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INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is October 2nd, 2005. This oral history session is being conducted with Milt Silveira of McLean, Virginia, as part of the NACA [National Advisory Committee for Aeronautics] Oral History Project sponsored by the NASA [National Aeronautics and Space Administration] Headquarters History Office. This interview is being held in San Jose, California, during the NACA Reunion IX. The interviewer is Sandra Johnson.

I want to thank you again for taking your time to meet with us, and I want to begin today by asking you to how you began working with NACA, the National Advisory Committee for Aeronautics.

SILVEIRA: There was a group of people that came out of [NACA] Langley [Aeronautical Laboratory, Hampton, Virginia] to do interviews at the college [University of Vermont, Burlington, Vermont], and before they showed up, of course, I was very, very interested in NACA. Also, the time period was 1951, and it was a time period when things changed in 1950 because the Korean War started, and like the graduating class ahead of myself, most engineers could not get a job. Yet when it came time for us to graduate, most of us had five or six offers. There were two of us at the University of Vermont that were offered positions at NACA, and that was really, really what I wanted to do. Also, when we were graduating, we also had taken advanced military, so we were commissioned upon graduation, and the thought with NACA was

that there was a possibility that they would want to get you a deferment so you wouldn't have to go on active duty.

We graduated on Friday and started work on Monday morning at Langley. My first assignment was in the Landing Loads Division. We did primarily all the research for both seaplanes and land-based airplanes. NACA at that time was a funny organization, from the point of view that our agency budget was in hundreds of thousands of dollars, not like NASA later on, which was billions. So there was things like we would run out of paper at the end of the year, and you would bring paper from home rather than getting it from the lab.

A couple of things, too, that were sort of interesting. When you became a young engineer, at that time the yearly salary was $3,100 a year as a GS-5 [General Schedule], and it took a while before you moved up to a [GS-]7. We went every two grades. You sat at a double desk. It was a desk that you'd have someone directly across from yourself, rather than having your own desk. We'd have maybe five or six telephones for about ten or twelve people in the whole room. I talked to the person, of course, across from me, and I said, "Well, Bob, how long have you been working on this problem you've been working on?"

He said, "Oh, about three years."

I said, "Good Lord, work on a problem that long?" After coming out of school, it seemed like if anything took more than a month, that was a long problem. But that was the nature of the work we were doing is it took a long period of time before you'd get the solutions.

Most of the people in the organization at that time were single. I left in September to go to the military. It got to the point where, as far as I was concerned, it was starting to get a little touchy, and I said, "Well, look, let me go in the service, do my time, and then come back, rather than continuing to try to get the deferment." So I left in September of 1951 and then returned to

NACA in March of 1955. When I came back in '55, everybody was married at that time, including myself, because I got married when I was in the service. So there was a big change in that.

Hampton and Langley in the '51 time period was such a—you couldn't buy a mixed drink. Social life was only what you yourself made. You would have parties that you would have at somebody's house or something like that. There wasn't much social activity along that line until that—as a matter of fact, that was still the same in '55. The only way that we did any partying was that we would have dinners at other people's houses. There was a group of us that got together frequently.

Being in the military reserve, I also had access to the Air Force Officers' Club at Langley Air Force Base, so we had some social life there. Also, a very close friend was a reserve Navy officer, so we would use the Navy Officers' Club at Norfolk, Virginia, too. Whenever we made a reservation at the Navy club, I was a Captain in the Army, and I'd use the title of Captain, which is very senior rank in the Navy, but not in the Air Force. Then whenever we would go to Langley, he would use his rank as a Commander, and they never figured out what he was, so he got a good reservation, also. So that was the way to—or at least the basis of our social life at that time.

First, I was doing research. I was doing some studies on landing gears for aircraft. We also were looking at some of the design that ended up being the landing test track at Langley. All the data we would take would be done manually. We didn't have electronic computers to take data then. We didn't have electronics measuring. Everything was measured by using a ruler or some mechanical gages. I was at NACA for three months before I decided to go on active duty. After three and a half years with the Army, including flying as a pilot in Korea, I

returned to NACA. At that point in the beginning of ’55, it was a time period when there weren’t any new engineers coming back to NACA. When I was interviewed, I was asked, “Where do you want to work?”

I said, “What’s available?”

He laid out the organization and said, “Anywhere you want to.” [Laughs] Because they just needed people in any organization that they had at that time.

So I had flown helicopters in Korea, and I said, “Well, I think something needs to be done about helicopters, so have me go to work in the rotor research.” So, again, I was part of the Loads Division and worked on helicopters’ loads and vibrations, actually in the Flutter and Dynamics Branch.

Again, the capability that we had is not as it is now. We referred to a computer as being a girl with a Frieden calculator that would sit there and punch numbers and try to get a solution. We would have problems where we’d take a ten-by-ten matrix, and to get a solution you had to invert it, and it would take a girl about thirty days to be able to do something like that. Nowadays these kids will do a flow problem, and they’ll use a million points, or a little over a million points, and it takes like less than five minutes to get an answer to something like that. So a great deal has happened during our lifetime as far as capabilities. I have three out of four of my children are engineers, so I watch the things that they’re capable of doing nowadays, and it’s incredible the capabilities that are now there.

One of the very attractive things in working at NACA as a young engineer was the graduate program that they had established. You were able to get some courses that were taught by people working on the staff, at Hampton High School, and you went to night school, obtained two courses, and the Agency would send you to a summer session at, at that time, it was the

University of Virginia [Charlottesville, Virginia]. So you did that two sessions at Hampton, then two summer sessions. Then mostly what you could do is take the project that you were working at at the laboratory and use that as a thesis, and you had a master's degree.

So that was very good. It was very attractive. As a matter fact, first planning was to go to NACA, get a master's degree, then go out and make some money in industry. Well, that was a great idea, other than thirty-six years, I was still there. [Laughter] The work we were doing was just so very interesting and very challenging that you would want to stay there, and you wouldn't want to change.

NACA was an organization, also, that had just some of the top people. There wasn't anybody that you could go to that didn't know what he was talking about. Most of the time they were the experts in that particular field. If you had a problem, you could always find somebody that could help to solve the problem. Like, for instance, when you're a young engineer, you didn't go to meetings and things like that away from the laboratory, because you weren't experienced enough to be able to do that, so I think it took about eight years or so before I took the first official trip when I was working for NACA. And indeed, the industry people really respected the capability of the agency.

In the about [19]'56, '57 time period a lot of emphasis was now being devoted to space, particularly after the Russian flight [Sputnik satellite] in '57. The entire Langley Laboratory, they offered courses at work in orbital mechanics, and almost everybody started looking at research associated with the space program. Even it intensified when they were looking for an organization to form the space agency from, and we would fill out applications or forms or whatever that "How much of your time do you spend working on aeronautics? How much do

you spend on space?" and things like that to sort of show that we're doing a lot of work in space and would be the best organization to be the new agency.

So it sort of changed what we were doing in a lot of cases. Like I got involved in doing some tests that we were concerned about, well, if you landed on the Moon, was it just a layer of dust that wouldn't support a vehicle or the thing. So we tried to do some tests to say if you landed in dust, how the object would go into the surface, and what would it look like, what its signature would be, and things like that. So we got all involved in lunar research.

Right after we became the space agency, that's when I decided it was time to really join it, and then you moved into the Space Task Group that was there at Langley, and then, of course, went with the group that went down eventually in 1962 to Houston [Texas] and formed there.

A lot of times in the technical reviews that we would have, anybody that wrote a report went through an editorial system where you would appoint a committee of people that would be working in a related field. They would tear apart your report, make sure it was accurate.

There were cases, as I say, a lot of this was done by hand. They would do an evaluation of a solution that would be diverting to be the correct answer, where someone took about a hundred terms, and it was still converting, and I think one of the members of the committee decided to do maybe another twenty, thirty, and they found out that about a hundred and twenty terms, it blew up. [Laughs] It wasn't right, so they had to redo the whole report and do some additional testing to do that.

Of course, that technical expertise, I think, ended up to be one of the very successes that allowed us to do things like the Mercury Program or the Apollo Program, because most of us had come out of the research laboratory and had very, very strong technical backgrounds.

I think that may cover most of the highlights of work during NACA, without getting into everything as far as NASA is concerned. Then, of course, from that point we went from being a small organization that we moved to Houston and turned out, and within a couple of years we were at like six thousand people. [Laughs] Crazy world.

Indeed, when you look back at the accomplishments of NACA, NACA was formed because of the lack of technical capability in aerodynamics during World War I. We never had an airplane design by the United States in World War I. We built airplanes, but they were British or French designs. The committee was formed primarily to get the knowledge so that we could design our own airplanes. In World War II, then we excelled in the design of aircraft. So it was money well spent. One of the things I'm most proud of, that I later was part of that organization. I really was.

So you think you have any further questions?

JOHNSON: Yes, I have a few questions. We'll go back to when you were in college, and you said that you wanted to work for NACA. How did you know about NACA and what was going on at Langley?

SILVEIRA: I started collecting pictures of airplanes when I was four, and I first flew when I was fourteen. I got my pilot's license on my sixteenth birthday. So I was always reading about airplanes and what was going on in the aviation world. In the literature, NACA was noted as being the people that did the research on aircraft. So if you wanted to be on top of it technically, be on the leading edge, then NACA, indeed, was the agency to do.

At the University of Vermont, the school only had a single one-semester course in aeronautics. The papers that I wrote in the course were basically on aircraft like the X-1 that NACA was working on at the time. I still am close to the university. I used to kid one of my professors that taught this aeronautics course. "Well, you know, based on that one course, I got to be Chief of Aeronautics at Johnson Space Center" [JSC, Houston, Texas]. And it was probably true, because my interest was, and I spent my spare time reading about aeronautics.

JOHNSON: When you first came there in 1951 for that summer, what were your first impressions? You've mentioned that you shared desks and that sort of thing, but what were your first impressions of the Center itself—or the Lab, at that time—itself and the facilities and where you went?

SILVEIRA: Okay. One thing that was a big surprise—I was raised on Cape Cod [Massachusetts], and, of course, went to the University of Vermont. The lab building that we were in really surprised me, in that we would have white restrooms and colored restrooms, and this was in a federal building. Then when you took the ferry to Norfolk, there was a white side and the colored side. So that was a little frightening to a young person that never saw any part of that there.

The thing that we knew, though, is that we were a poor agency. All the airplanes that we were testing were sort of given to us by the Air Force or the Navy. Although that was the case, we had probably the best technical capabilities, as far as wind tunnels and laboratories were concerned. It was a very serious organization.

One thing that was interesting was we used to work from eight o'clock to four-thirty, and if you were in the building at four-forty-five, you'd get locked in the building. Everybody would leave. Well, of course, after that when we became NASA, if you got out of the building by ten o'clock at night, you were pretty lucky. But people were very serious. Even though we had the limited hours, you always took reports home in the evening, and then you were going to school a lot of time working on advanced degrees, so you were still putting in a lot of hours, even though you had a formal eight-hour day there at the laboratory.

NACA was very fascinating place in the 1950 time period. We still had a lot of surplus World War II airplanes. We were breaking wings off of some aircraft and things like that to understand what the strength of some of these airplanes were and things like that. It was an interesting place.

JOHNSON: You mentioned that the restrooms were segregated, and it was a federal facility. Were there many cultures represented in the employees?

SILVEIRA: Not in the technical staff, because it was very difficult to find other people at that time period. There weren't many people that were getting degrees at that time. It's not like it is now, and we didn't have many women engineers, either, at that time period. [Laughs]

JOHNSON: Right. [Laughs]

SILVEIRA: I say that now even though my daughter is a GS-15 engineer at JSC. It was different for her to come through engineering school.

JOHNSON: Yes, a different time, and you mentioned the computers being the women that worked on the mathematical problems. What were those relationships like with the computers and the other people that supported the engineers in what they were doing?

SILVEIRA: It was very good. I think the technical staff were probably very humble in their capabilities or their education and whatever, and as a result, they were very compatible with the people that supported them. When you worked with someone in the shop that was one of the mechanics or technicians, you respected him because he was pretty smart, and he was doing things to help you. You didn't look down at these people or anything else. They were part of the effort that we were doing. As a matter of fact, in many cases, you looked for help from them more than they would look for help from you, as far as the technical was concerned. They were skilled craftsmen. The computer girls, most of them had degrees in mathematics, and knew the math pretty well, really well.

JOHNSON: So there was a lot of cooperation between the different groups.

SILVEIRA: Oh yes, very much so. Yes.

JOHNSON: What about the pilots? When they were doing the testing and everything of what you were working on, did you ever work directly with some of the test pilots?

SILVEIRA: Oh yes. As a matter of fact, when going to graduate school, there was a couple of pilots, and were very good friends. The pilots were very cooperative in trying to get flight data that you wanted, and there was always a good conversation going back and forth between the test pilots and the test engineers. As a matter of fact, even to now, many of them are very, very close friends. Well, they were very smart people. Probably better relationships with the test pilots than eventually with the astronauts. [Laughter]

JOHNSON: Did you ever have any desire to do that yourself, since you were a pilot?

SILVEIRA: Oh yes. Initially when I went to school, it was with the idea that I was going to go to work for Pan American Airlines, and you needed two years of college, and then I said, "Well, while you're here, you may as well get an engineering degree." Then when I graduated, the Korean War started. I decided that you have to put that off and do the military service. Then when I came back, I said, "Well, maybe I'm not interested in flying all the time," and I'd stay with the engineering design.

We had a number of cases where we would work very closely with the pilots. When I got involved in the Shuttle Program, I went out to Edwards [Air Force Base, Edwards, California; NASA Dryden Flight Research Center] and flew with the pilots to shoot some Shuttle approaches and said, "Okay, yes, this is the design that we need to use for the vehicle." So they're very, very talented people and very, very helpful people.

JOHNSON: Were the astronauts more academic at that time?

SILVEIRA: Yes, very much so. Most of them had at least master's degrees, and they were the experts in flying at that time period, yes.

JOHNSON: You mentioned there was a difference from '51 to when you came back in '55, mainly that people were single in '51, and most people were married in '55. Were there any other differences you noticed in the Lab itself as far as the atmosphere or what people were working toward, as opposed to what they were in '51?

SILVEIRA: Well, in '51 it was the time period right after World War II, so most of the engineers that had been at NACA either had been drafted into the service and remained at NACA, or basically were devoted to the work. So the social life was really different. Now, after World War II then they started, I guess, to get concerned about, okay, you need to think about a family and things like that, so the atmosphere sort of turned from being this totally devoted to work to now worrying about family life from that time on. So I think that was a big change in attitude of a lot of people, and you saw probably more social activity organized for the people, because they were more interested in it now. They were a little older and also were thinking ahead to what they're going to do.

JOHNSON: What type of social activities did they have planned there, or did you participate?

SILVEIRA: Well, of course, they would have annual picnics, and they would have various clubs, bridge clubs and things like that, softball and baseball clubs and things like that, so there was a

place to try to more socialize with ourself. Even the Laboratory, of course, got—like the Gilruth Center at JSC, they had a center at Langley they organized for basketball and other activities.

JOHNSON: When you came back you were working in the Vibrations and Flutter Branch and working on that as far as helicopters were concerned. If you will, discuss some of the projects and share some details of how you ran those tests.

SILVEIRA: A lot of the helicopter research was being done by Flight Research Division, where they used real helicopters and things like that. Most of our work was done on models and also in the wind tunnels. What we were trying to do is to—even nowadays when you get in a helicopter, they shake a whole bunch; there's a lot of vibration and things like that. What we were trying to do is to understand where the sources of the vibrations were and how they coupled and how they would either—when they would peak their amplitudes and things like that, to see how we could reduce some of the efforts.

After about seven years, I guess, I came to the conclusion that I was not going to do much good as far as this is concerned. You'd better go do something different. Because it's still a major problem with helicopters. The thing, too, that happens is, as you get older, and this is what happens with your flying, you start becoming more and more conservative in what you do, and to the point now I don't fly in a helicopter unless I really have to. [Laughs] And, as I say, I was a pilot for a number of years.

But what we were trying to do is to take in model rotors into wind tunnels, to do various regimes of the flight, and try to understand where the inputs were aerodynamically, and

structurally—would come from the structure to couple, and where the vibrations were coming from.

JOHNSON: And you said you worked on that about seven years?

SILVEIRA: About seven years.

JOHNSON: Okay. And was it NASA by the time you changed?

SILVEIRA: It was NACA, almost right up until the time when NASA was formed in 1958.

JOHNSON: If you want to, reflect now, if you will, on the time period around 1957 when Sputnik was launched. What was the reaction at Langley when that happened?

SILVEIRA: Oh, I think a lot of us were surprised. I think we were sort of disappointed that we weren't first to do it, why we weren't able to do things. Of course, a lot of the effort that the United States was putting into at that time was in the Navy program, the Vanguard Program, and of course, it had some terrible accidents right to start with, and we couldn't understand why people couldn't do things better than they were. Even during that time period, the Atlas was being developed, and of course, it had an awful lot of problems, too, and things like that, and we sort of felt that these people needed a great deal of technical help to solve some of their problems. We went to work on at that time to try to get at least the Atlas to finally work. We finally was able to launch a satellite that used a military rocket, the Redstone, to launch.

We went from having disaster after disaster to a point where things would work. I was a coauthor on an encyclopedia on space, with Dr. Hans Mark, and a number of the papers in the encyclopedia were written by the Russians. The Russians would cite that the Americans were amazing, from the point of view that you said what you wanted to do in the Apollo Program and you did it. And when you look at it, particularly in the Apollo Program, we built the Saturn vehicles, we flew them, and they didn't fail. We had failures that people really didn't see, but they weren't the type that were spectacular.

So after making two flights of Saturn V, we flew around the Moon, and the Russians just couldn't understand how we could do that, because everybody else would have a number of failures before they were able to do something like that. The Russians had a number of failures before they launched their first man, and we had a few failures in the Atlas Program before we got the Mercury on the ground. And the Chinese have gone through the same thing recently. So it, again, was because of the good technical capability that had been developed at NACA that carried on to NASA.

A lot of it, too, I think, is the difference between NASA and what it used to be, in that the people that came out of NACA and formed NASA were very technically oriented. They were interested in solving a problem, and they weren't interested in if I do this, then I'll be promoted and become a manager or something like that. They're more interested solving the problem than what their position was in the organization. I think that's a little different nowadays, that people aren't as oriented towards solving the problem and not being concerned and credited. They don't really think that the reason they're doing this is for their own benefit—that it's for the program, rather, than for them.

JOHNSON: During the NACA time, I know they had inspections at the different Labs. Do you recall any of the inspections at Langley?

SILVEIRA: Oh yes. [Laughs]

JOHNSON: Do you think you can describe some of those experiences?

SILVEIRA: In our branch we also had a group that researched noise. We were trying to reduce noise from aircraft and from jet engines. We had a congressional group at an annual inspection, and Bill [William S.] Lassiter was demonstrating the noise that you get out of a jet engine. He had a small model of a jet engine, and he said, "Now, for instance, this is the kind of noise that a jet engine makes." Well, this thing was loud, I mean really loud, and we lost the first three rows of the congressmen when he started it. They fell over each other trying to get out of the way. They thought the thing had blown up. [Laughter]

So it was interesting from the point of view that these people got out and they did see what some of the problems were being solved, and at least they came to realize the things that we were doing and that they were worthwhile. Even nowadays the noise you get from a jet airplane is a lot, lot less than it used to be. There is no doubt that the design changes in airplanes and engines make them much, much more efficient than what they were, and this was the result of NACA's research. But, yes, some of those exhibits were kind of fun for us to show off what we were doing. [Laughs]

JOHNSON: How much time was spent preparing for that, for those exhibits and those demonstrations?

SILVEIRA: Oh, probably maybe a month or so, or something like that, were devoted to them. But most of the time we would have some of these exhibits already prepared, because we would show technical groups that were coming to see what we were doing.

JOHNSON: You mentioned congressmen and those types of people there. Can you talk about some of the people that visited the lab during that time period?

SILVEIRA: Sometime, too, they would bring groups in, like the Navy would have a group of test pilots that would come in, and we'd have a demonstration. During one case, we were showing the way the helicopter blades were bending every time it goes around. One of the Navy pilots came up and asked, he said, "So does the rotor blade bend like that every time it goes around?"

I said, "Oh yeah."

"Oh." [Laughs] He looked like he's not sure he'd want to go fly a helicopter again.

But, of course, some of the congressmen were pilots and had some technical background, or some of them were ex-service people, so they had a pretty good understanding of what they were seeing and what we were doing for them.

JOHNSON: Was there much interaction between the different Labs, like between Langley and Lewis [Flight Propulsion Laboratory, Cleveland, Ohio] and Dryden at that time?

SILVEIRA: Yes, quite a bit. A lot of it was in assisting research efforts. I told you about the editorial reviews. Well, usually if we had a subject of a report that another Lab was also working at, then we'd have people from their Lab would review these reports before they're published. Again, a lot of times it was very helpful. Other times, "No, it's all wrong. You can't publish something like that." So it was good.

We particularly depended on Lewis to do most of the propulsion research, so we depended on them a great deal. NACA Ames [Aeronautical Laboratory, Moffett Field, California] was originally formed to support the Navy, because being out here on a Navy field. Later in NASA, but we would run models of the Mercury in the Lewis wind tunnels, and we did a great deal of research in the Ames tests from Houston, where we didn't have any wind tunnels down there.

Like always in an organization, there are groups that work together or work against each other, but some of that was good, from the point of view that it did improve some of the research that was done. Somebody would not put out a report that would have errors in it because there was another organization independently reviewing it and making sure that it was right.

JOHNSON: Was there any overlap, where one Lab would be working on something and another Lab would be simultaneously working on the same thing?

SILVEIRA: Yes, and I think that's very important, because having been a Program Manager and developing hardware, we were always very concerned about redundancy in the design, you know, that it should be redundant. Well, I think it's also very important to have redundancy in the analysis. If you have two groups, and they're calculating the same whatever, and they come

to the same answer, that's good. If they come up with two different answers, that's when you start worrying. [Laughter] But it's important, I think. A lot of times, some of the overlap strengthens the results, it really does, and the idea that it's bad to have redundancy, in analysis, I think is wrong. I think it should be done.

JOHNSON: Do you recall any competition?

SILVEIRA: Oh yes, all the time. [Laughter] We, as a matter of fact, got involved in looking at fuel slosh in the tanks of a missile, where the fuel would slosh back and forth and then feed back into the control system. We had done some tests, and then Lewis had done some tests, and the answers didn't correlate. It took a couple of years to get that squared away. [Laughter]

JOHNSON: During the NACA times, in the community surrounding Langley, how did the community in Hampton, Virginia, the people that lived around there that weren't necessarily involved with the Lab, did they know what was going on at the Lab, or did they have an awareness of—

SILVEIRA: Sometimes, but the local community thought we were nuts, and indeed, they had a term, "NACA nut." What would happen is an engineer would come into a store to maybe buy a toaster, and the salesman would talk to him, then went to do something else, and the guy is taking it apart with a screwdriver to see how it's made, because they were technical and they will want to know. One time, I think, we had bought a new car, and the wife took it into a gasoline station because the oil gauge had gone off high, and the first question the attendant asked was,

"Has your husband worked on the car?" [Laughter] And we were well noted for being mechanically involved in whatever we did, and if we were going to buy something, then we had to know how it worked before we were satisfied. So, yes, the local community knew us and knew we were a little different. [Laughs]

JOHNSON: Were they generally supportive of the work that was being done?

SILVEIRA: Oh yes. Yes, I think so. They think we're crazy, but they knew it was useful work. Because in a case during World War II, a lot of the engineers would not have any time to socialize or spend money and things like that, so a lot of them, right after World War II when automobiles became available, went out and bought new cars. Well, the only problem is that a lot of them didn't know how to drive, and then they had funny ideas about driving. They said like if you hung a string from the top of the steering wheel, and if the string was straight, then you were going straight down the road. That's the way he started to drive, and, of course, you can't do that. [Laughs] But these were some of the ideas that technically these people had thought it out and said, "Well, okay, if the wheel is straight ahead, then it will go straight ahead."

JOHNSON: What about security in the lab? Was that emphasized when you were working there, or did you have to go through any training?

SILVEIRA: Well, we had security clearances, and particularly when we had stuff that was related to the atomic program, then we had to get Q clearances high level security clearance at that time to be able to do that. Yes, there was a certain amount of the work that we'd do would be

classified. We also had restricted and confidential and secret and top secret, so there were more divisions so that we would classify some of the stuff at the lower ones, restricted and confidential, because, well, a lot of times this information would keep our industry ahead of anybody else in the world. So we were sensitive, particularly with the military part of it.

JOHNSON: Let's talk about that transition, after Sputnik and after NASA was formed, as far as your position and what you were working on and how that changed, and how the environment changed at Langley during that first year or so after NASA was formed.

SILVEIRA: Well, probably the biggest change was you didn't work from eight to four-thirty anymore. [Laughter] Indeed, where we were going into a totally new technical area, we were really doing a lot of studying outside. Of course, the military was having a lot of problems, so we were working very hard on that.

Now, NASA, and space was all new to us. We had to go out on contracts and had to write statements of work and review proposals and things along that line, so all that was sort of new and different to us, to do that, to write the proposal for Mercury and then to evaluate those proposals, and then to work with a contractor that closely to get the work done. We had a lot of new areas, technical areas, that we had to get done. I was mentioning this fuel slosh thing. Well, this is something that we didn't worry too much. We did a little bit about the fuel and tanks and the wings of airplanes and things like that, but not the extent that we had to worry about launch vehicles were concerned.

It was a totally, totally different atmosphere as far as—as I said, we moved about I think it was three hundred and some-odd, or four hundred, people from Langley to Houston, and we

had a very, very large increase in staff, so we had a lot of new people who did not have the experience in a research lab, as we had with NACA. So we had a whole bunch of new people that were thinking differently than we would, as far as research people were concerned. It took a while to organize and sort out who were the good people and who you wouldn't want to keep. So it was a big transition.

JOHNSON: Was that a point of contention, as far as trying to get people to think the way you were used to doing things at Langley and to do those processes?

SILVEIRA: It was a little bit of both, from the point of view that we were not experienced in building hardware, and a lot of these people coming in from industry were, so we needed that technical capability that they had. So it was a matter of getting a blending of the two rather than it being a conflict between the two, because in many cases, for quality systems and things like that, the people coming in from industry had a better idea than we did about doing that.

JOHNSON: You mentioned a while ago that one of your most proudest parts of your career was working at NACA. Is there anything in particular while you were there, any specific thing that you feel is your greatest achievement during that time period?

SILVEIRA: No. Not compared to later. It basically gave me the technical capability that I had, and then, of course, later when we were able to fly Mercury and that happened, that was a big accomplishment. I was a big part of Apollo, when we first flew Apollo 8 around the Moon, that was a big piece of me. Same thing with 11 for Apollo, and then, of course, I was Deputy

Program Manager on the Shuttle, and that was a big piece of me, too, when it first flew and was successful, then you felt pretty good about that. I really did. But I think as you went on you accomplished more and more than that, so even though it was based basically on the NACA technical capability.

JOHNSON: Well, during that time of transition, and then you joined the Space Task Group, and as you said, you moved to Houston, did you go to Houston on any of those look-and-see trips?

SILVEIRA: Yes.

JOHNSON: Can you tell me about those trips?

SILVEIRA: Well, we flew down. They had an airplane who would fly down to Houston, and my wife at the time was originally from Texas, so we went down and we looked at the area where the Lab was going to be, and she cried all the way back to Virginia and said, "I don't want to go there." [Laughs] But our reception at Houston was tremendous, because we were used to crowded schools, and we moved to an area where the schools would be built with empty rooms because they needed them in the future, but they weren't using them now. The people themselves welcomed us in the area. It was really also a wonderful time to raise children in Houston in the early 1960 time period. Then, of course, when it came time for the kids to go to college, going to college in Texas is pretty cheap. [Laughs]

JOHNSON: Well, you mentioned she cried all the way back. Did she see it around the time of Carla, Hurricane Carla?

SILVEIRA: No, I think the first impression that we got of Houston was nothing was developed down near the labs, like, and it just was like going out to West Texas; nothing there, at that time. But we first located in Houston in the Glennbrook Valley area, which is just north of Hobby Airport, and we were close to the city and then drove down to Clear Lake all the time, because we wanted to be near a big city. The wife was raised in the New York City, New Jersey area, so even being in Hampton was country. [Laughs] But it turned out all right, of course, two of the children still live in Houston, and the other two went to San Diego [California], which is pretty nice.

JOHNSON: Yes, nice place to visit.

SILVEIRA: Yes. Yes.

JOHNSON: Well, when you first began working in Houston, where were you located?

SILVEIRA: The first location that we went into was in the Rich Building, which was a fan manufacturing company that they had just built a new factory, and NASA leased the building before they moved in, so we were in a building that was supposed to be a factory. We moved in, and as the group grew in Houston, we moved to an apartment complex that, before it became

apartments, NASA leased it. They would cut holes and things like that to make offices in it, so I had my private office and private bathroom and everything else, which was sort of unusual.

It took just about eighteen months to build the Center, and then we moved to JSC, and I went into Building 16 down here. That lasted for a couple of years, and then as the Center grew, my particular branch got thrown out, and we went back to Ellington [Air Force Base, Houston] for a while, and that was pretty good, because nobody would bother us out there. [Laughter] But like all good things, you kept moving up in the organization, and then I got pulled back to the Center and into Building 1.

JOHNSON: What were you working on when you first moved to Houston?

SILVEIRA: At that time I was in a group that was calculating the loads for the vehicles, and that was part of the Structures Division. Then I got changed from that to go and be the Deputy for the Aerodynamics Group, and that was in the Spacecraft Design Division, and that lasted for three or four years, for a time period. During that time period, in the mid-sixty time period, I was still Deputy to Aerodynamics Group, but I also was made Program Manager for the Little Joe II launch vehicle. They were doing launches out of White Sands [Missile Range, New Mexico]. Then I came back for a short period of time, and then Bruce Jackson, who was the Branch Head, went to another job, and then I took over the branch from him.

JOHNSON: Why don't you, if you would, just talk for a few minutes about the Little Joe II Project?

SILVEIRA: [Laughs] That was interesting. I guess the program was about two years old, and it was supposably, okay, now we're into test phase, so all you have to do is set up the tests and things like that, and I found out that wasn't the case. We were still building the thing and trying to design it. It was supposably to do abort tests off of the Little Joe II vehicle to prove the launch escape system for the Apollo. It was good, from the point of view that the Program Manager that was from General Dynamics in San Diego was a well-experienced individual, and I learned a great deal about program managing from him, to the point where he could start a sentence, I could finish it, or I could and then he would finish it. We were very, very close in running the program.

It turned out to be relatively successful. We did lose one vehicle, but it proved to be an interesting test. We built eight vehicles that we flew five over a period of about five years, and the total cost of the program was $22 million. It was good, or bad, from the point of view that at that time, Apollo was spending a lot of money and having all kinds of problems, that we were probably one of the better run programs, and we would get all these inspections, because if the GAO [General Accountability Office] wanted to look at a program at JSC, they'd look at the Little Joe II Program, because that was in cost and everything else like that. [Laughs]

But, it was typical, though, of JSC at the time—I was Program Manager of the thing. All the people that supported, JSC people that supported it, did not report to me. As a matter of fact, we didn't even have paper to show that they were part of that program. When we tried to put together the paper for the GAO review, we looked for a piece of paper that made me Program Manager, and we couldn't find one. [Laughs] It was just said, "Milt, you be program manager."

"Okay." And there was not a piece of paper that was written to do that. But everybody knew I was the Program Manager, and everybody knew their job that they had to do, technically

and things like that, and that's the way the program was run. That was the spirit that prevailed in Houston, that we're program or problem oriented, more so than worrying about, "Well, I'm not going to do this because I don't have a piece of paper that says I ought to do it," and things like that. So it was an interesting time, it really was.

JOHNSON: That brings up an interesting point, because the time period, and with President [John F.] Kennedy's announcement that within the decade, we were going to be on the Moon, how did that energize the Center, and how was the reaction?

SILVEIRA: When he first announced we're going to go to the Moon by the end of the decade, I knew something at that time about heating and aerodynamics and things like that. I said, "He doesn't understand the problem. We can't do that." Of course, we sat down and made it happen. It was also interesting that when we became NASA and they issued our badges, our badges would expire on December 1969, the end of the decade. So I said, "Okay, that's the word. If we don't do it, you're out of a job." [Laughter] I thought that was kind of funny.

But indeed, a lot of us, as far as calculating the heating to a vehicle coming back from the Moon, had no idea. There were a lot of theories that heating goes straight up, and there's no chance, and then we didn't have any material that we could build to resist the heating, and all those kind of things. But we sat down and we just worked and found solutions to the problem. We really did. And, like I said, even our Russian counterparts said to me, "You people are lucky. You get away with whatever you said you were going to do."

JOHNSON: You mentioned in the Little Joe II that you lost one vehicle, and it turned out to be an interesting experiment, anyway. Can you just talk about that for a second?

SILVEIRA: Well, it was interesting. To begin with, on that particular test I had the wife along, and I was standing over in one area, and she said, "Well, I think I'll go sit in the stands and watch."

I said, "No, I'm going to stand here, because I want to be in a place where I can run." [Laugher]

So she said, "Okay, you know more about this than I do, so I'm going to stand with you."

What happened is we had a control system on the vehicle, and it was a very simple hydraulic system, and I think that what happened is we had a filter in the service car that introduced some contamination into the valve in this system, and one of the fins went over hard over, so the vehicle started to roll, and when it rolled to the point, structurally, it wouldn't take it, and it blew apart, and then the payload aborted off of the launch vehicle. So it was a little more realistic than what we thought. It was supposed to go to a hundred miles down around, and down range, and it only went about twenty. But it scattered aluminum all over the sky and things like that. It was a very realistic test from that point, even though it wasn't the planned one.

Then we had one additional test that we were going to do after that, and when we had a very difficult time proving this thing, because we didn't recover the contamination in the valve. We always worried about was that really the case, or something else. I would sit on the side of the bed listening to test results at four o'clock in the morning, because it was a very, very difficult time to understand is this what really happened, or was it something else.

We finally, six months later, we flew the additional vehicle, and then everything went perfect on that particular launch, and that was the end of the program from that point of view. But it was a very stressful time, to have lost a vehicle and be able to get the next one and be successful. One thing, I figured that being Program Manager and you lost a vehicle, that was probably the end of your career. But for some reason, they left me there and solved the problem and it worked, so it worked out okay.

JOHNSON: Well, you mentioned that when you were at Langley and the community thought of the people as the "NACA nuts," and then when you came to Houston and you were talking about how the community reacted. If you will, just for a second, just compare that and talk about the differences in how you were treated in the Houston area.

SILVEIRA: You know, at that time NASA and the Apollo Program were a national priority, so as a result Houston welcomed bringing the organization in that was going to be responsible for it. They went out of their way to welcome us. Like initially they were going to give all the astronauts new houses, which the government wouldn't let them do, and they would have events, like at the Astrodome, for the NASA people and things like that. So it was very welcome, and they would take us through the schools to show us the capabilities and the facilities that they had there and things like that.

Indeed, a little differently, if you went into a store and asked for an item, said, "Gee, no, we don't have that, but let me call their competitor and see if they have it, and then you can go down there and get it." This is the way the people were there, and it is very, very typical that happened just now with the New Orleans thing. Houston welcomed the people, and even though

you can think of all the terrible things that could happen as a result of that. I still think that Houston ordered that second hurricane to get people out of the Astrodome and to get them back to New Orleans [laughs].

But, Houston was a very, very friendly place. As a matter of fact, I had been to Houston when I was in flight training in San Marcos [Texas], and when the opportunity came to move to Houston, I said, "Yeah, that would be all right, because it was very, very friendly town." I think that, unlike what we had in Virginia, whenever you went into a store, people were very, very interested in helping you in doing whatever you could and things like that. I had the feeling at Langley that people were used to dealing with military people. They would only see them one time, and not worry about having them being a return customer. And that was not the case in Houston.

As I say, a place to raise the kids, really great. It was interesting, we decided—we looked around for a church, an Episcopal Church, and we went a couple of Sundays to the cathedral downtown, and the following week the dean of the cathedral came and visited the wife. She said, "Oh, my god."

And he said, "No, ma'am, I'm just the dean." [Laughs]

That was the kind of welcome we had into that church, that he would spend time to come out to the house and welcome you to maybe come and join the church. And a difference, too, because the cathedral in Houston has got a lot of money. [Laughter] To be welcomed into a group like that, it's really, really great. Great. They had an annual dinner for the people for the church. It was given by somebody in the church, and it was held at the Rice Hotel. It was a different lifestyle from what we had back in Virginia. It really was quite different.

JOHNSON: Did you eventually move to the Clear Lake area, or did you always live in that area?

SILVEIRA: Yes. After about ten years, we built a house in Nassau Bay, so we're right across the street. I used to walk to work.

JOHNSON: That's nice.

SILVEIRA: Oh yes. That was a lovely area to live in, too. It really was, really neat.

JOHNSON: There were the astronauts living in the Houston area, as you mentioned.

SILVEIRA: Next door and across the street and all, yes.

JOHNSON: What was it like? And you mentioned earlier about the test pilots being somewhat different than the astronauts, and what was that like as far as living next door and your kids going to school with their kids?

SILVEIRA: Of course, it's not all their fault, because the astronauts were looked up on as being national heroes, and that's pretty hard to live in that environment to start with. Even though the individuals themselves, a lot of them, were really neat people. Joe [Joseph P.] Kerwin lived across the street from us, and one Sunday evening we had come back from Mexico and the youngest one was feeling badly, so Joe's wife was a nurse, so we called Lee and said, "Would you come over and look at Scott?"

Well, Lee didn't come; Joe did. At first I thought, "Well, we asked Lee to come, why did you come?" Then I realized that Joe's an M.D. [Laughs] But, they were good people, and I think that they fit into the community very well, and the kids played with their kids, and I don't think they felt any less than they were—the other kids of the astronauts.

JOHNSON: Was there anything about your time, as far as NACA is concerned and that first transition into NASA, that we haven't talked about that you might want to talk about today?

SILVEIRA: No, I think we've just touched on the NASA thing, and I think there's a lot of stuff that we could talk about as far as impressions during the Apollo time and during the building of the Shuttle, and also the latter years that I was Chief Engineer at NASA and how things changed.

JOHNSON: Well, if we can do that when you come to Houston?

SILVEIRA: Sure. Sure, we can do that. Absolutely.

JOHNSON: Okay, well, we'll go ahead and stop for now.

SILVEIRA: Okay, good.

[End of interview]