ORAL HISTORY 2 TRANSCRIPT

GRADY E. MCCRIGHT AND ROB R. TILLETT
INTERVIEWED BY KEVIN M. RUSNAK
LAS CRUCES, NEW MEXICO – 8 MARCH 2000

RUSNAK: Today is March 8, 2000. This interview with Grady McCright and Rob Tillett is being conducted in Las Cruces, New Mexico, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Carol Butler.

I'd like to thank both of you gentlemen for joining us again. Before we went on tape, we were talking a little bit about some of the center directors and their feelings towards White Sands [Test Facility, Las Cruces New Mexico], and if you could, Mr. McCright, go ahead and tell us your thoughts on that.

MCCRIGHT: Well, one way to give you an idea of how some of the directors felt about White Sands Test Facility, it was about 1981, Rob Tillett was the manager of the center, of the site, and Dr. [Christopher C.] Kraft was Center Director [of the Johnson Space Center (JSC), Houston, Texas] and he brought a planeload of senior staff members out to White Sands. They generally did that every year or so, and we conducted a couple-of-day briefing to them about what was going on at White Sands and the problems we had and the successes we had, and just gave them a general status of White Sands.

In one of those presentations in front of Dr. Kraft and the senior staff from JSC, Mr. Tillett was making a presentation about the inadequate amount of travel money that was in the White Sands Test Facility budget. It was historically a shortfall in travel money at White Sands for years in the past. And because White Sands is located in Las Cruces, New Mexico, 850

miles from its headquarters in Houston, and some 1,600 miles from [NASA] Headquarters in Washington, and since White Sands today, and I don't remember the number at that time, today White Sands Test Facility has over 200 reimbursable customers scattered all over the country and all over the world, including Japan and England. We've done some work for the United Kingdom and Japan. Back in those days we didn't have near that many customers, but we had a large number of reimbursable customers.

Almost none of those customers, except maybe White Sands Missile Range and Holloman Air Force Base, were in this vicinity. They were all somewhere. So travel out of El Paso [Texas] is expensive, because it's not a major hub, and always has been. You have to drive fifty miles from here, or sixty miles, to the airport. So the travel from here is expensive, but it was necessary for us to have adequate travel money to do our job.

So Mr. Tillett made a presentation to Dr. Kraft and showed him how much money we had, and explained to him why it was important that we had more travel money. White Sands had been in the reimbursable world for probably five or six years at that time, so it was a new thing, but it was a growing part of our business. He told Dr. Kraft he really needed some relief on travel. Dr. Kraft kind of interrupted him and said, "How much money do you want, Rob?"

Rob, I believe, gave him a figure of about three times what the annual travel budget was for White Sands Test Facility. Dr. Kraft never asked him a question. Incidentally, I might calibrate that a little bit. That's peanuts to JSC travel budget. Even three times the White Sands budget is peanuts for JSC. He turned to Bill [William R.] Kelly, who at the time was the Director of Center Support at that time, he was the director of center support, turned to Bill Kelly, who we answered to for that very short period of time that they had the three directors of, we answered to Bill Kelly, and he said, "Bill, can you take care of that?"

Mr. Kelly said, "Yes," took a piece of paper out of his pocket, wrote down the figure on it, put it back in his pocket, and henceforth White Sands Test Facility has had a pretty good travel budget.

During that conversation, Dr. Kraft made a comment about his feelings about White Sands, and he said in mine and Rob's presence, he said that White Sands Test Facility, of all the organizations that reported to him at the Johnson Space Center and a few at KSC and some other locations where he had small organizations, of all those organizations he said, "I firmly believe I get the biggest bang for the dollars I spend at White Sands Test Facility than I do anywhere." And I believe that Gerry [Gerald D.] Griffin, who succeeded Dr. Kraft, felt the same way. He was high on White Sands Test Facility. I believe Aaron Cohen was positive about White Sands Test Facility, and I know George [W. S.] Abbey is.

I believe that all of those gentlemen, although all of them didn't express it to me that way, I believe Dr. Kraft put the rivet around the feeling that center directors have about this installation is because it's very small, very few NASA people here, we work on a shoestring, we work hard, we work fast, we get products out fast. I believe that we're very innovative in the way we do it. For that reason I believe they all felt that way.

When I came out here in 1994, just before I left Houston, a few days before I left Houston, I went upstairs and talked to George Abbey and said, George, "I'm about to leave for White Sands. Do you have any final instructions for me?"

He said, "No, I really don't." He said, "I feel very comfortable with you going out there." He said, "You keep doing what they're doing," and he said, "you go after all the reimbursable work you can get out of this program and from other customers around the

nation." He said, "You can be a great benefit to the program if you can expand the engine rebuild program."

So I came out with those marching orders, and I think he wanted that to come here. He told me about 1996 he wanted me to take over the APU [auxiliary power unit] rebuild, and they're still trying to get in that business, get that out of the program. George Abbey insisted that White Sands Test Facility take over all the facility support for TDRSS [Tracking and Data Relay Satellite System] in about August of 1996, '97.

TILLETT: Which didn't make the Goddard [Space Flight Center, Greenbelt, Maryland] people terribly happy.

MCCRIGHT: Did not make Goddard very happy and it was a bloody fight for months, but it finally happened. In early '98 it happened. So I think all of that says that George Abbey felt the same way. He wanted to get White Sands responsible for as much of his business as he could.

TILLETT: That business about reimbursable, wanting us to take on reimbursable activity, do you remember the first reimbursable program we ever got into? It was that engine test program for Japan.

MCCRIGHT: Oh, yes, right.

TILLETT: Ninety percent of the people in the agency told us it couldn't be done, there was no way to do it. Impossible.

MCCRIGHT: No way you can take another government's money and spend it here.

TILLETT: Or even money from private industry here or anything like that. They never really had worked out any mechanism to accommodate that kind of activity. We finally got it worked out through somebody in headquarters, I don't remember who it was, but somebody finally decided to be our champion in headquarters, and we got that Japanese test program that cost the Japanese something like three or 400,000 dollars. We didn't get the money. There was no mechanism to get us the money. It reverted to the Treasury. But that got people in NASA to thinking.

MCCRIGHT: We can offset some cost.

TILLETT: Yes, we can offset cost here if we let some of these people with money come in and give us the money and we do the work for them, just as though we were, sort of like we were private industry, except we're nonprofit-making.

MCCRIGHT: Because we're the government we can't make a profit.

TILLETT: Yes. I think it was that Japanese program that got people in headquarters and JSC and other places to thinking about taking on reimbursable customers. I think it's a common thing all over the agency now.

MCCRIGHT: It is becoming very common around the agency. As a matter of fact, about 1995 or '96, the *NASA Highlights*, annual *NASA Highlights*, maybe it was *NASA Spinoff*. It might have been the *NASA Spinoff*. There was a two- or three-page article in there about White Sands and how it does mechanics of how it does reimbursable work and how it collects a burden to offset the half a can of WD-40 that you can't charge to the job, the mileage on vehicles and tires and wear and tear on things that you can't charge because they're an infinite number of small little items that you can't directly charge, so that's a burden. That has been accepted. It's been accepted by the Congress.

We're doing it on engine rebuild work. The OEM [original equipment manufacturer] challenged that when they finally started losing the business, and we went to the floor of Congress and won. So it's been very, very well accepted.

So as Rob said, that's what started it, but it has grown and the mechanisms have got more accepted, they've been documented within the agency, and now the agency's using them in a lot of places. So you can get a lot of information about that out of that—and that's the *Spinoff*, I think it was, about '95 or '96.

TILLETT: I'd like to see that. I never saw it.

MCCRIGHT: I don't think I've got a copy of it. But Joel—

TILLETT: In the labs?

MCCRIGHT: Yes. Joel Stoffus [phonetic]. Stoffus. He was a principal of putting that together.

TILLETT: Somebody in JSC asked White Sands to put that together, as to how we did that?

MCCRIGHT: Yes, they edited it and wrote it and gave them a lot of the data. The comptroller office in Houston gave them a lot of data, because all that money goes through them. It now flows to White Sands. We don't lose it to the Treasury anymore.

TILLETT: Yes, but who challenged it?

MCCRIGHT: Marquardt.

TILLETT: Oh, they did. Oh, yes. Okay.

MCCRIGHT: Then they wrote to their congressman, and the congressman had a hearing. Matter of fact, an auditor from DCAS [phonetic], smart guy, one of the few that you find in DCAS, but he was a smart guy, came down here and did an audit on us, went out to Marquardt and did an audit on the cost, went to the floor of Congress and said, "It's costing you money to stay with Marquardt." So they didn't.

TILLETT: I'd bet it was twice or three times as much at Marquardt.

MCCRIGHT: Yes, it was something on that order, and I don't remember, but even after you—what he did was just some calculations to offset that we don't have to pay taxes and stuff, so he

did some calculations to offset, and it was still a couple times cheaper. That's been challenged up so high as the Congress of the United States and we won. I would guess that—I've been gone two years. I would guess that when I left it was a little over 50 percent of the business was reimbursable work, and it's probably 60 today. I don't know exactly what it is, but it's been growing ever since that Japanese test program.

TILLETT: That was in the seventies.

MCCRIGHT: It was in probably the mid seventies, wasn't it?

TILLETT: Yes, about '75.

MCCRIGHT: Because it was back when we were down at the core base, wasn't it?

TILLETT: Pardon me?

MCCRIGHT: About the time we were at the core base.

TILLETT: Yes. So it was '74 or '75, somewhere along in there. We had started to grow out of the core, but just barely.

MCCRIGHT: Yes.

RUSNAK: How did you end up with that project in the first place?

MCCRIGHT: I don't remember exactly, but my guess is that as most of these reimbursables come in from personal contacts of people, and I can't remember for sure, but I suspect one of the propulsion guys heard about the Japanese needed to test an engine and got a hold of somebody and found out a little bit about it. Or the Japanese came to the United States and said, "We don't have a place to do this," because they're so—I've been to Japan recently and they are so impacted with people, it is unbelievable.

TILLETT: Yes.

MCCRIGHT: Just like I was mentioning yesterday about, we just recently, about four years ago, did some drop-test on hydrogen-oxygen tanks and blew them up, because they wanted to know what happens if we have a catastrophic [failure] on the launch pad of a new launch vehicle. What happened, they had some public living less than three miles away. I think it was much less—it seems like it was a mile and a half or so that they had residences that close to their launch facility. What was going to happen is they're going to have a problem if they have a launch pad [failure]. So they came to us to do that, because we got more buffer out here than they do in Japan by many times.

TILLETT: That static test facility they had in Japan, that they were testing that engine in, that was a derivative of some sixties' technology American engine. We'd given them the data on that. It was unclassified and given release to the international community. Japan picked it up

and built themselves a launch vehicle, and I think it was the second stage of Earth [to] orbit, unmanned kind of Earth orbit launch vehicle. They wanted to be able to orbit things.

But I remember seeing—I never went over there, but I remember seeing pictures of their static test facility there, and it was it a little cove right on the ocean, and there were residences within 100 yards of their facility. It was just a tiny facility. There's no place in Japan, I guess, unless you go up to Hokkaido or someplace like that, where you can find any room.

MCCRIGHT: No place else on Japan you had much room. And I traveled more than 200 miles in the interior.

TILLETT: I was trying to remember who specifically guided that project to us, and for the life of me I cannot remember who it was.

MCCRIGHT: I don't know. It could have even been somebody from Washington called us and said, "Hey, Japan wants to test an engine. You guys interested?"

"Sure, we're interested, but how do we fund it?" I don't remember exactly how that one came. Most of them today, most reimbursable programs come in two ways today. They come because of past customers that we've been doing reimbursable work for for twenty years or less. Many of those come to us that way. Another way is because those customers talk to their friends in the industry, and then they call us and want us to do something. The other way, and probably the principal way, is White Sands Test Facility puts people on the road, and puts them on the telephone, and says, "You get to know your industry. You find out who's in the engine business, who's in the propellant business, who's in the flammability business, who's in the

hazardous testing business around the world," and through those personal contacts comes a lot of this.

So White Sands, while we don't really advertise in the journals and whatnot, we do a lot of personal contacts. A lot of stories, a lot of articles, are written up about things, engines or something that were tested, and somewhere in there it'll say it was tested at White Sands Test Facility. So we get a little advertising out of that.

Not long before I retired, a British Overseas—BOC—

TILLETT: BOAC, isn't it?

MCCRIGHT: BOC? Is that the British gas outfit?

TILLETT: Might be.

MCCRIGHT: BOC, I believe it is. Anyway, a British firm in the hazardous gas business, inert gas business, too, but they're in the gas business, came to us to test some tanks. All the way from the United Kingdom, because we've got the space to do it, we've got proven technology to do it, we've got procedures we've been using that have been revised constantly for the last thirty-five years. So a lot of people are coming to White Sands for those kind of tests.

Thank goodness the agency twenty years ago recognized the validity of doing this and let it happen, made it happen. So if it were not for that reimbursable work, White Sands would have had a really, really hard time surviving, because through the years there have been a

number of challenges to White Sands' existence. First one in 1970, and they come up about every three years, it seems like.

TILLETT: Up until about early eighties, and then never heard anything more about it.

MCCRIGHT: Well, there was one after that.

TILLETT: Was there?

MCCRIGHT: But there wasn't for a long time, but in 1992—

TILLETT: That was the year I retired.

MCCRIGHT: 1993, then. 1993, the AA [Associate Administrator] for the Office of Space Flight was Marine General Armstrong. Remember that?

TILLETT: I don't remember.

MCCRIGHT: I believe it was Armstrong. I've forgotten his name.

TILLETT: He came after—

MCCRIGHT: I worked directly for him for a while there. Anyway, I can't remember his name. He was an AA for Office of Space Flight, a Marine general. He assigned Darrell Branscomb. Remember Darrell?

TILLETT: Yes.

MCCRIGHT: He assigned Darrell Branscomb the task of going to White Sands, and Darrell got me appointed to the committee, and I went to Washington with Darrell and sat in the general's office. They said, "You go to White Sands and you come back and tell me how to close White Sands."

This was about '93, so Darrell and I and two more people came out here. [Richard A.] Colonna was there then, it was Dick Colonna was there, came out here and spent a week. We spent about three days or so, again letting White Sands give us presentations about what they were doing for the program. By then they were just getting into the engine rebuild business, the RCS [reaction control system] engines. I don't even think they had been certified yet, but they had rebuilt a couple under the watchful eyes of Rockwell.

TILLETT: We'd been servicing RCS engines before I left, but not rebuild.

MCCRIGHT: That's right. Then our nitrate problem is what first got them started. They flushed iron nitrate out of some engines and returned them to the fleet, rather than—Marquardt said you got to chuck them. Found a way to dissolve the iron nitrate, put them back in the fleet. But they had just recently got in that business.

So we heard presentations from the engine people, said, "Wait a minute. We want this to develop into an engine rebuild facility, and we don't want you to close it."

On the next to the last day we were there, they invited much of their outside customers. The Army showed up, Air Force showed up, Rockwell showed up, couple different groups at Rockwell for engines and for the OMS [orbital maneuvering system], and for the fleet leader program. People from Houston showed up. So these customers showed up saying, "Wait a minute. We need White Sands."

So the bottom line was Branscomb and I went back to Washington and put a presentation together. We sat in front of the general and gave him a presentation about "You can't close it and here's why," and it hasn't come up again since.

RUSNAK: Why did he come up with—

MCCRIGHT: Cost. It was cost. It was a cost move. If we can get rid of that facility out there, it costs us 40 million dollars a year, well, we can save 40 million dollars a year. Well, you can't save 40 million dollars a year. You'd probably spent 80 million dollars getting that done. I believe that, because of the efficiencies here. You have to go to White Sands to appreciate it.

In the early days, people in Washington had the idea that there's a couple of old rusty test stands, out there like Santa Suzanna [phonetic]. You remember? Santa Suzanna is rusty.

TILLETT: Yes, it sure is.

MCCRIGHT: There's a couple of old rusty test stands out at White Sands and we ought to close it. That started in late Apollo. You remember, Rob, we finally got an AA, and I can't remember what his name was, you and I and [Lawrence E.] Lundgren entertained him for one day out here. He got off of KSC's plane out in Las Cruces and we picked him up. It was about 1974.

TILLETT: Yes. Who—

MCCRIGHT: Anyway, he came here. We finally got him to come out here, because we needed to get set up for Shuttle. We were getting ready to start testing Shuttle engine. We couldn't get any money out of people to revise our data system that I talked about yesterday that we did, and all of the mods we needed to make a test stand, and all the things we had to do to be able to handle the OMS and the—

TILLETT: RCS.

MCCRIGHT: —RCS engines for Shuttle. So this guy came out here about '74, I think, about that time, and we entertained him for about a day. When he left here, he was just as excited about White Sands as he could be. That was my first experience with people who had never been here showing up at White Sands, and when they left they were just excited and enthralled about what happens here. It's not a couple of old rusty test stands; it is a huge facility. It's a hazardous test facility, and it's got ninety-four and a half square miles of deployment area, and that deployment area is invaluable to NASA, because they're hard to find anymore. You just can't find that large a piece of property that you can keep everybody out of anymore.

Since that time, I don't know, Rob how many people have we entertained that have never been here, that left with a very, very positive attitude about White Sands?

TILLETT: Just about all of them.

MCCRIGHT: Two hundred people?

TILLETT: Oh, yes. Virtually all of them left with a positive attitude.

TILLETT: Goldin, [NASA Administrator Daniel S.] Dan Goldin was out here on August the 17th, I believe it was, 1997. It was not a pleasant day in my life, but, anyway, I entertained him all day. All day long I was with him, and Congressman [Joseph R.] Skeen was with us, and for a short time [Jesse F. "Jeff"] Bingaman [Jr.] was with us, Senator Bingaman.

I took Goldin, I picked him up—actually the TDRSS people picked him up in El Paso, and we took him back to El Paso to the plane. But Goldin, we went on a tour, and about one o'clock or so he made a presentation. I just called everybody to the rotunda that I could get in there, get 600 people or so in there, and we got that many people in there and let him talk to them. And he had nothing but good things to say about White Sands.

But he's the guy that had the general try to close them in '93 or so, but he had never been here. I don't think, as long as he's the administrator, that White Sands has got any threat whatsoever, because he's been here.

TILLETT: Was that his first trip here?

MCCRIGHT: That was his first trip, yes. I'm not sure we've ever had an administrator here before.

TILLETT: Oh, yes, Jesse [Jones, manager of WSTF from 1972-1981] and I spent all day with Dr. [James C.] Fletcher when he was the administrator.

MCCRIGHT: I remember him being here, yes. That's right.

TILLETT: He was a hard guy to read.

MCCRIGHT: Yes.

TILLETT: Very stoic. I think he left with a positive attitude, but it wasn't something that he came out and said.

MCCRIGHT: Yes. Well, Goldin actually did. He was just very, very impressed with White Sands. I don't think White Sands, as far I know, has had no threats since. I mean, I don't think they'll have any for a good while. Like Rob said, we didn't have any from about 1980 until I went in '93. That one lasted about three weeks and we got it put to bed. And what was amazing about that, we went back and told the general why he couldn't close it, and all he said was, "Okay." [Laughter]

TILLETT: So then he just went back up to Goldin and said, "Hey, they can't do it."

MCCRIGHT: The thing was, that when our instructions were, "Go out there and close it." It wasn't, "Go see if you can." It's, "Go close it." We came back and told him why we couldn't and he said, "Okay." [Laughter]

RUSNAK: I thought maybe, if we could, start back at the beginning. Do you remember when the first time you two met or started working together, and what positions you were in?

MCCRIGHT: Well, I do.

TILLETT: Yes, I do. We both do, I imagine.

MCCRIGHT: Well, I showed up my first time on September 12th, 1966, so I met him within a day or two of that. I was a GS-7, fresh out of college, working in the Electrical Controls System Branch for [Kenneth B.] Gilbreath. As I recall, Rob was Chief of test conductors.

TILLETT: Yes. I was Chief of test conductors. I had been here two and a half years by that time. I was a GS-14 at the time.

MCCRIGHT: Rob was the chief of all the test conductors at that time, and there was a whole slew of them at that time. You probably had fifteen, didn't you?

TILLETT: Oh, probably not that many, but eight or ten.

MCCRIGHT: Ted Cieszko. [Laughter]

TILLETT: —and some other real winners. [Laughter]

MCCRIGHT: But we worked together from that time until I went to Houston in 1970, and then when I came back in '73, he was still here, and we worked together then. About 1981, for a few months in '81, we were peers. I became an office chief and he was office Chief of Propulsion at that time, so we were peers for about three months, and then he got selected for manager. So that's the only time we were ever peers.

TILLETT: Well, now, that's not really true. You were a peer in Houston when I was the manager there.

MCCRIGHT: Yes, for several years.

TILLETT: For several years.

MCCRIGHT: I was his peer after I was in Houston. I did work directly for Rob for about three months one time. I was detailed over, and Rob was running the Pearl [Program for Evaluating Apollo Rendezvous and Landing Radar] program, was landing and rendezvous radar tests for

command service module and lunar module. So I worked for him over there conducting flight tests with a T-38 and with a helicopter H—

TILLETT: I don't remember what model.

MCCRIGHT: SH-3 or something like that. Big helicopter for the landing radar.

TILLETT: That was T-33.

MCCRIGHT: T-33, I'm sorry. Yes, T-33 for the rendezvous radar.

TILLETT: Yes. T-33s, by modern standards, didn't have very good performance.

MCCRIGHT: They were slow, slow.

TILLETT: They were slow, slow, and the rate of climb was exceeded by some single-engine private planes. To make a rendezvous radar approach, they had to go to about Santa Fe.

MCCRIGHT: I think it turned around at the Omni station at Española.

TILLETT: Yes.

MCCRIGHT: I believe is where they—

TILLETT: Above Santa Fe. They were in full climb, max rate of climb, the whole way to Santa Fe and most of the way back, before they could get to the right altitude.

MCCRIGHT: When they turned, the SPS-16 radars we were using, huge radar systems, but they had a transponder on a T-33. But when he rolled around that Omni station at Española, the belly went to the north and we lost him. The radar started looking for him, because they couldn't see him his transponder, and it couldn't skin-track him. As soon as he got turned and lined up again, they'd pick him back up. But he was just almost over the horizon up there.

TILLETT: This is the kind of a case, kind of a reverse situation of the reimbursable work that Grady was talking about. This was work that the Army was doing for us, we were paying the Army for. We've done a lot of work with White Sands, and we've used their facilities a lot of times, because they have vast spaces and if you need to track something, or anything like that, they've got great huge old tracking radars and that sort of thing that are used to track missiles all the way from Green River, Utah, down here.

MCCRIGHT: As a matter of fact, we've used Holloman a lot. We've used White Sands more, but we've used Holloman, too, because we were operating those aircraft out of Holloman in those days.

TILLETT: Yes.

MCCRIGHT: They were NASA aircraft, NASA pilots, but we were using all the Army instrumentation. They were using Holloman Air Force Base as a sort of escape building and whatnot, and we hangared them over there. So over the years, we have spent millions and millions of dollars at White Sands Missile Range, still doing it every day, because Northrup strip is on their turf. We operate it, we modify it, we do just about anything we want to out there. We have to coordinate it with the range schedule, but we do about anything we want to out there. But we pay them for all the support we get from them. The fire rescue come from Holloman, so we reimburse Holloman for that. So there's a lot of interagency transfers of money.

TILLETT: One of the early jobs that we did for another agency, well, it wasn't really another agency, but it was for Marshall [Space Flight Center, Huntsville, Alabama], Marshall had a wind-profiling project that they had invented sometime back in the sixties. Grady got involved in that, too. What was the name of that darn program? HIREWIMP [High Resolution Wind Measurement Program] or something?

MCCRIGHT: HIREWIMP.

TILLETT: HIREWIMP, yes. I don't remember what the acronym stood for, but what it consisted of was launching weather balloons and tracking them to—

MCCRIGHT: At White Sands. We did it at White Sands.

TILLETT: Over White Sands Missile Range. To gauge wind sheer and what the upper atmosphere winds were doing, and we'd launch those things every day.

MCCRIGHT: Reams of data.

TILLETT: Yes, just reams and reams of data that we'd send back to Marshall. I don't know whether they ever reviewed all that data or not. But not only did we do it here at White Sands, but they also wanted us to do it up at Green River, Utah, which is a White Sands Missile Range facility in Utah. So two or three times a year, a couple of us would take all of our balloons and everything and go up to Green River, Utah, and launch balloons for a couple of days and come home.

MCCRIGHT: Another interesting test that I just thought about, and it tells a story about how a site can evolve. About 1968, or maybe '67, Bendix Limited came here and we did the lunar geophones test. Remember?

TILLETT: Yes.

MCCRIGHT: I've forgotten, it was ALSEP [Apollo Lunar Surface Experiment Package], wasn't it? Part of the ALSEP package?

TILLETT: Yes, part of the ALSEP package.

MCCRIGHT: They showed up out here, and they didn't have a place. It was British-built, Bendix. Not Bendix USA; Bendix Limited. They came out here and wanted, I don't remember, 200 yards, maybe, or maybe 300 yards. Then they launched, the astronauts were going to leave on the surface of the Moon, wouldn't fire while they were there, but they were going to put a cannon on the surface of the Moon and geophones out so many feet from it. After they left, remotely we'd launch a grenade, concussion grenade, not a fragmentation grenade, but a concussion grenade, down range and it would explode and geophones would read the vibrations in the lunar surface or below surface, subsurface. So then the geologist could tell what the formations are, get data about the formation of the Moon.

TILLETT: About the interior structure of the Moon.

MCCRIGHT: So when they came out here, we said, "Where are we going to do that?" I remember us talking about it, said, "Look, that dump road, the road to our dump, is from the main facility." We don't use that dump anymore. We've closed it because of EPA [Environmental Protection Agency]." At that time we were still using a landfill dump, municipal-type dump. That road is about four miles, maybe?

TILLETT: Probably not quite that long, but two and a half or three.

MCCRIGHT: Yes, two and a half, three miles. We went down near the dump, just before you got to the dump, took a bulldozer down there, graded the mesquite and greasewood out of the

way, and made us a dirt big open area. It was about maybe probably 100 yards wide and 300 yards long, wasn't it?

TILLETT: Something like that, yes.

MCCRIGHT: The British came out and set up their little cannon and geophones and boom, boom, boom, we did that. That was all that was done there, and we just left it. Now that facility, some thirty years later, is the 700 Area. We probably have a two and a half million dollar, or probably more than that, probably a four-million-dollar facility down there. That's where we did the drop test, LOX [liquid oxygen] and hydrogen tank drop test for the Japanese. There's a 250-foot tower down there with a navigation light on it, as we dropped them from that tower. There is a raft of instrumentation down there, high-speed instrumentation to catch the explosions. We did a lot of work for the Air Force down there. So that facility started out with kind of a "Where can we do this? Well, let's blade that area off and we'll do it," and now it's probably a four-million-dollar facility.

The JP-3 and 4 tests were kind of like that. We said, "Where can we do them?" We went halfway down the well road, which is six miles long, and built some concrete pads down there, huge ones. They're probably, what do you think they are, 200 feet square?

TILLETT: Hundred fifty to 200 feet square, something like that.

MCCRIGHT: Yes, something like that, square, and about six or eight inches thick. Then for aggregate we used foundry slag. We didn't use rock. The rock would pop.

TILLETT: We were simulating a carrier deck.

MCCRIGHT: That's right. Back in Vietnam there was—it was *Enterprise*?

TILLETT: Yes, I think so.

MCCRIGHT: Rob and I have seen the film, this film of this. Back during the Vietnam War, they had hot jet aircraft, hot meaning they're fueled and loaded with arms on board the carrier, and they got a fire started on the deck. Of course, the carrier was moving. The carrier probably went to flank speed to blow as much of the fire as it could back off the deck, because it was back on the rear part of the deck where it started. So I'm sure they went to flank speed to keep the flames rolling off the back of the carrier, rather than moving forward on the carrier, and it was the fuel. It was JP3.

TILLETT: JP4, I believe.

MCCRIGHT: Was it four? JP4 out of these aircraft that they spilled and got it ignited, and bombs started cooking off. They started pushing aircraft overboard. Do you remember that?

TILLETT: Yes.

MCCRIGHT: They were pushing aircraft overboard to get them out of the fire. The swabbies would run out there with water. You remember that?

TILLETT: Yes.

MCCRIGHT: There'd be a bunch of sailors come out there with water and they'd be spraying it on the fire, a bomb would go off, the sailors would throw the hose down and run, and in a minute they'd come back with a hose. The guys over here putting foam down, guys over here putting water down, washing the foam off. It just was almost was a catastrophic failure. So years later, it was—when did we do that? It was in the seventies, wasn't it?

TILLETT: Either late seventies or early eighties.

MCCRIGHT: Yes. It was probably in the late seventies, early eighties. Anyway, the Navy came to us and said, "We want to characterize JP3 and JP4 fires, and we want to do it on a carrier deck." So we built this big concrete pad, very level, with foundry slag as aggregate in it, because we were going to pour fuel on it and set it off. Then we built a big array of thermocouples that we could move back and forth through that fire, taking data, so we could tell how hot it is here, how hot it is here, how hot it is there, all the way across the fire. You'd cut a slice through the fire, and say here's the gradient of that fire. We probably burned—I don't know how many gallons of jet fuel we burned. A bunch. We probably did those tests ten or twelve times, I guess, didn't we?

TILLETT: I imagine, yes.

MCCRIGHT: That was kind of an interesting test, you know. It was reimbursable money from the U.S. Navy, and they did it here because we had the open spaces to do it, and we could get a burn permit from the State of New Mexico. You couldn't do that in Houston. You couldn't get a burn permit.

TILLETT: We had this clumsy kind of a gantry that had all the thermocouples mounted on it.

MCCRIGHT: It looked pretty flimsy. [Laughter]

TILLETT: Yes, it wasn't an engineering genius' concept, but—

MCCRIGHT: But it did move through the fire.

TILLETT: —it moved very slowly through the fire and carried all the thermocouples and everything with it so that they could get temperatures.

MCCRIGHT: Those facilities have been used since then. The only use I can think of since then, the Marines, during the Operation Roving Sand every year, when the combined military comes to White Sands, the Marines, the Navy, the Air Force, and Army, and they conduct some simulated military operations. Well, for the last three years that I was the manager, the U.S.

Marine Corps came to us and we put them down there on those pads and let them set up radars and air traffic control.

TILLETT: It started long before that.

MCCRIGHT: Did it?

TILLETT: Yes. I sent them down there three or four times, probably in the late eighties, early nineties.

MCCRIGHT: Okay. So maybe for ten years now they've been doing that. So we just use that place for them to set up their equipment. We talked to Kistler Aerospace about doing some flight test off of those pads. You know, that bedstead-like vehicle that they've got that they believe that they could launch? They launch it up a few thousand feet, launch a vehicle off of it, because they gain a few thousand feet, and then send it back down.

We talked to them a lot, about '95, or so, to do that flight test here. We can do that. We got the clearances from White Sands and whatnot to do it. We can only go up a few thousand feet, but it just takes more room to test the engine in a dynamic mode. So it never came to pass, but we talked to them about using those same concrete pads for a launch.

Then the Delta Clipper was tested at White Sands Missile Range. But all of the ground support for fueling and defueling, and all of that kind of propellant support was provided by White Sands Test Facility, reimbursed from the Air Force. That program eventually got transferred to NASA, but at time it was an Air Force program.

TILLETT: Another example of work, of a big reimbursable program that we did just locally, was when the Army was building that HELSTF facility, high-energy laser test facility.

MCCRIGHT: Fourteen and a half million dollars.

TILLETT: Is that what we got out of it, was fourteen and a half million?

MCCRIGHT: Well, it wasn't profit; it was the cost of doing the job.

TILLETT: The Army had private contractors come in and build their fluid distribution systems, and they had some pretty nasty chemicals that they had to handle, fluorine and hydrazine, and, I believe, nitrogen tetroxide and a bunch of stuff like that, because this laser was pumped with chemical energy. It's a powerful enough laser to shoot a plane down with very quickly.

Anyway, they had this fluid distribution system built. I don't know why the military does this, but they didn't hold that contractor's feet to the fire. They let him get away with murder. They didn't ever go after him legally or anything else, and they spent fourteen and a half million dollars with us to go back and rebuild that fluid distribution system that they had already had built.

MCCRIGHT: They kept the same designer for designing on the rebuild. Do you remember—and this is a story Rob thinks is funny. I don't think it's very funny. But Rob was Chief of Propulsion at the time. It was those few months that he and I were peers, that I was Chief of

Tech Support Office and he was chief of propulsion. The manager was named Jesse Jones. Rob and Jesse Jones and I went to California, to Huntington Beach, wasn't it?

TILLETT: Yes.

MCCRIGHT: To MCDAC [McDonnell-Douglas Aircraft Corporation]. They were the designers of this thing. So we went in and reviewed—we were just going to do a designer review just as we took over this job. So we went in there on, I don't know, went out there on Monday or something. That's when we saw Dolly Parton on the airplane. [Laughter]

TILLETT: Yes. Walked right by Dolly Parton. It was Costa Mesa we went to.

MCCRIGHT: Was it Costa Mesa? Okay. We were going to spend a couple days down in design review. Boy, we got in this design review and it was clear quickly to us, and we'd been building these kind of piping systems for many years, they didn't have spool-piece drawings. How did they connect these pipes? All they did was had one-line drawings, about all they had. Put a six-inch stainless steel pipe in here, certain gauge, is about all they had. We said, "Man, we got to have spool-piece drawings. We've got to know what kind of flanges, we got to know what kind of gaskets to put on the flanges. We've got to know all this stuff."

So we got into quite a discussion there, and I was a party to a lot of this technical discussion. I noticed Mr. Tillett and Mr. Jones walked back to the back of the conference room and were talking, and in a minute they called me back there. I'd gone out there expecting to stay

and come home Tuesday or so, and they called me back there, and I think I had two shirts with me and one suit. They called me back there and said, "Grady, this thing's not going well."

I said, "Yeah, I know."

He said, "We think you ought to stay here until you get it fixed." And I think I showed up ten or twelve days later when I finally got back. [Laughter] I forgot who stayed with me. [Richard] Schroats, maybe?

TILLETT: Schroats was along. I don't remember whether he stayed with you or not.

MCCRIGHT: Schroats might have stayed. I don't know, there was two of us that stayed.

TILLETT: Was Gene out there? Gene [W.] Frye?

MCCRIGHT: It might have been—Gene was working for the Army.

TILLETT: Yes, he was working for the Army at that time.

MCCRIGHT: It could have been me and Gene that stayed out there, because Gene picked up on it pretty quick, too, that this is not going to work. Gene had worked for NASA for—

TILLETT: Oh, twenty years.

MCCRIGHT: —twenty years, and then transferred to the Army, over at White Sands Missile Range and inherited this job, this HELSTF job, and he retired from there. Now he's working for the contractor out there rebuilding RCS and OMS engines.

TILLETT: When he should be retired.

MCCRIGHT: He should be retired now. Certainly should.

TILLETT: [John] Mathis is back out there working still. He's my age. Well, maybe a year younger.

MCCRIGHT: I don't know why they want to. But I think they're both talented guys, but they're getting old enough they ought to think about retiring.

TILLETT: Well, John [Mathis] retires for six months or a year, and then he goes to work for six months or a year.

MCCRIGHT: Well, do you know how many retirement parties they've had for Ski [Carl Radwanski]?

TILLETT: No.

MCCRIGHT: Five.

TILLETT: Five retirement parties for Ski.

MCCRIGHT: I was a party to the last two. I told him at the last one, "Ski, we ain't hiring you again. We're not going to do this again." [Laughter] But these are old NASA types that just won't quit.

TILLETT: Always used to kid Radwanski about having to adjust himself to four-wheel drive instead of spinning his rear wheels so damn much.

MCCRIGHT: Yes. White Sands has really been an interesting place to work for all these years. Most of the time there were some interesting and unique things going on that you—I spent fourteen years total at Houston. You don't get these kind of projects at Houston.

TILLETT: And you don't get as close to the hardware as you do here.

MCCRIGHT: No. I told them yesterday, I said, in Houston you tend to be compartmentalized, too. You tend to be an expert in some facet of the business. At White Sands, we don't have many experts.

TILLETT: A hell of a lot of generalists, though.

MCCRIGHT: We got a lot of generalists. That's right. And that made it fun, because not only was I involved in electrical distribution in the early days when I was doing engineering work and electrical control systems, I was involved in construction and steam generators. Spent two and a half years on a steam generator and that was really fun.

And Rob, he's a propulsion test conductor. He worked on the HIREWIMP program with weather balloons, and he worked on landing and rendezvous radar in the PEARL program. Worked on JP4, JP5 fire test. Worked on the grenade—I imagine you were involved in the British grenade thing.

TILLETT: Oh, yes. Yes, I was.

MCCRIGHT: That was back in '68 or so, '67 or '68.

TILLETT: I told them yesterday about the Viking work that we had done, which was extremely interesting work, and the time we simulated the over-temp, over-pressure problem on Apollo 11 right after landing.

MCCRIGHT: Yes. Yes, I was talking about that yesterday. There was another one I hadn't—have you mentioned to them about the lunar tools?

TILLETT: No, I haven't. Let me say something about that.

MCCRIGHT: Talk about the cleanliness level.

TILLETT: Somebody came out here, or I got a call from a guy in JSC, and I don't even remember who it was, but it was somebody in—what did they call the lunar lab there?

MCCRIGHT: The Lunar Curatorial facility. It was lunar receiving back then.

TILLETT: Lunar Receiving [Laboratory] back then.

MCCRIGHT: It was, yes. Back then it was lunar receiving.

TILLETT: Somebody from the lunar receiving lab that I had met, and he knew me and I knew him, he called me and he said, "Do you guys have any cleaning facilities out there?"

I said, "Well, yes, we maintain pretty high cleanliness standards for our propulsion systems and that sort of thing. So, yes, we do a pretty good job of cleaning."

MCCRIGHT: When was this, Rob, '67 or so? '66, '67?

TILLETT: Yes, probably, '67. Maybe even '68. It was at least a year and a half or two years before we flew, but before we landed on the Moon. He said, "Well, we have some lunar tools that are going to fly on the LM, and they're going to be used on the lunar surface, and we don't want any back-contamination kinds of problems, so these things have to be pretty clean."

I said, "What kind of tools are you talking about?"

"Oh," he says, "screwdrivers and pliers and stuff like that." He wasn't very specific.

But we ended up cleaning virtually all of the equipment that was used on the lunar surface. The cleanliness levels—

MCCRIGHT: Class 100.

TILLETT: Were what?

MCCRIGHT: One hundred lead-free, wasn't it?

TILLETT: Yes. I don't remember exactly.

MCCRIGHT: I'm thinking it's Class 100 lead-free, which we didn't do the lead-free. We had to make a lot of mods to get rid of all the lead. But we do routinely Class 100 cleaning, which means you'll find no particle larger than 100 microns.

TILLETT: But there were other stipulations. The organic contamination level was extremely low.

MCCRIGHT: Yes.

TILLETT: It was like millimicrograms per square meter kind of thing. It just really had to be cleaned completely of organics. We did clean virtually all those tools, and that led to another program that was kind of interesting. When Viking was getting ready to go to Mars, they had

the same kind of a back-contamination problem that the people going to the Moon had. This was even earlier. No, it was later. They went in '75. They launched in '75. They had equipment like that soil grinder that—

MCCRIGHT: Extracted the soil.

TILLETT: They went out with a little scoop kind of thing, robotic scoop, and they scooped in some Martian soil, and they dumped it into this grinder, and the grinder ground it up, and then it was transferred to a mass spectrometer and various other chemical, analytical equipment. All that stuff had to be cleaned organically, free of organics. It was something like a picogram per square meter or something like that. That really tested our mettle. As a matter of fact, I'm not sure that there was any way that they could tell how clean, that anybody could tell, really, how clean it was, because it was that clean.

MCCRIGHT: The object here was that when the lunar samples came back, Martian samples data came back, that if they saw any organics, it was resident there. It wasn't something we took. And that's what they were trying to get them so clean for. Ray [Raymond F.] Melton uses an example on that Viking cleaning program, he says, "We cleaned it to a level that was equal to taking one small, smallest drop of oil you could get, and spread it over one football field." Which is pretty hard to find.

RUSNAK: Before, each of you were talking a little bit about the sort of unusual origins in some of the facilities. Could you take us through the other facilities that are there, White Sands, and where they came from, what the original purpose was, and what they're doing now?

TILLETT: Well, just very quickly. The facility was built, it was originally called the Propulsion Systems Development Facility. I talked to you about the three-headed monster yesterday that existed during the early days of that facility. But it was designed for one purpose only, and that was to do development testing on Apollo spacecraft propulsion systems. Not engines. Systems. The contractors could develop the engines, but they didn't have all of the fluid piping and everything, and all the various systems, pressurization systems, so forth, that went along with the propulsion engines to constitute a propulsion system.

In order to do that, we built basically facilities in four areas. We put the administrative functions in the 100 Area. That included warehouses and shops and offices and all that sort of thing.

We put all of the laboratory equipment and computer equipment, which was pretty, not very advanced in those days, up in the 200 Area. We called that the 200 Area, and that was the labs. They had primarily the biggest lab there was chem lab by far in the early days, because they had to do a lot of analysis on our propellants and things like that, and do cleanliness work on them, and that sort of thing. The clean room, the cleaning lab was pretty good-sized, because we cleaned an awful lot of stuff.

Then we built a facility called the 300 Area, which consisted of two ambient test stands designed to test SPS, service propulsion systems. And ultimately test stand three—there was test stand 301, which is still an ambient test stand.

MCCRIGHT: OMS engine is tested there today.

TILLETT: Yes. Test stand 302, we eventually tore it down and put a big vacuum chamber there. Then to accommodate Langley [Research Center, Hampton, Virginia], some of the Langley tests that I was talking to you about yesterday, on bringing an engine down on simulated soil samples and that sort of thing, we put a twenty-foot extension on that chamber. So that chamber's about—

MCCRIGHT: About fifty-five feet.

TILLETT: —fifty-five feet.

MCCRIGHT: By about thirty-five.

TILLETT: Thirty-three feet in diameter, I think.

MCCRIGHT: Thirty-three feet in diameter.

TILLETT: So it's a good-sized vacuum chamber. But it doesn't have dynamic pumping capability. That is to say, it doesn't have a steam ejector system associated with it. It does have good vacuum pumps, though, and you can get it up to 250,000 feet.

MCCRIGHT: It now does have a steam ejector. There's a boiler sitting behind it.

TILLETT: You put a little one?

MCCRIGHT: It's small. It's small, we got some accumulators so you can—

TILLETT: That started when I was still here.

MCCRIGHT: But it's not very big. Mostly using mechanical pumps.

TILLETT: At the time we were using it for Viking, it was mechanical pumps.

MCCRIGHT: Yes.

TILLETT: So that was the 300 Area. It was originally designed for service propulsion system testing at the system level.

The 400 Area, which was just barely getting started under construction when I got here, 300 Area was pretty well finished.

MCCRIGHT: Had the first firing in '64 in 300, didn't you?

TILLETT: September the 22nd. I remember that because I won the pool. [Laughter] The 400 Area was to test the lunar ascent and descent engines. Since they operated only in a vacuum, it

was felt necessary that they be tested in a vacuum. Well, the descent engine had to be tested in a vacuum, because when you throttle that engine down to 10 percent, the chamber pressure was less than atmospheric.

MCCRIGHT: Yes. It wouldn't fire if you didn't have it.

TILLETT: Yes. So you had to fire in a vacuum. So in order to accommodate that, we had to have two vacuum chambers, each about 35 feet high by 33 feet in diameter or something like that. They had to be connected through diffusers to the steam ejector system, so that the rocket exhaust could be pumped out as fast as it was coming out of the rocket engines. In fact, the rocket engine helps the ejector pump by firing through a diffusers, it actually helps draw vacuum as well. We could maintain a vacuum under firing conditions with either the LM ascent or the LM descent or any comparably sized engine of about a 105 to 110,000 feet, which was good enough for the purposes. That facility was completed—was it complete when you got there, Grady, in September of '66?

MCCRIGHT: No. Natkin [a construction contractor] was still there.

TILLETT: Oh, were they?

MCCRIGHT: Yes.

TILLETT: But we had started firing with that boilerplate ascent stage, hadn't we?

MCCRIGHT: That's right. You had fired. That was in 402, though, wasn't it?

TILLETT: HE-3 was in 402. That's right, it was.

MCCRIGHT: It was an atmospheric test stand.

TILLETT: Yes.

MCCRIGHT: What they did was put a different skirt on it and fired it in an ambient condition.

TILLETT: You could do that with the ascent. You couldn't really do it with the descent.

MCCRIGHT: They couldn't fire the descent at all that way, but you could the ascent, because ascent was a higher PCN. It wasn't throttlable. But when I got there, Rob, we had not taken—we just right about the time I got there took the steam generator from [U.S. Army] Corps of Engineers. I remember the first time I went into the switch gear building down at the diesel pad, there were six big diesels, three V16s and three in-line 6 diesels. The V16s pumped water so that the six cylinders pumped alcohol for the propellant.

TILLETT: The 16s pumped LOX.

MCCRIGHT: No, no, no. They're electric pumps. They're big electric pumps under the LOX tank. Remember?

TILLETT: Oh, that's right.

MCCRIGHT: We had the LOX fire, because [a pump leaked and caught on fire. We later relocated the pumps so they were not directly under the LOX tank.]

TILLETT: The V16s were water pumps, yes.

MCCRIGHT: Anyway, the first time I went in the switch building down there, it was a little bitty thing, it might have been ten-feet square. I doubt if it was that big. All the control systems from the steam generator, chemical steam generator, were in that building. All of the time-delay relays were mounted on a piece of plywood unpainted and was tied to the structure of the building with No. 12 insulated wire, and it swung. Except for the wires that were on it, it would swing like this. If you pushed it, you could get it to move.

We took it over that way from the Corps, because we couldn't get the Corps to finish it. One of my first jobs there, along with Don [Donald R.] Visness and Manny [Manuel] Gonzalez [Jr.], fix it. The control systems we worked on. The mechanical guys had a similar problem with a plumbing system. So we took that over just about the time I got there.

TILLETT: We took a lot of those facilities over before they were really complete and finished them.

MCCRIGHT: Oh, yes. But we had this mandate, and you couldn't get the—the Corps of Engineers was building part of it for us. Some of those contracts were—Natkin was a big contractor.

TILLETT: They were electrical contractors.

MCCRIGHT: They were electrical contractors. They just didn't have the same sense of urgency we did, because we were working under the presidential mandate.

TILLETT: Parsons was the—

MCCRIGHT: Parsons was 300, wasn't it?

TILLETT: —300 and the north half of the 200 Area, they were the general contractor. Who was the general contractor for the LM facilities? I can't think of their name.

MCCRIGHT: Big company.

TILLETT: Yes, big, big company. Bigger than Parsons. It was kind of funny the way the site was built, because half of the 100 Area was built, and half of the 200 Area and all of the 300 Area was built under the Parsons contract. The other general contractor did the other half of the 100 Area, the other half of the 200 Area, and all of the 400 Area. There was a reason for that,

because half of the 100 Area was occupied by Grumman people, half by North American people. Half of the 200 Area, the same thing.

MCCRIGHT: Yes.

TILLETT: To get back to that steam generator that Grady was talking about, just for your edification, a steam ejector system is nothing but just high-pressure steam flowing out over—out through—

MCCRIGHT: An expanding nozzle.

TILLETT: —a couple of stages of expansion and contraction. In doing so, it drags all the molecules of air that it comes in contact with along with it, so it creates a vacuum in the vacuum chamber. But that thing was fueled—basically what we had were three rocket engines that burned LOX and alcohol, and the fire down into a 30-inch diameter steel pipe that was running horizontally. That thing's about 300 feet long. It goes to both test stands.

MCCRIGHT: Oh, it's got to be 300 feet, yes.

TILLETT: Yes. But right where the rocket engines fire down into the steel pipe, it was quenched with water. The fire was quenched with water and instantaneous steam, and the steam came out at what, about 300 psi—

MCCRIGHT: About 300 psi.

TILLETT: —and 500 degrees Fahrenheit.

MCCRIGHT: So super-heated steam. The quantity of water we're pumping is an eight-inch line with those V16 diesels were pumping with Byron Jackson pumps, great big three-stage pumps. I think the line's an eight-inch line, and I don't know how many gallons it is, the mechanical guys could tell you that, but it's in a pressure well above those 300 psi, because if it wasn't above that, you couldn't inject it into the stream. So that's a lot of water we're pumping with that thing.

TILLETT: Instantaneous was pounds per second was what, something like 500 pounds per second, it seems.

MCCRIGHT: About that. I can't remember exactly what it is, but it turned out to be about a million horsepower.

TILLETT: Yes.

MCCRIGHT: Converted to horsepower.

TILLETT: It burned 1,000 gallons of liquid oxygen a minute.

MCCRIGHT: When we first took over the system, we had one 10,000-gallon LOX tank. We quickly acquired a 28,000 LOX tank from the military, an excess, and added to it so we had a 28 and a 10. Later changed that 10 out to another 28, didn't he? So we had 56,000 gallons of LOX that we could run so we could have—

TILLETT: We could run almost an hour.

MCCRIGHT: Yes, run almost an hour. Had to make sure that the site water tank was full, because you're going to use most of it in that hour, so it's quite a process to do that. As a matter of fact, we had to transfer alcohol on the fly when we went to those small—we had an alcohol storage tank and a little run tank that we used in the early days. We never changed that run tank, but what we did was put some pumps in there that we could transfer alcohol at the same rate it's burning into that run tank while it's burning, while it's firing. A steam generator is one complex beast, and I had about as much fun when I was doing engineering work on that steam generator as I did anything. A lot of long hours and a lot of frustration.

TILLETT: But everybody that worked on it was really proud of their job.

MCCRIGHT: Absolutely. It was a lot of—we made hundreds and hundreds of mods to the electrical control system on that thing and the data system.

TILLETT: We made hundreds and hundreds of mechanical mods to that thing, too.

MCCRIGHT: Absolutely.

TILLETT: It was turned over to us as a piece of junk.

MCCRIGHT: Then we ruptured a steam line a year or so after got it. Remember, we blew the steam line up, because of the way it was—remember how that Y stage elbow would bounce when we first got it? We went in and put some shock absorbers on it and redesigned it so it wouldn't bounce so much. We blew it up, I guess, before we did that.

TILLETT: Well, the problem was the thrust.

MCCRIGHT: Yes. Thrust from the steam and thermal growth, too.

TILLETT: Yes.

MCCRIGHT: The thing was growing all the time because it was getting hot.

TILLETT: Yes. It wasn't adequately buttressed back in the direction of the generator itself. We had to redesign the whole thing. Then we blew the burst disk one time. Got an oversteam temp.

MCCRIGHT: Right.

TILLETT: And pressure and blew that burst disk. I was there that day and I was outside when that thing—

MCCRIGHT: I wasn't; I was inside.

TILLETT: I was just outside the door of the blockhouse when that thing blew, and, boy, you talk about an explosion. That made more racket than a case of dynamite would.

MCCRIGHT: If I remember coming—I remember rocks. It was right outside, just the T where that burst disk is, it comes up and Ts like this and the T went north and south.

TILLETT: To equalize thrust.

MCCRIGHT: Yes. The access road to the site was directly south. Do you remember where that little guard shack was right at the bottom of the hill?

TILLETT: There was a hill, yes. There was a hill in front of the south T.

MCCRIGHT: Yes. South T was—

TILLETT: South-pointing T, there was a little hill that came up about, oh, 50, 75 feet.

MCCRIGHT: Yes, 50 feet.

TILLETT: From that T.

MCCRIGHT: So the T actually blew out against that hill.

TILLETT: There was a rocky hillside.

MCCRIGHT: I mean, the steam did where it ruptured, blew out against that hill, and I remember seeing rocks scattered all the way to the bottom of that arroyo on the road, which is probably a quarter mile?

TILLETT: I'll bet it picked up close to a ton of rock off that hillside and threw it all over the site.

MCCRIGHT: That was quite an exciting thing. Then the ejectors, because of thermal growth, the ejectors ride on angle iron rails, so that when you go from 70 degrees outside, when you fire the thing, the steel's at 70 degrees, by the time it gets heated up it's 500 degrees, and so the thing grows two feet or so. So you've got to mount it on wheels so it can move as it grows. We started cracking the wheels on the end of it.

We finally put some cameras down there and looked it, and what happening is, as soon as the slug of steam got to the exit of the ejector, it was bouncing like this until it got set and then it stopped and it cracked its steel wheels on the thing. So we had to put some—I don't know, the mechanical guys did something to stop that from bouncing so violently.

I remember one time we measured the growth of it by putting a bead of grease all along the rail, and then after the firing went out there and looked how far it had smashed the grease. We knew how far it had grown. [Laughter]

Then we had a LOX fire. Were you up there the day we had the LOX fire?

TILLETT: No.

MCCRIGHT: For whatever dumb engineering reason, we put—those were 250-horse motors on those three LOX pumps, and I can't tell you how much LOX it pumped, but they were huge motors, bigger than this table, and the design put those LOX pumps right under that 10,000-gallon LOX tank. Now, the LOX tanks was probably ten or twelve feet to the bottom of the LOX tank up there, but they put these motors and pumps right on, the three of them, under this LOX tank.

One day as we started to fire that generator, the television picked up a fire on the number-one pump. We immediately shut down and the fire didn't go out, and it just kept burning. I mean, getting bigger and bigger and bigger. Well, why is it doing that? Well, this pump's full of LOX, the tank pressure is about [50 psi] or so, and so it's pushing propellant out, not pumping it, but just pushing it out right on the fire, because it was the pump that caught on fire. It got bigger and got bigger and got bigger. We turned the fire X on, we didn't have any run on the motor, on the pumps anyway. Turned the fire X on, and I'm thinking in a minute that tank's going to go. It just got bigger. When it was all over, we had charred marks all up around the tank.

Stan Shockey, I've got a great respect for—he was a contractor, but he was the contractor chief of the steam generation operation, and he was talented, talented guy. Stan Shockey was in the observation room, he wasn't running the console that day, and he came from the—that was up on the strip charts up there, but he came from the observation room around the outer door, down the hall, and in another door, and ran up there and turned and vented the tank. The TC [test conductor] was sitting there, I can't remember his name, he was a tall, lanky kid that was a TC for—I can't remember his name. But he was just sitting there saying, "What am I going to do? What am I going do?"

TILLETT: Who's the OD?

MCCRIGHT: I don't know.

TILLETT: Because he should have known what to do.

MCCRIGHT: Yes, he should have known what to do. I don't remember who the OD was, but anyway, Shockey came from the other room and vented that tank to stop the flow. You cannot stop a LOX fire. You cannot stop it. You've got to remove the LOX from it to stop it.

TILLETT: It'll burn just about anything, yes.

MCCRIGHT: Then another exciting test was the LTA5 [lunar test article], we burned it. Ed [Edwin W.] Sievers saved our bacon that day. He was a NASA OD [Operations Director]. I

was there. It was either, I think it was the 3rd of July 1967, because I had been planning to take off the weekend and the Fourth and taking that Monday off. I think the Fourth was on a Tuesday that year. Well, I got called in to support this test on the third.

I remember we loaded the vehicle and closed the door—no, we had not closed the door yet. The big door on the west side of the vacuum chamber was still open. We were getting prepared to bring the steam generator up and all that, but we hadn't closed the door yet. We had a fuel leak in aerozine-50, wasn't it?

TILLETT: I think so.

MCCRIGHT: Yes, it was aerozine-50, which is a mixture of propellants, but highly toxic, highly flammable. So we got the stand people, pulled all the stand people back and started trying to vent it, get all the pressure off of it, try to stop the leak. We're sitting in the blockhouse and the mechanical guys and the Grumman guys and the NASA guys, mechanical guys, were trying to figure out what we're going to do, how do we get in there. Because it's toxic, you can't go in there.

Somebody called the fire department. I think we brought them up and we're going to hold them at the blockhouse is what we were planning to do, just in case we needed them. We're going to bring them up to the blockhouse, but instead of coming to the blockhouse, the fire department went right on down on the T pad and right down on the pad, right up to [test stand] 403. They started getting out their hoses and all this kind of stuff, and we're trying to get a hold of them on the radio and bring them back.

They finally, before we got them back, they were just standing off with their hoses and all their fire-fighting gear off in front of the stand. They weren't up there near the door. But for some reason they decided to move the fire department up to the door. They moved them up to the door, standing six or eight feet behind the door, and Sievers was the OD and he thought about that for a minute, and all of a sudden, I remember just as clear as if it happened yesterday, Sievers said, "Get the firemen out of there." TC said, "Get them out of there?" He said, "Yeah, bring them back to the blockhouse." He didn't say why, he just said get them out of there. He wasn't comfortable with it, is why he did it, but he wasn't comfortable with it.

So he pulled them out, and brought them back to the blockhouse, which was about a hundred yards away. And they had no more gotten to the blockhouse when it ignited and went off.

I remember looking at the camera, and right out maybe 20 feet outside the door, this big door on the side of the test stand, there was one of those metal lockers sitting out there, and there were some hard hats sitting on top of it. All I remember is when the boom went off, I happened to be looking, and those hard hats went [makes sound indicating high speed] [Laughter] Just blew off the top of that locker and west. It was a pretty good explosion. It did a lot of damage to LTA5.

I was responsible for the control systems on the fire X system. I remember Sievers reaching over and banging the fire X on, I think there was three clay valves, big huge clay valves that have to operate to put water in the system, because it was a dry system. Those lights would go from green, they would go yellow. No, they didn't have a yellow on them. They lost the green, and when they got fully open, they have red. But we didn't have a yellow one when it was in transit. So they immediately lost the green, and I'm waiting and waiting and waiting, and

it seemed like ten minutes before they finally went red. It probably was five seconds, but they were pretty slow valves.

TILLETT: Very slow valves.

MCCRIGHT: I thought we were going to burn that facility down before those things opened, and if they don't open, it's going to be my fault. [Laughter] But they did, and put water on the vehicle. But it had some pretty extensive damage, which we repaired and continued to use it.

TILLETT: Remember when the LM descent engine blew itself up on test stand 401? It was descent. Pintel failed. We weren't even firing at the time. We were going through some sort of operation. I don't even remember what the operation was, but John Mathis and the NASA safety guy that worked for Dudley Fitts and I don't remember his name, Jim somebody, were down—

MCCRIGHT: I know who you're talking about.

TILLETT: —on the lower level in 401, outside the vacuum chamber, but down on the lower level, and that thing went kabang inside there and rang, and Mathis started for the ladder. The nearest ladder to it was that real steep one, and he started up those real steep stairs. It's not really a ladder, it's almost a ladder, just real steep stairs. He says Jim passed him halfway up. [Laughter] And he was going just as fast as he could.

MCCRIGHT: I was standing in [building] 440 where the uninterrupted power supply and the emergency power supply were during Apollo. We didn't use them after that, but we used them during Apollo. Don Visness was standing over by the transfer switch for the EPS. UPS [uninterruptable power supply] was always connected to the facility, but the EPS, emergency power supply, when you lost commercial power, it would sense that and it would start. The diesel would start, and as soon as it came up to speed, which was very quickly, it would transfer, transfer to the generator power. There was a transfer switch.

Don was standing about a foot, maybe, with his back to that transfer switch. UPS we had a lot of trouble with, lots of trouble with the thing. Those of us in the electrical business were over there nearly every day. How do the bearings sound, because it ran all the time, big huge bearings with a big flywheel, and had to change them a lot. So we'd go listen to the bearings and check temperature on them and this sort of thing.

He happened to be standing right in front of that transfer switch, and all of a sudden the EPS came up. We didn't even realize there was a power failure. First thing you hear is that engine starts, the big diesel starts. Before we could move, it transferred, and when it did, it missed the transfer, blew the switch up. The two doors on that transfer switch—and I was standing at the exit door about ten feet away, leaning up against a door frame, and when that happened, those door panels blew open and hit Don in the back, and he nearly ran over me before I could move out of the door. [Laughter]

But there were a lot of exciting times. It's hard to understand today, we didn't know a lot about the propellants and a lot about those systems and stuff when we first started operating them, and we made a lot of mistakes. We had a lot of propellant. We lost or vented a lot of

propellant, had leaks and stuff like that, and it's toxic propellants. So you had to be very cautious when you were up around the test stands and stuff.

We did some things I wouldn't do today for anything, but in those days the presidential mandate meant a lot to us. I mean, it really did. We really worked hard to try to get those tests done as fast as we could and qualify those vehicles so they could fly. I remember we were running a mission duty cycle one time, and mission duty cycle, if you didn't get all the way through the mission duty cycle, you didn't complete the test. You had to start the thing over again, because it was looking for—if you maintained a vacuum on this engine, and you fire it and you stop firing it, what do the temperatures do, how do they change. Then you fire it again in a few hours, certain number of hours or minutes or whatever, so that you can see that's what they're going to do in space. So what is the engine temperatures going to do, and how well is it going to fire the second time.

We were on a mission duty cycle one time and in a coast period, when we're coasting, we maintained the vacuum on the facility, but we—

TILLETT: Was this 401?

MCCRIGHT: This was in 401.

TILLETT: Descent?

MCCRIGHT: Yes, this is in 401. So I guess on this particular one we didn't have a vacuum in the chamber. That's right. But on the first run we had figured out we had, we thought we had a leak

in the gate valve seal, big nine-foot gate valve that filled with water, that you raise and let the steam go through it, and you isolate the chamber by lowering that gate valve and rams, pushes up and seat it. There's an O-ring seal around it that keeps it from leaking.

Anyway, the reason we went out there is that we thought we had lost that gate valve seal and we were going to lose this mission duty cycle if we had lost that seal. So after much confrontation, they decided that we'd send two people in the ejector. The vehicle is loaded now. It's at pad pressure, but it's loaded. So Gene Fry and I got to do that. So we went in the ejector, and it's dirty in there and all, you've got to have a flashlight, because it's dark. Those ejectors are how long?

TILLETT: Oh, 150 feet.

MCCRIGHT: Something like that. We go in this big huge nine or ten-foot opening at the end of the ejector, and go up and crawl around Z stage, and you get filthy, and crawl around in there, and go all the way up to—we didn't go up to Y stage, because Y stage was behind the gate valve. But they didn't want to take that inspection plate off, because they knew they'd lose the mission duty cycle, because you couldn't get it back on fast enough.

So we went up there and they raised the gate valve before we started up there. You don't want to be in there when the gate valve—I mean, the thing vibrates and all. So we went up there and stepped through the gate valve with a flashlight and looked at the O-ring on the back side of it, not the gate valve itself, but it's on the—it didn't move, the gate moved, but the seal didn't.

So Gene and I went up there and looked at that. There's a safety guy standing at the end of the ejector with a radio, because if anything happened, they're going to call us to get out of there, because the vehicle's loaded. We went up and just quickly looked at that seal and said, "It's okay. Let's get out of here," and we got out and went ahead and they lowered that gate valve then after we got out and we started the rest of the test.

I wouldn't go under an engine that's loaded with propellants today for anything. You couldn't pay me enough money to do that. But Gene and I were dumb enough when we were twenty-nine or so—we weren't that old, about twenty-six, I guess, to do it.

And while we were in there, they're holding that gate valve up with hydraulics, and while we're up in there, I think we were trying to get around Z stage. It's pretty tight around Z stage, and we were trying to get around it or something. The way the hydraulics worked is the hydraulic pump was outside the ejector sitting against the flume wall, and it would build up hydraulic pressure, and if you weren't demanding any more, it'd stop. The pressure was holding the gate valve up, but as the pressure creeped down, the pump would come on and build the pressure up. So when we were back up in there trying to get around Z stage, that pump cycled on and the gate valve went "uuum!" like that. [Laughter] I almost lost it, yes. But I wouldn't do that today. I'm sure Gene wouldn't either.

RUSNAK: If you want to talk a little bit more about the Apollo program, specifically I'm thinking of having some of the actual lunar modules and stuff there, the testing and during the flights, what kind of support would be going on at White Sands? Would you guys be ready for it?

MCCRIGHT: What they need to understand is we never had a flight LM here. These were always test articles. They would never fly. We never had a flight service module here; they were always test articles. That's not true anymore, because we do have flight engines here now, but in those days we did not have flight articles here. When we were doing lightweight airframe testing, they were just like them, they just didn't have all the bells and whistles on them. They had all the propulsion system bells and whistles, but not the guidance systems and all that. So we did not ever handle the flight hardware in those days. We now do.

But Rob can tell you better than I what we did when the missions were going up. In the early days, we were tanked and sitting at pad pressure. In case they had a problem on the flight, we could try duplicate it for them.

TILLETT: We generally had the service propulsion test article, ascent test article, and a descent test article sitting ready at the beck and call of whomever might need it during a mission.

MCCRIGHT: And we did a lot of simulations after missions to try to duplicate things that had happened on the mission, and still do that. Still do that today with Shuttle. Although today they're not sitting there tanked and ready to support, because we've gotten so much flight data off of these vehicles, the Shuttle vehicle, that we don't do that anymore. But we do a lot of trying to replicate a problem they had on a flight.

RUSNAK: Apollo 13 obviously they had the accident. Do you guys remember when you heard about that, and what your thoughts were? You had mentioned earlier that two years before that, you had done the duty cycle testing of the descent engine.

TILLETT: Well, I don't remember when I first heard about it, but I do know that we were sure watching television and paying attention to what was going on during that entire mission. We were very concerned about it.

MCCRIGHT: Yes. I don't remember exactly either. I think I was at home when I heard about it, but I'm not sure.

TILLETT: I don't remember.

MCCRIGHT: But I do remember that it was a national crisis, and the whole world, almost the whole world stopped to see what was going to happen. I think everybody in the world was looking at it. I know there were updates coming across the Times Square, the displays that give you the latest news and stuff. I know there were statuses and stuff going across that. I've seen pictures of people all over the world watching TV, just trying to figure out what's going to happen. I think a lot of us, and I'm sure a lot of people in Houston thought, "We're not going to get this one home."

TILLETT: I don't remember if we had any—did we do any real-time support? I don't think so.

MCCRIGHT: I don't remember any real-time support. Now, it's possible we did and I just don't remember it. I don't think we did. See, the problem was a fuel cell rupture. We weren't in the fuel cell business. We were earlier. In the early, early days we did some fuel cell testing out

here, and we're doing APU [auxiliary power unit] testing out here now, but in those days we weren't.

TILLETT: Actually it was a tank rupture.

MCCRIGHT: Oxygen tank, yes.

TILLETT: Oxygen tank rupture. They had a circulating fan inside that tank.

MCCRIGHT: When they stirred the tank, yes. A lot of people will tell you that was NASA's finest hour when we got 13 home. I feel like it was close.

TILLETT: Yes.

MCCRIGHT: The three missions that stick so vividly in my mind was Apollo 8, Apollo 11, and 13. Those were high points, as far as I'm concerned, of the agency's existence.

TILLETT: I kind of liked—what was it, 16 and 17, too, because they had the rover.

MCCRIGHT: Yes. They were neat interesting missions, yes.

TILLETT: Pretty neat missions to watch on TV.

MCCRIGHT: Another thing I remember, late in the program, last couple of missions, they would take the TV camera off of the rover and park the rover off from the vehicle, and there was a guy in mission control, and I can see his face, I can't think of his name, that when they were doing the counting, and a certain number of seconds, several, like ten or twelve seconds before the firing of the ascent, he would start that camera moving. Because it took, what, four seconds for the signal to get up there, and the camera's slow moving, so he started it moving, and just about the time they fired, he was looking at the ascent vehicle as it fired and went back into orbit. That was our vehicle, so it was exciting to see it fired in that mode. I guess we only saw it twice. I guess 16 and 17.

TILLETT: Well, 15 had a rover.

MCCRIGHT: Maybe it was 15, 16, I don't remember. Yes, 15, 16 and 17.

TILLETT: Fifteen was—what's his name?

MCCRIGHT: [Harrison H. "Jack"] Schmitt?

TILLETT: No, Schmitt was on 17.

MCCRIGHT: That's right.

TILLETT: I was thinking of the commander on 15 was the guy that became the center director at KSC.

MCCRIGHT: That was—

TILLETT: For a short period of time, until he got into girl trouble.

BUTLER: Dave [David R.] Scott.

TILLETT: Dave Scott.

MCCRIGHT: Scott, yes.

TILLETT: Dave Scott.

MCCRIGHT: Scott and [James B.] Irwin were on that flight.

TILLETT: Yes. Then 16 was John [W.] Young and—

RUSNAK: Charlie [Charles M.] Duke and Ken [Thomas K.] Mattingly [II].

TILLETT: —and Charlie Duke, on the surface. Seventeen was Gene [Eugene A.] Cernan.

MCCRIGHT: Schmitt.

TILLETT: Schmitt and the Navy guy, Navy captain.

RUSNAK: [Ronald E.] Evans.

TILLETT: Ron Evans.

RUSNAK: I think 15 was also the mission where when they were reentering, that they had one of the parachutes collapse because of the venting. Did you do any of the post-flight analysis work on that, any of the materials or anything?

MCCRIGHT: Well, I don't know. We very likely did test the materials on a chute, but I don't know that we did it as a result of that incident. I don't remember anything about it. We weren't in the chute business, other than materials business.

RUSNAK: Do you remember any other—

TILLETT: Well, wait a minute. Hang on a minute. Repeat what you said.

RUSNAK: Fifteen was the one where they were venting the RCS after they entered the atmosphere.

TILLETT: Yes.

RUSNAK: It was either the—

TILLETT: We did do something on that, Grady.

MCCRIGHT: I don't remember.

TILLETT: At 302. We went up on the side at 302, just because it's tall and sitting up in the air, and I can't remember what the heck we did, but—

MCCRIGHT: We might have done some venting to see it came back and had all the material.

TILLETT: We had a chute, or a partial chute, or something like that, and we sprayed it with oxidizer. I don't remember the outcome of it. I don't remember very much about it, because I wasn't intimately involved with it.

MCCRIGHT: I don't guess I was either, because I don't remember anything about it. I didn't work in 300 Area a lot in Apollo. I worked mostly in the 400 Area.

TILLETT: Yes, me, too.

RUSNAK: Do you remember any other sort of post-flight investigations that either of you did work on?

TILLETT: Well, I told the one yesterday, I guess, having to do with the high-pressure temperature in the fuel line after Apollo 11 landed on the Moon.

MCCRIGHT: I remember doing that.

TILLETT: That was a pretty involved test program that we went through.

MCCRIGHT: I did get involved in a little bit of the PUGS program up in the 300 Area, Propellant Utilization Gauging System, on the service module tanks. That was the crummiest gauging system I ever as associated with. We finally flew without it. Al Williams was really involved in that. I helped him out some. What they were doing was sensing liquid in the tank, little sensors on this pipe that went down through the center of the tank, and as those little sensors got covered with liquid, they'd change state—sometimes. We never did successfully fix it. We finally flew without a PUGS system.

RUSNAK: Neither of you I don't think had said anything about either Skylab or the Apollo-Soyuz Test Project much in your interviews. Did you work much on either of those programs?

MCCRIGHT: Well, you've got to remember all the hardware they were using was Apollo hardware. So we were still in the mode of being in a ready-to-test mode if they had a problem on board. However, we did do a lot of RCS testing for Skylab, didn't we?

TILLETT: Yes, we did.

MCCRIGHT: Because they were fired. They were going to be fired longer.

TILLETT: That's when Dan Haley [phonetic] and that crowd came out here. That was Skylab RCS. We did a lot of that. We did that in 301, because the flying profiles were just entirely different from what Apollo experienced.

MCCRIGHT: 3RC2, wasn't it?

TILLETT: Yes, 3RC2.

MCCRIGHT: 3RC2 was the name of the program. See, Apollo, here in the actual lunar flights, those RCS engines weren't used near as much as they were going to be when you're going to leave the vehicle up there ninety days. So we went through a whole new qualification program.

TILLETT: Yes. Totally different kind of duty cycle.

MCCRIGHT: Apollo-Soyuz, I don't remember doing much for that.

TILLETT: No. It was just a command and service module.

MCCRIGHT: It was a political thing. They just put it in orbit and connect up with the Russians.

RUSNAK: Both of you had mentioned earlier about how working out here as an engineer, you really got to become sort of a generalist, where you work on a lot of different things. I guess I was really wondering why you think the atmosphere out here was really different than at some of the other centers where you became very focused.

TILLETT: Well, I think a lot of it had to do with our relative independence.

MCCRIGHT: Yes. I think it had to do with independence, it had to do with we were totally hardware-oriented. Our business is hardware testing. I think our independence, like Rob said, gave us the opportunity to say—White Sands has always, certainly after Apollo, always operated with not enough manpower, not enough budget to do the job we're asked to do. So we said we've always had the philosophy here that if you take NASA engineers and let them do designs, just like the contractors were doing, let them conduct tests, we're going to get more out of our manpower than we are if we just let them be project engineers.

Now, over time it's moved back in the last few years, back toward doing a whole lot more project work here with NASA people. It's probably a necessary evil, because the staff, the NASA staff continues to dwindle down, and so it's unfortunate, but that's probably true. But for the bulk of thirty years or more, NASA had hands on the hardware, and I think it's because of

the leadership out here in those days we were willing to let that happen. We negotiated agreements with the contractors and let that happen. So the NASA people who are here for many, many years have been hands-on. There's not a lot of hands-on NASA people in Houston. If they are hands-on, they've got tunnel vision in one specific area.

The Power [and] Propulsion Division in Houston, where do they get their data? From White Sands. That's where the propulsion people in Houston get their engine data. They don't do engine testing there. They had done very little through the years. They had done some, but they haven't done much. So the subsystems managers for the propulsion systems are resident in Houston and Downey, California. All their data comes from here, because they don't test engines either place.

RUSNAK: I guess that leads me into what is my last question. How do you think NASA and the environment at White Sands has really changed from when both of you first started working through now? We've been kind of getting bits and pieces of that as we've been going on, but I just wanted to ask you.

TILLETT: It's a whole lot greater than a chameleon changing his color, I'll tell you that. For me it's a remarkable change. The attitude in NASA in the sixties, all the way up through the Apollo program, was a can-do attitude, gung-ho, pride in their job. Nobody was lazy. Everybody worked. Everybody worked hard and enjoyed doing it. You went home feeling good about your job and all that sort of thing, regardless of what your job was.

When I retired in 1992, and I don't know whether I got this on tape yesterday or not, but I guess I probably did, I was really leaving because I was afraid if I stayed much longer, the

bureaucratic burden, which I don't tolerate very well, was probably going to kill me. I left leaving twenty-one months worth of that big SES [Senior Executive Service] raise laying on the table, which would have given me another $15,000 a year in retirement money.

But the way I felt about the agency at that point, and I'm sure it's gotten much worse under the current leadership, was that it had succumbed totally to the bureaucracy, and it wasn't a hell of a lot better than the Department of the Army over here at White Sands. I've always said, boy, if you can't be any better than the Department of the Army at White Sands, you better quit.

MCCRIGHT: Let me say almost that same thing a little bit differently. The agency was created in 1958. We were starting really to work hard on Apollo less than six years later. The agency brought a few older people from other agencies, but brought a lot of people from industry, brought a lot of people fresh out with an open mind, and really and truly the people doing the work in Apollo, by and large, were young people. They just really were.

In those six years, and it was less than—it was eleven years when we did Apollo 11. The agency had only been in existence eleven years. The bureaucracy in eleven years cannot grow to equal what the United States Army bureaucracy has been in 200 years, and we've had an Army for more than 200 years. So they have continued to build the bureaucracy, and it's gotten harder to do business with them, harder to do business with them. Today it is harder to do business with the military at White Sands Missile Range than it was in 1960s, because their bureaucracy has gotten worse. But the main reason it's harder is because ours has gotten worse.

Now, in the, what, forty years what this agency's been in existence, you young people cannot possibly appreciate how the bureaucracy has grown in forty years. NASA is just about

as bureaucratic as the military now. Not quite. They're not quite. I still say NASA's not as bad as the military. We had a lot more—I believe Rob and I, as the managers of White Sands Test Facility, had a whole lot more freedom working under NASA than the general at White Sands probably has.

TILLETT: Probably.

MCCRIGHT: One reason is we're 850 miles from home. That's certainly a big part of it. White Sands has a reputation in Houston of being a team player, and still has a can-do attitude comparatively to Houston, and still efficient. But when the powers-to-be at Houston lay another bureaucratic non-value added, as far as White Sands is concerned, we tend to ignore it. And we've done that for thirty, forty years.

I got in lots of discussions, when I was the manager, with senior people at JSC, because JSC decided to do facility managers one way, and I said, "It won't work here. We can't do it that way. We don't have that many people here to do it that way." And I did it a different way.

There were a number of those instances that came up in the four years I was the manager that we just did not do. I was told several times, "George Abbey's going to make you do it," and I said, "I don't think so." And George didn't, because I could tell George why I wasn't going to do it that way, and we're a different animal than JSC. This is a small, well-knit group. Everything they do is hazardous. Everything they do. Materials testing is hazardous. All of it is. It's fire and smoke and hazardous toxic propellants. So we're given some freedom because of that, I think.

I don't remember a single occasion where George said, when I refused to do something bureaucratic that JSC wanted to do—I didn't refuse everything, only those that I was willing to spend my silver bullet on. I don't think he ever directed me to do one, because I had a reason why I wasn't going to do it that way.

One of the issues that came up right after I became the manager, within a year after I got back out here, J.P. [James P.] Harris [III] retired, Jim Neal retired. A guy from Washington became the chief of procurement in Houston. Washington never bought anything other than a desk, and that's about what they know about procurement. But, anyway, this guy, he seemed like a nice guy, but he decided that—I'm sorry, he was the deputy to the procurement office—the chief of procurement who was from IRS [Internal Revenue Service]. They brought her in from IRS.

TILLETT: IRS?

MCCRIGHT: Yes. And this guy from Washington was her deputy. So neither one of them knew very much about procurement, certainly not in the aerospace business. So they came out here right after they took over in and said, "We're going to transfer the responsibility for all the procurement here to Houston." And the people in the administration office here would not report to me anymore, they would report to the procurement office and the comptroller's office in Houston. And my answer to that was, "Over my dead body," and we went to the mat. And those administrative people here still report to the manager of White Sands Test Facility.

TILLETT: Made absolutely no sense whatsoever to do it that way.

MCCRIGHT: Makes absolutely no sense, and I tried to tell them. One of the examples I used on them, I said, "Look, when I've got a test to support tomorrow and I need a case of WD-40, and I go down to the administration office and tell the CO to get me a case of WD-40 and get it now, he's going to say, 'I can't do that, because I work for Houston. I don't work for you.'" I said, "That's not going to happen on my watch." And I was willing to break my pick over that one.

But when I went to the powers-to-be in Houston and said, "Look, this makes no sense whatsoever," they readily agreed and it was over.

We learned something in Apollo that makes me think of. During Apollo, the 300 Area was essentially run by, except for the facility systems, it was run by North American Aviation. The 400 Area, except for the facility systems, including the steam generators and those kind of support functions, were run by Grumman. The CO for those two contracts was in Houston. I think Rob would agree that after Apollo was over and Grumman and North American left here, we collectively said, "We ain't ever gonna do that again. Henceforth, whatever contract we're working on, the CO of that contract is going to be here," and it has been since. And trying to get a CO over the telephone to do something that makes him have to hurry or make him have to cut some corners or do some things real rapidly is not the same as walking down to a guy that reports to you and say, "Do it." I firmly believe that nobody working at White Sands ever wants to work with a CO not resident here.

TILLETT: You can't avoid it if you're dealing with prime contractors.

MCCRIGHT: That's right, but we have. We haven't dealt a lot with prime contractors.

TILLETT: That's right, we haven't.

MCCRIGHT: Some of the engine testing for OMS [orbital maneuvering system], if you remember, we only had a couple of prime contractor representatives here.

TILLETT: Yes.

MCCRIGHT: The people conducting the test were under contract to a local CO.

TILLETT: Yes. We've been a support services contractor-run facility ever since the end of Apollo.

MCCRIGHT: Ever since the end of Apollo. For my money I would not ever want to change that. I can't foresee any program NASA's going do in the future that you wouldn't work at White Sands in this manner. I believe that when the agency gives a person out here, the manager of this facility, the responsibility that for everything that happens in the State of New Mexico, wherever it happens, and in a lot of other states, too, but he's 850 miles from his support organization in Houston. Then this local person who's responsible for all that has to be given the authority, the responsibility, and the funds to be able to do it. If you try to run more and more of it out of JSC, 850 miles away, it's just not going to work.

When I was in Building 1, and the deputy or the director of center operations, if I wanted my CO, I only had to walk across the pond to get him by the throat. But if I'm out here,

it takes me a day to get there to get him. So it just makes no sense whatsoever. And White Sands' reputation is built on fast response.

TILLETT: You bet.

MCCRIGHT: It always has been.

RUSNAK: Well, unless there's anything else you guys would like to talk about, I've gone through pretty much my whole list here.

TILLETT: Well, that's good. I'm getting hungry anyway.

RUSNAK: Okay. Well, then I guess we'll call it a morning then. Thank you very much.

TILLETT: Well, thank you.

MCCRIGHT: Yes, thank you.

[End of interview]