NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

DONALD E. WILLIAMS
INTERVIEWED BY REBECCA WRIGHT
HOUSTON, TX – 19 JULY 2002

WRIGHT: Today is July 19, 2002. This oral history with Don Williams is being conducted in Houston, Texas, for the NASA Johnson Space Center Oral History Project. Interviewer is Rebecca Wright, assisted by Sandra Johnson.

Thank you again for visiting with us this morning and taking time from your schedule to support this project. We'd like to begin this morning with you sharing with us how your interest in aviation began.

WILLIAMS: That's a really kind of interesting story, Rebecca. As you know, I grew up on a farm in Indiana. My dad was a farmer, not a really large-scale farmer, on the order of 400 acres, of which 200 belonged to us and the other 200 were leased. So after school every day and most of the time on weekends, I was out in the fields or working around the farm on a tractor or with the animals or just doing general repairs. There's always something to do when you live on a farm.

I just remember vaguely, I guess this was like in the fifties or so, maybe when I was in high school and junior high. I'd be out on a tractor and I'd be hot and dirty and dusty and sweaty, doing whatever it was in the fields, and every now and then I'd see an airplane go by, a contrail, maybe. In those days, as the jets would fly across from somewhere to somewhere, I was thinking to myself that looks like a lot more fun than what I'm doing here. Turned out that it was.

Then I had an opportunity to go do [it]. So that was a unique thing to do, and get away from the rural background and into something much bigger and much more interesting.

WRIGHT: Did you follow this interest through to college when you went to Purdue [University, West Lafayette, Indiana]?

WILLIAMS: Yes. I applied for some scholarships in various places because my family was not really well off financially. I applied to the Naval Academy [Annapolis, Maryland] and the Air Force Academy, [Colorado Springs, Colorado]. I had an alternate appointment to the Air Force Academy. I was a second alternate or something like that, which, unless you're the first alternate or the primary, you probably don't have too much of a chance to go. At the same time, while I was in high school, I applied for an ROTC scholarship, Navy ROTC [Reserve Officer's Training Corps] scholarship, which I was fortunate enough to get.

Once you've been accepted in the Navy scholarship program, you get to pick a university that has a spot. You can't just pick the one you want, necessarily. But I'd also applied to Purdue, because it was close and I could have commuted if I had to. Fortunately I got into the Purdue Navy ROTC program also.

I had already decided that I wanted to go into some sort of engineering because I really liked playing with the mechanical things on the farm. We took things apart and put them together, fixed them, [and] built things. I liked to do things with my hands. I like to build things and I like to work on things. So I said, "Okay, here I am. I'm in this Navy scholarship program which is going to help pay my college costs, and I'm in an engineering curriculum, so I got to learn how to do [things]," which turned out to be a challenge.

Now I'm at Purdue, which is a good engineering school and has a good background. The background related to the space program, of course, hadn't really happened at that point, but it was coming.

WRIGHT: And there were several astronauts preceding you that had come from Purdue. Were you knowledgeable of the fact that you had people that had been astronauts that had graduated from that college?

WILLIAMS: Actually, not really, because the first group of astronauts I think were selected in 1959, maybe, and I was still in high school then. When I was in elementary school and junior high there weren't such things as astronauts, except, of course, in the comic books and the science fiction stories, which I read a lot of when I was a child. I guess I hadn't made the connection at that point between Purdue and the astronaut program. That came quite a bit later, actually.

WRIGHT: Then you moved on into your Navy service.

WILLIAMS: Yes, part of the Navy ROTC program, the scholarship program, is you're committed for a minimum of four years after you graduate and you receive your commission. I chose to go into the aviation side of the Navy. Each summer we had a training session that lasted six to eight weeks. The first summer I was on an aircraft carrier as part of the ship's force and worked in all the Departments, from Engineering to Navigation, to the Deck force. That was interesting and I learned a lot, but I decided, "Well, I don't know whether I really want to do this."

The second summer was split. It was three weeks in Quantico, Virginia, doing Marine Corps orientation. We charged beaches, did pull-ups and pushups, and runs through the night in the sand. That was okay, too, but it's like being back on the farm. There was a lot of dirt and dust.

The second part of that summer was in Corpus Christi, [Texas], in aviation and we got to fly. Once or twice in jets and a couple of times in a propeller airplane and once in a helicopter. I'm like, "Hmm, this is not all that bad."

My third summer, between my junior and senior year in school, I went onboard a submarine out of San Diego, [California] which is a nice place to be home-ported. The submarine service, even though it's quite challenging and very interesting, the view is not too good, so I thought maybe I'd apply for the aviation program.

During my senior year at Purdue, people who were interested in Navy aviation were sponsored by Navy ROTC unit there to go into—they called it the Flight Indoctrination Program, or FIP for short, in those days. It was basically a program that led to a private pilot's license, if you had enough time to do that. But you still had to carry your eighteen or nineteen hours of classroom work each semester, because there was a three-hour Navy ROTC class every semester, in addition to the engineering workload. I never quite got as far as getting my private license. I got maybe thirty-five or forty hours, and it's a [lot], but I didn't quite finish the program, because there just wasn't time with everything else going on.

When I put in for assignments after commissioning and graduation, I asked for aviation first and, fortunately, I got it. Then it was on to Pensacola, [Florida], and the rest is kind of history, which we're going to talk about.

WRIGHT: That's, I guess, the next step. Once you go through Pensacola, then you were assigned for duty, active duty?

WILLIAMS: Yes. The training command takes anywhere from twelve to twenty months or so, depending upon what line you chose to go into. You start out, everybody starts out—the commissioned officers start out in about a twelve-week Preflight class, which is academics and physical training, quite a bit of both. Engines and power plants and aerodynamics half a day, and the other half day swimming and obstacle courses and running and other kinds of PT [physical training] activities. At the end of that, you probably come out in pretty good shape.

All Navy pilots, in those days, at least, this was in '64, the fall of '64, go to Saufley Field, [Florida] which is an outlying field very near Pensacola, for Basic flight training in an airplane called the T-34 Mentor. It was a propeller-driven airplane used for Primary flight training.

It's kind of a screening process to categorize people into those who want to be Navy pilots and those who really want to be Navy pilots, because some people find out that it's not all that it was cracked up to be when they get into an airplane for the first time with a parachute and a harness and the straps and the seatbelts and the helmet and the microphones and all the other complex things that you have to [wear]. This is a pretty simple airplane compared to the ones that you fly later on. You go up and you do acrobatics and you do landings and you do instruments.

It's a chance for both the individual to decide and for the Navy instructors to decide whether or not this is the right kind of person to spend a lot of money on, because by the time you get through, say, high-performance jet training in the Navy, and probably the other services,

too, [they] have spent on the order of a million dollars on you. It's one of these things where you don't want to push everybody through there if they're not going to be productive at the end.

WRIGHT: Apparently you were productive at the end.

WILLIAMS: Yes, so far, so good, anyway.

Anyway, the Saufley Field Primary flight training lasts on the order of three months. Then you get to chose whether you're going to go to jets, large airplanes, or helicopters. Each student has a prime instructor in Primary, and mine happened to be a helicopter pilot. He was telling me how great helicopters were, and actually I seriously considered it. But in the end, I graduated high enough in my class at the end of the Primary training, and it's all based on your scores in both academics and the flying stuff as to whether you get your first choice or not. So I went, "This may be the only time I have a chance to do this, so I'm going to put in for jets and see what happens." And I was fortunate enough to be selected for that.

Then I got a set of orders to go to Meridian, Mississippi. That [was] the first time I'd been in Mississippi for about six months, actually. That's called Basic flight training or Basic Jets. Once more, academics and flying, lots and lots of flying, daytime, nighttime, formation, acrobatics, instruments, a little bit of tactical uses of the airplane in an air-to-air and air-to-ground kind of environment, [cross] countries and other things.

I distinctly remember the first time I got into a jet. Even though you've been in the trainers and the mockups, you put on a G-suit, a torso harness, a survival vest, a helmet, an oxygen mask, flying gloves, and a flight suit and you get into this fairly confined space, tightly strapped into this thing, and you put the canopy down and you go, "Hmm, do I really want to be

here or not?" It's quite uncomfortable, but you get used to it after a while. And it's one of those things like, well, you know, you feel sort of undressed when you don't have all that stuff on you and you're sitting in the airplane.

Probably one of the more difficult parts of that for me was the formation flying. That's the thing that stood out for me, because I had no experience doing that, and it turns out it's just a relative motion sort of thing. Pilots have to talk with their hands, so it's a relative motion control thing. The instructors would take us, two instructors and two students, and we'd go up together for the first formation flight. The two instructors were in the back seats and the students in the front. The instructors would fly the airplanes to start with, and they would join up in a wing formation and do some turns and do some cross-unders and do some maneuvering. Then they'd level it out and they'd say, "Okay, you got it."

Then the student pilots would take control, the wingman would take control of flying formation on the leader. For the first few seconds everything looked fine. You sat there and you looked at your leader and everything stayed where it was, then it just all went to—it all kind of [got] away and you [thought], "Oh, man, there's no way I'm ever going to learn how to do this. It's way too hard." But sure enough, after some practice and some drilling, you do learn how to do it.

That's kind of a basic thing that you have to learn in Navy aviation, and probably the Air Force also, is formation flying, because there's an interdependence between the leader and his or her wingman and the Division leader and the Section lead and the two wingmen, that go with those kind of basic formations, which follows through the entire implementation of the whole squadron concept. That's Basic flight training.

Then back to Pensacola for about three weeks for gunnery, which was a lot of fun, air-to-air gunnery, and my first shot at landing on a carrier. I actually got four carrier landings in the daytime there, which is pretty neat. That became "This is going to be great. This is going to be a challenge to do this." It's kind of scary the first time, particularly the catapult launches and the arrested landings, and the fact that the ship has a pretty small runway, but it was one of those exciting things and, "Hey, you know, let's go get on with this."

After that, Advanced flight training. In my case, I went to Kingsville, Texas, and flew F-9 Cougars. Nowadays they're flying Hawks, I think.

The Cougar was a fairly old airplane. It's a swept-wing jet, and was actually a combat airplane that was used in Korea, maybe the very latter parts of World War II, but certainly in the Korean War. Cougars were flown off aircraft carriers in the Pacific in the war against Japan. I was also fortunate enough, I guess, during that time, after the basic part of the basic flying and the instruments, to get to fly the single-seat airplane for the tactical part of advanced flight training.

[This was] my first time in a single-seat airplane, which was kind of nice because somebody gives you an airplane that's worth a half a million dollars or so and says, "Okay, go do it," so you do. That was a challenging thing to do, too, but it was also exciting. We had some good times. You meet a lot of very interesting people from all over the country who remain lifetime friends.

Then at the end, you get your wings, which is a very impressive ceremony. You probably don't realize it at the time, but there's not a [lot]—I mean, there's not hundreds of thousands of people every year that get a pair of gold Navy wings, so it's a fairly significant

moment in your life. Like I said, you may not realize at the time, but later on, as you reflect back on things, it probably is important.

Once again there's a decision to be made. It seems like you're always making decisions throughout your life, huh? There's another decision to be made on "Now what I do? What kind of fleet airplane do I want to fly?" The choices in those days were fighter, light attack, or all-weather attack airplanes in the jet pipeline, and that was pretty much it, although there was a photo reconnaissance option, which was kind of related to the fighter program.

I put in for the all-weather attack as my first choice, and light attack for the second one, because I liked the air-to-ground mission, and the fact that these airplanes are used for interdiction and you actually go after targets that are of importance to the cause, whatever it happens to be at the time.

I was selected for the light attack option and went out to the West Coast, actually to the Central Valley of California. There's a Navy base there that's out in the middle of nowhere called Lemoore Naval Air Station. You come in as a brand-new Navy pilot wearing these gold wings and thinking you're king of the hill. Of course, what you really are is at the bottom of the hill, because you start into a [unit], in those days it was called a Replacement Air Group, or a RAG.

Now it's called a Readinesss Training Squadrons, where you transition into the fleet airplane that you're going to fly in your squadron when you get to that, which can take about six months or so and usually does take four to six. I think it took us about five. A lot depends on weather, aircraft availability, [and] availability of the ships for workups. There it's not so much of the basics and instruments and formation, but how do you use this airplane as a weapons system and how do you operate all the equipment onboard. There's quite a bit of air-to-ground,

quite a bit of low-level navigation, quite a lot of formation and air-to-air kinds of things where you interact with each other and other aircraft in day and then nighttime, [and] for the first time, [night] carrier landings. The nighttime ones are quite a bit more exciting, obviously.

After [I finished the] RAG, I went to a light attack squadron onboard the *USS Enterprise*. [My first squadron] was VA-113, Attack Squadron 113, which was nicknamed the "Stingers." You don't know until about a month, or sometimes even a couple of weeks before you finish the [RAG] what squadron you'll go into, because it depends on which squadrons have needs for new pilots. I was assigned to Attack Squadron 113, and they were due to deploy in six days to the western Pacific, to the Vietnam area.

The squadron was already in Alameda, California, getting ready to load their stuff onboard ship, so I packed up my kit and headed for Alameda and reported onboard on the ship and they said, "Welcome aboard, Mr. Williams," Ensign Williams at the time, "you're going to be our maintenance material control officer."

I went, "Aye, aye, sir." As I turned around and left the ready room, after meeting the skipper for the first time, I said, "Wonder what a maintenance material control officer does?"

In the Navy, unlike some of the other services, you're really an officer first and a pilot second. The officer part of it is management and leadership and people and resources control sort of work, as opposed to just flying the airplane and using it to do whatever it is you're supposed to be doing. That was a challenge for me.

Fortunately, I had a good Chief Petty Officer who actually ran the shop and about eight enlisted folks that worked for him and ultimately for me. What I learned from that is, trust your Chief, because they know what they're doing.

My first flight from the *USS Enterprise* was during workups about 800 miles from Hawaii before we actually pulled into Pearl Harbor for a few days en route over there. I really didn't know anyone in the squadron at that point, but it was an interesting thing. But the people in that squadron I still know and interact with occasionally today.

WRIGHT: Wow. Lasting friendships.

WILLIAMS: Yes. That probably covers about two years' worth of time [I hope] that's not an excessive amount of time to talk about that part of it.

WRIGHT: At some point you became a test pilot.

WILLIAMS: Yes. That was sort of an evolutionary thing as opposed to something that I always wanted to do. In the process of my first two deployments to Vietnam and the workups in between—we called it the turnaround period—I got a little more interested in how do all these things work and how do they interact and what really makes the airplane and the control systems and the weapons systems work, and how do they fit together. So I actually put in for test pilot school [prior to] my first shore duty tour. The Navy has a rotational [system]. You [are on] sea duty for a while, then shore duty and back and forth [about] every two to three years.

When I came off sea duty after my first two deployments to Vietnam, I became an instructor in the RAG. While I was there, I put in for test pilot school. But, of course, in the Navy system, you have to be in the right place at the right time in your rotational pattern, [and] I

wasn't. You have to be on sea duty getting ready to go to shore duty, because the test pilot school and the subsequent tour, after you finish the school, is a shore duty billet.

Instead of that, I ended up going back to an Air Wing staff, and another squadron, flying A-7s this time, which was the A-4 replacement. In that Air Wing I was the Administrative Officer, the Safety Officer, and the Landing Signal Officer, and I flew with one of the squadrons, once again on the *Enterprise*.

At that time, the Navy had a rule that after you made two deployments to Vietnam, you didn't have to go back. Unfortunately, they ran out pilots, so that rule was sort of changed in the course of doing business. There I was back in the South China Sea again, participating in the Southeast Asia war games for the second time, [my] third deployment and subsequently [a] fourth deployment.

After that, though, I did get orders to the Armed Forces Staff College, which is a Joint Service College in Norfolk, Virginia, that has all four of the military services, plus some of the civil agencies have folks there. The idea is to introduce mid-grade officers to joint staff operations, learn something about the Army, the Air Force, the Marine Corps, the Navy and some of the civil agencies, which was very interesting because [there were] about a thousand people from all over the place and all walks of life, doing exercises and planning and studying and learning together. Plus, there was a series of seminars. About twice a week, a very senior officer or civil [servant], up to and including the Secretary of the Navy, who came down and spoke to the [school], and there was a question-and-answer period afterwards. So you [got] exposed to a lot of senior people, which was very interesting.

In the meantime, I was still hoping to get into test pilot training, so I had my application in, and sure enough, I got selected. That's a [competitive] selection. You don't just

automatically get it if you ask for it. Based on merit, of course. I was selected for the [U.S.] Air Force Test Pilot School at Edwards Air Force Base, [California] which one Navy pilot gets to go in each class, and vice versa, one Air Force pilot comes to each Navy class. That was going great. I'm going to get to fly some Air Force airplanes. This is going to be a real adventure, because you would rarely get to do that, this cross service thing.

About a month before I was due to leave Norfolk and go to Edwards, the Air Force cancelled the class that I was going to be in because they were transitioning it from a six-month- to a twelve-month-program curriculum. I went, "Oh, man, here it goes again." I'd applied twice before. This was the third time I applied for test pilot school and the first time I'd been selected.

So I called up [my] detailer and I said, "Now what?"

He said, "Well, there's space at Patuxent River [Naval Air Station, Maryland] at the [U.S. Naval] Test Pilot School. We're just going to send you there instead."

I went, "Great."

I moved up the road a ways into St. Mary's County, Maryland, and started into an eleven-month curriculum at the [U.S. Naval] Test Pilot School, which turned out to be a rigorous exercise. For example, we did half a day of academics and another half day of flying, and they varied from day-to-day, but the academics were very fast paced and very rigorous.

We started out with a calculus class, which was supposed to be a review. Basically it was four semesters of college calculus in twelve weeks. Then aerodynamics, control systems, stability and control, and performance measurements. For the first time I realized there was some use for [the] differential equations that I had learned when I was at Purdue. Because you can describe the motions of airplanes by using first-and second-order differential equations and how the control systems and the control parts of the airplanes interact with the basic stability of

the airplane. It was fascinating to me, because it was exactly what I was headed toward and what I wanted to learn.

At the end of test pilot school, depending on how you do, you get a choice of going to different parts of the Test Center to be an Engineering test pilot for the Navy. There's flight test, rotary wing, antisubmarine service test, and engine performance, [and] performance testing.

Flight test was kind of the most interesting place to go. Within the Flight Test Branch there, or Flight Test Directorate, there were several branches, of which Carrier Suitability was one. That's what I asked for and I was fortunate enough to get it, because the Carrier Suitability guys did not only interaction of the airplane with the carrier, but automatic control systems and feedback systems and every system that interacted with both the ship and the airplane itself, from the catapults and arresting gear to the flying qualities and performance of the airplane.

That was really interesting. I did some fairly interesting projects there, both as a test pilot [with] the control systems and the structural things that we had to do, and as a project pilot, where you actually run one or more projects. We put a ground proximity warning system in a tactical jet for the first time. We flew low-level flights to see if it would work.

I was the project pilot for tests of a new nose gear for the A-7 airplane, which was pretty exciting, because we did some nose-gear-first landings, which is not recommended, but sometimes happens. We did quite a lot of certification of instrument and automatic landing systems onboard the ships and Naval Air Stations. It was great.

At the end of that, it was time to go back to sea duty again, so here I was going back to a squadron on the West Coast, in this case back through another Readiness Training Squadron. I was going to do a Department Head tour, in this case as a maintenance officer in Attack Squadron 94, which [was] called the "Shrikes." The idea that in the progression of things, if

you're going to command a squadron, be an XO and a CO, an Executive Officer and a Commanding Officer, of a Navy squadron, you have to have had a successful Departmental Head tour as either the Admin [administrative] Officer or the Ops [operations] Officer or the Maintenance Officer.

Of course, I was really interested in the Maintenance Officer, because that individual controls most all the troops and all the work that goes on [with] the airplanes, which is what I was into at that point. How does it work? How is it put together? How do you take it apart? How do you repair it? All that kind of thing. How does it interact? So there I was back on the West Coast again.

I guess I should maybe stop for a minute and see if we've caught up with ourselves or where we are.

WRIGHT: We're doing fine. I'm interested, now that you're back on the West Coast and had all these responsibilities, at what point did you decide to find out about the astronaut program, or how did that interest begin?

WILLIAMS: That happened, actually, at Pax River. I was the Branch Chief of Carrier Suitability Branch when NASA announced—this was in 1976 or '77, somewhere around in there, NASA announced that they were going to accept applications for the Shuttle program. All the junior officers who worked for me—I was a Lieutenant Commander at the time, and I had a lot of Lieutenants, like a dozen or so test pilot graduates working for me, and about thirty or so engineers, and about thirty-five enlisted guys. It was one of those things where all these junior officers who were in their mid- to late twenties were putting in for this program because [it] was

the thing to do. I was busily writing endorsements for them, telling the next step up the chain of command how great they were and how they'd make great astronauts and so forth and so on.

Sometime during this process, I don't remember who it was, but somebody asked me, "Are you going to put in for the program, Williams?"

I kind of stopped and I said, "I really hadn't thought too much about this." I figured I was probably too old, because I was thirty-five at the time and all these guys were like twenty-six, twenty-seven, twenty-eight years old and they're really good pilots and good engineers and good test pilots. They were well qualified for this program.

I thought about it for a couple days and said, "Oh, well, why not." It cost me a few days to fill out [the] application and break down my flight time in a way it had never been broken down before on spreadsheets [which] I did, and I sent it in.

In those days, and now, as you guys probably know, in order to get into the astronaut program as a military officer, you have to be first recommended by your parent service; in my case, the Navy. My application and paperwork went on up the chain to a Selection Board, which is how the Navy selects.

In the meantime, I had [received] orders and gone back to the West Coast, and I was actually in the Readiness Training Squadron at the time when I got a letter one day that said, "We'd like for you to come to Houston for [an interview]." I was actually selected by the Navy as one of the people they recommended for the program by the Selection Board, and I went, "Great. So, that's nice. That's probably as far as it's going to go."

Then the people that were recommended by the Navy, their records were sent to NASA in Houston for screening. One day I got a letter from NASA, they said, "We'd like for you to come down for an interview," which was the next level of screening.

I went, "Golly, who knows what might happen here." Still, I didn't have a lot of hope that I'd be selected, because I was still pretty old considering some of these other people that were coming in to interview.

I came to Houston, to the [NASA Lyndon B.] Johnson Space Center, for a week of interviews and testing and indoctrination, and met some interesting people. It was a fun week because there was another seventeen or eighteen or nineteen people here from all over the country and all kinds of walks of life, some military, some civilians, and really a fun group of people.

I had a good time, but went back to California thinking, well, that was a good chance to meet some interesting people, but I'll never get picked for the program. That was in the summer of '77. I finished the Readiness Training Squadron refresher things, [and] went to my squadron. I was in the process of handing over the Maintenance Department [from] the guy who was getting orders to go to shore duty and flying with [the squadron], of course. Everybody [knew] that I'd gone to Houston for this interview, but that didn't make any difference, we still had to get ready for another deployment, which would have been my first peacetime deployment actually, which was kind of neat, as opposed to the Vietnam thing.

One day, it was about 6:30 or so in the morning, between 6:30 and 7:00, I was shaving, I had about a half a face of shaving cream on, and the phone rang, and I went, "Who'd call me this time of the day?" It turned out it was the Director of Flight Crew Operations, Mr. George [W. S.] Abbey, who you guys have heard a lot [about] and who is the former Center Director of the Johnson Space Center, an interesting individual and a guy I respect a lot.

But anyway, it was George Abbey, and he said, "How you doing? What's going on?" and small-talk conversation.

I go, "Why is he calling me, anyway?"

Then finally he says, "Well, you know, we're thinking that maybe, if you wanted to, we'd like for you to come down and join us here."

I went, "What time do you want me to be there?"

And he said, "Oh, by the way, we want you to keep this under wraps for a few days here, because we haven't announced it to the press yet, until we notify everybody who applied for the program."

I'm thinking, how am I not going to tell anybody this, right? So I have to tell the skipper, [and] I did, and somehow the word got out in the squadron, and after that, everybody started calling me R2D2. [Laughter]

Each Division Leader, which is a group of four airplanes, has a call sign, and so my Division became the R2D2 Division. We'd check in [imitating robotic sound], "R-2-D-2," when we checked in on the radio, which the guys invented. I didn't do it. I was kind of embarrassed by it, frankly, but it was fun. So we had a good time.

Then in February of 1978, NASA brought all thirty-five of us in that 1978 group down to meet the press.

Let me drop back for just a minute. When it was officially announced, there was a lot of media attention, because, first of all, it was the first group of astronauts that had been picked for the Shuttle program. It was the first group that had been picked for any flight program in nine years. The Manned Orbiting Laboratory guys in the Air Force, when that program was cancelled, they picked some of them, but that was in 1969, I think. It'd been nine years since anybody had been picked.

It was the first time civilians had been picked for the program, in addition to military officers. There were women in the program for the first time, the first six women. That was a big deal, and generated a lot of media attention in this little outlying Naval Air Station [where] I was near nothing, really. The closest decent-sized town was Fresno, California.

Can I just digress a minute and tell you [a] story? Because it's kind of interesting, to me anyway, as a vignette. One of the Fresno television stations found out that one of the new astronauts was living in Lemoore, and they wanted to do an interview. So I thought, "I guess I'm allowed to do that." I checked with NASA public affairs and they said, "Sure. We want the publicity."

My first time ever, probably, on television, and maybe my last, but I went into the studio for the evening news. It was like the ten o'clock news. I drove up there, I sat down, they put me on this [chair] and there's a camera looking at me, like the camera's looking at me today, and above it, of course, was this little screen where the guys read off all the stuff that they read off during the news, and the media people understand that sort of thing. Then it came time to do the interview and they said, "We introduce Don Williams, a local Navy pilot who has just been selected to the astronaut program. Welcome to our program."

I said, "Thank you very much." And then I realized as I started answering the questions and responding to what the news anchorperson was saying, that all his words were on the teleprompter, but when it came to me, it was just blank. We're going through this process and [I was thinking], what am I supposed to say here? I was answering the questions, [which] were fairly straightforward. "What's going on? When are you going to fly? What's it like in space?" And all that other kind of stuff, of course, which you can't answer since you've never done [it].

Then the very last question he asked me, and I'm seeing this rolling up on the teleprompter, I'm going, "Oh, great. This is going to be fun," because he then says, "Well, NASA for the first time has selected six women for the astronaut program. Do you think that's just a token response or what?"

I went, "Ahh," so I had to answer that, and I said, "Well, of course not. They're very well-qualified people. I met some of them while I was there two weeks ago. And it's time to do that."

But an interesting part of [it] was, you don't know that's coming until you see it roll up on the teleprompter and you hear the words coming out of this individual's mouth and you have about [snaps fingers] that much time to think of something to respond. It was my first introduction, probably, to real-time media with the camera in your face, kind of thing, not quite in your face, but in a studio. That sort of triggered me to be more prepared in the future, and fortunately, NASA had some media relations classes we got to attend [that] were presented by people who knew how to prep you for that kind of stuff when we got here.

WRIGHT: When you looked at this class of thirty-five, it certainly was a different type of a team or a squadron than you'd ever seen before. Did you have any apprehensions or hesitations of entering this new era of your career?

WILLIAMS: I was greatly impressed by the qualifications of these people. I knew some of the Navy pilots, and, of course, the Air Force pilots that came into the program and the Marine Corps officers that came in. We had sort of a common background and heritage in that we'd all been doing mostly the same things.

The civilians, though, which compromised twenty—let's see. There were fifteen pilots. Twenty out of the thirty-five of us were totally a new ballgame. They were scientists and engineers and doctors and people who were extremely well qualified in their field, but they were very interesting people, too. I was somewhat in awe of these people, because they had done so many interesting things and all I'd done was gone off and been in the Southeast Asia war games and been doing test pilot stuff, which I equated to nothing near what these people knew. They were really smart, they were very bright, they were very well educated, they were very articulate and had outgoing personalities. Some of us who'd been in combat were a lot more reserved, perhaps, around these kinds of people.

Some of them were quite bit a younger than I was, because I was thirty-six or seven at the time. The youngest, I think, that came in the program was around twenty-six or twenty-seven, so they were ten years younger than we were. When some of us were doing Southeast Asia war games, they were carrying signs on campuses. But we got along really, really well, and I think that's probably a tribute to the program that NASA had set up for the astronaut candidates, which I expect is even better now, because we were the first astronaut candidates that ever came into the program. Before that, everybody who came here was an astronaut, that's it, whether you'd flown or not.

We were astronaut candidates, which put us on a one-year program where anytime during that year you could decide, "This is not really what I want to do, it's not what I expected," and leave, no problem, no stigma, no questions asked. Or anytime during the year NASA could decide, "Hey, you know, we don't think this is going to work out," and once again, no questions and no stigma attached. I don't think that's ever happened in the course of the Shuttle program and now the Station program. But that was a new way of doing business.

I think the Agency was learning, as well as the individuals were learning, how to do this sort of thing, because, in effect, the number of people in the Astronaut Office almost doubled overnight when we checked in in August of 1978.

WRIGHT: And some of the Apollo-era astronauts were still in residence. Did you have a chance to exchange some ideas with them and work with them when you first came onboard?

WILLIAMS: Absolutely. Alan [L.] Bean was actually our sort of den mother, if you will. He was appointed to be in charge of the astronaut candidates, or ASCANs, as we called ourselves. John [W.] Young was the Chief of the Astronaut Office. Both [were] Apollo guys. There were two or three other [Apollo] folks there at the time, who I think subsequently left.

Those were people who were my heroes. These guys had been to the Moon. I mean, there were only twelve people in the history of our country that had ever been off of this planet and gone to another planet. You have a great deal of respect for those individuals. Of course, they came from a different era, though, because Apollo was over then and Skylab was over, and nobody had flown in space for at least—well, whenever the last Skylab flight was, in '74, so at least four years, some six years, maybe, some eight, some nine, some ten. They were the kind of people [who] had been waiting a long time for the Shuttle program to get going.

When we came aboard, there were great expectations for the Shuttle program, it was going to fly twenty-four times a year. Everybody was going to be flying within a year or two after we got there, and we were going to do all these wonderful things. Of course, it didn't quite turn out that way. It was a bit over—quite a lot overestimated, and even though we got there in '78, the first Shuttle launch didn't take place until April of 1981, almost three years later.

Then the program never got going as fast as it was expected to go, and perhaps in retrospect, and hindsight being 20/20, some people might have known that or seen it at the time. But we were young and we were eager, and we were excited about it and it was fun and we were learning a lot, and so it wasn't important at the time. The important thing was, we were there and we were doing it.

WRIGHT: Your training started, and covered a tremendous amount of new areas, because, again, the Shuttle was brand new and it was training for NASA, it was training for you. Can you tell us about some of the episodes or some of the experiences that you went through, the training, that are assumed to be most memorable, that was so different, maybe, from your Navy experience?

WILLIAMS: The flying part of it, as far as flying the jet airplanes that were used for space flight readiness training, was very familiar to me. To the civilian folks it wasn't at all, and so that was kind of unique, because now I knew something that they didn't. When we were flying with one of the doctors or the engineers or the scientists, that was all new to them, putting on all this equipment, getting in a confined space, and acting as a crew member. Of course, it was something I'd been doing for the last five or six years or maybe longer than that at the time, maybe ten. So I was very familiar with that and it wasn't any problem getting into that part of it.

The systems classes on the Shuttle, as far as how they interact and operate together, of something I knew a little bit about because of my test pilot training and experience and my fleet experience in the Navy.

The academics, on the other hand, particularly astrodynamics, orbital mechanics and the life sciences, [basic] sciences, earth sciences, ocean science, I knew nothing about. So it was

a nice interaction, quite frankly, between the scientists, doctors, engineers and the pilots. We complemented one another and we interacted with each other.

I distinctly remember several sessions where a couple of pilots would sit down with a couple of scientists or engineers and talk about the programs that were going on, the classes that were going on, the academics that were going on and the training that we were doing. We'd work with each other in teams, which, of course, was the whole idea. The flying parts and the systems parts, the same thing, we worked together in teams to make sure we understood how these things all worked and everything. So it was exactly what I think the ASCAN program had been designed to do, was to take this very diverse group of thirty-five individuals and create some sort of a cohesive unit.

Obviously you're not best friends with all thirty-four of the other people, and you probably single out a few that you interact with more than others, but I respected them all. They all had unique characteristics and qualities and you could learn from everybody, and hopefully a few people learned a few things from me while we were there.

WRIGHT: I'm sure they did. Tell us about some of your responsibilities when you worked with the Shuttle Avionics [Integration] Laboratory, the SAIL.

WILLIAMS: When we finished the astronaut training program, the one-year training program, we then became eligible, first of all, for public appearances. I briefly talked about that before, and there are some interesting stories that go with that [which] we can talk about if there's time.

WRIGHT: Anytime you'd like to share those.

WILLIAMS: Then we also became available for things they called technical assignments, for flight assignment first, but also technical assignments, which were assignments that were in addition to [our] duties in the Astronaut Office. [These] were support activities, [and] continuing training from astronaut candidate training to the general sort of training, as opposed to the mission specific stuff that came later.

One of my first assignments was in the Shuttle Avionics Integration Laboratory, which was an engineering laboratory at the Johnson Space Center, that had a mockup of the Shuttle cockpit, complete with all the instruments and all the controls and actually a full-sized payload bay with most of the hardware devices that were used in the actual Shuttle there [which were] interconnected with flight-worthy cables. The boxes were the same and the software that was used in the general-purpose computers was the same as actually was going to fly on the Shuttle at that time.

There [were] a couple of major simulation computer systems hooked up to it to simulate the environment. One computer basically simulated the atmosphere, and another one simulated the engines of the Shuttle. A third one simulated the aerodynamics and the equations of motion that are used to describe motions of airplanes.

The idea for astronauts that were assigned there was to fly simulated ascent and entry profiles to stress the systems and to make sure they would perform as expected and there weren't any glitches in the software or the hardware before the first flight. We ran these twenty-four hours a day, seven days a week for a while, for about a year and a half prior to the first mission, STS-1, doing all kinds of different aborts, all kinds of different contingencies, and all kinds of nominal and off-nominal ascents and everything that you could think of to make sure that it all

worked as advertised. It's important to have a crew member in there to perform the crew member duties and interact and make sure, as a sort of a quality check, that this is all going to work like we expect it to.

It was actually pretty exciting. I learned a lot about the systems, particularly the computer systems and data systems in the Shuttle during that time, a lot more than perhaps I learned later on. But it gave me a good foundation and a lot of familiarity with how the software is put together and how it interacted with the hardware, and how the crew interacted with the computer systems on the Shuttle. Other than the fact that working midnight to eight o'clock in the morning every third week wasn't too much fun—and the other two you'd work from 8:00 in the morning until 4:00, [or] 4:00 [p.m.] until midnight. Every week you'd switch to a different shift. It was seven days a week for a while. It was a tough schedule.

Plus, in the meantime you're expected to do all the astronaut training, the systems training that we were doing at the time, and the flying that the pilots had to do to maintain their proficiency. But it was an important thing to do and an important function to do. There were six of us, I think, assigned at the time and we traded off those weeks with two people on every shift.

WRIGHT: Were you also acting as Deputy Manager of Operations Integrations at the time or was that a separate role?

WILLIAMS: That was my [third] assignment, actually. I spent about a year and a half in SAIL, the Shuttle Avionics Integration Lab, and after that tour, then it was time to go do something else. Usually the tours lasted from one to two years, the technical assignments, depending on what

was going on. Actually, I was still in SAIL at the time STS-1 flew, and I think for STS-2, -3, and -4, also.

Then I was [assigned] to work as a test and checkout crew member at the Kennedy Space Center, [Florida] for a while before I went to the Ops Integration job. That group was called the "Cape Crusaders," as a sort of nickname. The job was to be the crew interface with what was going on at the Kennedy Space Center and the Shuttle test and checkout activities.

I spent a lot of time in Florida with real hardware now and the real Orbiters, the real Solid Rocket Motors, the real External Tanks, doing vehicle test and checkout. [It was] very important to have a crew member involved in helping direct procedures, making sure they followed flight procedures, understanding what the interaction of crew members were going to be during countdowns and after post-landing tests and during tests [when] we were checking out the Shuttle systems. Actually that may have been after STS-1. I was there for STS-2, -3, and -4, I think.

Whenever the actual flight crew would come down to the Cape [Canaveral, Florida], we'd be their escorts, particularly when the Shuttle and its components, tank, and the Solid Rocket Motors, were all stacked together on a Mobile Launch Platform in [the] Vertical Assembly Building. The crew would come down for a test, where they'd actually get in the cockpit and operate things during the test, the crew who was going to fly that [mission].

We'd always take them from wherever the office space was into the vehicle space, because it was one of those things where the crews would say, "You know, we should never go into the Vertical Assembly Building without a Cape Crusader," because you get lost in there. It's a huge place, as you well know. I thought that was kind of fun.

Mostly you'd get to meet a lot of very interesting people at the Cape, who were very dedicated people, very good at what they do, and very careful and methodical about what they do, which was a little frustrating to a real-time individual, the sort of individual who [likes] to pull back on the stick and see the nose come up in the airplane. Because the delay in getting things done because of the processes and procedures and the cross-checks and the cross-cross-checks and the watchers watching the watchers in some cases took a lot longer than perhaps some of us would like to see it happen.

We used to say there's real-time, which is what you see on your clock, and then there's Cape time, which runs at a different [rate] than real-time does. [It was] frustrating at times, but after you've been there for a while, you realize the need for doing that, because everything has to be documented, everything has to be recorded, everything has to checked and cross-checked in a vehicle this complex that's going to go through the environment that it flies in from launch like a rocket to landing like a glider, plus in between activities. You want to make sure that everything is going to work to the best of your capability. That was an important job and a lot of fun. I met a lot of interesting people there who were very dedicated.

I kind of got off track. At the end of that—

WRIGHT: Before you get to that, I'm curious, if you could share with us your thoughts of watching the launch of STS-2 and -3 and -4. You had been studying the Shuttle and you knew the operations. Everything you had learned was all in the classroom and now you were watching this new spacecraft.

WILLIAMS: Yes. The first launch that I actually saw, I think, was STS-2, Joe [H.] Engle and Richard [H.] Truly, and that was one of those moments in your life that you say, "Wow." That's about all you can say at the time, I think. It was very, very impressive. Not so much the fact that you knew what was going on and you knew there were two people up on the pointy end of this thing, but you also realized the amount of power that was contained in this stack of what was mostly inert sort of metal and wires and ones and zeros and propellant. It's an awesome amount of power that's contained there. Then I think that also reinforces the idea that you want to make sure everything's right to the best of our ability to keep that under control and doing what it's supposed to do, as opposed to what it's not supposed to do.

WRIGHT: And, of course, the thought of one day you'll be in the Shuttle going up to do your mission.

WILLIAMS: Yes. Oh, yes, that was a ways down in the future, though, at that time. I think reality had hit and most of us in the 1978 class knew then we weren't going to fly in one or two years, because here it was 1981 or '82 and we'd been there for four years, almost, and we were just now flying the second or third flight. The first actual crew member from our group to fly, I think, was on STS-5, maybe. No, STS-7.

WRIGHT: You're still at Johnson Space Center as now the Deputy Manager of Operations.

WILLIAMS: Yes, in those days the Shuttle program was organized into several levels. Level one was the NASA Headquarters Program Office, which set the policy, basically, and did the interaction with Congress and the other parts of the Agency.

Level two was actually the program management of the whole program minus the Washington parts of it, and that was in Houston.

Then the next level was level three, [which] were called the projects. [They were] the vehicle, the Shuttle itself, the Orbiter project, the External Tank project, Solid Rocket Motor project, the Space Shuttle Main Engine project, and a few others.

The Program Office actually oversaw each of those projects and exercised programmatic controls over [them] for budget, schedule, and content. They had configuration management, approval boards, direction, and authority over the projects to manage [them] at the programmatic level.

It was kind of a new adventure for me, getting up at that level of an organization where you were more interested in Requirements Documents and processes and the procedures rather than the hands-on stuff.

I was assigned to be Deputy Manager of Operations Integration, which in those days was called the Operations Integration Office. That office was responsible for security, launch and landing activities, and ferry missions for landing at Edwards, to get the Orbiter back to the Cape, and interaction interfaces with the Department of Defense, and a few other classified things. It wasn't much hands-on stuff. It was a lot of meetings and a lot of heavy-duty paperwork and a lot of participating in the decision process.

I worked for Jay [F.] Honeycutt, who later became the Director of the Kennedy Space Center, and Senior Vice President for Lockheed, where he still is, I think. A good guy. I'd

known him since the day I came to NASA, because he was Mr. Abbey's administrative assistant, I think, when we first checked in, when George was the Director of Flight Crew Operations.

We called Jay "The Bubba," which was a Texas sort of term for being a guy who gets things done, and he did. He was a good guy. I learned a lot from him. He kind of took me under his wing, and I got to interact with Glynn [S.] Lunney a lot, who was the Program Manager then, a gentleman I respected a great deal. He's not only smart, but he's capable and he's a leader who can get things done, although sometimes after sitting in a Program Review Control Board meeting, which we had every week on Wednesdays for like seven or eight hours, and having a series of presentations made and some decisions made and others not, I sometimes wondered, " do we ever make any decisions around here or do we just sit around and talk about things?"

In retrospect, when you go back and think about that, [it] was the process. It was a very interactive process, and as a hands-on person, you get a little frustrated with the bureaucratic processes that go forth. The thing to be learned, I think, about that is, in a NASA program everybody had a chance to speak their piece, which is not true for some other programs.

In the military, it's a hierarchical chain of command. The NASA program is very much more horizontal and people get a chance to say and make an input what they think and what their technical opinions are. Now, they may not be accepted, but at least you get a chance to present it, as opposed to a command structure where "These are your orders. Go execute them." I don't think I realized that at the time, but later on I did. I think as your perspective changes, you learn things. I learned a lot from that.

And I got to take a couple [of] trips. I was in charge of landing support for several missions that landed at Edwards or didn't land at Edwards. We had to be there anyway. I did a

trip to Europe to look at abort sites. We went to places in England, Spain, and Germany to look at potential abort sites for high-inclination flights, because at that point we hadn't flown any high-inclination flights. That was interesting, being the operational representative for the program, to make an input into the decisions about whether Fairford, which is a Royal Air Force base in England, or Torrejon, which is a Spanish and U.S. Air Force base near Madrid, or Rhein-Main [Air Base] in Germany, would be suitable landing sites. That was a broadening experience also.

WRIGHT: At what point did you learn that you were assigned to your flight?

WILLIAMS: In those days, it was one of those things where you're hoping that you get assigned pretty soon, after the first group of people start getting assigned in your class. Then one day you get a call to the Director of Flight Crew Operations office and you go over and say, "Oh, well, what did I do wrong now?" And you get surprised by [him] saying, "We want you to go fly," on whatever flight. In this case, it happened to be STS 51-D or whatever it was called at the time.

We went through several evolutions, which I'm sure we'll talk about, on that crew with that group of people. I go, "Yay!" I finally get into this thing seriously at this point.

WRIGHT: Tell us about the progression of that and how you met the rest of the crew members and basically how that evolved. As you just mentioned, you had a couple of changes of numbers and names.

WILLIAMS: Yes.

WRIGHT: Just take us through those and what it was like getting ready for that first mission.

WILLIAMS: It was exciting to start with, because you're finally assigned to your own crew, and Bo Bobko, Karol [J.] Bobko, was my commander. He was a guy I respected a lot, too. He was the pilot on STS-6. It was his second mission, and he had pretty much a rookie crew with him, a group of people who came from the 1978 class. He was our leader and our shepherd and our instructor and our teacher and everything else for that period of time.

Bo really knew the systems and the Shuttle backwards and forwards. He'd been a Cape Crusader actually when I was, when [I] worked at the Cape. He'd been at SAIL. He'd gone through a lot of backup training. He'd been a CapCom [Capsule Communicator] for STS-1, -2, -3 before he was assigned to STS-6, and flew with Paul [J.] Weitz on STS-6. They had a very successful mission. I had a lot of respect for him, first of all, as a crew member, but later on as an officer and a person and particularly as a pilot. He was really good for an Air Force guy. [Laughter] No, he was. He had Vietnam experience in F-105 Thunderchiefs. He was an Air Force Academy graduate and an Edwards test pilot school graduate. A very interesting individual who I'm still friends with today, and we talk to each other once in a while.

We started into mission-specific training, as opposed to basic training and astronaut candidate, advanced training in systems and interactive systems to mission-specific. Like, "Here's what you're going to do on your mission," which is a totally different ballgame, because now you have real launch dates and real profiles and real payloads and those kind of things instead of generic sorts of stuff.

At the time that mission was supposed to deploy two commercial satellites, which were to be launched out of the payload bay. [These] spinning satellites were to be launched by a [device] called a Payload Assist Module, or PAM for short, similar to the ones that [had] been launched [for] the first time on STS-5, I think. We were supposed to have two of those, plus a satellite called a SYNCOM, synchronous communications satellite. It was a communications satellite for the U.S. Navy. It looked like a huge drum that actually laid on its side in the payload bay and was deployed by rolling out of the cradle that it sat in. That was to be the first one of those to be launched.

It was a challenging mission to go forth and do. We were proceeding along the training process with Bo and myself and Jeff [Jeffrey A.] Hoffmann, who was an astronomer Ph.D., [M.] Rhea Seddon, who was a medical doctor, and [S.] Dave [David] Griggs, who was actually another Navy test pilot, but he was flying as a mission specialist on his first mission. He had been selected as a mission specialist, but eventually was [hoping] to transition to a pilot, which he probably would have.

We had a good time together. We started forming up into a team and we got to know each other and worked together both professionally and technically and socially and had a lot of fun.

We were supposed to fly originally in 1984, I think, in the fall of '84. We'd actually been picked for that mission in the fall of '83, which is typical, about a year ahead of time.

Well, during the summertime of 1984, there was a launch abort on [STS] 41-D. Hank [Henry W.] Hartsfield and Mike [Michael L.] Coats, and [their crew] had an engine start and then a shutdown because something happened in the systems that said they weren't ready, which is the way it was designed to work. Well, that put, first of all, a delay in the schedule, but second

of all, because of the stackup of everything behind that [mission] and the priorities, it caused a change in payloads and a great big change in crews and assignments.

The end result was the [STS] 41-D crew ended up taking the payloads that we were supposed to fly, the first SYNCOM, and an extendable mast thing. I forgot what it was called, but it was the first deployable mast that was in space. [Also] one of the Payload Assist Module commercial satellites, which was really almost our complement of payloads. It was very disappointing, because to go that far and be within three or four months of flying and then go back to square one was tough.

So when that all got sorted out, Hank Hartsfield and his crew went off to do that mission and we were reassigned, Bo and myself and the rest of the crew, were reassigned to do a Tracking and Data Relay Satellite deploy, which would have been the second one of those, which deployed on an Inertial Upper Stage. We jumped into that and went back to work again and learned how to do those kinds of things and that kind of mission.

In the meantime, Hank flew [and there were] one or two other flights in between. And in February, I think, January or February of 1985, we had actually gone into quarantine for the Health Stabilization Program, which you do a week before launch to minimize the exposure of catching a cold or something and having it manifest itself on orbit, which would be uncomfortable. We spent one night in the crew quarters here at the Johnson Space Center in the Health Stabilization Program or quarantine, if you want to call it that, and the next morning we're eating breakfast and we get a call [saying], "There's a problem with the on-orbit Tracking and Data Relay Satellite," or TDRS. "We think it's a generic problem. They're going to pull the payload out of the payload bay and your flight's cancelled."

I went, "Oh, man, what else can go wrong?" So, another big blow and a very disappointing one, I think, for everybody. Morale was really low for several days, like "Now what are we going to do?"

Once again, things got reshuffled, the schedule got reshuffled, and we ended up with another satellite deploy mission, which had a Payload Assist Module, commercial satellite on it, in this case a TELESAT for the Canadian Broadcasting Company, and a SYNCOM, the second Navy communication satellite, which ended up being the one we actually flew in April [of 1985].

Sometime in this process we had a couple of Payload Specialists added onto the [crew]. I think when we were going to do the Inertial Upper Stage, there were initially only five of us, and then when we got to the second iteration of this mission, we became seven with the addition of Charlie [Charles] Walker, who was a McDonnell Douglas engineer [for] an electrophoresis experiment, and the addition of Patrick Baudry, who was a French test pilot, who was going to fly as one of the first International astronauts. We had started working together and learning how to become a team on that mission, of course.

Then somewhere in this process of changing again, Jake Garn was approved for flying, the Senator from Utah, and he was assigned to our crew and replaced Patrick Baudry. Now we were seven again, but with Jake onboard. The day that happened, we all looked at each other and said, "Oh, man, this is just what we need, a Senator as part of this crew."

Rhea Seddon to her credit, and I give her total credit, we were sitting around a room, just the five of us, talking, and she said, "This is a good deal. You guys aren't going to believe this right now today, but it's going to be a really good deal. We're going to get a lot of positive press out of it, a lot of publicity, and we're going to learn a lot." I remember thinking about it, "Hmm. I don't know. Maybe, maybe not." But it turned out she was right.

Jake was a great crew member. He had been a Navy pilot and an Air Force reserve pilot for years. He knew how to be a crew member. He knew how to fly airplanes, and he was a great guy to work with. He was actually a very down-to-earth individual, even though he was a very powerful individual, one of a hundred of the most powerful people in the country. He was the senior Senator from Utah for a while and he was a ranking Republican member when the Republican administration was in power, of several major committees. He was a strong supporter of the space program, the human space flight program, and all the space programs, even before he was selected to go fly.

He came down and said, "Call me Jake," which we did. Bo kept calling him "Senator," and he said, "Call me Jake. That's what I want to be and that's what I want to do." …

[Tape recorder turned off.]

WRIGHT: We're back, and you were talking about the newest addition to your crew, Senator Jake Garn, and then hopefully you'll tell us about how that moved into launch and the [flight] itself.

WILLIAMS: Let me finish the story about working with Jake, with a vignette or two. Jake, because he was a Senator and a fairly senior one, used to be called back to Washington, [D.C.] a number of times for critical votes and for committee meetings and for whole Senate meetings. Almost every time that he came back to Houston and he'd join us in whatever simulation or training exercise or class or whatever it [was] we were [doing], he would almost invariably come

in and sit down and look around in the simulator or the room and he'd say, "You know, it's really nice to be back where people know what they're doing." [Laughs]

He also brought his administrative assistant down with him most of the time, and he sometimes stayed in Houston while Jake went back to Washington. His name was Jeff [M.] Bingham, who also became a very good friend of ours, of the crew. I learned a lot about the political process, both from Jake's perspective, which was a little bit different, but also from Jeff's, on how all these things are handled and maneuvered, and the compromises that are done, much more than I perhaps even realized existed, and there's a lot more even than that. But it was an educational process for me. I learned a lot and I enjoyed flying with Jake.

One other interesting perspective Jake brought to the program. He was a Republican Senator from Utah, and, of course, he told us how there ended up being two parties in Utah. Utah was a pretty heavily Republican-oriented state when it first joined the Union. But every state was required to have two political parties. So the leaders of the church, the Mormon church, of course, called all the important individuals in the state into a meeting in this auditorium that had an aisle down the center, and the leaders said, "Okay, now we have to have two parties in order to become a state of this new Union. So all you people on this side are now Democrats, and all you people on this side are now Republicans." And that's how it worked. Whether that story is true or not, I don't know.

The other interesting part of it, I think, was [when] we got ready to take our crew photograph, the crew picture which has all the crew members in it, and we had on our blue flight suits and we had the appropriate props. We're trying to arrange ourselves in this studio where the pictures are taken and Bo—Bobko—deferring to Senator Garn, said, "Senator, where would you like to stand in the picture?"

Jake says, "Call me Jake and I don't care, I'll stand anywhere you want me to."

[Bo] said, "Well, okay, Senator, but we would like your input as to where you'd like to stand."

Jake says, "I don't care where it is as long as it's furthest to the right." No political connection there, of course, but just a coincidence. If you notice in the crew pictures, on almost every crew picture that was taken as a group, he's always the furthest to the right, whether you're looking at it or whether it's on the crew's right, which probably just happened and it might be a coincidence, but on the other hand, maybe not. Who knows?

WRIGHT: Well, maybe he just knew his place, right? He just knew where to go.

WILLIAMS: Where to be, right.

Anyway, we did get through that training, which now became the SYNCOM and the TELESAT deployment, plus some middeck science experiments. We actually got through a whole week of quarantine without our flight being cancelled or payloads being taken away. We got down to the Cape and we went out to the pad on launch morning, a pad that I'd been to many times as a support crew member, but never as a real crew member, and crawled in and strapped in. The weather was a little shaky because there was an overcast about 12,000 feet or so, they said, from the weather people and the Shuttle training airplane crew that was flying around.

We didn't think we were going to go, and we were kind of just chatting around and talking about it, because we figured we were going to do a scrub turnaround for twenty-four hours and come out the next day. In fact, one of the crew members had even unstrapped and was sitting on the back of his seat just talking to the guys on the middeck.

Then the Launch Control Center said, "Okay, *Discovery*, we're going to pick up the countdown here at T-minus-nine minutes," and so all of a sudden there's this big scramble to tighten up your harnesses, get your helmets back where they're supposed to be, and everybody's going, "Oh, my gosh, we're really gonna go." We couldn't believe they were going to launch us, because there was still an overcast.

[I was] looking out the windows, straight up at the windows, and there [were] still clouds up there. Usually you don't launch through clouds because of moisture and the chance of damage [to] the tiles. But lo and behold, they finished the countdown and we launched. It was a quite a lot more than I expected, in looking back at that. It's one of those things where you hope you're pointed in the right direction, because it's going somewhere for sure when the Solid Rocket Motors light.

Sort of like a two-minute long catapult launch. A catapult launch on an aircraft carrier lasts about two seconds and you go from zero to about 180 miles an hour in two seconds. Of course, in the Shuttle you go from zero to about [4,000] miles an hour in two minutes or so. It's a very rough ride [with] a lot of mechanical vibration, a lot of heavy-duty low-frequency noise and a lot of things shaking and rattling and making a lot of noise. But having been in airplanes, on carriers, I wasn't too concerned with that. Bo had done a real good job of describing to us what it was going to be like, and so we rode it out.

I was surprised by the intensity of the flash and the fire when the Solid Rocket Motors separated after two minutes and a few seconds. It was like being inside a fireball looking out, which was a rather spectacular scene. In the meantime, as we were going up, we went into the bottoms of these clouds, maybe right around 12 or 14,000 feet, and we broke out of them about

19 or 20,000 feet, and I said to Bo—of course, we're hot mike intercom, I said, "Hey, Bo, you think we ought to give them a tops report?"

He [says], "Shut up and watch your instruments," which is what the pilot's job was, to manage the systems onboard the Shuttle and back up the commander for flying purposes.

The Solid Rocket Motors separated, and after that it got real smooth. I didn't get much of a chance to look out, because I took the commander's direction. I was supposed to be watching the instruments. So I was paging through the displays, looking at things and flipping a few switches so I could see different readings on instruments, making sure that things were working like they were supposed to and we could catch anything that [might] wrong.

When we got to engine throttle back, where you start throttling back to maintain 3 Gs, it was a little uncomfortable. But in those days, we were wearing two-piece flight suits and just flying helmets, except they were full-face helmets, kind of like the motorcycle guys wear with the visor thing. It really wasn't too uncomfortable at that point, just being pushed back in your seat by about 3 Gs, not much more than an amusement park ride.

The engines cut off and it got very quiet, except for the Reaction Control System jets that are firing to maintain attitude and separating you from the External Tank. Of course, in those days ascents were done [in] a head-down orientation. Nowadays they roll to heads-up part way during the launch profile. There's no up or down, really. It doesn't make any difference. I recall pulling a pencil out of my clipboard and letting go of it, just to see if we really were in zero G, and it stayed there, and I went, "Hey, about that? It really does work, just like they said."

I stowed it and didn't unstrap right away, because there were a number of things that the crew has to do to get the Shuttle ready for orbit, some of which are done from the seats and some of which are done from other places.

Finally getting through that part of the checklist and being able to look out for the first time, I thought about the reaction I was going to have when I looked out the window for the first time in earth orbit, having flown a few thousand hours of jet aircraft, both high-altitude and low-altitude, and learning how to navigate by looking at a map and looking out the window and seeing what it looked like and identifying features.

I'd studied the ground tracks quite a bit as to where the Orbiter ground tracks were going to [be] during daylight passes, because that was part of our observation project that is still ongoing today. I was expecting to be able to look at a map or a page in the checklist on the map and say, "Okay, now, here's where we are and this is what we're going to be seeing in a few more minutes."

I looked out the window for the first time, and I do it this way because by turning my head backwards, because that's the way you do that from looking down to looking up if you're inverted, heads-down orientation. The first thing I saw was the horizon and the blackness of space and the thinness of the atmosphere and everything blue on the Earth, and I just said to myself, "Wow!" So, so much for being profound. [Laughs]

You get used to it, I guess, after a while, although I don't know anyone who has made a space flight who ever says, "This is routine. I see it every day. I see it all the time." Whenever there's an opportunity and you're not busy doing something else, the windows were the most popular place to be always, and I suspect they even are today on the Space Station, because it has a nice optical-quality window and a couple of other windows to look out and see the Earth or see space or whatever it is you're looking at.

Then the on-orbit activities begin, and you have to get the Shuttle configured and start all the experiments and get ready to deploy the satellites and so forth and so on. It's fairly busy.

It's a fairly small space for seven people floating around getting used to zero G, of course, which is a new sort of adventure, and getting on with the Flight Plan, which we practiced a lot in the simulator. It's fairly well rehearsed, with the exception of you can now do it in three dimensions instead of just two. There's an up and a down, in addition to the left and right, and a forward and aft.

Learning how to maneuver yourself in zero G without crashing into things or other people is a bit of a learning experience. I think most of us crashed into the bulkheads and the decks and the overheads a few times before we learned to use tiny little movements of fingers and toes instead of hands and arms and legs and feet. That was a unique experience, because all of us were rookies, really, except for Bo [and Charlie Walker]. He had [five] people who had flown for the first time, plus himself [and Charlie].

WRIGHT: Was it an experience that you enjoyed and were looking forward to the whole week, or did you find all your time so full of activities and tasks that you didn't have a chance really to enjoy being there?

WILLIAMS: No, initially I think there was some of that, like you've got to follow the checklist, you've got to get this thing, you've got to get the next thing done, you've got to plan ahead, you've got to be ready and have the proper materials, cameras, instruments, devices, checklists ready at the proper time to do whatever you're supposed to do. But then after a couple of days, it gets to the point where you go, "Hey, I'm in space. I ought to spend a little bit of time enjoying it."

Then my favorite place was, since I sat in the right seat, that seat kind of belonged to me. But you spend very little time in the seat in orbit, because, first of all, it's not very comfortable in zero G. And second of all, there's not much to do up there except for the systems monitoring duties and configuration duties that the pilot has and some of the maneuvers that you have to do. The most comfortable position for me and my favorite position was hooking my legs around the headrest of [my] seat that I sat in during ascent and entry and just sort of stretching out behind it and looking out this about three-foot-by-three-foot overhead window at the view, which was a spectacular view, and taking some pictures along the way. Whenever Williams wasn't doing something that was on the checklist or eating or sleeping, that's where he was hanging around the windows.

WRIGHT: You did have a full line of activities that your crew was supposed to, and did, accomplish. Share some of those activities with us, because from what we read about, we understand that not everything went as smooth as you would have hoped.

WILLIAMS: No. The two most important parts were the satellite deploys, and then after that, the experiments. The first satellite deploy went off pretty much like clockwork. The second one, the checklist and the checkout of the systems, both from the Shuttle and on the ground, worked just fine, just exactly like they were supposed to.

We deployed the satellite on time, maneuvered away from it, Bo flying the spacecraft away from it, and we were watching the clocks counting up to the point where an antenna was supposed to deploy on the satellite. And, of course, we were taking pictures of it with television

and cameras that we had onboard. The antenna didn't deploy. We waited about thirty seconds, and Bo or Jeff or somebody said, "The omni antenna didn't deploy."

It was an omni-directional antenna, a communications antenna for the satellite, which then was supposed to be followed by systems activation, which [were] going to cause it to spin up for stabilization. Then about half an hour later, fire its rocket engine to put it into a transfer orbit to get it up where it was supposed to be to do its job. None of that happened, of course.

We reported, "Houston, the antenna didn't deploy."

And they said, "Stand by," which is what they always say when you [call them]. They came back and said, "I understand the omni antenna didn't deploy?"

"That's affirmative."

"Okay. Stand by."

In the meantime, we're going, "Well, now what are we going to do?"

A few minutes later, the [Mission] Control Center, having gone to general quarters and made some decisions on what to do, decided we'd better go ahead and do the separation maneuver to get away from this thing just in case its Solid Rocket Motor did fire, because you don't want to be around that when it fires. It can damage the Shuttle spacecraft, the windows or the tiles or anything else, because of the particles that come out of there.

[We] did the separation maneuver and the SYNCOM disappeared several miles away and we went about our business. But we were pretty disappointed, because [when] something like that goes wrong, even though it may not be your fault, it happens on your mission, people go, "Hey, these guys did okay, except they didn't get this done."

We're talking about what could be done and what couldn't be done. This was on a Friday, I think.

Later on that day, the Mission Control Center came back to us and said, "We're thinking about a rendezvous with the SYNCOM satellite to do an inspection and see if we can figure out what we can do about it, and we're working on a plan for that."

So we went, "Great!" We had actually trained for a rendezvous mission on the second iteration because we were going to fly a spacecraft called SPARTAN [Shuttle Pointed Autonomous Research Tool for Astronomy], which was a deployable spacecraft. A scientific spacecraft that had some instruments onboard, astronomical instruments mostly, for space science purposes, and it actually deployed out of the payload bay and then was recaptured later on with the manipulator arm. We had actually done some training for that, which is why the ground even considered doing a rendezvous and some proximity operations, as formation flying was called.

Bo and I are thinking to ourselves, "Great. We're going to get to do something we weren't planning on doing." Then we started looking at each other and he said, "We don't have a rendezvous checklist onboard."

Rendezvous in space is a fairly complicated process. It's not like a formation flight where you just join up with another airplane because you have to take the orbital mechanics into effect, and there are several maneuvers and burns and things that have to be done at very precise times in order to keep from either overshooting it or crashing into it or missing the thing entirely.

We're thinking about that, and then about the time the end of the day came, the ground said, "We're thinking about a plan here to have you rejoin the SYNCOM, do an inspection and maybe do an Extravehicular Activity," or a spacewalk.

So Jeff Hoffmann and Dave Griggs' eyes lit up with that revelation, because they were our contingency EVA [Extravehicular Activity] crew members and, of course, never

expected to do a spacewalk. Never in the history of the [Shuttle] program had there been an unplanned spacewalk. There had been some Shuttle spacewalks, but they were all planned before that.

They were all excited about that and started hustling around, digging out their checklists and breaking out the equipment.

In the meantime, sometime on Saturday, I guess it was, the [Mission] Control Center came back and they said, "We want you to build a fly swatter," and this other thing using some onboard materials. This was like in Apollo 13 almost, except a much smaller scale, because they got a group of people together over a weekend, and by the time Sunday evening came, we had a full-blown plan to do this thing, including a rendezvous checklist that was uplinked on the teleprinter and a bunch of plans for it. But we didn't have [an] on-orbit fax [or a] real-time digital image transmission of things that the programs have now, so everything had to be sent up on a teleprinter, a typewriter, if you will. Describing how to build something, it was just words and pictures with little *x*'s in the form of whatever they were supposed to be.

They transmitted this entire checklist up, which ended up [being] a roll of teleprinter paper that was maybe fifty feet long and it was all over the middeck. You'd see some pictures of that on the mission [archives].

We proceeded to take one of checklists that we'd already used, I think it was the one used for transition on-orbit activities, which [was] done now. It was called on-orbit preparations or Post Insertion Checklist, which was done, and we cut the rendezvous checklist and prox ops [proximity operations] checklist up into pieces and pasted them in, taped them in this book so we'd have a checklist to use for the rendezvous, which was a challenging thing to do.

[We] started reviewing the procedures, the EVA guys were starting to get [their] suits ready and do their checklists. By Sunday evening, over a weekend in Houston they called a team in, they'd figured out how to construct these devices out of onboard equipment because none of it was planned, to go out and do a spacewalk, lash these two devices, which we ended up calling a fly swatter and a lacrosse stick, which we were to build onto the end of the manipulator arm. Then the spacewalkers would come back in, we'd rendezvous with the satellite and use the manipulator arm to try and trip a lever on the side of the satellite, an arming lever, which the ground was thinking [might be] what caused it not to activate.

We proceeded to get to work in building these things and cutting and pasting and constructing and talking a lot back and forth to ground and sending video back down [asking], "This is what it looks like according to what your instructions were. Is this what you're thinking about?" And they'd go, "Yeah, but we need to make these little modifications here and there."

We proceeded with all that, started into the rendezvous process, Dave and Jeff got ready for the spacewalk. They got into their suits, went outside, proceeded over the next several hours to lash these two things onto the end of the manipulator arm on an unplanned spacewalk. We took pictures, and it was kind of hard to believe that there we were looking out the window at a couple of our crew members who were now satellites in the payload bay. That was quite an adventure, and an unexpected one, of course, on the mission.

To shorten the story up, we executed the rendezvous. Bo did a masterful job of flying it up close, and we got into formation flight with the satellite. It was spinning, of course, at the time. The idea was to take the satellite, which weighed about 20,000 pounds, which is like a big drum and had solar cells all over the outside of it, and, while it was spinning, to let the devices drag along the surface right where this arming lever was, of course in the right attitude, and trip

the arming lever, which was a little lever about as long as your finger that poked out the side of the satellite.

We did that, caught it at least five or six times, [but] it didn't activate, which was really disappointing, but we figured, hey, we did everything we could.

As you guys know from the history project, later on another flight that Joe Engle commanded re-rendezvoused with that satellite. They did another EVA and [captured it]. They did a heart bypass on it, really is what happened. They took up some special cable harnesses that had been fabricated for the purpose and hooked them into some of the ground connectors and test and checkout connectors on the satellite itself and then were able to reactivate it. It subsequently boosted itself up into geosynchronous orbit and became an operational satellite.

That was a pretty neat mission, too, that those guys did, and my hat's off to them for a successful [mission]. They ended up having to capture it with their hands, in spite of the fact that they had some tools to do [it] that didn't work quite right. So Jim [James D. A.] van Hoften was the hero in that one. [He] actually deployed the satellite himself, a 20,000-pound satellite, by just pushing it off with his hands and arms and shoulders. That was pretty neat.

Back to the mission. After that was over, we separated from it again and cleaned everything up and proceeded to finish up the rest of the science experiments we had onboard. There was a plant growth experiment, an echocardiogram experiment, which is the first time an echo had flown onboard. [Charles] Walker, of course, was doing electrophoresis experiments, the protein substance separations, and Jake was doing a bunch of medical experiments, and the rest of us were supporting other kinds of things. We had a materials processing experiment onboard, the middeck kinds of things, and the rest of us were doing our jobs until it came time to come back.

Then it was one of these [times] where the weather was a little questionable in Florida. They were thinking about sending us to Edwards, and Bo talked them into letting us stay another day, which we wanted to do anyway. We got an extra day on orbit out of it, which was great.

Then reentry day came, and we did the appropriate get ready, get set, the de-orbit burn, and came into the atmosphere out over the Pacific Ocean somewhere, and it was dark there. It was daytime in Florida, of course, but it was dark there. I distinctly remember the de-orbit, or the reentry process, of looking out and seeing nothing but stars and then seeing a very, very pale pink-type glow outside the windows as we started back down into atmosphere. I mean, it was almost not there. You say, "Well, is it really light up there or isn't it?" And then it got a little deeper pink and then it finally got like rose-colored and then red and then bright red and then white, and it was flickering all over the windshield. Of course, that was the plasma [created by] the atmosphere as the Orbiter [was] blasting through it about Mach 20 or so. It was like a fire. It was like being inside a fire for several minutes during the reentry, which was quite spectacular. If you do a reentry in the daytime, you never see any of that, but at night you do, and it's absolutely spectacular.

Of course, what you're looking at is 1,500 degrees right outside of these three panes of glass and on the stagnation points of the nose cone, the leading edge of the wings and the leading edge of the tail, you're looking at 2,000 degrees. Of course, aluminum—being a little bit of an engineering guy—starts losing its strength at 350 degrees and I was thinking, "I hope this thermal tile stuff works." Of course, it did, so that wasn't a problem.

The other thing I remember about the entry is it was daylight when we crossed the northern part of Mexico and part of Texas. We came almost right across Houston and along the

Gulf Coast of the U.S. on our way into the Cape, was the [sensation] of moving really fast, which of course [we were] at Mach 7 or 8 at that point, and the ground was really moving by compared to the way it does on orbit, which is about the same relative motion that you see when you're on a commercial airliner, except you're much higher and much faster. But it's about the same relative motion. When you're coming in during entry, it's a lot of faster, a whole lot faster.

We're approaching the Gulf Coast or the Western coast of Florida and we're going to go almost right over Tampa, St. Petersburg area, MacDill Air Force Base, and the Sunshine Causeway Bridge, which many people have seen, probably, the people who live there. We were a right bank at that time so I got a chance to look out. The Shuttle banks back and forth to the left and right during reentry for energy management purposes.

I was looking out, and we were about Mach 5 at the time, headed for the landing field, the Shuttle Landing Field at Kennedy, and we were over Tampa and I'm looking down at the causeway and I can see MacDill and we're at about 75,000 feet or so. It's a beautiful day and I look out ahead and I can see the Shuttle Landing Field.

I look down at Tampa and I look up ahead at the Shuttle Landing Field, which is about 100, a little over 100, between 100 and 150 miles away, and I look at the instruments and we're doing Mach 5 and I'm going, "No way are we ever going to slow down in time to land at that airport out there. We're going to land 100 miles out in the Atlantic Ocean."

But sure enough, it does. It all [works] like it's advertised. We came in overhead the Shuttle Landing Field at about 50,000 feet or so and did the normal approach to landing. It was a right turn, which is not the ideal thing you like to do. As a commander, you'd much rather do a left turn because you can look out and verify landmarks that you've practiced on. So Bo is asking me where we are and I'm going, "You're right on. You're doing great." We roll out, and

sure enough, we're lined up with the runway right about where we're supposed to be. Bo did a great job, perfect landing, touchdown, rollout.

There was a crosswind of about 12 knots or so, gusts to 17, I think at that day, direct right crosswind, so that ended up requiring some right rudder and right brake more than left brake to keep it centered down the runway as we're rolling out. We're down to maybe just almost walking speed, maybe 5 knots or something like that, and there's this big "bang, thump, thump, thump, thump." I knew right away what it was. It was a blown tire, having blown tires before in airplanes on carriers and on runways. That's exactly what it sounds like.

But we're almost stopped anyway, so it turned out not to be a big deal and not an issue. Of course, the only thing to worry about is, since this tire is blown, there could be some debris problems which might cause a puncture or might cause some reason to have to evacuate, a fire or something like that. But there really is not a lot of stuff around the landing gear that's flammable when you reenter and land, so it wasn't a great danger. It turned out not to be a big deal. The ground crew came up and made sure everything was okay, and we proceeded to do the power-down of the systems and the shut down and climb out and greet our friends on the ground after a very successful mission. Even though we didn't recover the satellite, it did subsequently get recovered, and that was a lot of fun.

WRIGHT: Regarding the landing, had there been discussion about doing an autoland with your mission?

WILLIAMS: Yes, we did talk about doing that for a while during one of the get-ready, get-set flights, and it might have been the first iteration of that when we were still at 5 person crew. Bo

and I had a very strong input into what training was going to be required for that. I, of course, had a lot of—one of the jobs I did back at Pax River, when we were talking about that, was automatic landing systems and certification of automatic landing systems both on the field and onboard ship.

The Navy has an automatic landing system on carriers that you can actually land hands-off. Most people don't actually do it hands-off, but close. We had determined what was going to be required [for] testing and what was going to be required in the way of training for the crew and what the emergency procedures takeover criteria were going to be. We did probably more than half of the training that we had decided we were going to do in simulators and Shuttle Training Airplane to practice.

I wasn't real confident, having had quite a bit of experience before as a test pilot. Because the simulator was perfect, you did the same thing over and over and over again, but the ones and zeros never change. Also, the simulator doesn't fly through a real atmosphere. The question in my mind was, "We need to do this and see if it's consistent in a real atmosphere in a real airplane where there are gusts and there's turbulence and there's thermals and there's the flying qualities of the airplane and the interaction of the aerodynamics." We did [runs] in the Shuttle Training Airplane, but it wasn't very consistent. Sometimes you'd land—it'd be a perfect landing at half a foot per second, 2,500 feet down the runway, exactly where you're supposed to land, right on the centerline. The very next pass when not much has changed, you'd land 5,000 feet down or you'd land on the end of the runway, the approach end of the runway, or it would go way low and scrape it in over the approach [lights]. Sometimes, you'd land at 195 knots and sometimes at 215 and sometimes at 160, which is disastrous in the Shuttle. You don't want to do that. It had to be within a certain box. I wasn't real confident in the system, even

though the engineers said, "It's going to work, it's going to work, it's going to work. It's certified and we've done all this [testing]."

At some time during the course of this whole thing, for various mostly technical reasons, but based upon performance that we'd seen so far, it was decided to not do this autoland Development Test Objective, or DTO, it was called at the time. It was scrubbed from the flight, which we weren't unhappy about, because neither Bo nor I had a lot of confidence in it at the time, and I still don't. To this day we've flown over a hundred missions and never made an automatic landing in a Shuttle, even though the system is there and it is certified.

The real question I think was, "Why would you ever want to [do] this?" Because one reason for having a commander and a pilot on a Shuttle is redundancy. The thing that was used to sell the autoland system was "Well, if the weather's really bad, we can get them back in." Well, if the weather's really bad, you don't want to land there anyway, because it's going to eat up the tiles and there's a good chance of structurally damaging the spacecraft to do that kind of thing in really bad weather. And if it's foggy, how do you know where you're supposed to be if the visibility is near zero? You don't want to do a zero-zero landing in that kind of environment. In fact, the flight rules precluded a zero-zero environment and precluded flying through clouds that had moisture, and precluded descending through clouds at the kind of speeds that you'd be doing the approach and landing.

The second thing that really bothered me is there is no independent monitoring system. In the Navy airplanes I flew off the ship; there were two systems. There was the one that you coupled the autopilot to that controlled the airplane, and there was a totally independent instrument landing system that you could display on a different [instrument] in the cockpit that told you where you really were. So if it was night and the weather was crappy and you couldn't

even see the ship until you got into a quarter of a mile or something like that, you could fly that automatic approach, but how do you know whether the system is really controlling you to where you want to be or not without some independent means of monitoring? So that was another thing that bothered both of us.

Even to this day that doesn't make sense, which is probably why we've never done an automatic landing in the program. It's there, it's a certified system. If we ever need it, if a crew were totally incapacitated, it could be used, but the process of getting ready to do that, of developing the flight rules, developing the monitoring criteria, developing the takeover criteria, training to do that sort of thing, what happens if you get in real close, and it happens onboard ship sometimes, the airplane would [make] some kind of strange movement. Like sometimes it'd head to the left or the right or it'd go up or down, and you don't want it to do that in close, because there's very little time for correcting that sort of thing. So you're constantly sitting there waiting to just disengage it.

In a Navy airplane I did it with my little finger, because that's [where the switch was located]. In the Shuttle you had to actually punch a couple of buttons up on the glare shield, and we took to flying with our fingers on those buttons every time when the auto system was flying it, just to be ready to take it over. You have to practice the takeover, because if it starts in a direction and then sets up an acceleration or a velocity in that direction before you get much displacement, you have to make the decision fairly quickly to take it over before it gets outside the envelope for a safe landing.

So it's there, it's a certified system. I suspect if we ever need it we'll use it. "We" being the program. But there's a lot of overhead and training and getting ready for this to do it

for a crew, to actually do a routine one just because it's time to do one. Then there's a question of the flight rules, of why would you ever use it.

The other thing is, you would never ever use it in an abort landing, which is when you might really need it, because the Shuttle is very heavy, much heavier than you normally land. You land in a strange airfield in Europe, somewhere in the United States, or in Africa that's certified for emergency Shuttle landings, and it probably doesn't have the Microwave Landing System that's required to make the autoland system certifiable and work. It didn't make sense to do that. It never made sense to me to do that. I argued against it, when the program decided to do it, you [say], "Aye, aye, sir," and go off and do the best you can.

WRIGHT: Well, at least you got the option to not have to use it.

WILLIAMS: Eventually that test objective was cancelled anyway, so we didn't do it.

WRIGHT: Several years before you flew again, on your mission that you were selected as a commander, you had some duties in between that, if we could briefly go through those, in between your mission time.

WILLIAMS: Yes, I guess the one I remember is, of course, when we came back from that first mission, that was in April of '85, and I was reassigned to another mission which was supposed to actually fly in the fall of '86. I was quite happy about that, had a crew assigned, and we were excited about getting together and starting training.

My pilot on the next mission was to be Mike [Michael J.] Smith, who was a Navy A-6 pilot, a guy that I'd known for quite a while, a really topnotch individual, and I was looking forward to flying with him. It was going to be his second mission, the first being a flight in January of '86, and we were supposed to fly in October, I think.

In the meantime, I was assigned to be Deputy Chief of Aircraft Operations, which is NASA's Air Force at Ellington Field, [Houston, Texas]. That was like a Deputy Division Chief's job. Another management job but this time a little bigger than what I'd done at Pax River and much more complex because we had five different [types] of airplanes, a staff of maybe [300], 15 pilots, about 40 engineers and about 250 or so contractors who maintained and did the engineering work on the airplanes. For the fleet of T-38s, the Shuttle Training Airplanes, [a] Gulfstream, and the zero-G airplane, [as well as the 747 Shuttle Carrier Aircraft].

[I was responsible for] day-to-day management of that operation, because the Division Chief took care of Division-level things and the Deputy took care of everything else. It was a good leadership and management job which was kind of exciting to me, and that's the direction I sort of wanted to head anyway.

[I was assigned] there [from] the summer of '85 [through the summer] of '86. When we lost the *Challenger* and her crew [in January '86], that put a big hold on everything, of course.

WRIGHT: Where were you when you learned of the *Challenger* accident?

WILLIAMS: I was actually in the Astronaut Office spaces, which were then on the third floor of Building 4, before Building 4 South was built. It's now called 4 North.

Of course, I was interested [in the launch]. We always watched launches, because that's an exciting and critical part of missions. We had a small conference room in the Astronaut Office that had air-to-ground loops [and the Flight Director loop] in addition to the public affairs commentary.

Maybe fifteen minutes or thirty minutes before [the] launch, I happened to be walking by that conference room. I looked in there and looked at the television, NASA's closed-circuit television, and they [were showing] the pad cameras. There was probably a dozen different cameras on the pad in different areas that they switch around a few seconds on each one just examining everything that's around. I knew it had been cold there and had rained the night before, but I was surprised how much ice there was on the fixed service structure and rotating service structure and around the Shuttle. There was huge amounts of ice on there, like an inch or more, big icicles and frost, and it was in the thirties, I think, that day, mid-thirties or something. It was starting to melt off, but there was a lot of ice on all this steel out there that I, of course, climbed all over. I'd been in every nook and cranny of that when I was a Cape Crusader.

I looked at that and I stood there for maybe a minute or two and watched through the cycle of cameras, and I said, "There's no way they're going to launch today."

I went back to my office and was working on some paperwork, [when] somebody came by and said, "Hey, they're at T minus 9 and starting the clock."

I [said], "You're kidding me." Because I figured there was absolutely no way they were going to launch that day.

I walked over to the conference room, and sure enough, they did launch. And the rest is history. You watch that [event], and when the mishap occurred, it was, of course, [an] initial

shock. I knew what had happened almost instantaneously, being from an airplane background. Other people probably didn't who were in the room at the time.

It just got very, very quiet and I was standing in the doorway watching at the time. I looked at that picture and I just shook my head and walked away and went back to my office and looked out over the green grounds—even in January it's green in Houston, the Johnson Space Center—thinking to myself, "We lost them." Having been in a squadron, you lose—you know, aviation, any high-performance military aviation business, people have mishaps and sometimes lives are lost and sometimes they're not, but not in that kind of a highly visible manner. That was a very sad day, and it still is, probably always.

WRIGHT: Were you assigned to special duties during that time, after *Challenger*?

WILLIAMS: My job was as Deputy Division Manager of Aircraft Ops. The first thing I did after the dust settled in the next hour, I think, [and] realizing that this crew had been lost, was to get myself back out to Ellington Field, because the Division Chief was in Florida, and start talking to the team out there. I said, "Okay, guys, there's going to be a lot of requirements for transportation, maybe even today, and certainly in the next twenty-four hours. Let's get every airplane that we have here up and ready to go, all of them, the entire fleet, and standby for orders," which we did. That was my initial contribution, I guess.

WRIGHT: And was your initial reaction proven to be correct, that you had lots of action out there?

WILLIAMS: Oh, yes. There were a lot of requirements laid on us right away, [to] transport people and things. Later on during the aftermath, in the Navy, and most of the military services we had a thing called Casualty Assistance Control Officers, or CACOs for short, is the acronym. When you lose somebody in a squadron, another squadron member is assigned those duties to support the family and make sure they get everything they need and all the help they need and [are] able to navigate through the bureaucracies and get things done and just be there for them.

I went in to talk to Paul Weitz, who [was] the Deputy Chief of the Astronaut Office, and I said, "P.J., we're going to need CACOs for these people, and I'd be willing to volunteer if you want me to."

He says, "Yeah, you're right. We'll let you know within the next day or so."

I was assigned to Dave Griggs' family, who was another Navy guy. Not Griggs, but Mike Smith's. Let me try it again. I'm getting out of order here. This happened later on. I was assigned to Dave Griggs' family after he was killed in a small airplane crash.

For the *Challenger* thing, I was basically back at Aircraft Ops and running the show out there until the Division Chief got back and took over, and it was the day-to-day operations. Of course, everything was put on hold and the whole flight schedule just collapsed for the next two and a half years or so until the teams discovered what had caused it, fixed it, and did all the testing that had to be done and [got] ready to go again.

WRIGHT: At any time during this stand-down period did you feel that maybe what you needed to do was to exit the program, or did you want to continue?

WILLIAMS: Oh, never. I knew we'd get it fixed and we'd fly again. You have to have confidence in the system and the people that are going to do it. You're sad about what happened and you go through the standard series of things that you do when that happens, of shock, grief, anger, and acceptance. It takes different amounts of time for different people to get there and it took me probably as long as anybody else. In fact, today I don't like to think about that, because it was a very sad time and I lost a number of good friends all at once, and it didn't need to happen. But I can't blame myself for it, because I didn't have anything to do with it, other than the fact that I was there and part of the team. We talked about that a lot amongst ourselves and other people, because you feel some amount of guilt on something like that, like "What could I have done to stop it?" And the answer is nothing, because I wasn't in the decision process at that time.

WRIGHT: As you moved along and started to look towards goals, one of the goals was to be your next mission. As you mentioned, Mike Smith was supposed to fly with you and, of course, had to be replaced. Tell us how you learned when your new mission was going to be scheduled and how all of that took place as you went along, to get everything back to normal.

WILLIAMS: The crews were assigned for the next several missions. The first one was supposed to be the crew that Rick [Frederick H.] Hauck commanded, which turned out to be STS-26, which was the next flight after *Challenger*. We were like third or fourth in line after that I think. We lost the *Challenger* in '86. It was going to be a real busy year. There were like twelve flights scheduled that year or something like that, which was the most ever, I think.

The plan was to do these along a sequence. Well, some of the crews were kept intact and some weren't. The ones further out, the ones in the fall, mine and the next two or three were

all broken up and reassembled into other crews. So sometime during [the] process of this turnaround stuff, part of which I spent at Ellington and part of which I went back as a lead for the Cape Crusaders and spent some time in Florida again, with test and checkout and all that, get-ready, get-set stuff.

I was reassigned to a mission that we actually ended up flying. It eventually was planned for October of '89, to deploy the Galileo spacecraft, which was a really interesting mission, because we got to work with the Jet Propulsion Laboratory, [Pasadena, California]—we'll get into that discussion [later]—and a totally different crew than the one I was originally assigned to, which was going to fly in September with Mike Smith. None of the same crew members were involved. They kind of broke up that crew, even though we'd started to work together and form up into a team, and reassigned everybody, and I got an entirely new crew. In this case, Mike [Michael J.] McCulley as the [pilot], and Ellen L. Baker, Shannon [W.] Lucid, and Franklin [R.] Chang-Diaz [were mission specialists] when we were reassigned to the Galileo mission. That was kind of a mix master time when nobody knew exactly what was going to go on until things got sorted out.…

WRIGHT: Were there differences between pre-flight activities for your STS-34 mission, compared to your first mission? Mostly because of changes that had been made after the accident.

WILLIAMS: The big difference was, as far as crew is concerned, was pressure suits that were now required for launch and entry. That was a whole new training exercise to learn how to operate within those and use them and do the survival training. Different environment. Other than that,

the abort procedures changed a little bit. The contingency abort procedures changed a lot. Contingency abort being where you're not going to make it to a runway. In the original Shuttle program, you were supposed to ditch the vehicle, the Shuttle, which might have been a challenging thing to do, to put the spacecraft down in the water somewhere and not break it into lots and lots of pieces. The new procedure was to bail out, and so there was a lot of effort put on that and, of course, a lot of practice and training.

But as far as the launch, on orbit, and entry procedures, they were mission-specific, of course, for each flight, [and were] not changed a lot. Having gone through that exercise for STS 51-D and its predecessors, and then being assigned as kind of a test-the-system crew during the stand-down and going through them again, it was really my third time through almost the whole process of a mission-specific training. So I was comfortable and sort of knew what I was doing, I think.

I had two folks who had flown before, namely Franklin and Shannon, and two rookies. So the idea was to get that team formed up and get the two new rookies integrated into it and get going on this new mission.

WRIGHT: You were also going to be in a different Orbiter. Did you have any thoughts about "Now I'm not using *Discovery*," and going to *Atlantis*?

WILLIAMS: No, that wasn't it. They're pretty much almost carbon copies of each other. *Columbia* is the one that's really different, because it was built for the original orbital flight test program, and so its systems are different, although it's been overhauled now and is pretty much the same as the other ones. *Challenger*, *Discovery*, *Atlantis*, and eventually *Endeavour* are pretty

much exactly the same. It's like walking out on the flight line to an airplane. They may have different tail numbers on them, but they all are pretty much the same.

WRIGHT: And a big difference on this mission, of course, was you were commander. What did you hope to accomplish with your crew and what thoughts and words of leadership did you pass on to them as you got ready for your mission?

WILLIAMS: First of all, the perspective from the left seat is a lot different, not because you're physically sitting there, but because of the responsibilities of command. With [the] authority that you're granted to take this billion-dollar spacecraft and these human beings and this several-hundred-million-dollar science spacecraft that's been put together by thousands of people, and successfully complete the mission and you're given the authority, once the Solid Rocket Motor lights, to go do it, with some help from the ground, of course, but, nevertheless, the onboard decision is the commander's and no one else's.

There's some amount of loneliness at the top, if you will, of being a commander of something like that and having that authority, and with it comes the responsibility for accomplishing the mission. And with those first two comes the most important one, in my mind, which I learned early on as a midshipman at Purdue in Navy ROTC, is with the authority and responsibility comes the accountability, and if something goes wrong, it's not somebody else's fault, it's the person in command's fault.

In the Navy, if you run a ship aground, if it happens in the middle of the night and you're the Captain of the ship and you're in your bunk, it's not the helmsman or the Officer of the Deck that gets relieved, it's the Commanding Officer who's accountable.

The same thing is true when you command a mission. You're accountable for the performance of the crew, for the accomplishment of the mission, for getting the objectives completed successfully and for getting the spacecraft back so somebody else can use it again. That's the name of the game. You know, any landing you walk away from is a good one, right? If they can use the airplane again, it's a great one.

The perspective is different, first of all. You have to exercise some management functions of not necessarily the crew, because they're really part of your team, but everybody else that you interrelate with, the ground team, the training team, the payload team, the administrative team, everybody has to work together to make this thing happen. That's a management function to make sure you keep people informed, communicate, and people understand each other.

The leadership part of it is to set goals and objectives and make assignments fairly and treat the people fairly and with respect [for] their capabilities, and manage that function of it. But with that comes the responsibility and authority and accountability that goes with it. So it looks different from the left seat.

That's what I came to Houston to do in the first place, was to command a mission and do it successfully. That was my goal when I first came to Houston. I had hoped to do it in a much shorter time than, let's see, '78 through '89, eleven years, but, nevertheless, that was my goal and I was finally about to reach that and say, "Okay, this is what you came here for. Let's go do it."

WRIGHT: And after a couple of rescheduled dates, you were able to launch and move on to orbit.

WILLIAMS: Yes, we had a weeklong delay for, I think it was another Inertial Upper Stage, an IUS problem, and then that was fixed and we were ready to go again, and then there was another weather delay. I think the first time we attempted to launch it was an abort field, landing field, problem. But then we actually got to go on a nice day in October and had a great mission.

WRIGHT: Tell us your thoughts of watching the Galileo deploy and you being able to guide the Orbiter away and set that satellite off to do its mission.

WILLIAMS: We spent a lot of time with the Jet Propulsion Lab and the contractors and the Air Force [team who] control the Inertial Upper Stage getting ready for this mission, to make sure we understood our part in it and what we had to do and what troubleshooting we had to do.

The first time we really saw the spacecraft, though, in all its splendor--we'd seen it in pieces and parts in test chambers, but in all its splendor it was when we opened the payload bay doors on orbit, and it was absolutely spectacular. I was floating back to the window. I was looking out and saying, "Wow, that guy's really big isn't it?" The Galileo spacecraft and its Inertial Upper Stage [weighed] about 47,000 pounds, which was the [heaviest] payload that had been carried by the Shuttle to date. It filled almost the whole payload bay except for the very front part. When we elevated the spacecraft up on its tilt table and got ready to deploy, it really looked big.

Then when we actually deployed it, Shannon was the person who executed the deployment, Shannon Lucid. I was flying the Shuttle from the back, from the commander station in the back window looking out there, and the spacecraft came up over the crew module of the

Orbiter and it was supposed to miss us by twelve or fifteen feet and it probably did, but it looked a lot closer than that. Said, "Boy, that guy is really big. I hope it misses us."

We did the initial separation maneuver and then the separation maneuver to allow its rocket motor to fire, and went off about our business. …

[Tape recorder turned off.]

WRIGHT: I think we were talking about the Galileo and working with JPL [Jet Propulsion Laboratory].

WILLIAMS: Yes, the spacecraft was—I really enjoyed that mission probably even more so than the first because it was my goal to command a mission, first of all, and I got to do that. But secondly, because we knew that Galileo was going to be a lasting program as opposed to the first flight, [where] we deployed the two satellites, [but] it turned out to be a unique flight, too, because of the spacewalk. The Galileo mission we knew, if it was successful, the spacecraft was going to end up in orbit around Jupiter several years later and then there [were] going to be several years of data and images sent back. It was going to be a living, ongoing program, and we got to be a part of it. That was a really unique experience.

Plus I got a chance to interface with the JPL team, a bunch of other people that I had become acquainted with before, who were extremely professional people, very smart and capable team of people there who know what they're doing and designed a spacecraft that turned out to be very robust in spite of an early failure in the mission that occurred with the high gain antenna not deploying.

WRIGHT: Your mission was only five days, but, of course, this was the major goal, but you had other experience and other tasks to do. Are there any that you can share with us now that bring back some memories?

WILLIAMS: Yes. I think two or three, perhaps. The first flight of the Shuttle Solar Background Ultraviolet System, or SSBUV, that acronym. It was a [NASA] Goddard [Space Flight Center, Greenbelt, Maryland] small payload that actually fit in a Get-Away Special can that Franklin and I were in charge of [operating]. It was kind of unique because it was an ozone-measuring device, which, of course, is ecologically important to our existence here on this planet. That was kind of fun because we got to work with the Goddard guys on one side and the JPL guys on the opposite coast.

Then there were several medical experiments that were of interest, a blood-flow experiment and a retinal scan experiment, a student experiment that was actually sponsored and designed by a high school student that Shannon and I worked with. And perhaps even more unique was the first Toys In Space mission, which was done in conjunction with the Houston Museum of Natural Science, and that turned out to be a lot of fun. That actually was on the first flight; I'm sorry. It was the first flight we did the Toys In Space.

WRIGHT: We can talk about that, because we didn't have a chance to talk about it either. Would you like to—

WILLIAMS: Yes, can we drop back?

WRIGHT: Sure.

WILLIAMS: Let's go back in history a little bit here, since through the magic of television we can turn the clock back if we want to here.

That was something that was added on kind of late in the program. One day we met with Carolyn Sumner, Dr. Carolyn Sumner, who is in charge of part of the Houston Museum of Natural Science up in Memorial area. She came down with a big box full of toys and said, "We want you guys each to pick one or two of these and we're going to fly them onboard the Shuttle. It's been approved by the program and we want you to do some ground-truth video of what you're doing and explain and talk about [them]," which we did in the simulators, the mockups, "and then we want you to do the same thing on orbit, and we're going to make a video of this to be used in classrooms [so students can see] the differences," which turned out to be a lot of fun, because here we are, a bunch of kids, playing with toys. And Bo Bobko said, "Okay, guys, now you've got to pick one or two, because we can't take them all."

"But we want to take them all! This is going to be great fun."

So we did, and it turned out to be very interesting. Perhaps some unplanned kinds of things occurred, and it turned out [a] video was produced from that first Toys In Space, I've gotten more comments from schoolchildren and from other people who have actually seen this. This thing got distributed all over the country and sometimes in other nations, so a lot of people have seen [it]. They say, "I saw you on TV with the toys in space."

"Yes. Well, we had a lot of fun."

WRIGHT: Did you get to pick the toys you wanted to play with?

WILLIAMS: I picked a paddle ball, which is something I'd fiddled with before just because I was curious as to whether there would be any difference. I [also] ended up with this little plastic flipping mouse. You wind [it] up and you sit him on the table and he does back-flips. [He] became our unofficial mascot for that mission, and we called him Rat Stuff.

WRIGHT: Going back to STS-34, as your mission started to close down, you began preparations for landing, and was this going to be a different landing, because not only were you going to be landing the Orbiter, you were landing out at Edwards.

WILLIAMS: Yes, the flight was originally planned to land in Florida, [but] the weather was bad and it was forecast to stay bad. We tried to talk them into letting us spend another day or two until it cleared up, which it was forecast to do, [but] the ground, Mission Control, decided no, they really needed [us] back, because there was a short turnaround between that flight and the next flight. They said, "Okay. Not only do we want you to come into Edwards, but we want you to come in two orbits early," because the winds were forecast to pick up.

[We said], "Aye, aye, sir."

We got everything ready to go and did another reentry and this time landed on a lakebed at Edwards. It was kind of interesting because sometime during the mission [training], during the preflight, get-ready, get-set for that mission, I was thinking to myself, "You know, if we ever have to land on a lakebed, I'd like to have landed on one before, instead of this being the first time." I'd never landed on a lakebed.

One day when we were out practicing [landings] at Edwards in T-38s, I asked the tower if I could land on a lakebed [runway] and they said, "Yeah, go ahead." So I actually made three or four landings on different runways, touch-and-go's on a lakebed, just to get familiar with them. I'm kind of glad I did, because we ended up landing on a lakebed runway and I wasn't expecting that at all.

[We] landed on Runway 23, which did not have a Microwave Landing System, so it was more of a hands-on landing perhaps than it would be with the Microwave Landing System, because you have a more accurate glide slope and lineup display with the Microwave Landing System than you do without. But, once again it was successful. Any landing you can walk away from is a good one, right? We rolled to a stop and got the [vehicle] secured, and scrambled out of there, and when your feet get back on the ground you [think], "Hey, we did it and it worked." It was a successful mission, and I look back on that with quite a lot of pride.

WRIGHT: If we can for just a minute or two, talk about what you felt like when your feet got back on the ground. You were talking earlier about adjusting to space. How was it to adjust back to being on the Earth?

WILLIAMS: Having done it once before, I knew what to expect to some extent. As probably other folks have described, you feel very heavy, like four or five or six times your normal weight when you try and get out of the seat, even after spending only five days in zero or near zero gravity.

Your sense of balance is affected slightly to the point where you don't want to do any rapid head movements, because you feel like you're going to tip over or stumble or perhaps not be able to stand correctly or walk correctly. Caution, I think, is probably the word that I would

use. Be careful for the first few steps, the first time you go down a stairway or up a stairway, or climb into a vehicle, or drive, until you get yourself reoriented to the 1-G environment that we all grew up in since we were babies.

That presents, of course, some interesting ideas about what happens to people who do longer duration space flights, or maybe some day live on the Moon or another planet, which has a different gravity environment than that on Earth. Can you come back? We don't know yet, do we?

WRIGHT: Not too long after you returned [from] STS-34, you announced your retirement from NASA. What moved you in that direction?

WILLIAMS: Actually, it was reaching the goal that I set for myself when I came there. It was to successfully command a mission and then what's next? I distinctly thought about that some before the mission and "What am I going to do after this? This is a lot of fun, I'd love to stay here and fly for a long time." But once you reach that goal, then what do you do?

I had decided that I had four alternatives. I could stay and fly again, which was an option, and that was offered to me. I could go into a NASA management job as a civil servant, which was also a possibility. I could go back to the Navy as an officer, because I was still on active duty, and military officers were detailed to NASA. Or I could go into private industry and see if I [could] make a living there.

I explored all four of those over the next few months, and it turned out just by a matter of timing, I guess it was, I ran into an individual that had been a neighbor of mine and had been a Flight Director in Houston. His name [is] Neil [B.] Hutchinson, who you ought to

interview for part of this program, if you haven't already. [He] was looking for a person with the qualifications that I had, for a potential job that he had for the company he worked for then. It turned out it was a good fit mutually for both of us, and so it was time to move on and do something else.

I did explore all three of the other options, though, and decided on that one and never looked back. When you get into the flying business, particularly jet flying, it's hard to turn loose of it for some people. But I decided, probably sometime when I was at Pax River, or before, even, that when it came time to hang up my helmet and G-suit and oxygen mask, I was going to do it and walk away and not look back. That's not easy to do for some people, but if you make the decision early enough, I think that you have time to consider all sides of it from whatever direction you're going to look at that, and you're at peace with yourself and comfortable with that. It can be done. And I'm a witness to the fact that it can be done, because I never really looked back. When I see jets take off and land, I [watch them], like all of us do maybe, but I don't have any need to do that again. I've been there and done that, and so I don't need to do it over and over and over again just to prove to myself that I can do it.

WRIGHT: Looking back over your career with NASA, what do you consider to be your most challenging milestone and/or your greatest accomplishment?

Williams: The mission commander job by far. The responsibility that weighs somewhat heavily upon you and the accountability that's always there, always there sitting on your shoulder like, "Okay, Don. This is your chance. Go do it." That was a challenging thing to do.

The second most one from, a crew member and a pilot perspective is learning enough about a very complex vehicle that you can fly and operate it in all of its environments from the launch pad to the landing, [and] post-landing activities.

I'll give you an example. I flew A-7 [E's], the Corsair [II] airplane, a light attack airplane, off of the *Enterprise* in all kinds of weather, at night and [and in a] wartime environment. That airplane had inertial systems, radars, weapons systems, environmental control systems, hydraulics, electrical, heads-up displays, electronic warfare systems, and communications. It was a fairly complex airplane, and flying that by yourself at night off a carrier on a scale of one to ten is about a seven or eight, roughly, in complexity.

The Shuttle on that same scale is about a thirty. It's two orders of magnitude more complex. It's amazing. It's largely due to the environment it flies in, from a rocket launch to an orbiting spacecraft, to a hypersonic reentry, to a conventional gliding kind of airplane. The systems onboard to make that all operate are very complex and they all interact with each other and they have a lot of redundancy by design. But the redundancy also adds complexities, because you have to know how to gracefully fault-tolerant them down as you have failures, which you have lots and lots of in simulators and hopefully not too many in orbit. So it's a very complex flying machine and it requires a lot of attention to detail by everybody, not just the crew, by everybody.

The mission commander challenges, personal challenges, and for me personally being able to—I don't know whether you ever master something as complex as a Shuttle, but you get pretty familiar with it to a point where the 800 or so switches and controls onboard there, you know what every one of them does. And when you pull one, push one, turn one or toggle it or

whatever you do to it, you have some idea of what happens inside the spacecraft, whether it's under your foot, next to your arm, or seventy feet away in the back.

WRIGHT: As we start to close down our session today, I was going to ask Sandra if she has any—anything that you have?

JOHNSON: No.

WRIGHT: And I want to ask you if you have any other segments of your NASA career and/or the missions that we didn't get to talk about? Are there any other thoughts that you would like to share today before we close, anything else that might come to mind that we didn't go through as we were going through your career?

WILLIAMS: Maybe two, the first one being the teamwork that it takes to pull this off. I think you may have heard a lot of other people say this. But in order to successfully pull off a Shuttle mission, or any human space flight mission, [it] takes thousands and thousands of people all doing their job correctly every single time. You cannot afford [for] anybody to fail and have a successful mission. And I think every crew member that you ever talk to will probably say that, if you ask them about the teamwork that's required. A lot of credit goes to the invisible people, as they call them. The training teams, the flight control teams, the planning teams, the contractors, and civil servants that make all this happen. The secretaries, the people that take out the trash, the people that glue the tiles on the Orbiter, the people that do the launch countdown,

the people that paint the towers, the people that make the hardware and the software that make it all work.

Every single one of those people has to do their job, and there's thousands of them, and it all has to come together in the end. Those of us, who get on the pointy end of the spear, if you will, maybe get a lot more credit than we deserve.

You have to have trust. You have to trust them, and that's a special thing about being part of this human space flight program. It's a very special thing and it's very unique about this program and perhaps aviation in general, particularly high-performance carrier aviation, where you depend on the people that work on the airplane, that work on the catapults, that work on the arresting gear, that drive the ship, that fuel the airplane, that load the airplane, that fix everything that goes wrong and get it ready to go, so you can go fly it and do your job. That's part of the team. So, being part of a huge team like that is a really fascinating and wonderful thing. I mean, that's an enjoyable thing to do.

Then, finally, the perspective you get from on orbit of this planet of ours, which has been described in much better words than I can put it, but you say to yourself, "Hey, it really is round," which is good, because otherwise all this orbital mechanics and stuff wouldn't work. The perspective you get, that there are no boundaries between nations and there's no labels on anything. The only visible boundaries, quite truly, that I recall seeing as I go back and look at the video and the pictures, is between the land and the sea. Therefore, why is it that we fight over things so much and we disagree and we argue about lines that are drawn on the surface by humans, which seems to cause people to disagree about things, when, in fact, we're all in this together.

I'm not necessarily an advocate of world peace and world unity, but on the other hand, getting along with each other seems like the right thing to do, because we don't have anyplace else to go right now. Maybe some day we will.

WRIGHT: Maybe some day we will, and then who knows where your career will bring you again.

WILLIAMS: Yes, there you go.

WRIGHT: It might be on the pioneering part of that, as well.

WILLIAMS: Yes, I hope that I see humans back on the Moon in my lifetime, and perhaps on Mars, but I don't know now. It's looking increasingly unlikely that that will happen, but it's a matter of time.

WRIGHT: And hopefully with a lot of good planning we'll get there.

WILLIAMS: It's already been done. It's a matter of time now, and having the national or international or global will to do it. The technical parts are pretty much solved of going back to the Moon. That's fairly straightforward. Going to Mars is a little harder, but it can be done if there's some driving force to do it. I don't know what that is, though.

The real question, I think, to be answered is "Why." In the case of the Moon, that was an easier one because [it] ended up being a competition, and everybody likes to win.

Americans, in particular, like to win. If you're on a team or if it's your hometown team, you want to win. That's sort of in our psyche. You don't like to lose.

But why go to Mars? There's no compelling reason to do that right now. People say, "Well, because it's there." That's not a compelling reason.

"Because we need to."

"Why?"

"Well, it'd be fun." Nope, that ain't it.

There has to be a good reason to do [it], and this is not my original thought, but let me mention it anyway. There's only three reasons that people explore: the first one is fear; the second one is greed; and the third one is curiosity. Throughout recorded history, people left their homelands where they had been for generations and for centuries because they were oppressed or being made slaves, and migrated to places they'd never been before and never heard of before because they were afraid. And other people have migrated to various parts of the world because there was a chance to get rich or make lots of money or become wealthy. Example, the California Gold Rush in the 1800s. Example, the movement of people from other nations to America when it first became a nation and we became this great melting pot, or whatever it is we call ourselves nowadays. Then there's the curiosity thing, like, "I wonder what's over the next hill." Another hill probably, but you don't know that until you go there. "How are we ever going to know if we don't go?" as this fifth grader once said, and it was quoted widely in some NASA [publications].

But until there's one of those first two drivers, then it's probably not going to happen because of the fiscal realities that we live in globally today. Internationally in the whole world, there's not enough resources to go do a Mars mission, just to go there. But if there's some

reason to go there, for example, survival of the human race, or if there's some reason to go back to the Moon because there's a lot of money to be made, a lot of wealth to be created, then guess what? It's going to happen. And I'm curious about it, too. I would have loved to have been an Apollo program astronaut and gone there. I'd love to be a part of the first Mars crew, but, somebody will get to do that.

WRIGHT: We look forward to watching it, I would imagine from day-to-day, as we know from the last few years, we just never know what's going to happen.

WILLIAMS: And maybe your kids or my grandchildren will. We'll see.

WRIGHT: And we could sit and listen to their stories.

WILLIAMS: There you go.

WRIGHT: Well, we thank you today for talking with us, and appreciate all your time and effort.

WILLIAMS: You're welcome. I enjoyed it.

WRIGHT: Thank you.

[End of interview]