

# NASA HEADQUARTERS NACA ORAL HISTORY PROJECT ORAL HISTORY TRANSCRIPT

JOHN G. MCTIGUE  
INTERVIEWED BY REBECCA WRIGHT  
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WRIGHT: Today is September 29<sup>th</sup>, 2005. This oral history session is being conducted with John McTigue of Lancaster, California, 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. The interview is being held in San Jose, California, during the NACA Reunion XI. The interviewer is Rebecca Wright.

Today we're going to be focusing on Mr. McTigue's first days at Dryden [Flight Research] Center [Edwards, California], which was then known as the [NACA] High-Speed Flight Research Station. He has detailed many of his duties of his career in a lengthy interview conducted in June 1998 by J. D. "Dill" Hunley, who is the historian at Dryden. We're going to talk about NACA as well as some areas that he would like to further discuss during this interview that weren't covered by Mr. Hunley's interview.

But we're going to start by first talking about July 1952 when you first joined NACA and came out to California. I understand you had an interest in flying, but yet you spent your career in flight testing and research. Tell us about those first days, those first jobs, and how the testing and the research got into your blood and you just never left it.

MCTIGUE: Well, I ought to go back just a little bit farther. My wife had—well, it wasn't emphysema, but she had lung problems. In fact, eventually she had to have a third of one of her lungs removed, and so we were looking for a dry location, and this all came about to be very

productive in both areas. It was good for her to be moved to a dry location. It was good for me to get involved with flying. But one thing that NACA had and NASA doesn't have, it had a funding problem that was great. You had to pay your own way to your first duty station, so we paid coming all the way across the country ourselves to get to the Flight Research Center.

WRIGHT: You started in New York. Is that where you were originally?

MCTIGUE: I started from New York. My wife and I graduated from college at the same time and got married and came across the country on our honeymoon. So that kind of summarizes how we got there, but it also points out that NACA was very, very short on funding, extremely short on funding, and so they weren't passing dollars out to everybody just to do stuff. In fact, when we were going back to Headquarters, most of the time we were flying our DC-3 back and forth across the country. We'd play cards all the way across the country.

WRIGHT: You took quite a risk for a one-year contract.

MCTIGUE: Well, I mainly wanted to find out if I was going to like the desert or not. Turns out that you either love the desert or you hate it, and turns out that both my wife and I were able to like the desert. I love climbing and backpacking, and so the High Sierras [mountain range] here are just tremendous for doing that. I've hiked almost the whole John Muir Trail at one time or another. Had Boy Scouts over eighteen years, so we'd go on trips of about a hundred miles each summer and be gone for about ten days. Parents would bring us in one place and bring us out another, so it was an environment.

Plus there was a group of people at the High-Speed Flight Center, Don Bellman was one of them, that were rock hounds, and there are all kinds of minerals around this desert you can get, from opals, petrified wood. It's loaded with different stuff. And at that time, you could go out and get almost anything you want. Now you're restricted from picking stuff up, but back then everybody was into rockhounding. Not everybody, but a lot of us were in rockhounding, and so it was just the kind of extracurricular activity that kind of blended in with our work activity that made us all a family, and quite frankly, we were a family out here.

I came out here and I used my last \$50 to pay our room rent. Had to wait for my pay before we were going to buy any extra food. But I was raised on a farm, and my wife was raised on a farm, and we didn't have a lot of money, so we weren't used to be able to go out to parties and go out to places and do things like a lot of people from the cities are. So the austere conditions just didn't affect us in any way.

My wife had a teaching certificate, and so we ended up basically at the Marine base in a one-room apartment. That's all it was, was a one-room apartment with a door that led into the bathroom, and the kitchen and the beds and everything else were out in the other room. But because my wife was a teacher, she got hired on at Edwards [Air Force Base], and that opened a door to us to be able to go to Wherry Housing [military housing for families], and boy, that was great. We got a two-bedroom apartment with everything in it. We had a refrigerator, stoves, the heating, cooling. It was really nice.

WRIGHT: I guess the commute was good, too.

McTIGUE: Oh, just a mile and you're at work. The commute was very good.

But what did I do when I got here? Well, the first thing I did was start off with doing loads calibrations on airplanes. It was putting loads on and then measuring, looking at the resultant data from the strain gauges on the oscillographs that we had out there. We had filmstrips that we had to read.

I think there's lots being missed nowadays, because by taking the filmstrips and going through them, you had a feeling of what was going on. So you didn't read every tenth of a second. You only read where things were changing, and where the things were changing, you made your two chip points, and you were able to plot your curves. When you asked the people to read your stuff out, you gave them time periods to read stuff out in different increments. But this was all because you were looking at the data on filmstrips, and you could see what was going on.

Now the poor engineer—I say that, because he's poor from one standpoint; he goes in and says, "Give me one-tenth of the data from time zero on through to time eighty-six," or whatever. Well, he ends up with a stack of data on his desk that's maybe six inches high, when maybe he only needed to look at about a quarter-inch high.

But the one advantage he has that we didn't have is that data nowadays is coming out in engineering terms, fully—the computers go through and analyze it and bring it all out in engineering terms, whether it's loads terms, whether it's aerodynamics term, or whatever. It all comes out in engineering terms. In fact, on the B-2 that I worked on, we had probably a hundred times more data coming in to us than what the Shuttle has, real time. Had people at consoles looking at the stuff and being able to analyze it. They were there to save the pilot's backside if anything went wrong. Now that's all there for them. They've got it analyzed for them to be able to look at. Back then we had to take the data, point by point, and then put it through the

equations to get the refined data that we needed for our analysis. Much nicer for the present-day engineer, and a lot faster, too.

Let's see. Going from doing loads testing and—

WRIGHT: Now, did someone show you how to do that, or was that something you learned on the job?

MCTIGUE: Oh, we had mentors that were tremendous. We had very, very good engineers. The majority of them were trained back at Langley [Aeronautical Laboratory, Hampton, Virginia] that we had out there. Of course, we were a substation of Langley at that time. Very good engineers, and they wrote good flight test reports. The NACA reports are still being looked at today. There are still people calling and getting NACA reports, basically air foil data, stuff like that, that was done back in the wind tunnels.

I think a lot's been lost, from NACA to NASA. NASA doesn't analyze its data the same as NACA did. You went through and you also gave a plus or minus on it as to what the extremes of the data you have; in other words, what you felt was the scope of the accuracy of that data. Now they print it to the tenth decimal and say it's accurate. Well, I say that's a lot of baloney. There's nobody reading stuff that great.

Where'd I go from doing loads? Well, I was right in the middle of doing that kind of stuff and being a civil engineer, and we were building a new building. Somebody recognized I was a civil engineer and said, "Hey, we need him up at where we're working on the new facility." So for a year, about, I was taken away from what I was doing and taken up there, and I was counting steel down in the hole, twenty feet down in the ground, just to be sure that the right

amount of steel and the concrete and everything going in was going to be right for the vehicle—for the building. I enjoyed civil engineering work, because that's what I did. I worked for the U.S. Bridge Company for summertime one time for [about] two months, and that was interesting work. So, when you get involved with something, it's interesting, whatever you're doing. If you get involved, and you try to find out just what the details are and why you're doing it, it's going to be interesting to you. But if you sit back and let the stuff slide on by and you become lazy, well, it becomes disinteresting.

Got through there, and I came back to South Base, and I got involved with [Edward] Holloman, doing moment of inertia, and some of the pictures that I've given you will show you the kind of jigs I had to develop to put the airplanes on to measure their three axes of moments of inertia and also to come up with the principal axis.

Again, it was stuff that I wouldn't have known how to do if there hadn't been mentors around to tell me, "This is what I need to do. You go out and develop how you're going to do it." And they left me alone to go out and do that. Here I had at that time—and think about it—a million-dollar airplane. Back in [19]'52, a million-dollar airplane was a pretty expensive airplane, experimental airplane. And I had it setting on a bunch of knife-edges and being supported by some springs. The springs, what we did, we changed the springs, and when you changed the springs, you changed the frequency, and so you got a couple of different sets of frequencies from that. When you combined them together and did your least squaring of it all, we were able to come up with the moments of inertia and, obviously, the principal axis from it, too.

So it was things that they do now probably a little differently, but I'm not so sure. I do know that the people nowadays, they're going to be looking back at their time and think it's the

best of times, and in many ways, it will be, because the technology is progressing so fast, and computers are progressing so fast, advancing, that we're going to be fifty years from now—because I'm talking about fifty years—fifty years from now it's going to be entirely different, just tremendous. I can't see the exact future, but I can see that there's going to be a heck of a lot of changes made, and I think probably for the better.

Now, one of the things we're not going to be doing, as I mentioned previously, I came out here when we had propellers on the airplanes, and we were just starting to fool around with jet engines. And some of the analysis we did back then is that jet engine airplanes just weren't going to work for airlines, because every twenty-five to thirty hours, you had to change the engine. Well, now you go 50,000 hours or more, okay? So that's changed, and what made that change? The technology for metallics and for material changes that [allow] you to be able to go to higher-temperature material for those engines to make them last.

But besides that point, our capabilities of flying the airplane without a pilot have increased tremendously. Now, if you go out to Edwards and you go out to the Wherry Housing area or throughout Edwards area, all the streets there are named after people who lost their lives doing flight testing. There's a book out that I think everybody should read. It's called *Flight Testing in Old Wright Field*. It talks about how these guys were flight testing by the seat of their pants back during World War II and right after World War II, developing the technology of being able to prove out that the airplane was going to hold together. There's one story in there about a guy that's going up, and he's flying a—it must have been, I think, a Canadian built—I'm not sure just what airplane it was now, but it was all wood. It catches fire. He bails out, and the next day, he goes up, flies another one. It catches fire, and he bails out. These guys, they did their job.

WRIGHT: How often did the flights go up? I know that you mentioned once before that you had flying like two rocket flights a week. I know that was later on, but when you first got there, how many flights did you see go up? Were they about two a week?

MCTIGUE: About that serious, yes. We had the X-1s out there. The X-2s were just coming in. The X-3 was coming down about, oh, almost a year later or so. We had the X-4 out there. We had the X-5. It was just one after another; these were all X airplanes. Plus we were testing the modern-day fighters at the same time. We had the 100s. We had the 102s and the 106s, both of those being the Delta wing airplanes that [Richard T.] Whitcomb worked on to find ways to make them be able to go supersonic with his Coke bottle [shaped fuselage].

WRIGHT: Talk some about the relationship between NACA and industry and NACA and the military. Did you have to have a clearance to work on these?

MCTIGUE: Oh yes.

WRIGHT: And how secretive was the work? Just give that whole idea of what it was like to be in those days, with the Cold War and working with those.

MCTIGUE: Everything we were doing was secret. We were advancing the technology. We were working hand in hand with the Air Force. The Air Force and NACA were just like one. We were right there working together. We had the loads airplane and the [aerodynamics] airplane of

the 100s, the 102s, the 106s, the 104s. We got all those, and we were the ones that proof-tested them, not the company. The companies took them out to a certain place, but NACA and the Air Force combined were the ones that did the test.

WRIGHT: Why was that?

MCTIGUE: Why was that? Because we were a committee, and our committee was responsible for advancing aeronautics. The committee was composed of industry people, military, and civilians. It wasn't headed completely by civilian people. It was headed by a group.

Nowadays—I know from my experience on the B-2 that the Air Force does not trust NASA. It doesn't trust them to keep a secret. Yet I know they can do it; I've seen it, okay? But from working on the B-2 and talking to the people, I was able to get a few people from Dryden to come in and help, but I couldn't get as many as I wanted to, because the Air Force said no.

WRIGHT: During the mid-fifties, was industry trusted by the Air Force and by the government? Working with the different airplane manufacturers, did—

MCTIGUE: Back when?

WRIGHT: Back when you were working with NACA during the mid-fifties.

MCTIGUE: Oh, heck, yes. We worked very close with them. In fact, it's interesting that you brought that up, from the standpoint we didn't have very much money, and some of the

companies didn't have that much money, either, for their program. They'd come up to start doing a flight test program, and they'd need some rivets. They'd need rivets that were three-quarters of an inch long or a half-inch long, and if we had any, we'd share them with them, okay? Or they'd need some other part. They'd need bungee cord or they'd need some aluminum material or whatever. We shared. When they left and went back to their home base, they'd bring all their stuff that they had left over to us, and we'd put it in our warehouses.

When we moved up to our present facility, we had a complete warehouse filled with stuff. We were there with that for probably five years or six years, and we hadn't ordered. NASA comes in, in its great wisdom, and says—I think it was NASA at that time; yes, I know it had to be—and said, “If you haven't used it in six months, get rid of it.” We had hundred thousands of dollars' worth of material we took to the junkyard. And six months later you needed it, and so you went out and you had to buy it. So how costs changed just because of rules and regulations that developed someplace else by people who don't have to work the programs.

I look back and see the people who were working for NACA, Dryden, and so forth. They all had worked up the chain. They knew the people they were working with. They knew who they can trust. They knew how to get stuff done. Nowadays we're having people coming in from the outside who don't know the people inside. The first thing they have to do is get their own people in, and you start seeing changes in areas which shouldn't be changed, but have to be changed because that's the only way those people know how to work.

WRIGHT: And speaking of change, did you see a significant difference in the environment and structure at Dryden in [19]'58 when, no longer NACA, it now became a NASA facility?

MCTIGUE: Well, as far as looking at all ways we could to support space, [Hubert M.] Drake and a few other people were actually working hand in hand with NASA Headquarters on the future vehicles, [X-20] Dyna-Soar [Dynamic Soaring] and all those kind of things. In fact, I was working the heat transfer on Dyna-Soar at that time period. In fact, I started the Heat Transfer Division at Dryden, myself and one other person. But it evolved into people doing a lot of work in heat transfer. I also was responsible for getting the heat facility built out there. That was the one [other] job I took on. It's interesting. They find you can do something, and they load you up.

WRIGHT: That's true.

MCTIGUE: But it's good, you know. It's nice to be able to change and do different things, because it broadens your perspective. Let's see, where was I?

WRIGHT: Talking about the impact of NACA transitioning into NASA.

MCTIGUE: Well, to begin with, we didn't see that big of an impact, because we were kind of a small center, to begin with. But we saw our people leaving to go to other places. [Dr. Walter C.] Williams left, and when he left, then [Paul F.] Bikle came in. You know, [Richard E.] "Pappy" Day left with them. [Kenneth S.] Kleinknecht. There was a whole bunch of people left at that time to go support the new space activities.

One of the things that bothered me is that they didn't listen to us completely. The X-15, as we built it, had a nitrogen atmosphere for the pilot. He had to wear a pressure suit all the time.

We suggested that for the Apollo [Program]. They said, “No, it’s got to be a breathing atmosphere.” So they put a breathing atmosphere in, but they also pressurized it, so now it was a higher pressure, and when that first spark fire occurred in the Apollo, it was just an inferno from there on, because you had a very heavy, oxygen-rich atmosphere under pressure, and everything burned up inside, the pilots and all. It was just a tragedy.

We had a letter that we had written previous to that, which I think they asked us to retract, suggesting that they go to a nitrogen atmosphere. [Laughs] I don’t know what ever happened to that letter. But it’s those kinds of things that we felt we weren’t being trusted to make good decisions.

WRIGHT: Did you see your funding change? You had talked earlier about NACA didn’t have funding to begin with.

MCTIGUE: Well, we had a little bit more funding. In fact, we were able to get a couple of chase planes that we needed, some 104s and so forth. But we didn’t see a big change, because the space programs were really absorbing them. One of the things I did is I followed that pretty close, and when I was working on the Space Shuttle with [Donald K.] “Deke” Slayton, I knew when all the funding for facilities was going to stop dropping down. So when I saw that was going to happen, I went back and talked to Jack Levine, and I said, “Jack, I’d like to get some facility money out here to update all our facilities to first-class position.” And Jack worked with me to go to other areas back at Headquarters, and before anybody else in NASA knew about it, we had all the funding we needed for the next five years to do the upgrading of all our facilities.

Someone from Ames [Aeronautical Laboratory, Moffett Field, California] called me and said, “You SOB, you stole all the facility money.” [Laughs] But I didn’t steal it. I went and got it when I was thinking about it. But that’s the way it happens when people see you taking something that they never had to begin with.

WRIGHT: That’s true.

MCTIGUE: Okay. I went through the changeover, but there was other stuff happening back then. I had been involved with the high temperature area, and about that time—it was about [19]’58, ’59 time period—they were opening other positions up in the Operations area for somebody to become Ops [Operations] Engineers. And always having had hands on—I worked at a junkyard to get myself through college, so, it’s those kind of things—I didn’t mind getting my hands dirty, so I went and applied for a job and got it.

One thing led to another, and finally X-15 number three blew up, and I want to be sure I point out that it was not the engine that blew up. It was the ammonia tank that blew up. It overpressurized itself due to a malfunctioned valve. About two weeks later I got number three to rebuild. So, to me, that was very lucky to be able to get that and spend time at North American and learn how companies do things, because I had never been heavily involved with the companies doing things. So that was a very, very strong learning experience for me.

WRIGHT: Did you spend days, weeks with them at their facility?

MCTIGUE: Oh, I'd go down and spend at least a few days a week for a year down there with them. I brought my own people down to put the instrumentation stuff in, and we had a big fight with their union people, because the union people didn't want our people putting the instrumentation in. I said, "Okay. Move the airplane back up to Dryden and we'll rebuild it up there." [Laughs] That ended the discussion.

In fact, with Northrop when we built the M2 and the HL-10, it was entirely different. They didn't have unions. They welcomed us coming in and worked with us on how to do stuff. We knew the propulsion system, so we basically designed the propulsion system; they built it. We built the control system in our own Rocket Lab that we had at that time.

We don't have a Rocket Lab anymore, and that's another thing that bothers me a little bit. I don't know how to rectify that. We've basically—NASA has gotten rid of its technicians. There's very few technicians left. We've gone to contractors. I worry about that. How do you monitor a contractor if you don't know how he's doing it? If you've got people who know how to do something, you can bring them in and discuss, "How would you do this?" and so forth, and then you go down and see how the contractor is doing it, and if he isn't doing it in an efficient manner, you can sure as heck tell him. We don't have that capability. We don't have people who [have] hands-on [experience] anymore. Really, that's one of the things that does bother me. We've lost our capabilities of building things.

The M2-F3 we rebuilt. Did quite a bit of it down at Northrop, but we built a whole bunch of it ourselves up in our own hangars. We did the load assessing of it. We did the building of the fins, and a good portion of the skin we put back [on at Dryden for the HiMAT, Highly Maneuverable Aircraft Technology]. I think that was the same thing. We'd run out of money. When I got brought into it, they'd already spent twelve million out of sixteen million and hadn't

put one piece into the jig yet. We finished up for just a little over sixteen million, because we said, "We'll take the number two vehicle just the way it is, and we'll build it ourselves." They wanted to be sure the right instrumentation was in, so they went ahead and did their instrumentation in a good portion of it. We did the final in the wings and so forth ourselves. We said, "Forget about the control system." They were having all kinds of problems with the control system, so we [designed and] put the control systems in ourselves.

On the HiMAT we did a lot of that ourselves. We designed the whole control system ourselves. We plugged it into our central computer system, and our people, our technicians, developed the control system at Lewis [Flight Propulsion Laboratory, Cleveland, Ohio] for the vehicle, and it worked out very well. There was stuff that we could do because we had hands-on experience. I don't think we could do that now.

WRIGHT: When you first joined, were there a lot of people that were new coming in at the same time you were?

MCTIGUE: Yes. I think there was about, I would guess, twenty, maybe twenty-five people. Probably didn't have over 225 people, and we were flying a lot of airplanes.

WRIGHT: Was there a lot of competition between the different groups?

MCTIGUE: No. Worked hand in hand. Everybody worked to help each other out. As I said before, we were like a family.

WRIGHT: Tell me about your days, your normal days. Were they long?

MCTIGUE: To begin with, no. They didn't make me work more than like eight, maybe nine hours a day. When I got into the X-15 time period, they became long. I put in eighteen-, twenty-hour days. In fact, when I was rebuilding the X-15 and getting it ready for flight testing, I brought my trailer out and parked it next to the vehicle. I had two shifts. They were working twelve hours, each shift. If anybody had a question, they'd come wake me up. They'd say, "What's this about the APU [Auxiliary Power Unit]? How do we do this or that? What's the difference in the pressure which it can stand?" You know, those kind of things that were just basic questions.

WRIGHT: You must have felt quite a sense of pride to see her fly.

MCTIGUE: Oh, tremendous. The whole crew did. I had a crew chief that nobody wanted. Littleton is his name, and he was—there's a picture of him in here someplace; here we are. Duke Littleton, right here he is, if I can find him. He's in the other page. This is my night crew that came in. Duke was the main crew chief. He would check things to the nth degree. He went over and over, making sure that everything was right. I never had an uprange landing. I flew the airplane for twenty-six flights, was it, twenty-seven flights, and never went uprange. All the other airplanes were landing at Mud Lake [Nevada] and so forth, and I'd give [credit] to the crew I had. They were good. They made sure that the airplane was right before—in fact, Joe [Henry] Engle wrote me on the bottom of a [picture] of him in the airplane, and he said, "Thanks, John, for a good airplane. It was the pick of the litter." I've got that.

WRIGHT: That's a nice compliment, yes. You talked earlier about the pilots and the risks that they took, but do you feel like you took a risk when you took on the operations of handling the X-15 number three?

MCTIGUE: When I signed my name there, I said the airplane was ready to go. Is that a risk? I didn't think of it as a risk. I thought of it as an honor that I was able to say, "I got an airplane together as best I could for you guys to take flight." It's a different feeling.

WRIGHT: There were bad days when you were there with the plane crashes. How soon was the feeling turned back around where people could move past the sorrow and get back to work?

MCTIGUE: Well, I remember when [Joseph A.] Joe [Walker] passed away and crashed his 104 into the [X]B-70. I imagine it was a good week before people started to—we were getting ready to fly our airplane, and we took the airplane off, the B-52, brought it [back] in [the hangar], and checked everything over again. It was such a loss. We lost so many friends, and they were friends, and you still miss them, no matter what. In fact, I was just talking to Joe Walker's wife, what was that, a week and a half ago at that—

WRIGHT: You had a nice celebration at Dryden, didn't you?

MCTIGUE: Yes, we did. I gave a little talk, not much, but I just expressed my feelings of everybody back then. Gave Neil [A. Armstrong] a little hard time with his landing on South

Lake bed. [Laughter] The only airplane that little old ladies in Pasadena saw, you know. That's when he overshot the runway—overshot the airfield, I should say. Neil gave me my first flight in a 104, so he showed me how X-15 pilots approached the runway. I thought, "It takes a hell of a lot of guts to go shooting down at that runway at that angle and at that speed, and just flare before you get there." [Laughs]

WRIGHT: I was going to ask you if you got a chance to fly in any of the planes that you had to work on.

MCTIGUE: It was something that they did, and it gave you appreciation for what the pilots had to go through. I was glad that I had that experience. But I had experience in flight testing before. We had an F-51 that we did load testing on and we had wing testing of a glove and so forth on, and they took everything out of the back of where the pilot was and they made a seat there for any engineers that—that's all you did was add a seat to sit on. But it was fun; to me, it was fun, because I like flying.

WRIGHT: We talked a little bit about the technical reports that NACA came up with and still so many people read today. Did you have an opportunity to contribute to a lot of those reports?

MCTIGUE: Contribute to them from the standpoint of calibrating the data, supplying the data, for the people that made the reports. I don't like to write. I'd rather go out and do something. I'll write if I have to, but I'm one of the people that just rather do the work than sit there and do the

writing. Unfortunately, that doesn't do you some good in some places, but in other places it does.

Because of the knowledge I had and the way I did things, people kept calling and asking me to work, like I got called up there at Ames to work on the short-takeoff and landing airplanes that Jack was pushing, and Jack called me to work on the X-34. It progressed like that. Different people would call you and you'd do different things. I don't know. I think I'm very lucky to be able to go from one program to another, one type of a program to another.

WRIGHT: Did you ever stop to think during those days that you weren't just working, you were actually producing history?

MCTIGUE: Never thought about history. Never did. I just was trying to do the best job I could at the time, that's all. In fact, when Ames took over Dryden, at that time period, I decided I was going to leave. And why was I going to leave? Well, I remember when we were under Langley. When we were under Langley, granted, they were two thousand miles away or whatever it was, and if you needed another filing cabinet or if you needed another drafting machine or something, it took you forever to get it, because they'd review it and say, "They've got four of those. They don't need another one."

I could see the same thing kind of happen with Ames, even though Ames was three hundred miles away instead of two thousand. But they weren't living with you. They didn't see your needs and so forth. And we had been a Center long enough that we kind of had our own way of doing things and our own way of keeping a record of our stuff, and I just felt, well, it's time to leave.

I knew “Sy”; I knew [Clarence A.] Syvertson real well. I appreciated Sy. He’s an honest guy. He’s always nice to talk to and always very friendly. So it wasn’t because he was the [Ames] Center Director I left; in fact, I would have stayed because of him, but it was because I just felt it was time to leave. That’s when I went to work for Northrop [Corporation]. So that’s kind of ended my career.

But in the meantime—

WRIGHT: Start a different one.

MCTIGUE: Yes. In the meantime I had a lot of that programs I’ve worked on. I’ve worked on all the X airplanes, putting loads and so forth on them. I had supercritical wings. Worked on the short-takeoff and landing airplanes up here at Ames. And that all happened because people knew I could build things, so that’s why I was called in.

Then I came back and had the Dryden Flight Research’s project management of our responsibility for the Shuttle, the building of the hangars, the building of the taxiway up to it, the building of the Mate-Demate Device, the preparing of the offices and everything up at North Base for the people to move into from Houston and from back in Florida coming out. So we had a lot of people come in at that time, and we had to have facilities for them. I became Dryden Flight Research Center Project Manager to Deke Slayton, kind of his Assistant Project Manager from Dryden.

Deke Slayton, by the way, taught me a lot. Deke was a tremendous guy. He really was. I really appreciated Deke. And Tom [Thomas U.] McElmurry. I haven’t heard from Tom in a

long time. I don't even know if he's still alive. But in any case, I really appreciated working with Deke.

WRIGHT: Through all those years did the people at the Dryden Center remain as a family?

MCTIGUE: In a sense, they did, but with so many new people coming in that they didn't know, obviously you have that how do you get support, and that was my job, to try to get support from in-house. But then we were about 80 percent, 90 percent getting ready to go into the testing on top of the 747; drop airplanes are drop airplanes. Jack Levine called and asked whether I could support him with HiMAT, and the first answer he got back was not only "No," but "Hell, no. He's got other jobs he has to do."

So he went up the ladder and other people called, and eventually they came down and asked me how much time I could spend. I said, "Well, I could reduce my time down on the Shuttle to probably 25 percent or maybe 20 percent." I don't remember what I said at that time. "And I could spend the rest of the time on the HiMAT." So that's what I did.

WRIGHT: I was thinking when you were talking about the Shuttle that you've worked with Joe Engle on X-15 and then he came back with the ALT [Approach and Landing Test], so that must have been a fun time for you both.

MCTIGUE: Yes.

WRIGHT: Different roles, but same relationship.

MCTIGUE: Joe's quite a guy. He was out at our meeting. I had to give him a hard time.

WRIGHT: I think he probably expected that. [Laughter] Well, you brought some photos. Let's go through some of the things, maybe. Let's just kind of review these and see if there's anything else you want to talk about. I know you brought me this one of this B-52 wind tunnel gust photo. Tell me about that?

MCTIGUE: Well, a B-52, they had to position the X-15 under it and then go through dropping it at different angles of attack so they could determine how the adapter on the wing would be built so that the X-15 was set at the right angle of attack for dropping away at about a half a G. And so a lot of effort was spent by Langley going through that and looking at gusts and all kinds of stuff that the airplane would be subject to while on the B-52.

Then later when we had the lifting bodies, the lifting bodies were a whole lot shorter than the X-15, so we had to make an adapter that was farther forward on the wing so that the lifting body pilots, if they had to eject while mated, they could eject up over the top of the wing. In doing that, we changed the whole aerodynamics locations over how the vehicle was setting on there, and we had to determine what was the right angle of attack for that vehicle and build the adapters so that each particular lifting body would have its own adapter for a B-52. So we had an adapter to the regular X-15 pylon, and for each of the lifting bodies, and we developed the location of it and how the lifting body would be put on by doing tests like this in the Langley tunnels. It was important to us.

WRIGHT: Oh yes. All right. Well, thank you for that. Let's see what else do you have. This you said, I think, was the night crew?

MCTIGUE: That was one of my crews. I had two crews, and that was one. I have another picture with the other crew, but I don't know where it is right now.

WRIGHT: This is with the X-15 number three.

MCTIGUE: X-15 number three, yes. We usually have had the number on here, but you don't see it on this one, but you do see it on this one here. See the three up front here?

WRIGHT: How long were you in the role of being in charge of that airplane?

MCTIGUE: Had it from two weeks after it had its accident till after its twenty-sixth flight, and then I turned it over to somebody else that took over.

WRIGHT: Then where did you go from there, do you remember?

MCTIGUE: Then that was when Bikle asked me to take over building the lifting bodies, and that's when I started building lifting bodies. Then when I was building lifting bodies, they were having some problems with the Corps of Engineers getting the heat facility built, and Bikle called me in to head that outfit, see if I could end those problems. I had Ski Markey out there to help me square the whole thing away, and so we got going on that.

WRIGHT: Then tell me about the supercritical wing.

MCTIGUE: Supercritical wing was a fun job. We needed an airplane to put it on and Whitcomb determined that the F-8 would probably be a good airplane. So I went out to the Navy and see what kind of airplanes they had, and pretty soon I had F-8s coming in. They had gone through PAR [Progressive Aircraft Repair], which was basically progressive air repair and so forth, so they were really up to speed on being good airplanes. I got two of them, and then I got another one, and then a two-seater one became available and I went and got that one.

WRIGHT: Now, when you say you went and got them, where did you go and how did you do that?

MCTIGUE: Oh, I just went to the Navy. I went back and Admiral Peterson, who was [an X-15 pilot] at that time he would have been Commander Peterson.

WRIGHT: Was it a local base?

MCTIGUE: Back in Washington [D.C.].

WRIGHT: In Washington, okay.

MCTIGUE: Yes. Talked to him and he put me on to certain people, and found out that certain airplanes were going to become available. And then all of a sudden there would be an airplane taxiing up our ramp, and the pilots would look down and say, "McTigue's been at it again."

[Laughter]

WRIGHT: Got a new one.

MCTIGUE: Yes. So we modified one of them, and we used that and calibrated it ourselves. We had the wings built, and we modified the adapter to it and the cone and so forth up at the top, and we built that all based upon Whitcomb's design. Whitcomb, actually Whitcomb came out a few times to look at the vehicle, and we got pictures of him with a great big wooden file, making believe he's filing it. [Laughs]

But I mentioned previously in that other report that we found some things that they had only thought could exist. Had never seen them in wind tunnels or anything, but they knew that they were possible, and they were called striations. They were little corkscrews that started up at the leading edge, and they made a little corkscrew design down the wing until it passed where the transition point was. He looked at that and he just was overjoyed to see those, because he knew they were possible and had never seen them. But that was a program that turned out good, too.

WRIGHT: All right. How about this one?

MCTIGUE: That's the HL-10 [Horizontal Landing]. We had the M2 first, and we were flying it and then decided to put the rocket engines in. By the way, that's another experience that I don't think you could do nowadays. I went out and got parts for the rocket engine out of an airplane out at the college in Lancaster [California]. I got parts out of the airplane in front of our building. I went back to Wright Field [Dayton, Ohio] and got engines out of their museum. I went down to the museum in San Diego [California] and got engines out of their museum in San Diego. I brought all those engines back. There was like eight of them, and parts. I had [Reaction Motors], the manufacturer of [the engines]. They were the LR-11s, liquid rocket engine, and they rebuilt them all for me, and we tested them in our Rocket Lab, just pressure-tested them and everything to see that all the functions were there, for \$50,000. I had been looking for an engine for [the lifting bodies] for about six months, and the closest I could get to an engine with it was around \$20 million. [Laughs] We used that engine for a good many years after that.

We used it in the M2s. We used it in the HL-10. We used in the X-24A, the X-24B. They weren't the best engines in the world. They were known to blow up [a chamber] every once in a while. There were four chambers, and every once in a while we'd lose a chamber. They wouldn't allow me to fly these nowadays.

WRIGHT: The chance of a risk, or the risk of taking risks, do you believe that's changed as well?

MCTIGUE: Oh, definitely. Definitely. There's no such thing as taking a risk nowadays.

WRIGHT: Here is another group.

MCTIGUE: Oh, that was just—I run across that—just of Roy Lafton [phonetic]. We've all ordered something, and I can't even remember what the heck it is now. I'm sitting there in the middle. I just thought, I'll just grab that. This was the X-15 award.

WRIGHT: Do you remember the first award that you got?

MCTIGUE: I got two Exceptional Awards, but I think this was the first one I got, and then after that I got two NASA Exceptional Awards with the clusters and all that, and I've never wore them. [Laughs]

WRIGHT: It's nice to get, though.

MCTIGUE: That's another picture of the HL-10 in flight. As you can see on the HL-10 here, this here is a new—right along the end of that part of the wing, or the back part of the tail, I should say, horizontal part of the tail on either side. That's the redesign with a bulge on it. Now, why was that needed? Well, Bruce [A.] Peterson flew that the first time, and as he pulled up and angle attacked, he lost control. He wasn't able to do anything. Because the flow stopped going over the top surfaces of these two horizontal stabilizers in the back. We went back to Langley and they looked at some of the data, and, lo and behold, they had a point at that angled attack that they'd discarded as an extraordinary point. So they went back and redesigned it and they put these bulges on, and that corrected it. That made the flow now go over the surfaces, and they kept control.

WRIGHT: This one, you were telling me, has to do with the tail loads.

MCTIGUE: This is the tail loads for the F-104, and they had to change the engine on it. The engines of that time period [did not last long]. I had a glove on the wing and I was checking the flow over that glove for laminar flow. It seemed like I was changing engines every time I turned around. It was this case where the engines just weren't holding together that good at that time. So they had to change this, and they wanted a new calibration of the vertical and horizontal tail at the same time they were changing the engine. Well, you can't do it on the airplane, because they're working on it, so I designed a—if you look in there, there's a great big plate underneath that that's bolted to that, and then that's bolted to these plates that are bolted to the floor. It was just a simple design. I'd have a load stand here, which I'd put loads against the horizontal tail there, and we hooked up hydraulic pressure to it so that we could be kept in place.

WRIGHT: Now, when you say you designed this, did you have to draw it out and get approval to build it, or did you—

MCTIGUE: I just looked at it, and I called the technician over, and I said, "Hey, I need to do this. Will you cut something out to do that? And I'll bring you down the work order." So I brought him down the work order with a sketch on it.

WRIGHT: And it worked.

MCTIGUE: And it worked. I didn't have a committee to go over the fine points of where the loads were going. I knew what kind of loads were going through those bolts. A bolt can only take so much load.

WRIGHT: So that was the simple process and a simple method to—

MCTIGUE: Simple process. I couldn't do that nowadays. I'd have three committees looking at me, plus the safety officer.

WRIGHT: How about this one?

MCTIGUE: That there is the moment of inertia rig that I told you about. I don't know whether I can show you the springs on that one or not. But if you look over here, you see there's little pads on either side here that that's held up on? On top of that was little knife edges in which we just worked on that whole thing. I had something along here. I had a problem that anything that I put on a vehicle that contacted to try to give me a position over here or a frequency, would change the frequency. So I got to thinking about it, and I had them develop me a little photo cell with a bulb inside of it, and I had them focus that bulb so that the filament gave me a straight line, and that straight line was what I had going up and down here, and that's how I measured the frequency without having to attach it to anything.

WRIGHT: Now, is that instrument still being used?

MCTIGUE: I doubt it.

WRIGHT: Did other people use it?

MCTIGUE: Hell, they got better stuff nowadays.

WRIGHT: But it worked for you at the time.

MCTIGUE: It worked for me. This is the X-4. The X-4 was unique in that it had engines that used airplane gas. It didn't use JP [jet fuel].

WRIGHT: That's interesting.

MCTIGUE: Okay. What other experiences did I have that I haven't talked about?

WRIGHT: Tell me what you feel like was your greatest accomplishment while you were working for NACA, before NASA moved in and changed life as you knew it there.

MCTIGUE: Okay. [Laughs]

WRIGHT: What do you feel like, the things that you did?

MCTIGUE: See, after NACA is when I got into the Ops Engineering. But before that, I got involved with Project 12-26, which was the beginning of the X-15 Program. So I did a little bit of laying out of instrumentation and stuff like that, which helped the X-15 get developed. So I got involved with programs early on which helped me in the future. Did I accomplish anything? Not anything that anybody else couldn't do because I was still young. I was still just learning, and I had mentors who helped on everything.

But developing these means of doing the inertias and so forth, that was something that I was able to do by myself, and that was an accomplishment. Not a great accomplishment. I did more things better in the future. But back then that was doing something that helped us get going with—in fact, we did the inertias on all the airplanes using that, when we did the D558-II, in both the jet version and the rocket version. They brought the X-2 in and I did that, too, before it crashed. In fact, on the X-2, at that time I was still working on research. I went to my instrumentation people, and I had them put a series of thermocouples on the inside right along the nose of the vehicle. We got the first and only Mach 3 heat transfer data, and that was all they had for years before we got other vehicles that went that fast. So, in a way, that was an accomplishment.

WRIGHT: Now, did the pilots work closely with you as you were making these changes? Did they know—

MCTIGUE: They knew what I was doing and stuff, but that was stuff that would not affect their airplane. See, that was instrumentation. It was internal to the airplane.

WRIGHT: That's interesting. Well, I'm trying to think if there was other—one thing I would like for you to explore a little bit. You've talked about it off and on, but I want to share a quote with you that you used so that you can explain it fully. In Mr. Hunley's interview with you, you made the comment that you "lost out on doing the work the way that NACA used to do work." Could you share how you felt NACA used to do work, so that we know what you mean by it that you've "lost out on it"?

MCTIGUE: Well, part of it I just talked to you about. On the X-15, which was NASA, we still were following a lot of the way we did stuff at NACA time. I'd come back from a flight on number three, and there'd be a buckle or something in the skin, or I had to replace something because of something that happened during flight. I'd see the buckle or I'd see a tear someplace. I'd look at it, and I'd bring my sheet metal man out with me, and I'd say, "Straighten the buckle out. Put a doubler here. Use a standard rivet pattern, and I want it so many inches long and so wide, so it just takes the stress over a certain [portion of the skin]."

I did that all in my head, because I was a civil engineer and knew how stresses and so forth distributed on a surface. And I said, "I'll bring a work order back." The majority of the time he'd have it all finished by the time I'd get the work order there. And if you deviated from what he told you to do, what we said we were going to do, he'd be madder than hell at you. So, I always made sure that if he did something, I covered him with it. And we didn't have a big problem with our inspectors and everything, because I had the paperwork there. He had the work order. It was done. He signed it off, and the inspector signed it off, and it was logged in the book.

Now, if I had to do something like that, there would be a committee looking at it. There'd be people saying, "Well, are you sure the stresses are going that way? Are you sure you've got enough rivets in there to take the loads that are going to go on?" Everybody would be second-guessing your thinking, and you'd have to do a complete analysis of this that might take you a week, and that's on a computer. It took me maybe two hours to make the drawing, and it took the person who was doing it about the same amount of time. And it was done and the airplane was ready for flight.

Something else I did on X-15 number three that I had forgot to mention, ammonia was something that you always carried a lot back with you in the airplane, because it was coming in at a certain angle of attack, and so the tanks, each of the departments of the tank carried a little of it along the very bottom of it. When I was rebuilding the ammonia tanks, I had North American [Aviation, Inc.] put a little scooper right down at the bottom of each one of those, and a line that went out to the back end. So when we're in our postflight and we're cleaning everything out of the airplane, we drained all the ammonia out of the airplane so that it wasn't in the hangar. In the hangar the damn thing would pop off every once in a while and it would distribute a little ammonia throughout the hangar. Or if you went to vent, you got ammonia throughout the whole hangar. So my airplane was the only one that, within a day, was completely dry.

Now, how did I do that? Well, that was easy. I was down in North American. I was sitting right next to the Chief Engineer, [Charles H. Feltz] and I said, "I want to do this."

He says, "How important is it to you?"

I says, "It's important to me to maintain the airplane. It helps me get things done faster."

So he called the engineer that was responsible for the tank over, and says, "Do this." It was put in the drawings. It was checked by all the stress people. It went through a complete

systems check and all down there. So when it came up to us, nothing had to be done, because it was all taken care of down at North American. Could I do that nowadays? I doubt it. I doubt if the company would go that far out on a line.

I also had them put in, onto the vertical tail, a tube going all the way up through the tail and right to the back of that big—if you look at a vertical tail, it's about that wide at the back end, and I had them go right against the back end of that plate with a tube and an outlet, so they could put a camera in. So I had a camera on the back of my airplane that was looking back down at the Earth.

WRIGHT: Oh, neat. That was fun.

MCTIGUE: These were things that I could do that I didn't take a risk for, because somebody else, they had to be able to do all the analysis for me while I was still getting the plane rebuilt. I don't think I could do that nowadays. Granted, we were NASA at that time period, but we were still so close to NACA that we were using the procedures and working with the technicians and everything the way we always did. Just like we did the engines for the lifting bodies. You couldn't do that nowadays. Maybe we shouldn't have, I don't know, but we got the job done, and nobody got hurt.

WRIGHT: And accomplished a great deal.

MCTIGUE: Yes. We were lucky, maybe. I don't know.

WRIGHT: Well, I thank you for talking to me about all these good things and sharing all this good information.

MCTIGUE: Well, as you'll find, my English isn't sometime that good, so you'll see.

WRIGHT: The information's great. That's all that we care about, so thanks again.

[End of interview]