ORAL HISTORY TRANSCRIPT

ROB R. TILLETT
INTERVIEWED BY KEVIN M. RUSNAK
LAS CRUCES, NEW MEXICO – 7 MARCH 2000

RUSNAK: Today is March 7, 2000. This interview with Rob Tillett is being conducted in his home in Las Cruces, New Mexico, for the JSC Oral History Project. The interviewer is Kevin Rusnak, and is assisted by Carol Butler.

I'd like to thank you for participating today.

TILLETT: Happy to participate…

RUSNAK: Okay. I'd like to start. If you could tell us about your background, where you grew up, and what kind of interest you may have had that led you into the NASA career.

TILLETT: Well, I grew up on a remote cattle ranch on the Wyoming-Montana border. It was so remote that when I started school I had to board out from the first grade through high school. So I kind of got used to being self-sufficient, I guess you might say, or independent.

When I was little, I had an interest in science, and I always wanted my dad to buy me a really good microscope, you know, and all that sort of thing. In high school I got really interested in physics, and that's what I ended up majoring in in college. I don't know what else there is to say, really.

RUSNAK: That's fine. Before you went to college, you spent some time in the Army, is that correct?

TILLETT: Actually, it was between my freshman and sophomore years. I was in the National Guard. I had one month to serve for my three-year term of service in the National Guard when [Harry S.] Truman, President Truman, that is, activated or extended everybody's enlistment, whether it was National Guard Reserve, regular Army, or whatever, by one year. So I ended up spending thirteen months in the Army, about eight or nine of those in Korea.

RUSNAK: So what type of work did you do for the Army? Anything related to—

TILLETT: I was a supply corporal and a truck driver. [Laughter] Nothing related to anything.

RUSNAK: Then you obviously had a chance to go back to school and work on your physics degree?

TILLETT: Right.

RUSNAK: Did you have any particular interest there?

TILLETT: As a matter of fact, that worked out pretty good, because my G.I. Bill carried me right to my bachelor's degree and that was it. It would have run out like three days after I got my bachelor's degree.

What was your next question? I'm sorry.

RUSNAK: I was just asking you about your specific interest in physics, if you had any.

TILLETT: No, not really. You know, at the baccalaureate level you don't really have a chance to specialize or anything. I was just kind of interested in everything.

When I graduated, I went back to the ranch for a year, and I decided that being a 25 percent partner in a family-owned ranch wasn't my cup of tea, because I was the junior partner and took orders from everybody else. So I decided I'd just strike out on my own.

I went back to the University of Wyoming [Laramie, Wyoming] for one semester of graduate work. I got a summer job in San Diego [California] with Convair [Division of General Dynamics]. The reason we took that was because my wife's folks, my mother-in-law and father-in-law, were living in San Diego at the time, so we had free board and room. It was so much fun to make money for a change, that I just never went back to school. I stayed with Convair, which very quickly became General Dynamics Astronautics. I was on the Atlas program.

RUSNAK: What was your first job with Convair?

TILLETT: First job, they put me in when they hired me was as a temporary or a part-time hire. Not part-time, but just a temporary hire, summer hire, was in the Standards Lab calibrating transducers and that sort of thing, you know. I got fed up with that in a heck of a hurry.

One of the organizations that paid a lot of attention to transducer calibrations and that sort of thing was the Test Evaluation Group. They did flight test evaluation, static ground test evaluation of engines and all that sort of thing. One of those guys came down quite frequently to review our calibration data, and I got to talking about him, what his group did and all that sort of thing, and I decided that's where I'd like to work.

So I went up and started talking to the powers-that-be in flight test evaluation, and pretty soon I was a missile test analyst. Then I was a flight test engineer, and then I was a senior flight test engineer. That was very, very interesting and very rewarding work. Probably the most interesting work I've done in my entire career was flight test analysis on the Atlas.

RUSNAK: Really? Why so?

TILLETT: Well, I don't know, I'm more of an intuitive-type engineer or scientist than I am, you know, sit down with a pencil and a piece of paper and work out problems. I intuited my way to solutions of a lot of flight test problems that we had on the Atlas. As a result, I advanced fairly quickly in that organization. I could write, so I ended up always writing the summary to the flight test reports, which was usually an eight- or ten-page introduction that covered everything. It was a lot of fun. In that job for about five years.

RUSNAK: Of course, the Atlas had some problems at the beginning.

TILLETT: Oh, yes, because it was really plowing new ground, you know. We had a lot of things. We did a lot of things that had never been done before, and, as a result, we had a lot of

failures. Some of them were pretty spectacular. I saw a couple of the spectacular ones. I was close enough to one to just about want to run around and dive under the car. [Laughter]

RUSNAK: Where was that one being launched from, do you remember?

TILLETT: Yes, that was launched from the Cape [Canaveral, Florida]. The other one I saw was launched from Vandenberg [Air Force Base, California]. I was a little further away from it, I didn't have to duck. But it was kind of funny, that one from Vandenberg, we were reviewing the movie film afterward, and the thing went up, and it got up, oh, probably a couple thousand feet and blew up. Well, what happened was one of the rate gyros died. The motor wasn't spinning, so it took off with an inoperative gyro and it had no—I think it was pitch rate control. So the thing did a couple loop-de-loops, and finally range safety blew it up with the destruct package.

The guy was on this long-lens 35-millimeter camera in a gun mount, you know, tracking this, and he was tracking pieces down. One of the pieces I think he tracked down was the booster section, and he tracked it all the way down to the ground, and it hit right by the pad, and in the background you see this guy hoofing it just as fast as he can down the road getting the hell out of there. [Laughter] He had hid out to have a really good view of the launch, and then it blew up right over his head. I don't think they ever found out who it was, but the commanding general at Vandenberg saw that film and, boy, he had launched an investigation, and how could they breach security like this, and he was really upset. I just thought it was funny.

RUSNAK: Do you remember what the biggest problems were at the time?

TILLETT: On Atlas?

RUSNAK: Yes.

TILLETT: Yes, the first, and I was the one that kind of came up with the solution. The first one blew up about four or five thousand feet, and the second one blew up about the same altitude, maybe a little bit higher. But what was happening, there were indications of excessive heat in the engine compartment, and what was happening was the aerodynamics weren't quite right and it was picking up the exhaust, the fringes of the rocket exhaust, and recirculating them back up into the engine compartment and burning everything up, overheating the 10,000 psi helium spheres. Boy, when one of those goes off, it makes a bang, let me tell you. When they redesigned the aft section to improve the aerodynamics and to seal off that engine compartment so flame couldn't circulate back up in there, why, then that problem was solved.

Most of the other problems that we had were isolated things, like that rate gyro, you know. That caused a revolution in the whole missile industry, that rate gyro. They invented a method of determining whether the motors were spinning or not, the gyro motors, the gyros themselves were spinning or not before they took off.

They had things like, they called one of the tests the kick-the-can test. You know, you send a technician up there and he bangs on the side of the gyro package, and you watch the data coming out to see if every gyro is reacting to that.

Then there were, oh, I guess electrical induction tests that you can determine whether the motors were operative or not and that sort of thing. Every time you'd have a failure, you know,

that would cause a fix. You'd probably never have that problem again if you could determine what caused the failure in the first place, and sometimes it wasn't easy to determine.

But it was a fun program. Unlimited funds, you know. We were trying to beat the Russians to an ICBM [intercontinental ballistic missile]. I guess I should say Soviets at that point in time. So money was not a problem. Overtime was not a problem, except you worked too damn much of it. I worked eighty-hour weeks for quite a long time.

RUSNAK: How much time did you spend down at the Cape?

TILLETT: There were several of us doing the same work that I was doing. Probably, oh, I don't know, four or five of us, and we just rotated. So I'd usually spend a month down there every three, four, five months.

RUSNAK: Did you have a chance to run into any of the Space Task Group people down there for NASA?

TILLETT: Oh, yes. Yes. In fact, one of the early Mercury—Mercury was launched off Atlas, you know, and one of the earlier Mercury test launches had a problem at capsule separation. I happened to be the one that worked out what caused the problem and all that sort of thing. So I went in to tell my boss, Al [Alfred D.] Mardel was who the guy was, he worked for NASA shortly after that, tell him what I had found out, and it happened that the test conductor from the Cape was sitting in there talking to him in his office. So I kind of butted in and told Al what I had discovered, and the test conductor from the Cape, and I can't remember his name, was kind

of impressed, so he invited me down to give a presentation to the whole launch crew. So I went down and did.

Then NASA was just beginning to do things down there. You know, this was about—oh, what year would this have been? Around 1959 or '60. So I said, "Gee, you know, I sure would kind of like to see what NASA's doing and get an introduction."

NASA assigned one of their engineers to be my tour guide for the next two days. He happened to know [Virgil I.] Gus Grissom, and we ran into Gus in one the bars that evening, and we spent the whole damn night drinking with Gus. [Laughter] That was probably the last time I ever saw Gus, because I went back to Convair and then I went to Thiokol [Chemical Corporation, Brigham City, Utah] for a year, and by the time I went to the Cape, I didn't see those guys very much. I saw John [H.] Glenn [Jr.] and [M.] Scott Carpenter and Al [Alan B.] Shepard [Jr.] quite frequently, but I just never really ran into Gus again. You know he was one of the three in the capsule fire.

RUSNAK: As someone who worked on the Atlas and had seen some of these spectacular failures, what did you think when you found out NASA was going to put a guy on top of this and launch him into space?

TILLETT: I didn't know much about NASA's reputation at that time, but we soon learned that [Wernher] von Braun was a stickler for making sure that everything on the launch vehicles that he was responsible for was double-checked, triple-checked, quadruple-checked, and so on. Marshall [Space Flight Center, Huntsville, Alabama] had an outstanding record with those launch vehicles they ultimately built, you know, the Saturns.

But the Atlas was a little more sensitive vehicle than the Saturn. Its tanks were what they called monocoque construction, and they had to be pressurized. If they weren't pressurized, they'd just collapse like a balloon with all the air let out. So they were more sensitive to little problems than the Saturns. Von Braun built a lot more redundancy into the Saturns than Convair built, or the Air Force built, into the Atlases and Titans and things like that.

So, yes, but once I'd kind of started working with the NASA people, I understood that they were going to be extremely thorough, and I felt pretty good about it. And besides, they had an escape tower on there for problems that occurred early on in the flight that could get them out of the mess.

RUSNAK: Also in that same time frame, I think it was in the election of 1960, President [John F.] Kennedy, or I guess soon-to-be President Kennedy, made a big deal about the missile gap and how we were lagging behind the Soviets in missile technology. As someone who was working on essentially America's premier ICBMs, how did you feel about that at time and what were your thoughts on that?

TILLETT: Oh, I thought that was great. Just that much more impetus to keep us going, you know, and keep us funded and keep the program interesting and fun to work on.

The last year I was at Convair—I should say General Dynamics—I was project engineer. I was booted upstairs and became a red badge. Convair had a badge system that you could just glance at a guy and tell how far up he was in the organization. They had solid-color badges for the hourly people, and they were either, what were they, they were white, green or—

gosh, what was the other color? I don't remember what the other color was. That was for the three different shifts, because it was an around-the-clock operation, seven days a week.

Then the professional people wore a candy-striped badge, just a little round badge with red and white diagonal stripes across it. So everybody knew, well, that's an engineer or, you know, something like that. Supervision wore a solid-red badge. Project engineers were considered supervision, although we didn't supervise anybody, but we were—I guess "management" is a better term. We were in management. Then the blue badges were corporate people.

RUSNAK: Can you tell us some about the other project you worked on, the Midas system?

TILLETT: Well, that was when I was a project engineer. I was responsible for the boosters for MIDAS [Missile Defense Alarm System] and SAMOS [Satellite and Missile Observation Satellite], and they were Air Force, top secret Air Force payloads. One of them had to do with fancy photography. They were basically for spy satellite kinds of things. Gee, all I did was just coordinate the efforts between our people at Convair and the customer, who was the Air Force, through TRW [Thompson-Ramo-Wooldridge], generally. Generally, TRW usually represented the Air Force in those kinds of dealings. That wasn't as much fun as being a flight test evaluation type. You get involved in bureaucracy and people's egos and all that sort of thing, you know.

RUSNAK: For someone who got a degree in physics, how was it moving into these more engineering sorts of areas?

TILLETT: I think for the kind of work that I ended up doing throughout my career, I think physics was a far better thing to study than any branch of engineering, because it made you think. It wasn't so much what you learned as you learned how to think differently from the engineers, and so I could kind of fill in the gaps when the engineers would falter. By the same token, I couldn't go out and design something because I didn't have any training in that, or experience. And I wouldn't want to be a design engineer anyway; I wanted to by an analytical type.

RUSNAK: You also mentioned that you worked for Thiokol for a short period of time. Why did you move, and what types of things did you work on there?

TILLETT: San Diego was getting to be a big city, and I came from a very remote ranch, and that many people around me, I was beginning to feel closed in. Working for Thiokol up in Brigham City, Utah, was a way to get back in the kind of country I liked. That was the primary reason I moved.

But when I got to Thiokol, I found it was no Convair. The management there were, I hate to run anything down, but management was not a responsive or a responsible management, to my way of thinking. I managed to stick it out for about almost a year, and then I had to leave.

By that time, Al Mardel, who had been my boss at Convair, had gone to JSC, which was then MSC, and he headed up a group in ASPO [Apollo Spacecraft Program Office], Flight Test Integration, I think, or Test Integration Group, something like that. He got a hold of me and

wanted me to come down there, and I said, "If I can get a [GS-] 14, I'll come; otherwise I won't." They managed to get me a 14, and so I went down there.

RUSNAK: So was it a big change, moving to Houston then?

TILLETT: Oh, yes. I managed to survive Houston for ten months. [Laughter]

RUSNAK: What kind of projects were you working on when you first came down? What specific areas?

TILLETT: Developing the flight test program for the Apollo spacecraft.

RUSNAK: That involved—?

TILLETT: Oh, boy, that involved just a whole range of things, you know. How many flights do we need? What's the best way to test them? What kind of instrumentation should we use? When do we need to start using Saturn Vs as opposed to Saturn Is or -IBs or whatever? How many times do we need to test an Earth orbit before we do a lunar orbit test? It's just all that kind of stuff. Everybody had different ideas about it.

I tended to be less conservative than most and would do fewer tests than a lot would. I didn't stay in that job but less than a year, but ultimately it came out about the number of flights that I thought it should take. Some people were saying we ought to fly two or three or four

times that many flights just to get confidence. Well, hell, once the thing's working, go to the Moon with it.

RUSNAK: Let me follow up with George [E.] Mueller and the all-up testing. How did you feel about that, where they would test the Saturn V with all functional components, rather than doing it stage by stage?

TILLETT: I thought that was great. I think von Braun was in favor of that, too. Was it Mueller that kind of invented that philosophy?

RUSNAK: He is usually given credit for that, yes.

TILLETT: Is he? Okay. I wasn't really aware of that. I kind of thought that was von Braun's own personal idea, but it might have been Mueller sticking it down von Braun's throat. I don't know. But, yes, I always believed when you test something, test it in as full a configuration as you possibly can.

RUSNAK: There's certainly a lot of payoff that you can get through that in terms of time and saving dollars, I guess.

TILLETT: Yes. Apollo had a very short flight test program. It was extremely short.

RUSNAK: After ten months, you moved out to this area. How did that opportunity come about?

TILLETT: One of the guys you've already interviewed, Owen [G.] Morris, was in the office next to me, and at the time he was responsible for the Little Joe flight test program out here at White Sands [Test Facility, Las Cruces, New Mexico]. We were just passing the time of day one day, and somehow or another the idea of White Sands came up, or the subject of White Sands came up, and I said, "You wouldn't need any good test conductors out there, would you?"

He says, "Boy, I sure as hell do."

I said, "This humidity and these chiggers, and all that sort of thing, has just about got me down. I've got to get out of this place."

He said, "Well, boy, if you want to be a test conductor on the Little Joe program, you got a job."

So in less than a month, I was out here. When I got here, I reported to the head of the Little Joe program, to a guy by the name of Henry [R.] Van Goey. Hank decided that he needed me over at a place called PSDF, Propulsion Systems Development Facility, which was still under construction. That's the NASA facility out here now. I think he had a big row with Owen over it, but he made me the ASPO representative at what is now known as the White Sands Test Facility, what was then known as PSDF. Then later it became White Sands operations in the transition between PSDF and White Sands Test Facility.

RUSNAK: So what was it like out here at that time? White Sands wasn't very old.

TILLETT: Oh, it was wild. We had three different groups represented out at the PSDF. There were three different Houston organizations represented, each with their own head honcho and

each totally independent of the other. It was referred to as the three-headed monster. [Laughter] It was Henry Van Goey representing ASPO, and Wes [Wesley] Messing representing administration, and Bill [R.] Gantz representing [Joseph G.] Guy Thibodaux's propulsion organization in engineering, and they chose to argue about everything.

For some reason, I got elected to be the official scribe for those meetings. I remember one time Wes Messing standing on the conference table on one end, and Van Goey standing on the conference table on the other end, and Gantz sitting there in the chair egging them on, just shouting at each other and pointing their fingers. Pretty soon it became evident to the powers-that-be in Houston, "Hey, we really do have a monster out there. We've got to take care of this." And they sent Paul [E.] Purser out to be the site manager for a period of time until they could find a permanent one, and the permanent one they found was Marty [Martin L.] Raines.

RUSNAK: What stage was the flight testing program at at that time? How far along was that when you became involved with it?

TILLETT: The Apollo flight test program? Boy, I'm trying to relate what was going on at Marshall and what was going on out here is kind of hard to do. The Little Joe program was testing the escape system. I think probably the other part of the flight test program was just the early basic tests of the Saturn I and Saturn IB, and they were doing micrometeorite experiments and that sort of thing and just getting the Saturn set up so they were sure that it was going to be a reliable vehicle and all. I just can't interweave the two. I just don't remember.

RUSNAK: I guess what I was wondering is, relative to the booster flight testing, I was wondering how the things like the service propulsion system and the systems aboard the craft were—

TILLETT: Oh, okay. I can't associate it in time really with what the Saturn program was doing, because I don't remember their time scale that well. I wasn't closely enough integrated into it. But the first vehicle we had out here was a service propulsion system, heavy-weight test article. Boy, what was the designation of that thing? I can't think of it right at the moment. That came in the summer, spring or summer of '64. I got here in February of '64. That came in the spring or summer of '64, and we got a big pool going as to when the first firing was going to be and I won it. [Laughter] If I remember correctly, it was September the 22, 1964.

Then I spent most November, December, and part of January in Downey [California] at North American [Aviation, Inc.] working on spacecraft. Well, Spacecraft One had gotten to the point where it was ready for a lot of its final testing and checkout and all that sort of thing. That was the first Apollo spacecraft, Spacecraft 001, it was the propulsion test article, and it came here. We got it here in, I think, either late January or early February, possibly, of 1965.

Of course, there was still site construction going on. We got the service propulsion system [SPS] test facilities up and running before the lunar module test facilities were. Well, North American was well ahead of Grumman [Aircraft Engineering Corp.] anyway, simply because they had a contract a hell of a lot earlier than Grumman did.

I realized that I was going to end up being in charge of the test conductors and operations directors and that sort of thing on the lunar module facility, so I went over there as much as I could. I still had kind of operations direct responsibility for some of the propulsion tests, but I was able to assign a couple of other guys to pretty well cover that for me and I could

go over to the LM [lunar module] facility and keep track of progress there and try to pick up any facilities problems and get them taken care of before we got the test articles there to test.

RUSNAK: So do you remember any particular vexing issues with the SPS early on?

TILLETT: No, it was a pretty doggone successful propulsion system. It was pretty benign. It didn't create us a lot of problems, unlike the lunar ascent system which that engine went through a couple of different—they took it away from one contractor and gave it to another a time or two before they finally found somebody that they felt like they wanted to leave the contract with.

RUSNAK: Mr. Thibodaux was relating some of the problems they were having with the injector system on the ascent stage.

TILLETT: Yes. They really had performance problems. They weren't getting the performance out of it that they needed.

RUSNAK: And that was showing up on your test stands?

TILLETT: Yes. It was also showing up at the manufacturer's test facilities as well. Guy was intimately involved with all of that sort of thing, much more so than I was, because at that point I was more LM facilities related and I wasn't paying all that much attention to SPS testing. But

that was Guy's responsibility. He had to make sure that they had a proper propulsion system when the time came to use it.

RUSNAK: As you were in charge of the LM facilities, how did you go about deciding what you needed for that and setting it up for the system?

TILLETT: All the design and that sort of thing had pretty well been taken care of before I got out here. As we went along, we found design deficiencies and corrected them, and there were a lot of them. We had problems meeting cleaning specs for the propellant plumbing systems and all that sort of thing. We had just literally tens of miles of plumbing out here, just humongous amounts. Those things had to be cleaned to—I don't remember the level designation, but it was damn clean, particularly from the point of view of organic contamination of any kind. It wasn't quite so bad, because you could filter like dust and things like that, you can filter that out.

Then the humidity, they wanted all those pipes to be just as dry as possible, so they had to be dried to a dew point of minus-60 Fahrenheit before any propellants were introduced into them. The people that were doing these plumbing jobs, you know, they were plumbers. [Laughter] They hadn't dealt with space flight systems before and, boy, they just had fits trying to meet NASA specs, but eventually it all came together.

Then we finally started getting ascent and descent propulsion test articles down here out of Grumman, and for the most part they were pretty successful. We did blow up one descent stage. The engine blew itself up, actually. It was a design deficiency having to do with [unclear]. You know, that was the throttleable engine. They corrected that, and then we really never had any more problems in the descent stage, which was the one I worked with a lot more

than the ascent stage. Just really surprised everybody on how reliable it was and how you could throttle through its range with no problems at all. Just test after test just went off like clockwork. Everybody was really pretty laudatory about how good a job TRW had done on that LM descent engine.

RUSNAK: Was there a typical regimen you would put each article through or did it vary from each?

TILLETT: It varied, because as you learn things from one test you've incorporated different instrumentation and different profiles and all that sort of thing in to pursue that, a particular aspect of it, whatever it was. So it was a lot of variety.

You know, back in the early days before there ever was such a thing as an artificial Earth satellite, they decided that the Navy was going to be responsible for launching our first artificial satellite. Then, of course, Sputnik 1 came along and that kind of hastened everybody up a bit, to say the least. The Navy decided to use the Vanguard to launch the very first artificial Earth satellite. It turned out it was not the first. Of course, the Soviets put up the first one.

But I happened to be at the Cape, and a couple of my friends from the Test Evaluation Group in San Diego were with me. We were down there on some of the early Atlas flight tests. We happened to be there at the time they were going to launch Vanguard 1. So we took the car and we drove over just as close as we could before locked gates and security guards and that sort of thing stopped us, as close as we could to the Navy launch pad. So we were sitting there watching the whole thing and listening to Cocoa radio, who had a news broadcaster somewhere in the vicinity. I don't know where he was.

But you know, what happened was, the damn thing blew up on the pad, and the little old three-pound satellite, or whatever it was, was laying there, I guess with its radio active, beeping along on the pad. The radio announcer said something to the effect that, "We have ignition! The engines are running!" Then there was this horrendous explosion, and he said, "Boy, there's a lot of smoke and fire, and now the smoke's clearing. Ladies and gentlemen, the Vanguard missile is gone!" [Laughter] It was gone all right, there was so much rubble on the ground.

RUSNAK: Gone in pieces instead of gone into space.

TILLETT: Yes. You know, that kind of triggers another thought. We were down there—I think the missile was—the Atlas test vehicle was 3B. It was one of the B series, anyway, and I think it was 3B. When the Vanguard failed, somebody finally came to their senses and gave von Braun the opportunity to launch a satellite. Of course, that was in, what, October of '57, and he launched in January. He said, "I can launch before the end of January," and he did, with Redstone.

I was down there on whatever vehicle this was, 3B or—boy, I can't remember the designation for sure. At one time I knew them all the way from 1A to 100E. But, anyway, there was a lot of secrecy going on in the hangar, and guys were coming in that nobody ever saw before, and people were getting run out of the hangar at various times, and nobody knew what the hell was going on. It turned out that within Convair only the base manager and the test conductor for that pad that that vehicle was being launched from knew what was going on, and that was when they took a lot of the guidance packages and other packages out of the instrument pods to save weight. Instead of putting on an ICBM nose cone, they put on a monocoque-type

pressurized aerodynamically sharp nose cone, and they put in the tape-recorded message of [Dwight D.] Eisenhower's Christmas message.

We found it out the day after launch. I went down to the guidance station, because I was responsible for guidance system at that time on the Atlas, and I went down to the guidance station. We were using the radio control guidance at the time. Anyway, I went down there and those guys said, "Come here, look at this plot. Look at this guidance plot. The damn thing plotted right off the end of the world." [Laughter]

What it is, is an instantaneous impact predictor and it's reading velocity and acceleration and all that sort of thing, the point in space at any instant of time, and then converting it into if everything were shut down at this instant, here's where it would impact. Of course, the vehicle's way back here, but the instantaneous impact points [IIP] are going way out there. The IIPs were just plotted out, and they went clear down to the South Atlantic and then just plotted right off the edge of the world. And those guys just thought, "My God, our instrumentation's gone. What's going on?"

Pretty soon, as soon as it was confirmed that it was in orbit, in a good stable orbit, then they announced what it was. But some of those guys, they were either—I think they were FBI [Federal Bureau of Investigation], either FBI or CIA [Central Intelligence Agency], I don't remember which. People that nobody recognized, you know, and they were kind of skulking around there. But, boy, we were really proud of ourselves when we found out. Boy, we got an Earth satellite.

RUSNAK: As someone who had spent some time working on classified projects of your own, what sort of personal effect does that have, where you can't really share a lot of what you're working on?

TILLETT: Oh, you kind of get used to it fairly quickly, and you know who you can talk to about it and you know who you can't. When you're with somebody that you can't talk to about it, you talk about something else. I have avoided like the plague ever getting a top secret clearance. I did not want a top secret clearance, because of, first of all, the harangue that—it's a stack of forms that high you've got to fill out to get the damn thing. Then, secondly, I just didn't want it, because I didn't want the responsibility of having a top secret clearance, and the jobs that I did didn't really require top secret clearance.

At one time that was used as a kind of a badge of distinction at JSC [Johnson Space Center, Houston, Texas]. They had a yellow badge. Those were people with top secret clearances, and they just typically ran all of the division chiefs and above through top secret clearance investigations and gave them yellow badges so that they would kind of stand out.

RUSNAK: It's sort of the same idea as back at Convair.

TILLETT: Yes, a caste system, which I never really approved of, and which JSC finally decided it was a bad thing. That was probably—yes, that was during Chris [Christopher C.] Kraft's directorship.

RUSNAK: Which brings me to another question, how were the relationships between NASA and the contractors that you worked with?

TILLETT: Oh, at first it was kind of troubling, because the contractors didn't believe—they had worked for the Air Force or the Army or the Navy so long, and the military always gave the contractors pretty free rein, and NASA wasn't like that. NASA was in there checking every damn step, and it took a while before the contractors finally understood that. It was primarily the prime contractors, or the development contractors that were a little bit difficult to deal with. Our support contractors got the message fairly early on.

The Zia [phonetic] Corporation was our original O&M [Operations and Maintenance] contractor out here. We had the propulsion test article up in the 300 Area, in Test Stand 301, and we were just ready to do it, we had test-fired it a few times, and we were just ready to do a test-firing early one morning and we found out there was no damn water in the million-gallon water tank, so that our fire-suppression systems and all that sort of thing wouldn't work.

What happened? The damn Zia idiots had on their schedule to drain and refill the million-gallon tank to do some sort of O&M thing. Oh, I just came unglued. I got a hold of the base manager for Zia and his subordinates and gave them the worst tongue-lashing they ever had. Marty Raines was fairly new as the manager by that time, and, boy, he came to my assistance and he gave them a tongue-lashing. They said, "But it's on the schedule. That's what we're supposed to do. We're responsible for this damn facility."

Then we made them finally understand that they were very definitely subordinate to the test programs. That was what the facility was being built for, not just something you'd go out

and play with valves and flush water systems and so forth. But we had to delay the test for a day, because it took that long to fill the water tank back up. They never did that again.

RUSNAK: Well, they were learning from experience, I guess.

TILLETT: Yes, they learned from experience. That wasn't the only kind of a run-in like I had with them. When I was over in the 400 Area on the LM program, two or three times they did some kind of facility maintenance task without coordinating with me or with Grumman people or whoever, you know, to know what our schedule was, and it really screwed things up. They'd get their hands slapped severely every time. Finally, they pretty well learned.

The O&M contractors we had after Zia weren't quite as belligerent. They had been here in other roles anyway, so as time progressed, the relationships between NASA and the contractors got better and better.

RUSNAK: Did any of the issues with the prime contractors show up at White Sands?

TILLETT: How do you mean?

RUSNAK: With North American or Grumman, did you have any big issues with the work you were doing with them?

TILLETT: Not really that I can remember. That LM ascent engine was always a problem, but Thibodaux was mainly taking care of that at the contractor level. I can't even remember whether

we fired one of those. Who was it that was building that engine? It was Bell, wasn't it, that started out on that engine and was having so much trouble with it? I don't remember whether we fired a Bell version here or not. I think we did, but I just can't remember for sure.

RUSNAK: Were the contractors then satisfied with the test regimen you were putting their engines through?

TILLETT: Well, yes, because they were intimately involved in coming up with that test regimen. In fact, they were responsible for coming up with that test regimen subject to our approval and Thibodaux and his people's approval. Thibodaux's people looked at it from, "Are we learning what we needed to learn about the propulsion system?" We looked at it more from the point of view "Is it compatible with the facility and our capabilities and all that sort of thing?" And it worked pretty good.

RUSNAK: In terms of contractor relations, the Apollo 1 fire had some repercussions. Did the fire cause any changes out of White Sands?

TILLETT: Yes, it sure did. It just invented our materials test program out here. It gave it a real quick boost. We had just kind of dabbled a little, the laboratory people, had just dabbled a little bit in testing certain kinds of materials, maybe for reasons of their own, I don't remember whether they were involved with any of the people at JSC in doing this or not, but, boy, that sure gave it a kick in the rear, I'll tell you, when they had all that problem with flammable materials in the cabin and that sort of thing. We got into a materials test program that ultimately we

became the materials test experts for the agency. Marshall would never admit that, but we were anyway.

RUSNAK: Why do you think that ended up at White Sands? Was there a logical reason behind that, do you think?

TILLETT: I'm not sure that there were logical reasons behind a lot of things that happened at NASA. But we had a good test facility. We had a good laboratory. It was being under-utilized. We had good support contractors that were willing to work for a dollar, work for their pay instead of loafing and all that kind of thing. I think it just—we didn't have any unions at that time, which kind of simplified matters management-wise and productivity-wise.

It was just something, I think it just kind of grew like Topsy. We started doing this little thing and this little thing and that little thing, and pretty soon we had a whole mountain of things we were doing in terms of materials testing. It became our mainstay, along with propulsion testing. The two were just about equally important by the time we got to the Shuttle program. We did most of the materials testing with the Shuttle program, at least for everything that we were responsible, that JSC was responsible for, which was everything except for the main engines, just about.

RUSNAK: I want to also ask you about some of the people you worked with on the Apollo program. Who do you think were some of the key individuals that really made a contribution?

TILLETT: To the Apollo program?

RUSNAK: Yes.

TILLETT: George [M.] Low, first and foremost. Of course, there were thousands of people that made important contributions.

RUSNAK: Well, ones that perhaps you had a chance to work with on a close level.

TILLETT: I think George Low was probably the key guy in the Apollo program. He took over as the ASPO manager right after the fire, and he really got the program back on its feet again.

But Max [Maxime A.] Faget, golly sakes, he had an awful lot to do with it Apollo. In fact, I think it was Faget who invented, and ultimately got approved, the lunar orbit rendezvous concept.

Joe [Joseph F.] Shea was important. It was kind of on his shift that the fire happened. There was just so many people. All the flight test people. Chris Kraft, another very, very important element. Then, you know, give me a phone book with all their names in it and I can— [Laughter]

RUSNAK: Sure. Of course, there were many, many people that were involved in and made just such great contributions.

TILLETT: Chris was a super guy. Too bad he couldn't stay as the JSC director forever. He was sure the best one they ever had. And don't tell Aaron Cohen I said that. [Laughter]

RUSNAK: We'll try not to mention it to him. Speaking of JSC, JSC was White Sands' parent organization, I guess.

TILLETT: Yes.

RUSNAK: How did that relationship work?

TILLETT: You know, for a long time that was kind of muddied water. We never really had a parent organization in Houston. We never really had stature on the picture pages of the phone book and that kind of thing. Finally, Chris kind of started it, and he was the guy who was probably more responsible for me getting the job as base manager out here than anybody else. Actually, it was Gerry [Gerald D.] Griffin that made the selection, because Chris had gone by that time. But Chris had filled Gerry's ear, I think, pretty good, because there were some pretty stiff competition for that job. A couple guys from the Cape and another guy from out here, Dave [David L.] Pippen.

But I guess probably because of Chris's intervention, it was probably never a whole lot of question that I would be selected. Griffin was very happy with the selection. Gerry changed the management structure, and he had—what'd they call them? Vice-presidents? They were like super directors or whatever, but there were three of them. Bill [William R.] Kelly was one, he was in charge of admin, all of the administration functions and a lot of other things as well. White Sands was one of the other things. So I reported to Bill, the best boss I ever worked for,

really a good guy. We really got along good together, and he helped me get White Sands established in the JSC hierarchy.

RUSNAK: Getting back to Apollo for a few minutes, did you follow the flights as they were going, I mean from a professional standpoint?

TILLETT: Oh, yes. Yes, we got quite involved in it. When [Neil A.] Armstrong and [Edwin E. "Buzz"] Aldrin [Jr.] landed, they just damn near aborted after the landing because of temperature and pressure problems in the systems that hadn't—because of heat soakback. We were selected to simulate that, and we used one of our big vacuum chambers to simulate those effects and work out solutions to them so that Apollo 12 wouldn't have the same problem.

We got involved in an awful lot of those kinds of activities. We were a troubleshooting facility. We were responsive, much more responsive than the Marshall test facilities. Their bureaucracy was—by that time von Braun was gone, or going, or whatever. I think he was gone. I don't believe von Braun was here when—I believe he had either gone to headquarters or on out the door before we ever landed on the Moon, if I remember correctly.

Then we got involved quite heavily in Viking in a couple of issues. One of the issues was, when we land on Mars, we want to disturb the surface with the engine as minimally as we possibly can. They set some guidelines of, I don't know, two or three millimeters of surface disruption or some darn thing like that. Well, you don't know what the surface is made out of at this point, so how do you know much you're going to disturb it? You don't know whether it's dust and how deep the dust is, and how fine it is and all this kind of stuff.

So that they decided that they needed to develop a lander engine that had as little dynamic pressure on the Martian surface as possible and then cut the engine off as high as possible, and so build the structure so that you could drop it six feet or whatever in the Martian gravity, which isn't really very far in Martian gravity, without any damage to the structure or any of the components.

So different engine designs came here from various and sundry places, different manufacturers and everything. This was Langley's [Research Center, Hampton, Virginia] responsibility. We were working with Langley on this. Ultimately we found an engine configuration that reduced the dynamic pressure on the Martian surface by about, I think a factor of 6-to-1 relative to a single-bell contoured nozzle.

So that phase of the program allowed them to get closer to the surface before they cut the engine off, therefore reduce the weight of the structure and a lot of things like that, and saved, oh, millions, tens, maybe hundreds of millions of dollars in the Viking program to be able to lighten that load.

We didn't invent that. We were just the test facility that discovered that, hey, this is the configuration you want. What we ended up with were eighteen little nozzles and none of them pointed straight down; they were all angled out, which reduced the efficiency of the engine a little bit, because the vector wasn't perpendicular or parallel with the line of flight, but it reduced the efficiency a might, but it was worth it in the amount that they could save in structural weight and all that sort of thing.

So then they decided we've got to get samples. We want to know what the engine does to the Martian surface, so that we can delete those effects from any test results that we have. So we set up Viking Chamber 302, which is a big vacuum chamber, and it was probably equipped

with the best vacuum pumps that we had. It did not have a steam generator on it like the ones over in the 400 Area where you could, you know, you could fire a 10,000- or 15,000-pound rocket into that vacuum chamber and suck it out as fast as it would go in with that big steam ejector system. But it had good vacuum pumps, and we could get to about 250,000 feet simulated altitude, which, I can't convert to microns right at the moment, but in any event.

They decided that if they went over to Sunset Crater, just north of Flagstaff, and they got some of the pumice or whatever over there, and ground it up so it was real fine, that that would be the best simulation of Martian soil they could possibly come up with. So they came in here with truckloads of this damn stuff. [Laughter] And we built simulated soil beds and we put a lander engine on a winch system where we would winch the thing down at the rate that the thing was supposed to come into the Martian surface over these simulated soil beds with all kinds of instrumentation in them and everything, and then cut it off at the proper altitude, measure the actual deformation of the surface, measure the chemical contribution to the surface and all that sort of thing.

What was the first thing we found out? The damn engine was generating hydrogen cyanide. [Laughter] In pretty drastic quantities. We said we don't know if indigenous Martian life forms are sensitive to hydrogen cyanide, but if they're anything like Earth life forms, they sure as hell are. [Laughter]

So that created a real crash program with Langley and Martin. See, that was a mono-propellant agent, used a catalyst bed, hydrazine and a catalyst bed. So where in the world was the hydrogen cyanide coming from? Because there shouldn't have been any nitrogen in there if you're using pure hydrazine. At any rate, you shouldn't have been able to make cyanide.

They went through a program that cost I don't know how many millions of dollars, and ended up with a—they found out that the problem was in the process of making the hydrazine aniline was used somewhere in the process and aniline had the necessary constituents to be able to form hydrogen cyanide, and the cyanide was forming in the exhaust, in the rocket exhaust. They had to make an aniline-free—well, they had to make a carbon-free, that's what it was, they had to make a carbon-free hydrazine. Is that right? What the hell is the chemical formula for hydrazine?

At any rate, they had to get the aniline out, and once they did that they could—and they ended up going through some sort of a freezing fracturization process that was inordinately expensive, and I think the propellant that we used out here subsequent to that and that that actually flew to Mars was worth thousands of dollars per gallon, to be able to purify it to the point we wouldn't kill all the little indigenous life forms on Mars when we got there. [Laughter]

That was a really interesting program. That lasted for quite a while. We did all of the test work related to that, to those issues.

RUSNAK: Was there work you did for other centers?

TILLETT: Oh, yes. We worked for Langley, we worked for Ames, for Lewis. Even Marshall finally came around and asked if we would do certain little things for them, and so we worked for them. I guess we worked for just about every center at one time or another.

RUSNAK: Marshall had its facilities out at Stennis [Space Center, Hancock County, Mississippi] for testing a large propulsion system.

TILLETT: Yes. They also had facilities for testing smaller ones, and they were really hurt when the Shuttle program came here, the Shuttle OMS [orbital maneuvering system] and RCS [reaction control system] programs, came here instead of going to Stennis. They were fighting hard for them. But so were Air Force-related facilities and that sort of thing. The AEDC [Arnold Engineering Development Center] at Tullahoma [Tennessee] were fighting for it. They really wanted it.

RUSNAK: So was there then issues between White Sands and Stennis for who would get what piece of particularly Shuttle, I guess?

TILLETT: I wouldn't say there were issues between us. We were independently trying to get—we were trying to stay alive. After the Apollo program testing was done here, we quickly went from 1,500 people or thereabouts, because all of the Grumman and North American people disappeared, with the exception of just little small engineering crews that stayed for some residual testing that had to be done. For example, on the LM when they went to the J tanks, the J Series tanks on the LM, then we had to go back and do some recertification work. So Grumman kept about ten people here.

North American, I guess they went to nothing until—what was it that they had to come back for? I don't remember. But at any rate, they came back with a crew of ten or twelve people, something like that.

But right after the massive exodus, headquarters was going to shut down the White Sands test facility. Didn't have any use for it anymore. And, man, we scrambled. They sent a

big task force down here that was composed of people from headquarters, mostly headquarters, but representatives from just about every center. They finally decided to keep us open on what they called a productive standby basis. The total personnel at the site, NASA and contractor combined, was arbitrarily limited to no more than 200. Actually, we got down at one point to around 150.

Then when it became evident that they were going to need full-up test article, test locations for Shuttle OMS and RCS—and, of course, originally Shuttle OMS and RCS were hydrogen, hydrogen and oxygen, and then they went hypergolic later on when the problems got too severe, because of the stop, start, restart, restart, restart kind of capability. That's easy with hypergolics, all you've got to do is open a couple of valves. But with hydrogen and oxygen, you've got to have some kind of an igniter. If you're going to start like an RCS, you start and stop that thing thousands of times during a mission. What's the reliability of an igniter operating reliably for thousands of times? Nobody knew.

So we did understand hypergolics because we'd used them in LM ascent and descent and Shuttle propulsion system. So the decision was made to go with hypergolics ultimately.

Jesse [C.] Jones was the site manager by that time. Ken [Kenneth B.] Gilbreath had gone to Houston. By the way, Jesse's a guy you might want to interview. He's at Texas Tech [University, Lubbock, Texas]. He was the site manager here next to the longest of anybody. I was the longest. Jesse was here about eight years, I think, and I was here ten or eleven, almost eleven years as a site manager.

Jesse and I and a third person from here, and I don't remember who it was. It might have been Gene [L. Eugene] Lundgren. It might have been—I just don't remember. But we went to headquarters and we gave a presentation to the acting administrator. Boy, names are

coming hard. There was almost like a triumvirate. There were three people who were sort of acting as a triumvirate administrator at that point in time. That would have been—when would that have been? '72, '73, somewhere in there. I think George Low was acting administrator for a while, but then he got ill.

I'll tell you who one of them was. One of them was Willis [E.] Shapley, and he was probably the lowest one of the three. The other one had—one was a big, big happy guy with an Italian name. Anyway, we had to go give a presentation to these guys, and I guess Tullahoma, AEDC at Tullahoma sent people up and they gave a presentation, we gave a presentation, and I don't know who else did. Probably Mississippi Test Facility [later renamed Stennis], which I think it was still known as in those days. But ultimately we were selected for the OMS and RCS testing, which is why the place is still open.

Since then we've proved ourselves capable in so many ways, and Grady [E. McCright] can tell you more about that than I can, because he hadn't been away from it as long as I have, but we've helped so many programs in so many ways that they'd never shut the thing down. We're the best buy in the agency. We're more productive than any other facility.

RUSNAK: When you became manager, what state was the facility in then? How secure was your future, and what sort of programs were you looking forward to?

TILLETT: Quite secure. We were well involved in OMS and RCS testing at that point, and it had a future. So by that point in time, we were over the hurdle of being shut down.

RUSNAK: You mentioned a little bit before about how you became manager about—

TILLETT: About Chris?

RUSNAK: Right.

TILLETT: I started out out here, well, just watching the facility construction for Henry Van Goey. Then I was responsible for overseeing the initial test programs on the boilerplate test article. By the time Spacecraft 1 came along, I had another guy that I had assigned to Spacecraft 1, and didn't have to spend a lot of time with it. But I was kind of what they called the chief operations director, and I stayed that way until the summer of '68.

Marty Raines was leaving. He knew he was going to be leaving. Bill Gantz was going to be made the site manager. So they made Bill the assistant site manager for a period of time so he would get familiar with what Marty was doing before Marty left. So they needed somebody to be in charge of the propulsion test organization, and they gave the job to me. I got my 15 out of it. Boy, I stayed a 15 forever, it seemed like to me, from '68 to 1982.

What was the question?

RUSNAK: We were talking about how you became the site manager.

TILLETT: Then I was head of propulsion for the next fourteen years or whatever. Ken Gilbreath was the site manager. He was selected over me. We were the two people being considered for the site manager's job when Marty Raines left. Bill Gantz didn't get it, by the way, because he cheated on an expense report and got canned. Well, he didn't get canned; he got demoted from a

15 to a 13 and shipped to JSC and stuck off in a little corner someplace in Ralph [S.] Sawyer's organization. Never saw him again. Talked to him once on the phone. But, boy, they pushed him out of here like nobody's business. So with Gantz out of the picture, and it was a good thing, he would have made a lousy site manager. He was just one 275-pound ego. Man. And a loose cannonball to boot. You never knew what to expect from him. He wasn't consistent. But he was strong-willed and he could make the contractors do what he wanted, so that was why he was considered for the management.

So anyway, Ken and I were the two considerations, and Marty had the responsibility of making the selection, and he selected Ken. Ken was in charge of the laboratories at that time and I was in charge of propulsion. So Ken became the manager and he was only the manager here a couple years. He had impressed some of the folks at JSC, so he went down as the Assistant Director or Deputy Director, I should say, of Center Operations.

For whatever reason—oh, I guess the reason was, is because the guy had a little bit more seniority than I did at NASA and he had expressed a desire for years and years and years to be the manager at White Sands test facility and that was Jesse Jones. He was head of TTA [Thermochemical Test Area] at JSC, working for Thibodaux. So they sent him out as the manager, selected him, and sent him out.

In those days, the selection process was pretty easy. You get the job, get out there and get it done. You didn't have to go through all of this. Well, first of all, it wasn't an SES [Senior Executive Service] position at that time, so you didn't have to go through all the SES stuff. It became an SES position halfway through Jesse's managership.

So when Jesse left, then, of course, I had to compete for the job, go through all the SES paperwork and all that sort of thing. That's how I became manager.

RUSNAK: In your years as manager, what type of projects were going on there?

TILLETT: Well, of course, involved in all aspects of a lot of things associated with Shuttle, still doing OMS and RCS work, heavily involved in materials. Probably had just as much manpower in materials testing as we did in propulsion by that stage. Other kinds of systems testing that, you know, a special problem would arise, like the Viking thing that I mentioned to you, but not that one, because that one was all gone by that time. Any special problems like that, we were always prepared to jump to and tackle anything, reassign people as necessary to get any particular request done as quickly as possible, by whenever they needed it. If it took working twenty-four hours a day, seven days a week, that's what we did.

RUSNAK: Did the Shuttle landing facility also fall under your—

TILLETT: Yes.

RUSNAK: Could you tell us a little bit about that?

TILLETT: Northrup Strip, now known as White Sands Space Harbor. I liked Northrup Strip better. Al [Alexander S.] Paczynski worked for me out here, and he was kind of responsible for that. He worked pretty close with flight crew people. I think he went down there and gave a slide presentation or something, if I remember correctly, to some of the people, flight crew operations. I don't know whether it was the astronaut office was specifically, but—who was the

flight crew director then? Oh, boy. That goes back a long ways. Warren [J.] North, probably. Or possibly the seventh Apollo astronaut. What's his name?

RUSNAK: [Donald K.] Deke Slayton?

TILLETT: Deke Slayton. He was head of flight crew operations for a while. I don't remember when that switch took place, so I don't remember who was head of flight crew. But, anyway, whoever it was was involved in the presentation thing and everything, about where they were going to fly the Shuttle Training Aircraft [STA]. Al gave them a pretty good presentation, apparently. I didn't go. They did some trial flights out here and so on and they ended up selecting White Sands as the STA training facility. They established a little bit of an office there at the airport in El Paso [Texas], two or three people in it. We worked fairly closely with them. Not as much for the STA. Well, we had to keep the runway in acceptable condition, and deal with the Army and all that sort of thing, close that interface so that they didn't have to worry about dealing with the Army or the Holloman Air Force people or anybody like that. Joe [Joseph S.] Algranti was one of the people, I'm sure, that was involved in making that decision. Hell of a nice guy. One of my favorite people.

Then it was recognized that there were times of the year—there wasn't a landing facility at the Cape yet, and if it had been complete, they weren't really willing to use it quite that early on because it's limited in size. It's narrow and it's short compared to what you could get at Edwards [Air Force Base, California] or what you could get here. It was recognized that there are periods of the year when Edwards is under water. So they decided, hey, they'd better have a backup landing facility. So that's when we got the job to really make Northrup Strip into a

landing facility. That's something—well, it's 300-feet wide, and seven miles long, with 300 fit aprons on either side of the 300-foot main strip that are hardened to the point where they'll support a Shuttle. By the way, the Shuttle leaves deeper tracks out here than the 747s.

RUSNAK: Really.

TILLETT: The ground pressure's higher.

RUSNAK: What other related facilities were necessary there for processing the Shuttle after landing and mating it with a 747?

TILLETT: We didn't really have to worry too much about that, other than to coordinate with the military and satisfy the Army that we weren't going to blow up the Shuttle and release a whole bunch of nitrogen tetroxide or hydrazine, and it'd go downwind and kill half the soldiers on White Sands with it. Oh, that was a bureaucratic bunch of nonsense. Fortunately, they had a good commanding general here at the time, and he and I got along really great, and it was his subordinates in safety and in security and all these things that were just such a pain in the neck, you could hardly stand it, you know, but that was kind of our role.

The people that actually serviced the vehicle and got it back on top of the 747 to ferry it back to the Cape were really Cape people. They had a hell of a contingent of people out here. We supported them and we kept the Army off their backs so that they could do their job. It was a lot of fun.

RUSNAK: You mentioned earlier having some Apollo flight support in terms of analysis of certain failures or whatnot. Was the same going on then for the Shuttle, and do you remember any particular events?

TILLETT: Yes, there was a lot of that went on with the Shuttle, more materials-related than propulsion-related, actually. One example was the SSME [space shuttle main engines] oxygen flow control valve. It was designed with a dead-end pocket in it, and the gas had to turn like 90 degrees, and it's hot oxygen besides, by that point, because it's gone through the resert tubes on the main engine and it's used to keep the oxygen tank pressurized. The flow control valve was one component in that pressurization system.

I don't remember who it was that got a little bit antsy about that flow control valve in the first place, whether it was our people or whether it was somebody in Thibodaux's organization, or just who it was. I don't remember. It might even have been somebody at Marshall, but I doubt it, because Marshall would never go to JSC and ask for help.

But we instituted a big test program on that flow control valve, and what we would do is start flowing oxygen at elevated temperatures, I think around 300 degrees or something like that. Maybe it was higher, maybe it was 500, I don't remember. But, anyway, we would flow oxygen through that at elevated—at the kinds of conditions that it would see in actual service on the Shuttle during the SSME burn. Then we'd design and build a device to inject tiny amounts of particulate matter, lights, and then when we simulated what they'd found in typical aerospace components, tanks and things like that, that had been replaced in the past.

Sure enough, we injected, I don't remember what it was, a tenth of a gram, I think, we injected a tenth of a gram of this contaminant in there, and it was all real tiny fine particulate.

Blew that oxygen control valve all to hell, consumed it. Then people sat up and started—there were a lot of people that thought the test was nonsense, but we did have some people supporting it at JSC.

The valve was never redesigned, but—well, it was redesigned in terms—I don't think the flow path was ever redesigned. But the materials it was made out of were re-selected using more like inkanils [phonetic] and monails [phonetic] and things like that. They're not nearly as sensitive to ignition in an oxygen environment as stainless steel. Stainless steel and pure oxygen will just burn like crazy if you get the temperature high enough.

RUSNAK: Starting in '84, NASA began work on the Space Station, originally being Freedom. Did you provide any support for that program?

TILLETT: Not really. Well, I'd better back off of that. Yes, I guess we did. We had a little propulsion module. The attitude and reboost systems on the original Space Station configuration, and that's probably the '84 configuration you're talking about, we did some test work on that, in Test Stand 302. I don't know why I'm so vague on that, but I just don't remember much about what went on there. I think it was a very short-lived program, for one thing, because designs were changing all the time and that sort of thing. That was supplied by Rockwell.

RUSNAK: What impact did the Challenger accident have on White Sands? Was it similar to after the Apollo 1 fire?

TILLETT: It concentrated our materials testing on booster seals and seal materials and things like that. We did quite a bit of work associated with that, but it was all materials. It was just little bits here and pieces of that kind of stuff that they needed done.

RUSNAK: Had you done that kind of work on the seals before that?

TILLETT: No, I'd never seen the seal material before then.

RUSNAK: Then were you beginning to see it just as part of the investigation or this was after that?

TILLETT: Kind of both. We sent people to the Cape as part of the investigating team as well, that assembled all the pieces of the Challenger in that one hangar and tried to get as much information out as they could. They were kind of constrained from talking about that even to me, so I never did learn a lot about what they contributed.

One of them was Frank Benz [phonetic], who was the director of something or other in Houston. No, I think he was a division chief. Real capable guy. He was head of the laboratories for a while here.

RUSNAK: Do you recall any other significant projects or areas that you worked in before you retired, that we haven't covered?

TILLETT: No, once you get to be the manager of a place like this, you kind of get disassociated from the nuts and bolts of the test world.

RUSNAK: Sure.

TILLETT: Although being a kind of intuitive engineer, guys were always coming to me and making presentations of one sort or another about projects that they wanted to do or ways they wanted to do something or whatever, you know, and somehow I could always intuit whether it's going to work right or not. A lot of young very, very bright engineers got sharply taken aback when I pointed out errors in their thinking and in their calculations and so forth. It was just purely an intuition kind of a thing. "That can't be the right answer, you know, it just can't be." You go back and go through it, and, sure enough, you find out where a wrong assumption was made or something like that.

I had a lot of fun doing that kind of thing. That was about as close as I got to the technical world. Otherwise, it was running the support contracts. When did that happen? I guess it happened right after the Apollo exodus. We didn't have any prime contractors here anymore, and nobody thought we could survive with just a support contractor, because support contractors had always been thought of pretty much as O&M kinds of contractors. Here we were taking one support contractor and making him not only O&M, but also our test contractor and our managerial contractor and all kinds of things like that. He had the whole spectrum of what we do out here to work on, and it worked out very well. Primarily we had one support contractor doing everything, and that varied from time to time. Sometimes there would be a smaller contingent of another contractor or whatever. But it worked out real well.

In 1971 or '72, a company by the name of Dyna Electron [phonetic] out of Albuquerque [New Mexico] was selected, against my better judgment, for the support contract role here. The vice president was a guy named Randy something or other. They had contracts all over White Sands missile range, including a big data management contract at Holloman Air Force Base. They were trying to unionize at Holloman, and he was afraid he was going to get stuck with a union. We had polled our people, and they were like 80 percent anti-union, our hourly people. They didn't want anything to do with it, with a union. They were happy. We were taking good care of them. They were paid better than just about anybody else in the local area and they were happy.

So Randy decided, being the vice president of Dyna Electron, he decided a good way to make sure we don't get union people, get stuck with a union is to include White Sands Test Facility and all their people. Well, White Sands test facility didn't have all that many blue-collar workers or hourly workers at that time. It was—oh, what did we have? We probably had 250, 300 hourly people at that time. The contract at Holloman was way larger than that, much larger than that. Randy got us a union, is what it amounts to, and we've been stuck with it ever since. That's a managerial headache, primarily for the support contractor manager and his labor staff, labor relations staff. But I was involved in it on a daily basis one way or another.

In 19—when was it? 1974? Yes, I believe in 1974, Lockheed won the support contract, again over my better judgment, because I thought General Electric should have won it. But Lockheed did, and they turned out to be a very, very good support contractor. They weren't cheap, but they were good, and they understood the rules of a support contractor and they worked hand in glove with the NASA people and it was just a very good almost symbiotic relationship.

RUSNAK: If we could pause for a minute to change our tape. We were just leading up, I think, to talking about some of the things you were doing before you retired. What prompted you to leave when you did?

TILLETT: Dick [Richard A.] Colonna took over that job from me. Well, I presume you haven't interviewed him because he isn't around anymore. They had a very contentious support contract, selection process. I think it killed him. The pressure killed him. He died at lunch at headquarters.

RUSNAK: Wow.

TILLETT: With a heart attack, severe heart attack. No other indication he had ever had any problem in his life, but I think it was just pressure. If I had stayed here another two years, I'd have probably been right where he is, pushing up daisies.

NASA has become a very bureaucratic organization. It isn't like it was in the Apollo days. In Apollo we were goal oriented, and somehow NASA got to the point of being red-tape oriented, driven by headquarters primarily. They had to oversee everything that everybody did, and they didn't know a hell of a lot more about what they were seeing, but they had to oversee it anyway.

Then there was just study after meaningless study after meaningless study that we had to do. I was constantly having to devote valuable resources, my own as well as lot of my people,

to doing these insignificant damn studies for headquarters, and some of the organizations at JSC, I might throw in. It was really getting to me.

A lot of people said, "Well, hey, you know, bureaucracy's part of the job," and just let it roll off like water off a duck's back. I ain't built that way. When I'm doing something that's nonproductive, it really upsets me, and I was doing a hell of a lot of nonproductive stuff by demand from headquarters and from JSC. I would complain to Aaron [Cohen] and other people about it, and they didn't seem to be upset about it, but, boy, it sure upset me. So I said, boy, I'm going to get the hell out.

And I got out financially at about the worst possible time I could, because SES [Senior Executive Service] had just gotten a 21 or 22 or $23,000 raise, and you go on high three for your retirement. Your high pay for the last three years determines your retirement pay, your retirement paychecks. My retirement paycheck was going up at the rate of $7,000 a year, and I had one and three-quarters years to go when I retired. So I would have gotten 12 or $13,000 more in my annual retirement if I'd stayed another eighteen months—twenty-one months, actually. But I don't think I'd have survived another twenty-one months, so I'm glad I made the decision I did. Nobody could believe I was going out at that time, because I was cutting my own throat financially in the process.

RUSNAK: Have you been doing any work since then?

TILLETT: I consulted for a couple of months with Lockheed on a recompetition, which they lost. [Laughter] My consultation didn't do them a hell of a lot of good. Lockheed was a far better

contractor than what they have now, but he was also a very expensive contractor, and cost is a big issue.

What was the question?

RUSNAK: I was asking about the type of work you've been doing since you retired.

TILLETT: I did that for a couple of months, about a year after I retired or thereabouts. I haven't done a lick of work since, other than what I want to do. [Laughter] I always keep busy. I'm involved in a lot of things. You can see there's books all over the damn house. I read a lot. The bigger of the two dogs is trained in agility and obedience. We have an obedience title and we're awful close to our fifth and sixth agility titles. We travel all over. Like the last week in January, I was in Phoenix [Arizona]. The third week in February, I was in Las Vegas [Nevada]. The fourth week in February, I was in Denver [Colorado]. Lot of traveling. Let's see, I've got a reprieve. In about two more weeks I'll be in Tucson [Arizona], and the week after that in Albuquerque, and then beyond that I don't know, except Memorial Day I'll be in Amarillo [Texas]. I like to go to Amarillo on Memorial Day. So we get around.

RUSNAK: It certainly seems like it.

TILLETT: The other dog, Chili, we just rescued a couple weeks ago. He turned up, of all things, in my daughter's yard. She lives out near Doña Ana. Turned up in her front yard one morning, and she recognized him as a Beardie [bearded collie], of course. So she called Geri [Geraldine E. Tillett], who's by the way, president of the Doña Ana County Humane Society, so she's

heavily involved in all kinds of animal issues and she's a wildlife rehabilitator, which takes her about fourteen hours a day in the nesting season. It's purely volunteer work. I wouldn't volunteer that much of my time, but then I'm lazier than she is.

Anyway, she had the dog taken up to the shelter and put a hold on him until I got back from Las Vegas, and I went up to see him, and he just looked like a fat little pig. He was about that big around. You see how skinny he is now. That was all mats. He had mats that thick all over him. There was no way of brushing them out, so they just had to clip him. They did manage to save the hair on his face and ears and tail, but I asked them to do that. For goodness sakes, save his beard and all, because he is a Bearded Collie. So I've got my work cut out for me, because he's just like a big puppy. But I'll probably make him into an agility dog, too. Then I'll have to carry two of them around.

I sure wonder what his past was. He didn't know anything about a leash. He wasn't housebroken. He's probably a year or fifteen months old. Nobody ever took care of him. He had a little old narrow strap of a collar on with no kind of identification, no tags or anything. I just can't imagine what kind of a history that guy has. Somebody owned him, but they sure never took care of him. How long he had been away from there and been on his own, I have no idea. But he sure loves it here, I'll tell you that. [Laughter]

RUSNAK: Well, he came to the right place.

TILLETT: Yes. A lot of people have said, "When I get reincarnated as a dog, I want to live with the Tilletts." [Laughter]

RUSNAK: Well, I can see why.

Looking back on your experience with the space program as a whole, what do you think your greatest contribution to it was?

TILLETT: That's a tough question. Boy, I think just being here and keeping things going in whatever area I was responsible for, and making sure that I did my best to not let something slip through the cracks. That's not very grandiose, but whatever my responsibility was at the time, I took it seriously.

RUSNAK: In a similar vein, what do you think the most difficult moment was for you?

TILLETT: When I was sitting out here in the visitor area next to my office watching the TV when the Challenger went. I just couldn't believe it. But, you know, before anybody on TV said anything, you immediately know something's wrong. You know what you're looking for. I knew it probably within a second of when I saw the rocket motor blew, just from watching. That was pretty tough. I stuck around for about thirty minutes and I had visitors from JSC, and I just finally told them, you know, "I'm done for the day. I'm going home."

RUSNAK: It was certainly a difficult time for everybody involved.

TILLETT: Everybody.

RUSNAK: Are there any other people that you'd like to mention that we haven't already talked about, that you think really had a valuable contribution?

TILLETT: Oh, yes. There was, gee, I'd like to mention my whole staff at White Sands test facility, but there were a few key ones. Joe [Joseph] Fries, who is the current manager of the facility, he's always been a real steady guy. Grady McCright worked for me for a long period of time, and it just devastated me when he got offered that job by Ken Gilbreath in Houston. Of course, it was a good move for him, because he was really—I really relied on him for so many things.

Dave Pippen, who I ended up taking his job away from him because of managerial kinds of problems, but he was the guy that really made the materials test facility work. He was good at what he did, but he didn't know how to manage a contract without violating every contract rule in the U.S. Government, and I just finally had to relieve him of that job. He retired right after that. He just stayed about a month and called it quits. Hated me for it. You know, I can understand why, but I had to do it. That was difficult. That was one of the most difficult things I ever did, because he had contributed so much for so long a period of time. But he was a tough guy to work with. My God, he was tough. Even for me, he was hard to work with, and I just felt so sorry for the contractor people that worked with him, because he was so hard on them. I don't know why some people have to be that way. Because he had so much technical talent and drive. He made that laboratory what it is, the materials testing capability and everything. It's solely due to that guy.

Jesse Jones, whom I mentioned, was my boss for a number of years and he was a good manager. He had a tendency to get too involved with little tiny nitpicking details, but other than

that, you could finally talk him out of it. "Jesse, damn it, don't worry about that. I'll take care of that. You just worry about your job. I'll worry about mine." [Laughter] We had a very good relationship. I like Jesse a lot.

There were a lot of other people over the many years, contractor people as well as NASA people. Gosh, Ed Shales [phonetic] was the manager for Lockheed support services contract out here for years and years. He was their manager while Jesse was still the manager here. Then he was their manager while I was the manager here. He was just one prince of a fellow to work with. He understood a support contractor's role, and I didn't even have to remind him of it, you know. He just did it.

There were a lot of good people over the years. A few who weren't so good, but fortunately they were in an extreme minority.

RUSNAK: We always like to give people a chance to mention some of the others.

TILLETT: It's kind of like when somebody on TV or on a CD or someplace tries to give credit to so many people. They have to stop somewhere.

RUSNAK: Right. And we don't even give you the benefit of notecards or whatever.

TILLETT: Right.

RUSNAK: Looking back, would you have imagined as either growing up on the ranch, or in college, where your career would have led you?

TILLETT: I had no idea at all. But you know, an interesting thing with that. There's always a class prophecy for the high school senior class. I was working at White Sands, New Mexico, in that class prophecy. [Laughter]

RUSNAK: Really.

TILLETT: Yes.

RUSNAK: That's amazing.

TILLETT: What they were thinking of, that was shortly after the atomic bomb and all, they thought I'd probably be working in nuclear physics. Unfortunately, I quit school before I was far enough advanced in physics to be of any use in nuclear physics. But I thought that was kind of interesting that my prophecy came true, at least geographically, if not functionally.

RUSNAK: That is quite an amazing coincidence. I'd also like to ask Carol if she has any questions for you.

BUTLER: I have one. Did you go back to a high school reunion and tell them that you were working at White Sands?

TILLETT: Oh, yes. They already knew it, because my sister-in-law's sister, I don't know what makes her to me, but, anyway, she was one of the class of '49 graduates along with me, and she made sure that everybody knew that that prophecy had come true.

I didn't go to some of the earlier reunions. I went to the 30th and the 41st—you might ask why 41—and the 50th. The 50th was last summer. That was fun. The 41st, they had a reunion of all the classes, the graduating classes, from '38 to '51. That was interesting, because a lot of your friends tend to be a year older or a year younger or two years older or younger, and we got to see people that we would never ever been able to see any other way. That was sure a lot of fun.

RUSNAK: Unless there are any other areas that you'd like to talk about, those are all the questions I had.

TILLETT: We'll probably get into, you know, if Grady and I can jog each other's memories tomorrow, why, we'll probably get into some more of these sidetracks, but that's about all I can think of right for the moment.

RUSNAK: Great. Well, then I'd like to thank you for participating.

TILLETT: It's been a pleasure.

[End of interview]