going to do about this, but I'll see if I can find one."

I called the Las Cruces Police Department and told them who I was and that I was involved in the Northrup Strip, we called it in those days, and I worked for NASA and I needed an International fuel pump. I said, "I know you can't tell me who you've got to call this list of to who you call an emergency with an International dealer. Would you call them? I need it now."

They said, "Well, no, we can't tell you who it is, but we'll call them and see if they'll do anything for you."

They called, called me back and said, "He'll meet you down there."

So in the middle of the night, we went down and opened up the International Harvester place and got a fuel pump for that truck and got it out there to get it fixed. Those were the kinds of things that were happening around here. We had to get a High Ranger, which is a man-lift out of Minnesota. It's the only one we could find that was tall enough to reach the tail of the Orbiter when it was stacked on the 747. So it was an exciting time. I mean, it really was. It was as close as I've ever come to the logistics that would be necessary to fight a war in the middle of nowhere, and it was demanding, not just for me, more so for the people that worked for me, probably, because they were out there around the clock.

On the day of landing, the scheduled day of landing, this was in March, you're at my house in March and you can see how the wind's blowing. This is a calm day. It blows badly here in March and April, and we really had very nice weather for those two weeks. It had been unusually good, but on the day of landing, they were going to land about mid-morning, and John [W.] Young was in the STA making approaches to Northrup when the wind started getting up. I mean, it got up. It got so bad, you could not see from here to that fence. John said, "We're not going to be able to land today." So we postponed it a day.

By the time that wind blew that afternoon, all afternoon, it blew some of our tents down. We had drifts blow sand in the PAO area and some areas up against some buildings and stuff, it was probably eighteen inches deep. The runway got eroded, wind erosion. So



we had people, Army people, NASA people, even one of my engineers was driving a road grader most of the night that night. We had to grade it, compact it and get ready for the landing the next morning. The wind didn't quit blowing until probably dark that night, I don't remember, but very late. Usually around dark it lays down.

We were ready the next day. We landed. Some of the guys were shoveling drift sand out of the PAO areas as the buses bringing the visitors that were coming in for a landing. So I guess the highlight of my tenure as the Chief of the Technical Support Office was recovery of STS-3. It just put the area on the map. It put Las Cruces on the map, and that's the only Orbiter that's never landed either at Edwards or KSC. It was *Columbia* that landed here. It took us about ten days to get it out of here, de-service it. We had a de-service pad we'd already built, because in case it ever came in, we had to pour yards and yards, hundreds of yards of concrete for that, and you couldn't do that after it landed. You had to do it before that. So we had already built a de-service pad.

The Orbiter made a great landing the next day, and we towed it that afternoon to the de-service pad. The wind got up again after it landed, and we didn't get the engine plugs in fast enough. Gypsum can get anywhere. I had in that communications building, I mentioned that was probably a 20-by-20 building, in the middle of that building I had a communications rack there that we had double-wrapped in plastic. We weren't using it, so while we were not using it, we had it double-wrapped in plastic. When we got ready for the STS-3 they went over and unwrapped it, I happened to be there when they unwrapped it, and there was gypsum in it. It just gets everywhere.

So we could have never kept it out of the Orbiter if the wind blew. We're a lot smarter now and they've since built a de-service pad on the west side of the lakebed, so that the wind blows away from it, not to it. So if you had to de-service another one, you could do it without that problem, but we weren't that smart in 1982. But it was a great effort by lots of people.

BUTLER: It certainly took a lot to pull all that together.

MCCRIGHT: One other thing I want to mention to you is, the 747 had never landed on that lakebed. Of course, neither had an Orbiter. But a few days after it landed, A.J. Roy flew the 747 up to El Paso, and he came up in a car. He said, "I want to go out on that lakebed, on the runway. Before we bring the 747 up here, I want to drive it." I said, "Okay." So I got permission to go out on the runway in a car, and I took A.J. and his co-pilot. I don't remember his co-pilot's name. But A.J. was sitting in the front seat with me and we started down the runway and he said, "I want you to go fast. I want you to get up 90 miles an hour or so to see how rough this is."

So in a government car I did, I got up around 85 or 90 miles an hour. A.J. said, "Oh, this will be okay. We can get in on this."

While we were doing that, his co-pilot said, "Hey, A.J., our flights rules say if we take off with the Orbiter and have an engine failure, lose one of the four engines on the 747, at takeoff after they rotate and lose an engine, we have to go around." They go on up around and come back and land immediately. He said, "What are we going to do here? They've got seven miles of runway."

A.J. said, "If we lose an engine on takeoff here, we're just going to set it back down, because we've got seven miles of runway. We're not going around."

So the morning they took off, I went out there and stood about—I don't remember where I stood, probably less than 5,000 feet from where they started rolling, and they were airborne by the time they got to me. So they still had [30,000] foot of runway.

So it really was a great time. It really was. It's one of those experiences that I wouldn't take anything for and I don't want to do it again. [Laughter]

BUTLER: One of those unique experiences everybody should have.

MCCRIGHT: It was a unique experience. I might mention, one of the questions you had asked me earlier is about what we did about the cost reductions that the agency's been involved in for close to twenty years now. One of the things I might mention to you that White Sands did, is prior to the recovery of STS-3, about 1981, it was right after I became chief of the office, we contracted with the U.S. Army, White Sands Missile Range Army, to build the fluid systems for them at the high-energy laser test facility, which is about 50 miles east of where we sit right now. So we spent about a year and a half building that, year and a half, maybe two years, building that fluid system for them. They contracted for the design of it. We were not satisfied with the design and went in to their design contractor and made them do a much more detailed design of it.

This was a real hazardous fluid system, because fluorine was one of the constituents that we had to handle over there. Fluorine is bad, bad news. The reason the Army contracted with NASA to do it is because we do a lot of stainless steel work out here. We've got toxic propellants out here  $N_2O_4$  and hydrazine, aeroxine 50 and that type of propellants. So we had experience doing that. White Sands Missile Range did not. So they contracted with us to do that. So my office was responsible for reviewing the design and constructing and proof-testing and so forth that facility. So we spent fourteen and a half million dollars of the Army money in about two years, less than two years, to construct and perfect and turn over to them that fluid system.

What that bought for us is we were able to hang onto those skills that we needed but had no job for right now. So we hung onto probably 200 people that we would have had to lay off about 1980 because the testing for Shuttle by then was on the downturn, because we're getting ready to launch in '81. So it bought us a year and a half or probably two years of time to keep those critical skills.

What we did with the Army is they had to pay actual costs plus a burden. That burden helped us maintain the facility over here, to keep the machine shop up to support that effort and all those kinds of things. We had started doing that at White Sands back in the mid seventies, probably '76 or so. We had started doing a little work for a lot of different agencies and charging them actuals plus a burden. The burden was for those many facility support items, welding rods, toilet paper, chem wipes, and alcohol and stuff that you could not charge them actuals for, because you bought it in bulk and you used a pint for them and you used a gallon for NASA.

So what we did is made an estimate as to what facility support services and photographic services and some other things that you couldn't charge. At that time, at least, you could not charge the actuals. You still can't. I mean, how do you charge for part of a bottle of WD-40 to different projects? So we charged them a burden. We got JSC to agree to that, that we could do that. And today that's about 50 percent of White Sands' business, so it's grown and grown and grown over the years and it's allowed White Sands to stay competitive with other agencies. It's allowed us to keep critical skills that NASA needs part time and use them, divert them to other agency jobs. Now we're even doing some private industry jobs. We are allowed to do that if there is no private industry anywhere in the United States that can do that.

Some of the unique things we can do because of 94 square miles of property that we have out here, large deployment areas. We've got a buffer zone so people can't live very close to us. Where Houston is encroached on real badly, we're not out here. So that allows us to do many, many things that Houston couldn't do, that Marshall couldn't do, that other facilities couldn't do. So they allow us to do commercial work if we're not competing with private industry. In many things we're not, because private industry doesn't do those things.

So White Sands' forte is hazardous experimental work, and virtually everything we've done for thirty-plus years has been hazardous work and remotely controlled work and

hazardous toxic propellants and high explosives. We can actually detonate high explosives out there and we have. We did some tests just a year before I retired for Japan, for the government of Japan.

We are exploding hydrogen and oxygen tanks, which make a big boom, and we can do that because we've got more buffer zone around that facility than they do their launch facility. That's the reason they wanted to see, how big's the bang going to be if we lose a vehicle on the launch pad? We proved they're going to be in trouble if they did. There would be some private property that would probably be damaged, that they were that close.

White Sands got into that reimbursable business long before we did the HELSTF [High Energy Laser Test Facility] job, but that's probably the biggest single job we've ever done is that fourteen and a half million dollars.

We consider a reimbursable job anything that is not in JSC's White Sands' budget. Not the JSC budget, but the budget we get from JSC. So if we took a job for Marshall—and we do some work for Marshall—if we take a job for Marshall that's not in JSC's White Sands' test facility budget, it's reimbursable work to us, because it wasn't budgeted for us. It's offline budgeting. I don't know exactly today what they're doing, but when I left, it was the reimbursable work, offline non-JSC budgeted items was probably 50 percent.

Now, you need to understand when I said JSC White Sands' budget, if we do something at White Sands for Leonard [S.] Nicholson that was not budgeted for White Sands, Leonard has to give us the money, because it wasn't in our budget, it's in his budget. So if he gives us that, that's reimbursable, because it wasn't in our forecasted budget.

BUTLER: It certainly seems like while the initial goals for the test facility have remained the same, it has evolved over time to many different areas that hadn't been anticipated.

MCCRIGHT: That's right. One area I didn't mention that I really should. The basic goals for White Sands, as far as Johnson Space Center is concerned, are much the same as they were originally: engine testing, engine development, off-nominal testing. However, in 1967, on January 28, 1967, the Apollo 1 fire. Once the dust settled after that fire, the agency realized that we were putting materials into the inhabited area, the cockpit area, that had not been tested in an oxygen environment. We were putting payloads on the vehicles that had not been tested in a vacuum, and many, many materials and flammability-related issues.

White Sands immediately got in that business in about '67, in mid '67 or so. We started testing materials. That has grown into a huge business, a huge part of the business. It's accepted that JSC funds a lot of it, but we also get funded by Marshall and many others. We do it for a lot of agencies now, not just NASA. We do it a lot for the Navy submarine people, because it's very much like a spacecraft; you can't get out of it just real quick if you have a fire. So we do a lot of naval testing.

That evolved because of that fire in 1967 and it has grown to probably—it's probably, at certain times in White Sands' history it's been much larger than the propulsion testing. During the buildup of Shuttle, it probably wasn't near as big as Shuttle testing. Today it's probably larger than propulsion testing, because we're just kind of in a maintenance mode out there.

Another big, big job that came along just before I came back here as manager, and we really, really went after that business while I was the manager, was the engine repair business. So all of the RCS engines, all of the orbital maneuvering engines that are repaired for the fleet are done at White Sands now. When I came back, we'd done a few RCS engines. We were recovering a lot of engines, too, that the vendor would say, "Scrap engine. We need to build you a new one." We're recovering a lot of those engines and putting them back in the fleet. So that has grown to be a big business now, and that's, I'm sure, larger than—well, it's probably as large as the propulsion testing.

BUTLER: Certainly those are some pretty vital areas there for the agency and long term and maintaining. Like materials testing, I'm sure is pretty vital with the Space Station work going on there.

MCCRIGHT: Right. And as long as Space Station flies, it will be an ongoing business, because new materials show up on the Space Station, testing for outgassing, testing for flammability, testing for point of ignition in various environments and that sort of thing.

I chronologically kind of out of sequence, because I jumped from when I came back here in 1973 through my tenure in '84 and jumped to when I was a manager in '94 about White Sands.

BUTLER: That's all right.

MCCRIGHT: I do have some things to talk about at Houston, too.

BUTLER: Yes.

MCCRIGHT: In 1984, [Kenneth B.] Ken Gilbreath, who was the Director of Center Operations, called me and said, "I've got a division down here that I need to make some changes in." He said, "I would like for you to consider coming back to Houston and taking a division." Mr. Gilbreath was my first supervisor when I came to NASA. He was Chief of the Electrical Branch when I came here in 1966. He, about two years later, was the manager of a site. Then in '74, I believe, he transferred to Houston as Deputy Director of Center Operations. By 1984 he was the Director of Center Operations.

So when he called me in the fall of '83, actually, in the fall of '83, I was very, very reluctant to go back to Houston, but by then my children were not out on their own, but they were out of public school. So I considered it for a few days, and thought, "Well, I'm probably as high as I will ever go at White Sands," because the equivalent of a division chief in Houston, and there's only one job higher than that and that's the manager. So the likelihood of JSC ever appointing me to manager of White Sands is probably pretty remote.

So I thought about it for a month or so, and talked to Mr. Gilbreath several times in the interim, talked to him, and finally I called him and said, "Okay, I'll take the job. If you've really got a division that you think I can help, that whatever I bring to the table will be of benefit to that division, I'll take the job."

So in February 1984, I moved to Houston and became the Chief of Plant Engineering [Division]. Plant engineering was responsible for all of the construction monitoring, being any modifications made to the facilities at JSC, whether it be new construction or modifying facilities, all of it, the construction activity was monitored and the oversight was from Plant Engineering Division, responsible for roads and grounds, janitorial services, plant operations, meaning the central plant, the chillers and the boilers, the emergency backup power, and chillers for the Mission Control Center, electrical power distribution, all the utilities.

I equivalently, when I went from White Sands to Chief of Plant of Engineering Division, had a budget larger than White Sands' budget and had about twice as many contractor and NASA employees as the whole of White Sands did at the time. So although I was equivalent of division chief here, it's a much smaller in comparison to that division chief job in Houston.

So I went to Houston in the Plant Engineering Division. I guess I was successful in doing what they wanted me to do with that division, because in 1986 they asked me to apply for a NASA fellowship program. And I resisted. They said, "No, you really need to do this."



I said, "I don't want to do this. I don't want to be gone for three months," and this and that.

They said, "No, you really need to."

So they kind of put a little pressure on me. So the agency only chose one person for this fellowship from the agency. I went home and told my wife, I said, "Hey, they're putting pressure on me to apply for this fellowship and I don't want to, but the chances of me being selected are between slim and none, so I'm going to satisfy them, I'm going to go ahead and apply for this program."

She said, "Yes, you're going to get selected."

I said, "No, I'm not." I said, "I won't even get out of JSC. I won't be the candidate for JSC because there will be ten or fifteen candidates and then they'll chose one."

So when the selection process at JSC decided who they were going to send forward to Headquarters, sure enough, I was the name. So I told my wife at that time, I said, "Don't worry about it. Don't worry about it. All the centers are going to send a name in. They're only going to pick one and it's not going to be me."

And she again said, "Yes, it's going to be you."

"Nah, don't worry about it."

Well, it was, and so I wound up at Harvard [University] for three months, and I went there in February of '86 and came back to Houston on the 5th of May '86. I truly was concerned that—I was a division chief at the time, and I was truly concerned that by the time I got back, after the division had run well for three months, they would forget about me and it'd be the end of my career. I really was concerned about that.

Harvard was another one of those experiences, after I'd been out of school twenty-five years or so, went off to Harvard, went to school five and a half days a week, and long, long hours trying to read all the case studies and stuff and get ready for the next day, it was a real, real physical and emotional burden to go there and be away from home and be away from the

job and all for three months. But anyway, I survived Harvard and came back to Houston on the 5th of May, I believe, of 1986. I think it was on the 6th of June, Mr. Gilbreath called me over to his office.

While I was gone to Harvard, the Deputy Director of Center Operations retired. He called me up at Harvard. His name was [William A.] Bill Stransky. Great guy. Bill called me at Harvard and said, "Hey, I'm going to retire."

I said, "You're going to what?"

He said, "I'm going to retire."

I said, "Oh, man, Bill, I hate to see you do that."

He said, "Well, don't worry about it. They won't fill this position until you get back."

And I thought, "You don't think so?"

I said, "No, I don't think so."

He said, "It'll take them a long time to fill it. Don't worry about it."

I said, "Well, I sure hate to see you go anyway."

Anyway, he left and he retired. I got back on the 5th of May, the thing was on the 6th of June, Mr. Gilbreath called me over to his office and said, "I want you to be my new deputy."

So I said, "Well, I haven't really finished all the things you wanted me to do in plant engineering."

He said, "Yes, I know, but we'll just leave you acting over there."

So I became the Deputy Director of Center Operations and was Acting Plant Engineering Division Chief for about six months. After six months we finally selected a new division chief and I then became the deputy director. Of course, at that time, Center Operations had seven divisions: Plant Engineering Division, Facility Design Division, Tech Services Division, Management Services, Logistics, and Security. Is that six or seven?

There was seven of them total. Photo and TV was the seventh one. So we had a large organization there, seven divisions, including the history office at that time.

So I was Mr. Gilbreath's deputy for seven years, and then he retired in April of '93. He announced his retirement on a Wednesday and he was going to retire on Friday. I knew it before that, but the center didn't. He announced it on a Wednesday and retired on a Friday, and Thursday about one o'clock the director called me up to his office and said, "Come Friday when Mr. Gilbreath leaves, you're the Director of Center Operations." So I knew before he left that I was going to be the Director of Center Operations.

The seven years that I was deputy director were certainly the most management challenge seven years that I had. The center budget was getting reduced, we were struggling every year about how can we maintain the services that the center expects from us with less budget. There were heated, heated budget arguments between all of us. I mean, everybody was going through the same kind of thing, and the institution was just getting whittled down every year.

We reorganized a few times. We reorganized the Facility Design Division and I acted as division chief over there twice for about six months during that seven years. We took all the economies that we could find. One of the things we did is when the budget got so bad that we could not maintain the services that the center had expected of us, we went to those using organizations, engineering directorate, mission operations, those two in particular, and ISD [Information Services Division] as a smaller one, but we just told them, "Look. We can't do it anymore. If you want some of these services, you're going to have to pay for them, because we do not have the money to buy the material and just issue it to you."

ISD had to do a similar thing when PCs became a big thing and we were buying so many every year, they had to do the same thing. COD [Center Operations Directorate] had to start paying for theirs and other people had to pay for theirs, because ISD's budget just wouldn't support it. In the early days with NASA, you just called on those services from the

provider and the provider fought for his own budget and provided those things to you, but in the mid to late eighties and early nineties, even, it got so bad you couldn't do that.

So that was one of the ways we fought the budget problems in COD. COD was in a little bit of a unique situation in that if somebody wanted services from us, like Technical Services Division, which was the manufacturing arm of COD at the time, and I now work for engineering directorate, if engineering wanted us to build them a widget, it might cost \$100,000 to build it. We didn't have in our budget the \$100,000, and it was a piece of flight test hardware, so it engineering or MOD [Mission Operations Directorate] or somebody's going to have to pay for it, because we don't have the budget to do it. That's the way we survived in COD. A tough way to live. Tough way to live, you're the bad guy on the block most of the time. Those directors understood it, because they were under budget crunches, too. They didn't like it, but they understood it. So it was a miserable time from a budget standpoint.

That's still going on. When I retired two years ago, it was still going on. I'm sure it is today. There has been some short periods of time where we get a little relief from the budget, but it was pretty tough. There was a time when I was deputy director of COD when we had over 100 million dollars' worth of budget, and one year had a 90-million-dollar construction budget. So I mean, we had a lot of money when I first became [Deputy] Director of Center Operations, but it went downhill from there on. And the whole agency's gone through that process.

BUTLER: If we could take a quick break here, and we need to change out our tape.

MCCRIGHT: Sure.

BUTLER: You were talking about some of the difficulties in dealing with the budget challenges and keeping things running, and that the other people at the center would understand, they wouldn't necessarily like it, but they'd understand. Were there ever times where it just, I mean, as it kept becoming more and more of a problem, or that you would just question whether it was possible to keep it all going?

MCCRIGHT: There were many, many times I questioned whether it was possible to keep it going or not. One of the things that we never did, we all recognized we couldn't sacrifice was mission support. Whatever you have to do for mission support, you've got to do. But things like PAO handed out lithographs like they were going out of style. A school kid would write in and say, "Can I have a picture of Shuttle?" and they'd send them fifteen. I do not deny that that was good for the space program. I don't deny it was good for kids, and one of the obligations we have is to keep this thing going in future generations, not just NASA, but the scientific technological advances in many aspects of life.

I think it was a good thing to do, but it got to the point where we just could no longer afford it. I was having to provide the lithographs, get them made, and they're not very expensive apiece, but we started having to cut down on them. We finally cut a deal with PAO, said, "Look, if they ask for a picture of the Orbiter, send them one, and maybe send them a picture of a crew, but don't send them a whole selection of things," because we just could no longer afford it.

So those are the kind of things you hate to do, but you have to. Taxis. You probably don't even remember when we had taxis running all over the center, but we had probably a staff of about twelve to, depending on the time frame, twelve to twenty drivers of taxis. You could call, anybody could call logistics, or transportation, and say I need a taxi at Building 1 to go to Building 45. And they would pick you up at the front door of Building 1 and take

you to 45. You and two or three other people, maybe, but they would, you know, take them on.

Then we got to the point where the first economy move we made is we said, "We're no longer taking you in the mall area. If it's anywhere in the mall area, you walk. If you need to go out to the 400 Area or out to the 200 Area, we'll take you, but we're not taking you in the central mall area." That was not met with great popularity. But we just no longer could afford it, so we had to. We cut the number of drivers down to five or six, maybe eight, I don't remember exactly. Because we'd run taxis up to Ellington [Air Force Base, Houston, Texas] and places like that.

Then for a while we were picking VIPs up at the airport if they requested a taxi in the middle of the night, and we'd get a government taxi up there and pick them up and bring them back. Finally, I said, "No, no more of that. If you want to do that, if you want a taxi, you ride a taxi and let your travel pay for it. We're not going to send a government taxi."

Then we got to the point where—and I was a party to this—we're going to have to go to buses. We're going to have to run some bus routes. If people want to ride them, it will give people on the mall an opportunity to ride a bus, which they didn't have at that point in time. We'll run over to the contractor facilities and we'll do all this. It turned out we could lay off about three drivers and then we could run the buses.

Now the buses were never totally, and aren't today, I'm sure, totally satisfactory to everybody, but it was one of those economy measures that we had to do. It is not impossible for you to get from Building 1 to the Rockwell [Corporation] buildings over on Gemini. It's not pleasant, but you can do it. Used to we ran taxis, and we just could not afford to do that any longer. So now we run buses, whether we need them or not.

If you have to go over to the Rockwell building and the government doesn't provide a way to do it, and you can't get a government car, then you can theoretically charge mileage on your car. Not if there's a bus running, because you could have ridden a bus. So that's the

reason we had to do those things and nobody liked it. I didn't either, but it was a survival technique. So there's just thousands of those examples of things we did.

You asked if I ever thought it was impossible to keep it together. I once made a budget presentation to the deputy director of the center and the associate director of the center, and it's the worst one I ever had to make. I went in and made a budget presentation. I said, "These are the services COD is no longer going to provide." And they were some severe cuts. The response I got from those two gentlemen—and they're both very good friends of mine, I like them very much—they were caught with, "What are we going to do?" too, and they said, "But we can't do that. The center cannot survive if you make those cuts."

I said, "Okay." I put another chart up, and I said, "All right, how about these?" I had developed these slides, and I went in there, "All right, how about these cuts?"

They said, "No, those are just unacceptable cuts."

I put another slide up and I said, "All right, how about these?"

They said, "No, they're not acceptable reductions in the services that you provide us."

"Okay, what do you want me to do? You tell me what you want to do," and I got no response. It was that bad. They didn't know what to do either.

So that's when we increased the demands on other organizations, that if they wanted services from us they're going to have to pay for them. You cannot get blood out of a turnip. I mean, there are many economies you can make, there really are. I believe that in good faith we made most of those between '88 and '91 or '92. I think we made many of those. I'm sure they've made some since. But I know that after I left JSC, they took a lot of reductions in grounds maintenance. The reason that did not occur on my watch was the powers-to-be at the center were not willing to do it at that time. It was proposed, but they weren't willing to do it. The leadership at the center changed and now they are. So be it.

But that's the kind of problems we went through. As the budget got worse and worse, I probably was spending 50 percent of my time on budget matters at its peak, maybe. Before

I left, I think it had tapered off to some extent. I truly believe nobody holds that against me personally. They all knew. It was just a fact of life. They were all facing that.

But on the upside, it was probably the biggest management challenge I ever had, but it was some of the most fun I had, too. I really had a good time as Deputy Director of Center Operations. Most of it was a lot of fun, even the heated budget arguments. I mean, some of those budget arguments I would not even want to relate to you is how bad they got, the emotional confrontations that happened between deputy directors and directors, and deputy directors and me and the comptroller. It was just a bad time. But I don't think any of those people feel badly about it. They knew why it was happening. They weren't blind to that.

But on the upside, some of the highlights I had, let's see, I was still plant engineer and division chief when we had the President [Ronald] Reagan memorial service for the *Challenger* accident. Now, that was another challenge because I was the division chief at the time, in charge of all the facilities and most of the preparations and stuff for the President coming.

The accident occurred on a Tuesday, and on Wednesday afternoon I got a call to be in the director's conference room at ten o'clock that night, on Wednesday night, because Reagan was going to come down. We knew during the day Wednesday that that was going to happen. So we had started thinking about what, gee, what are we going to do? How are we going to pull this off? Thinking about where would we do it. We decided to do it in front of Building 16 on the mall and outdoors.

So I went to this meeting at ten o'clock on Wednesday night in the director's conference room, and the White House staff was there and the Secret Service was there, and two or three of my people and PAO people and the associate director, I think, was there. So we started talking about what we thought of how we might do this and so, of course, the Secret Service had many, many concerns. White House staff had concerns. So I finally went



home on that Wednesday night about 2:00 or 2:30 or so in the morning. I don't remember exactly what time.

But I went home, and got up and went back to work at 7:30 or so the next morning, and worked all through that day. We had another meeting Thursday night at ten o'clock with all those White—we'd been working with them all day, during the days. I went home on Friday morning shortly before sun-up and took a shower and changed suits, and went back to work at eight something, I guess, I went back to work. As I recall, that memorial service happened about eleven o'clock in the morning.

So I got back out there just shortly after sun-up, early, before six o'clock or so, and by then we'd roped off the big area and we had metal detectors that the White House had brought down. There was a planeload of White House uniformed security that came. There were sheriffs and constables and Secret Service everywhere. I was given a Secret Service pin to wear on my lapel so I could cross the barrier wherever I needed to. I would not have been successful without that, because the Secret Service will run you through a metal detector, and if you're of a person involved in their support, they'll give you this little pin you can wear. It allowed me to cross the barriers and whatnot and move around.

I remember telling a contractor project manager up in the middle of the night on Thursday night, or I guess it was early night on Thursday night, to go get some more plywood. He said, "I don't have any more plywood." It was after ten o'clock, because the Home Depot and stuff was closed.

I said, "Look, go get—" how many sheets of plywood, I don't remember how many it was.

He looked at me and he said, "All right, I'm going to get the plywood, but don't you ever ask me where I got it."

I said, "Done."

At his retirement party about seven or eight years later, I told that story. I said, "And to this day I have not asked him where he got the plywood." [Laughter] I'm sure he stole it from another project somewhere, but anyway.

BUTLER: He didn't tell you after the party, either, did he?

MCCRIGHT: No, he didn't tell me after the party. What we were using it for is building a podium he was going to speak from. We didn't have enough plywood, so get some more, and he did. But those are the kind of things in a crisis. STS-3 recovery was a crisis. Reagan's memorial service in 1986 was a crisis. People will do way above and beyond the call of duty to make those things happen. I have been firmly convinced over my career, you can ask people to provide services and time that's well outside the realm of reason for a short period of time, if you've got a good reason to do it. You can't continue it very long, but you can get people to do amazing things on a short term.

That was a highlight of my years in Houston, one of them. When Reagan came back in '88 or '89, when we launched STS-26 he came back again. I was deputy director at the time, but I was involved a little bit more remotely than I was the first time, but in that visit, too. That was another highlight. I mean, it took a lot of work on a short period of time dealing with it.

I remember on that second visit I got in an argument at one of those meetings with Secret Service and the White House staff. The Secret Service was insisting that we put handrails around the platform that Reagan was going to speak from. Both the White House staff and Secret Service were deathly afraid he was going to fall. They were absolutely petrified that he would fall. So we had to make everything as smooth as possible and all. I said, "Okay, we'll put the rails up."

The White House staff said, "No, we don't want any rails up there, because it blocks part of the view of the public and the TV cameras and all." So, okay, we won't put the rails up there.

The Secret Service said, "No, we demand that you put the rails up there to protect him."

I said, "Wait a minute." I said, "I can't satisfy both of you. You (this was a lady from the White House staff) and you, Mr. Secret Service man, you go out of the room and y'all sort it out, and when you come back here and tell me, I'll do what y'all decide, but I can't satisfy both of you. So y'all sort it out." They did and we didn't put the handrails up. [Laughter]

Then JSC safety got in the issue, and they decided we were going to have the handrails up about two hours before Reagan showed up. I told the director of safety, I said, "There's not going to be any handrails."

And he said, "You're violating OSHA [Occupational Safety and Health Administration]."

I said, "That's right, and that's Mr. OSHA that's going to stand right up there and talk to us." [Laughter] I said, "They're not going up there, and if you don't like it, go talk to the White House staff. Don't talk to me." He didn't, and we didn't put any handrails up.

But it was a fun time. It really was. I have fond memories of those two visits of President Reagan. I have another memory of [President] George [H. W.] Bush visiting when he was the President one time, and we painted a stairwell, because he was going to go down it, and couldn't get the paint to dry. It was still tacky when he went down the stairway, and this is embarrassing, but we had to hang "Wet Paint" signs on the stairway. I believe the President of the United States thinks everything in the world smells like fresh paint, because we painted everything when they showed up. But it was a fun time.

Certainly the biggest job that I ever had in NASA was Director of Center Operations. White Sands manager is an equivalent grade and it's a hazardous testing, and it's more technical than the Director of Center Operations, but Center Operations was certainly probably the highlight of my career. Anybody looking at my career would say it was. Probably self-satisfying maybe was White Sands manager, because I started out here as a GS-7 and wound up as the manager, so that was kind of a pleasant experience.

But when I was Deputy Director of Center Operations, in August of 1986, I was appointed charter board member for Space Center Houston, and it was added to my job description to give me the protection of the government from lawsuits and whatnot, and allow me to use special time to do that. So I served as a charter member for ten years along with John [W.] O'Neill, Harvey [L.] Hartman, Carolyn [L.] Huntoon, Charlie [Charles F.] Bolden [Jr.] part of the time, P. J. Weitz part of the time, Sue [Susan] Garman part of the time.

That was a thoroughly enjoyable time. It was a stressful time, certainly in the early days of that, because nothing had ever been financed in the government that way before, and the government does not own that facility. The Manned Space Flight Educational Foundation, Incorporated, owns it, of which I was a board member. We publicly financed 64 million dollars. So 64,400,000 we acquired from NASA Headquarters; actually, Congress. Congress edicted that NASA Headquarters provide us 10 million dollars for infrastructure support, being able to get back on JSC and tie onto the water lines and the sewer lines and all of that. So the Congress actually paid for that. It just flowed through Headquarters to the Manned Space Flight Foundation.

I wrote the technical specifications for the design competition over the Christmas holidays of 1987, probably. I can remember, on leaves at the kitchen table, writing specifications for the design competition and also specifications, the first brush at the specifications for the building, this building and structure and whatnot.

We contracted with Walt Disney to do the preliminary design, Walt Disney Imagineering. That was an experience that I'll be forever grateful for. We were out there in Glendale, California, at their facility. Bill [William R.] Kelly was chairman of the board. I forgot. Hal Stall was the president at that time, too. Chuck [Charles A.] Biggs was the vice-president. Norma Kersman was the assistant secretary, I believe, and Wayne [L.] Draper became the treasurer. I guess Hal and Bill Kelly and Chuck Biggs and I, I guess, were out at Glendale, California, talking to Disney about the preliminary design. Those folks are absolutely amazing. They know their business. They know it very well.

We had a working lunch out there the first time we visited. A guy named George, who was on the original design team with Walt Disney when they conceived Disneyland in 1955, was in this meeting. He was chief architect there at the time. I remember we got to talking about what the facility might look like and what we might do, and he took his salad bowl and turned it up in the middle of the table, and took some salt and pepper shakers and spoons and forks and stuff like that, and almost did the preliminary design for what the structure might look like right there at the table. And it almost turned out that way. It had a dome all the way across the top then. It's now flat across the top. That was a wind loading and a cost issue, but it looks very much like he had in mind at that time.

Then I was in a conference room out there that we met in a number of times. I was sitting at the end of this long conference table, and it had high walls and little windows around the top, maybe twelve-inches tall windows, all the way around the top. There were drawings pasted all over the walls of Disneyland and Disney World and Epcot Center and the one in Paris. They were just opening the one in Paris at that time. So there were just drawings all over the place. Somebody made the comment, I don't remember, maybe Hal Stall made the comment, because they would refer to Walt Disney quite often. They would say, "Well, Walt felt like this was necessary to handle the public," and Walt this and Walt that. Somebody made the comment to them, said, "How long has Walt Disney been dead?"

They said at that time he'd been dead twenty years. This guy said, "Well, it is very, very evident that Walt Disney's influence, his ideas still have a great influence on where this company's going."

They said, "Oh, yeah. Oh, yeah." Said, "He was very powerful in what he believed, and he was right in most cases." Not all. As kind of an aside, they said, "We're in the room, we're sitting in the conference room where they originally conceived Disneyland."

We said, "Really?"

They said, "Yes." They pointed at me at the end of the table, and they said, "And that's where Walt always sat." And this just gives you a little warm and fuzzy feeling to be in an environment like that. But it was a pleasure to work with them. They had thousands of concepts and ideas. And if we didn't like this one, here's another one, you know.

During the early design phases of this, we traveled quite a bit. Went to Huntsville, we went to the Cape, went to Disney World. The Land Pavilion at Epcot, if you walked into it and stopped and looked around and thought about Space Center Houston, that's almost the same design of the structure. Very similar design. That was where they took us to say, "This is what we've got in mind."

So that was a very pleasant experience. It was exciting, trying to get it open and doing the design and doing the construction. I was responsible for monitoring the construction from the board's viewpoint. I was chairman of the operations oversight committee while it was being built, after it got opened and operating. It was a very rewarding experience, because it was the most fun—I've been involved in a lot of construction in my day, and it was the most fun construction I've ever been involved in, because I was doing it like the private sector, not like the government and I didn't have to worry with the competitive requirements of the government, and we could go to who we wanted to.

It was a cost savings-type contract, cost-incentive contract, where they can make money by saving us money. So they just had a jillion ideas about how to improve the construction and the design while we were building it. Many, many of them were approved by us, because they saved us money and we shared that savings with the contractor. The government's now doing a little of that, but they weren't in those days. So it was a lot of fun for me. I think if you talk to any of the board members, I think they would all tell you that it was unique.

I was one of the principals that helped get through Headquarters a fifty-year lease on that property. I mean, boy, I don't know how many times I went to Washington before we got that signed. Sue Garman helped me a lot in some of that. General Billie [J.] McGarvey was the chief of NASA facilities at the time in Headquarters and he helped a lot with that. We had to get Congressional approval. Normally the government signs contracts for five years or ten, and this is fifty. So it was a great challenge for me, but a great deal of fun, too.

I will be forever thankful that I was on the board, and it only became not so much fun when we started having problems paying off the bonds that we [sold]. We had to restructure our debt. That was a painful process. I went through the first debt restructuring. I don't know if they've done it again or not, but the first one we went through was a very painful process. But other than that, it was a pleasant experience.

BUTLER: It certainly must have been nice to see it all come together and see the public response to it.

MCCRIGHT: Yes. As a matter of fact, I was in Houston three weeks ago and took two of my granddaughters through Space Center Houston for the first time since they were old enough to remember it, at least, and they were just absolutely enthralled with the whole thing, so it made me feel really good that they were.

I believe that Space Center Houston now, although I haven't been a board member now for about three years—yes, about three years—it appears to me from what I've heard that they're on better financial footing than they were when I left. I was in there twice while I was in Houston, and there was a big crowd there both times. So I hope they're doing well, and it seems that they are.

BUTLER: They always seem to have a crowd when we go by.

MCCRIGHT: Yes, I was glad to see that.

BUTLER: It did come up that you ended up going back to White Sands as manager, as we talked about a little bit before. But you had also mentioned that when you came back to JSC that you were thinking, "Well, there's not really any further up I can go at White Sands," that you hadn't even thought about really getting the manager's job.

MCCRIGHT: Well, I would have been eligible for it if it had been vacant, but I always felt before I went to JSC and spent the last ten years down there, which, by the way, the last ten years in Houston I really thoroughly enjoyed it. I really did. But I had a different attitude. I wasn't worried about children then, and it was much easier to go live in the big city.

But while I would have been eligible for the manager of White Sands, I did not believe that the director of the Johnson Space Center would appoint someone at White Sands as the manager because he didn't know us well enough to feel comfortable doing that. I felt even stronger about that after I got to Houston, looking back at White Sands, and got at the senior staff level in Houston, I said, man, I guess I can understand that. I wouldn't either. If I was a director, I would feel very reluctant to appoint somebody that's an office chief at White Sands to be the manager, because we just don't get enough exposure to them to know them



that well and feel comfortable, because the manager out here is 850 miles from his boss. The director of the center has to feel confident with whoever he puts out here that he can leave him alone and let him do it, because he's too far away to influence him very much, certainly not on a daily basis. When I was the manager, I talked to the director of the center almost every other week regularly, and occasionally in between, but you don't even talk to him very much. You just go on and do your business.

So I think that I probably would not have been appointed the manager had I stayed out here. Maybe I would have. Maybe they would have by then known me well enough to feel comfortable doing it, but I wouldn't be too sure.

But the ten years I spent in Houston as a division chief, as a deputy director, and as Director of Center Operations, in all the committees that I was on in Washington, and all the time I spent in Washington, and one year I went to Washington twenty-six times from JSC, so I got a lot of exposure at Headquarters level, too, the knowledge that I had of the agency was many times as broad when I came back in 1994 than it was when I left in '84, because when I was here in '84, I did very little work with Washington. When I went to headquarters, I went to Houston. And when I was in Houston when I went to Headquarters, I went to Washington. So I got a much, much broader understanding of the agency and certainly was known much more widely than I would have if I'd stayed at White Sands, within the agency. So I think that that's one of the reasons that they sent me back out here.

The other reason that they sent me out here is, I had no intentions of ever being able to come back to White Sands after I became deputy director, really. I never had any thought that I would get back to White Sands, and certainly not after I became Director of Center Operations.

But in December of 19[93], the manager of White Sands died suddenly of a heart attack, so for about six months there was no permanent manager of White Sands. The deputy manager here was acting for those six months. He certainly was a capable guy. He is now

the manager of White Sands, because they are now comfortable—when I retired, they were comfortable enough to send him back here, because he had transferred to Houston in the interim and gotten on in Houston. But he was my deputy, and he's a great guy, and I think he's doing a good job for White Sands today.

But at the time that the manager died, I suspect there was not that confidence in Houston of making the deputy manager the manager, because deputies in Houston work with center senior staff and the director and the deputy director all the time, but the deputy out here does not. So when they had to find somebody to put back out here, I think they looked around and knew I had hypergolic propellant experience and rocket engine testing experience, and knew me well enough to feel comfortable sending me back out here. So I came back out here in July of '94, and I continued to be the manager for four years.

In '97, my deputy transferred down to Houston and became the Deputy Director of Center Operations. He stayed down there for about a year, and when I announced my retirement, they sent him back out here as the director of the facility. I think that was a good thing for everybody.

BUTLER: Sounds like Center Operations at JSC might be the training ground maybe for the White Sands managers.

MCCRIGHT: Has been for the last two times.

BUTLER: Certainly there's a lot that applies.

MCCRIGHT: Yes. Well, all the managers at White Sands, after the first one, first manager at White Sands came from the Army when we just built place. The second one came from White Sands, that was Ken Gilbreath. But he only stayed manager for about two years and

transferred to Houston as Deputy Director of Center Operations. The third one came from TTA [Thermochemical Test Area] in Houston to be the manager out here. The fourth one, Rob Tillett, was an incumbent here, but had worked in Houston earlier, many years earlier, but he had worked in Houston, knew a lot of people there. Then Dick [Richard A.] Colonna came out here as the fifth manager from Shuttle Program Office. After he had left it and been the NASA liaison in Australia for a year, then he came to White Sands as the manager, and I was the next one. So three of the Deputy Directors of Center Operations have been the manager at White Sands.

BUTLER: While you were manager at White Sands, what was your biggest challenge at that point in time, and what were some of the projects that you were involved with?

MCCRIGHT: We were certainly faced with—at that time we were still in the budget reduction process. It was ongoing. White Sands had done many, many things to offset some of those budget reductions, such as going out after a lot of reimbursable work. They had just started, and weren't even certified yet, to rebuild RCS engines. When I got back out here and took a look at that I said, "Gee, I agreed, that is a service we can offer to this agency much cheaper than getting it done with the original equipment manufacturer." The original equipment manufacturer was reducing that staff all the time and just about to lose most of the expertise to actually do it, because the engines are so old.

So we really went after that engine rebuild work. About a year or so after I came out here, we became certified to do the OMS [Orbital Maneuvering System] engine repair work. So now White Sands is the depot for engine repair—repair, refurb, and recertifying, and put them back in the fleet. We do that work for the NSLD at Florida. We do that for the logistics people in Florida. So that has increased our reimbursable work by a pretty large percentage, just doing that engine rebuild work. There are always RCS engines going

through there, and occasionally an OMS engine goes through to be refurbished and recertify. We have to fire them and recertify them.

So my goals when I came back, the director of the center at JSC told me the week I left the center, I went up to see him and said, "Well, I'm headed to White Sands now. Have you got any last-minute instructions for me?"

He said, "No." He said, "I'm comfortable with you going out there or I wouldn't have sent you out there." He said, "I would just tell you to go after all the reimbursable work you can handle because it's good for JSC. It offsets the cost of White Sands."

So I did, and I think over my four years we increased the reimbursable work over 20 percent. We even got into the flight hardware building with ORCA. We just got started in the ORCA business. That was the first flight hardware White Sands ever designed and built, tested and delivered. It was not even built when I retired, but we had been involved in the project for several months at that time, so we were beginning to get into that business. I think White Sands is in a unique position to offer design, build, test, qualify and deliver flight hardware that's hazardous fluids-associated: liquid oxygen, gaseous oxygen, hydrazine, nitrogen tetroxide, that sort of thing. So increasing reimbursable work was one of my big goals, and fighting the budget reductions and finding more efficient ways to do the business.

Another big thing that we did that turned out to be, I think, a good decision. When I came out here in '94, they had recompleted the contract in '93. It was not awarded until June of '94, and I got back in July. I came back the 11th of July '94. In that contract it stated that the contractor would become certified to ISO 9001 [International Standards Organization] within eighteen months. The deputy manager at White Sands elected to not do anything, because he knew I was coming, and he elected not to do anything till I got here. It was only a month, but when I got here in a month, he said, "I haven't let them get started on that, because I feel very strongly that if you don't sign up to it and if you don't support it, we should not do it."

I said, "Well, what's ISO 9000?" because I did not know.

So over the next few weeks they educated me on what it was, and I went over to Fluid Systems Division of Allied Signal in Tempe, Arizona, who had just become certified in ISO. I spent two and a half days, grueling days, over there going through what they had done, why they did it, what their lessons learned were, how expensive is it and all of that. I convinced myself in those two and a half days that for White Sands Test Facility, being in the hazardous testing business, it was the right thing to do, because ISO 9000 does not ensure that you will have a high-quality product. In and of itself it doesn't. What it ensures is that if you follow the rules that you lay down, you will have a consistent product. Not necessarily a good one, but it will be consistent. It'll either be consistently good or consistently bad, but you'll do it the same way every time. In a hazardous-test business you have to have testing and engineering discipline rigor into the system or somebody's going to get hurt, or you're going to blow up an engine, or somebody's going to be killed.

So I came back, and in consultation with my deputy, the deputy program manager, and the program manager for the contractor, and a few other people, we decided that, yes, it's the right thing to do, and, yes, we ought to go for it, and, yes, we ought to go for it in twelve months instead of eighteen. Because we'd already lost by that time about three months. I was convinced that if I give you eighteen months, you'll take nineteen. If I give you twenty-four months, you'll take twenty-five, and if I give you thirty-six months, you'll take thirty-six or thirty-seven months, but you'll do most of the work in the last twelve months. And I said, "We can't afford to drag this thing out. If we're going to do it, we have to do it now."

So everybody signed up to that twelve months, some very reluctantly, but they signed up for it. To make a long story short, after a lot of management intervention and a lot of gnashing of the teeth, and a lot of long hours, I couldn't give them a lot of budget relief. I told them, "You're going to have to do this and meet the commitments that you've made to

your customers. We could go back and if I could negotiate with the customer and he could slip it, fine. But if he can't, you're going to have to meet the date you committed to."

So it was a very rigorous, tough twelve months. We exposed everybody at the facility to what is ISO 9000, even the machinists and the carpenters and the janitors. Everybody went to a four-hour class about what it is. Then there were a smaller number of people that were actually involved in implementing it.

But to give you an example of why I thought it was a good thing to do—this is 1994 I'm talking about—during the process, where we had to go review all of the procedures and the processes that we used to do the work out there, and many of them hazardous, during that process, one of the guys brought a procedure into a meeting and laid it down in front of me and said, "Hey, look at that procedure that we're reviewing." I thumbed through it and I had signed it in 1976.

And I said, "You haven't revised this since 1976?"

And he said, "No," and he kind of laughed.

And I said, "Are you still doing it this way?"

"Well, not exactly like that."

And I said, "That's the reason we need to do ISO 9000." It forced us to go review all those things and revise them. We didn't have to revise them, but what you have to do to qualify for ISO 9000 is say, "This is what I'm going to do. This is what I did, and I can prove that I did it that way. I have some substantial evidence that says that's the way I did it." And the certifying people don't really care what you do, as long as you do it like you said you're going to do it, you write it down, and you do like you said you're going to do it, and you can prove it. It's not up to them to ensure you have a quality product. It's up to them to ensure you did it like you said you're going to do it.

But that whole process cost—I hope it didn't cause any divorces, but it cost an awful lot of long hours and tough time, and the final result was that we got certified on the first

certification inspection. We were the first NASA facility to be certified. We were the first government facility to be certified, because we certified all of it.

There were some isolated organizations that had been certified within the government and within NASA, but nobody had done an entire facility, an entire installation. We were recognized by the agency for doing that. We were submitted for and awarded a Hammer Award from Vice President [Albert] Gore [Jr.] for being the first government installation to be certified ISO 9000.

MCCRIGHT: I went to almost every center and Headquarters, after we became certified, over the last year that I worked, by invitation, because I went to Headquarters and made a presentation to Dan [Daniel S.] Goldin, and he said that day, "This agency's going to be certified to ISO 9000." So I got the opportunity to go to almost every center invited me to come and said, "What'd you do and how'd you do it? Because Goldin says we're going to have to do it." So I did that. And each and every time I did that, I said, "I want the record to reflect that the day I was in Headquarters and made this presentation to Goldin, he said before my presentation, 'The agency's going to do this,' not after." [Laughter]

But, anyway, White Sands got a very—I believe it was the right thing to do. They're still certified.

The other unique thing about this is we did not—normally what you certify is a company. We didn't certify the contractor and we didn't certify NASA. We made an agreement with the ISO Certification Board that in our particular case we can't certify NASA and we can't certify the contractor, we should certify the facility, so that whoever the contractor is, we take these same procedures and say, "Now you execute them." And no

matter what the changes are in the facility management staff or the employee staff, it's still the facility that's certified, not the companies. And this is the first time that was ever done.

So it was a good experience. I'm glad we did it. It cost us a lot of money, but I firmly believe that probably by now it has paid for itself. As a matter of fact, it was not but about a year after we got certified that a customer came to us and said, "Could you do this job for us?" and we looked at it, a commercial customer. And we said, "Yes, we believe we're unique enough in our facilities and capabilities that we can do this job for you and not compete with industry."

Normally when a new customer shows up, they want to come in, they want to look at some of your processes and your procedures and all this kind of stuff. They had given us the specification of what testing requirements they had, and we said, "Yes, we can meet those." And we said, "What else do you want to look at?"

Somewhere along the way they said, "Aren't you ISO 9000-certified?"

We said, "Yes, 9001-certified." We said, "Yes, we are."

They said, "We don't need to look at anything else." So it's been a good thing for White Sands.

BUTLER: It certainly sounds like it's paid off.

MCCRIGHT: Yes. I might close by saying for the record that I had a fantastic career. I wouldn't take a minute for any of it. I wouldn't take \$1,000 for a minute of it. I worked for the agency for over thirty-two years and I am thankful to NASA and the federal government and the space program that I got the opportunity to be involved in many of the things that I was. I will be forever grateful.

BUTLER: You certainly have had some very exciting times.



MCCRIGHT: Yes, I sure have.

BUTLER: If I could ask you jut a couple final questions.

MCCRIGHT: Absolutely.

BUTLER: Looking back over this unique career, what would you say over all of that would have been your greatest challenge? You've certainly had a lot that you've talked about.

MCCRIGHT: Well, STS-3 recovery will always be in my mind as one of the biggest engineering challenges, to get the facilities and the capabilities and the support mechanisms in place in just the few days we had before the Orbiter landed. That was a big challenge. It was a big challenge for the agency, for me personally, for the people that worked for me. I'm very proud of that. So that certainly was one highlight of my career.

Apollo 11, Apollo 8, Apollo 13, they're all highlights of my career. One of the things, when you talk to people of my vintage is, that we have to say that probably one of the biggest highlights of our career was Apollo 11, successfully getting Apollo 11 home. I was twenty-six years old. If I really say that was the highlight of my career, it's been downhill for the rest of the time.

It was a very exciting and self-satisfying thing for me. Apollo in total was a lot of hard work, a lot of long hours, but greatly rewarding. It will never happen again, certainly not in my lifetime. Probably not in the space program. We've missed too many opportunities for that to happen again, because the nation's not seen fit to sign up to go to Mars. If they sign up and say, "Yes, let's go to Mars," but they don't say by a certain year, it will not be the same.

The one thing that happened in Apollo is when President [John F.] Kennedy challenged us to do it by the end of the decade. He made the money available to do it, and it took a lot of money. I don't believe that's going to happen again.

So everything, including Space Station and Shuttle, has been drawn out and drawn out and drawn out and drawn out, and I believe that that will continue to happen, and I'm sorry for that. Anybody that worked with Apollo would probably tell you the same thing, that they're sorry that happened.

But there's been so many other delightful things that have happened in my career I am proud of. The *Challenger* will be a low point in my career forever. Apollo 1 fire a low point in my career and everyone else's. But because the *Challenger* happened, I'm sorry, but since it did, one of the highlights of my career was the memorial service, getting ready for it and supporting it in Houston in January of 19[86].

Certainly, ISO 9000 at White Sands is, I believe, one of the things I did right. It was the right thing at the right time. I think it's made White Sands more efficient, safer, more consistent, and so I think it will pay off in years to come.

Space Center Houston will always be—it was in my job description, so it was a NASA job, but it was privately funded. We did it like the private sector does. I got to work with Disney Imagineering. I got to work with some of the best talent in NASA on the board of Space Center Houston: John O'Neill, Bill Kelly, Hall Stall, Chuck Biggs, just all retired now. But they were just great people and were a pleasure to work with.

So if I look at what single thing, I guess I'd have to say Apollo 11, probably, but was Apollo 8 thrilled me. Apollo 8 was a gutsy mission, very, very gutsy, one that they decided to do in less than eight months, I think, and executed it in less than eight months. Apollo 13, nobody who was involved with Apollo 13 can't say it was not a grand and glorious day when they successfully landed. So because I was involved in Apollo, that will probably, as time goes on, be more and more important to me. But not to say that the recovery of STS-3 wasn't

a personal challenge, and Space Center Houston, and the memorial service, and many, many other events that were.

I've always said, and this is certainly a true statement, I'm very fortunate that not only do I get to read history, I helped write it. Being in this business, you're in the news virtually every day, not me, but the activity of the space program's in the news, and it's part of history, and I was there.

BUTLER: You certainly were, and certainly gutsy, a lot of exciting things going on. You'd mentioned that early on that you were interested in becoming involved with the space program if it was at all possible. Would you ever have imagined where it would take you?

MCCRIGHT: If I'd done what now?

BUTLER: Would you have imagined back when you were first wishing to become involved with the space program, would you have imagined where you would end up?

MCCRIGHT: No. As a matter of fact, to give you a little story about that, the romance of the space program and the technical challenge of Apollo was probably what drew me to it. But I was working part time for the post office during the last summer that I went to college, and I was sorting mail and stuff like that in the post office. While we were sorting mail one night, somebody said, "What are you going to do when you get out of school?"

I said, "Well, I've already accepted a job with NASA."

There was a young lady working there part time that said to me, "You're going to go to work for NASA?"

I said, "Yes."

She said, "Do you think you'll ever be sitting at a console and controlling a space flight?"

I said, "No, I doubt if I ever will."

She said, "I just can't imagine you ever getting involved in that program for many, many years. It's so technically oriented and you must have to have so much experience."

I said, "Yes." I felt like, yes, that's probably right, because I didn't know.

Two or three months later, I was at White Sands, I was working for Ken Gilbreath. I had been here two or three weeks, and he sent me a copy of a memo he had written, adding my name to the signature authority on test preparation sheets, which is the way you change a facility and you conduct tests. He had given me the authority within three weeks of when I went to work, to sign those documents. And I was absolutely amazed that a green engineer would be given that kind of authority in that short a period of time. Now, certainly there were checks and balances there. I mean, more than one person signed them, but he had given me the authority to sign for his office.

Throughout my career, I believe NASA has given me all the responsibility and all the authority that I chose to accept. I'm not known for turning much down. I think that that's just absolutely amazing that you could do that. But if you look back on Apollo, there were a few gray heads working on Apollo, but most of the people were very young. Most of the people who were intimately involved with flight hardware and controlling flights and making technical decisions about the flight were in their late twenties. So it was really an amazing time. There are some people my age that we'll talk about in a minute, that if you have not talked to you should, because they were in their twenties when they made some very critical decisions that proved to be right.

BUTLER: Throughout your career were there any people that made a big influence on you or what you were doing at the time, that you'd like to mention on the tape?

MCCRIGHT: Yes. Ken Gilbreath made a big influence on me, because he's my first supervisor. When he retired, I replaced him as Director of Center Operations. I worked for him off and on for over thirty years. I didn't work for him for fifteen of those years, but I did for the last ten I worked for him. He was a big influence on me.

John O'Neill, who's just a great guy, was a big influence on me. Bill Kelly was a big influence on me. Aaron Cohen. Rob Tillett was a big influence on me, because I was detailed to him on the Pearl Program in 1968, probably '68, for about three months over on the other side of the hill where we were conducting landing and rendezvous radar tests for the lunar module and command service module.

Gene [Lawrence Eugene] Lundgren, who was a former Chief of Technical Support Office at White Sands, was a big influence on me. And an engineer that retired, just as an engineer when I was very young and green, named Chuck [Charles H.] Provine, who was a World War II vet. From a technical standpoint, he helped me an awful lot. He was the kind of guy that was very knowledgeable, but if you went to sit down and talked to him, you had to pull it out of him to get much out of him. I remember going to him one time and showing him some electrical power distribution service I was working on and telling him what I was going to do. He said, "Now, are you sure you want to do that?"

I said, "Yes, why not?"

He said, "Well, just think about it."

The more I thought about it, the more he led me to the conclusion that if I didn't distribute the different phases through these conduits, I'd have eddy currents between the conduits and they'd get hot. This never occurred to me to do that. So Chuck Provine had a big technical influence on me, too.

Once I got to JSC and got up into the deputy director position, Gene Kranz had an influence on me. Henry [O.] Pohl, Chief of Engineering, had a lot of influence on me. So

there are many, many people that I owe thanks to that I got to where I got the opportunity to do the things I did.

BUTLER: It certainly took a lot of good and talented people to help the whole program come together.

MCCRIGHT: Yes. NASA is a very unique organization, as far as talent's concerned. There continues to be, and there certainly was in the early days, some extremely talented people.

Something you asked me in a letter about the interview process when I came to work here.

BUTLER: Yes.

MCCRIGHT: That's an interesting story. I was at college, applied to JSC, received an offer in the mail—no, I take that back. A personnel person from Houston called me and asked me if I would accept a job at White Sands Test Facility, and I said, "Yes, I will." We talked about what is it and all. He didn't know much about it, but what he told me was enough to say, "Yes, I'll take the job." I received a written offer in the mail. I never talked to anybody at White Sands. I never talked to anybody technically at JSC.

When I got to White Sands, after I'd been there a while, Mr. Gilbreath showed me a letter he wrote to personnel when they'd notified him I was coming. He protested and said, "I don't know this person, I've never talked to him, I have no idea if he's technically competent." He objected to the way they hired me. I guess when he made me deputy director of his organization, he had finally decided I was going to be okay, I guess. [Laughter]

BUTLER: I think probably so. Well, it certainly sounds like over the years enough people thought that you were okay. It certainly panned out well for everyone, it sounds like.

MCCRIGHT: Yes, I've had a great career.

BUTLER: I'd like at this point to ask Kevin if he has any questions.

RUSNAK: I'll save mine for tomorrow.

BUTLER: Okay. I want to thank you so much for sharing all this with us.

MCCRIGHT: You're welcome.

BUTLER: You certainly had some interesting times.

MCCRIGHT: I give you the opportunity when you're transcribing this or thinking about it, if you've got any other questions, call me or whatever, and I'll be glad to give you my views on them.

BUTLER: Great.

MCCRIGHT: When you talk to other people some things may come up that you want to talk to me about, I'll certainly be happy to talk to you.

BUTLER: Wonderful. You'll have a chance to review the transcript, too, so if you think of anything at that time we can always add that in as well.

McCRIGHT: Okay.

[End of interview]