ORAL HISTORY TRANSCRIPT

CHARLES R. HAINES
INTERVIEWED BY KEVIN M. RUSNAK
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RUSNAK: Today is November 7th, 2000. This interview with Charlie Haines is being conducted in the offices of the Signal Corporation in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Rob Coyle and Carol Butler.

I'd like to thank you for taking the time out to do this interview with us. It will be interesting to talk with you for the next few hours.

HAINES: I think it's an interesting idea. I'd like to see how it goes.

RUSNAK: Well, we've been pretty successful so far, and I'm sure your contributions will be equally valuable.

So, then, if we could start, as I suggested, with some of the interests you had when you were growing up, the kind of career you envisioned for yourself, and how maybe you got interested in aviation or engineering and the kind of things that may have led you to the space program.

HAINES: I became interested in aviation in high school with my first airplane ride. I thought it was exciting, and it got me to thinking about aviation. After high school, I went to college at Texas A&M [College Station, Texas] and got a degree in aeronautical engineering. I went directly into the Air Force via ROTC [Reserve Officer Training Corps] and reported to the Air Force Flight Test Center at Edwards, California. I had a great career there, five years, if you can call five years a career. It was a wonderful place to be, exciting, educational, and it was a good experience because they work your tail off out there.

RUSNAK: What kind of work were you doing?

HAINES: Flight test engineer, flying as the test director, so to speak, on test flights. In my five years, I spent almost five years of that time working on the [Convair] B-58 [*Hustler*], which is a strategic nuclear bomber, very latest thing at that time, mach 2. I was flying mach 2 in 1958.

That led directly—indirectly, I guess it sounds like—but directly into my wanting to come to NASA, because although I felt like what I was doing was very important, there had to be a better thing to do than develop nuclear bombers. There had to be a better answer, and I got this crazy idea that the space program was an alternative way to compete with other countries such as Russia. Interestingly enough, the last program I worked on at NASA, I was working with the Russians.

RUSNAK: That's an interesting turn of events during the whole range of the space race, as you went from the beginning in competition to the end where now there's some cooperation going on.

HAINES: Yes.

RUSNAK: About the same time you had graduated from college or were getting in the Air Force was when the Russians launched Sputnik, starting this whole event. What do you remember of some of these early happenings of the space race?

HAINES: Well, I remember it was very frightening and disturbing that the Russians could beat us at something like that, that Sputnik. That was in college, I guess. I was in college when Sputnik flew.

My position in flight test gave me an interesting perspective on the manned space program because all the test pilots that I worked with thought the manned space program was a weird thing. They described it as a monkey in a cage, because the early space program, Mercury, the pilot was very much a passenger, and the test pilots that I worked with didn't like that aspect of it. Some of them did become astronauts. I knew Deke [Donald K.] Slayton at Edwards. I knew Leroy [L. Gordon] Cooper. We called him Leroy. He's Gordo here. Tom [Thomas P.] Stafford, Frank Borman, and probably some more that would come to mind. Ted [Theodore C.] Freeman.

RUSNAK: Edwards, being the center of Air Force flight testing, is really the training ground for a lot of these people who came to the astronaut program. Were there any particular skills or experiences you developed there that you found useful in your later work?

HAINES: You mean at Edwards?

RUSNAK: Yes.

HAINES: Mostly how to work hard. I did learn a great deal, I think, about flying and the crew's role in flying. In fact, much of my career at NASA was spent in crew integration, crew training, things like that, flight control. Not mission control, but flight control, piloting.

RUSNAK: As you had mentioned, with Sputnik there was a kind of shock that the Soviets could beat us at something, and this was really sort of a national phenomenon in things like the missile gap and such. As someone who was working in the Air Force and with some high-tech things, what impact did this sort of negative publicity about the American technical community have on you?

HAINES: Oh, I don't recall any reaction except I had to work harder. It was a fearful time. Nuclear holocaust seemed not very far away, and there were several instances when I was in the Air Force where the strategic arm of the Air Force went on high alert. The Berlin Wall, Cuban Missile Crisis, it was a fearful time.

RUSNAK: Certainly the space program is a less overt way to do some of this competition in a less threatening fashion, in the manned space program, anyway.

HAINES: Well, I felt like it was a necessary thing that we ultimately move out of the Earth into other worlds. I still feel that. The picture we saw from the Moon on Apollo 8, when they took the picture of Earth from the Moon, had a lot of play at the time in the press and people saying, "We can now see the Earth as one rather than as different countries." That's very important, very, very important to me.

RUSNAK: Getting that picture was close to the end of what President [John F.] Kennedy had pledged in 1961, that NASA send someone to the Moon and bring them back by the end of the decade. But when he made that pledge, you weren't yet with NASA. Do you remember that having any particular significance to you, or did you think it was something even feasible?

HAINES: At that time and for many years thereafter, I thought it was wild. I think in the early years here at, then MSC [Manned Spacecraft Center] it was an exciting goal, but it seemed so unreachable. We had to have so much luck. We did have a lot of luck. We had government support. Kennedy and [Lyndon B.] Johnson were certainly an important factor in giving us the support we needed to do this, and we had some great leaders like Walt [Walter C.] Williams and Bob [Robert R.] Gilruth.

RUSNAK: It's certainly because of the hard work of people like yourself that we did get there within the time frame President Kennedy had established.

HAINES: A lot of people worked very hard for many years. I've heard people say, "We missed the sixties," and I think in a way we did. We were very insulated here from the rest of the world, not just at work, but the communities we lived in. It was very rare to have a neighbor who wasn't involved in the space program. I'm not saying we worked all the time, but even in your recreation, you were dealing with and you were talking about the space program.

RUSNAK: Did you personally have a lot of awareness of these other things going on once you had become enmeshed in the space program?

HAINES: Other things, like what?

RUSNAK: Either civil unrest or Vietnam, these kinds of large issues?

HAINES: Yes, we were aware of it, but I don't think we involved ourselves in it very much.

RUSNAK: Bringing you back to Edwards, how did you find out about an opportunity to come work at the new Manned Spacecraft Center they were going to build down here?

HAINES: NASA was getting a lot of publicity. *Aviation Week*, which I read faithfully because it was what I was interested in, was full of stuff on NASA. As a native Texan, I guess that was part of it, too. I was interested in coming back to Texas.

RUSNAK: Can you describe for me how you applied and whatever interview process was going on, how you came to work here, specifically?

HAINES: Wrote them a letter, got a response asking me to come down for the interviews. I remember my first interview was with this character named Gene [Eugene F.] Kranz. I don't know if you know him. You've probably met Gene. He is a character. He's a good friend of mine, and I've grown to respect him and like him over the years, but he was very different to me at that time.

I decided I didn't want to be a flight controller in places like Guaymas, Mexico and so forth. So I looked elsewhere and interviewed some people in the Apollo Program Office. I guess it was called the Apollo Spacecraft Program Office [ASPO] at that time. They thought my flight test background was very useful, so I did go to work in November of '62 in the Apollo Spacecraft Program Office. I think it was the Flight Technology Office.

RUSNAK: In 1962, you were one of something like 2,000 people that NASA brought in to the Manned Spacecraft Center. It was really expanding in size tremendously. Can you describe for me what it was like to be a new person down there, what the atmosphere was, the kinds of facilities they had, and the other kinds of people that were there?

HAINES: Yes. Of course, we were working then throughout Houston in various facilities, mostly along the Gulf Freeway [Interstate 45] on the southeast corner of Houston. One of the things most people would remember about that time was we reorganized every month, it seemed, trying to find a way to make all of this come together. Everybody was trying to create the job. Of course, JSC—MSC—had been in existence for some time before I got here, perhaps a year, depending on when you really draw the line for the start.

But new people were coming on, you know, every day, and it was a lot of flux trying to figure out what the job was and how to do it, and, for many of us, trying to learn how to work with contractors. I know in my job at Edwards I hadn't had much experience working with support contractors. I had no experience working with support contractors, and no business dealings working with aerospace contractors.

My involvement with aerospace contractors in the Air Force was just strictly technical. Never worried about dollars and schedules and things like that. Never worried about paperwork.

RUSNAK: So then these were obviously things that you concerned about. What was the first job that you had, the types of activities you were doing?

HAINES: I was working on trying to make sense of a test program, and it was hard to get my teeth into that. I never did very well at it. I spent a few months in that job and moved to a different job that I thought was better suited for my experience. It was called Crew Integration Branch, still in the Apollo Spacecraft Program Office. There we were worrying about crew training and crew procedures and crew controls and displays and crew equipment like spacesuits and so forth, from a program office standpoint, you know. What are our requirements and how are we going to pay for it? Working with the various offices throughout Johnson Space Center on developing those things.

RUSNAK: Is there anything else you remember from this first job in working out these tests and things like reliability and all of that?

HAINES: Nothing comes to mind at the moment, worth talking about.

RUSNAK: Crew integration was something that obviously you had a little bit more interest in, at least.

HAINES: Well, there were more things happening at that time. The flight-test program was awfully far away, and I wanted something that I could get my teeth into at the time. I got more than I could deal with.

RUSNAK: What kind of issues were you looking at? What were the first problems that you encountered?

HAINES: I don't know the first, but just for example, one of the first manned flights—of course, now, this Apollo. I never worked on Gemini or Mercury. But the first flight crew came to our office, the first manned flight crew came to our office, said they needed help getting crew procedures. Malfunction procedures were coming along very slowly. They were being developed by the spacecraft contractors, Rockwell [International] and Grumman [Aircraft Engineering Corp.]—North American [Aviation, Inc.], at that time, and Grumman. They were coming along very slow, and they asked for some help on getting the malfunction procedures developed.

I got a team of probably six General Electric [Co.] support contractors, people that I knew, and we took up the task of getting malfunction procedures developed, worked on it for several months, and developed new formats which are still in use today. It was a very interesting job. We sat down with the designers at North American and at Grumman, the subsystem designers and the subsystem test people, and worked over the systems until we knew how they worked and what their symptoms were when they weren't working properly and how best to deal with them.

That same small group of people, we also developed the integrated schematics that the Apollo flight crews took with them on the flight. They were a little different than the schematics the flight controllers developed for their own use. Ours had certain advantages that the flight crew appreciated, so that was a very interesting job.

Crew training, of course, was always, I think, a misunderstood priority. It was always a big deal meeting the crew training requirements. The astronauts were very serious about training. They didn't want to be the one that made the mistake. They wanted to train and train and train until they could do this job without any doubt.

We had, of course, a stable of ground-base simulators. On Apollo, one that I ended up working on was the lunar landing training vehicle [LLTV] in early 1969. I left the program office and went into what was then Flight Crew Operations Directorate to work on the lunar landing training vehicle. I don't know if you're familiar with that crazy thing.

We were out at a corner of the field at Ellington [Air Force Base, Houston, Texas], had our own little world out there, our own hangars, our own maintenance people, our own engineering staff, our own buildings. I was the assistant program manager in the early part of '69, and I took over as program manager as soon as Neil [A.] Armstrong's training was completed in June of '69, and I was the program manager until the end of Apollo. That was an interesting job trying to keep that crazy thing flying, trying to survive a crash.

There had been two accidents before I took over. There was one probably in 1970, late seventies, early '71, I can't remember exactly. We lost another vehicle. Finished the program with our last remaining vehicle.

RUSNAK: And now it's over in Building 2 on site.

HAINES: Yes.

RUSNAK: When you were working crew integration, you seem to be at the nexus of a lot of different groups. You've got the astronauts, these contractors, probably the people from Engineering and Development [Directorate] here at JSC, and the flight controllers. How did you manage all these different groups and what, from each of them, went into the areas that you were concerned with?

HAINES: I don't know. That's a little vague, you know, but I guess one thing I could say about that is that managing the people was pretty easy because everybody was working so hard to get the same job done. There was more work than could be done. There wasn't a lot of competition for work. Everybody was working together, rather than working for themselves against each other.

I probably spent most of my time in the crew integration job working with the Flight Crew Operations Directorate on both the astronauts and the crew integration people over there. Spent a lot of time working with the Crew Systems Division. For example, I can tell you a couple stories. We would have mockup reviews, and as a program office representative, my job was to organize and run the mockup reviews. The crews would come out. More than the crews, but the flight crews especially would come out and examine the spacecraft and run drills and then find out if they could really make this thing work and really fit in it and so forth.

The first command module mockup review we had, we put three astronauts in spacesuits in the couches, inflated the spacesuits, and the middle crewman popped out. The suits were just too big for that space. There was a big redesign of the spacesuit after that.

RUSNAK: I'm sure you want to make sure all three guys will fit in there.

HAINES: Another interesting story from my personal standpoint was, in spring of 1968 I had a pretty severe accident, broke my neck. It took me several weeks to get back to work, a couple of months, and when I came back to work, I was wearing a neck brace. While I was still wearing a neck brace because of this spinal injury, I went to North American and I was reviewing some test data, ground impact, landing impact test data, on tests that North American had been running, and I noticed some anomalies in the data that they tried to excuse as bad data. We were getting a lot higher impact accelerations and Gs than predicted and higher than were tolerable. This is, of course, the parachute landing.

The plan was to land on water except for certain aborts that could lead to a landing on land. Water wasn't much of a problem, but the land landing was pretty severe. Depending on how the spacecraft landed on a wave, the water landings could be [very] hard, [but not as hard as land landings,] if it landed flat on a wave depending on the parachute swing and the wave angles and so forth.

I got some dynamics engineers from our Engineering and Development here to see looking at the data, and they agreed that we couldn't excuse the data as bad data. I don't know if you're familiar with the design relative to this question, but the couches were suspended on struts, on like shock absorbers, to attenuate the loads of landing. The attenuation system they had developed was in some cases actually amplifying the accelerations rather than dampening them.

We spent several months getting a redesign done here at JSC, not by the contractor, done mostly by the Crew Systems Division, developing a new attenuation system. It was too late to fly in the first manned flight, the [Walter M.] Schirra [Jr.] flight [Apollo 7], but we got it in on Apollo 8. But I thought it was interesting at the time because part of the job was talking with experts around the country on what the human tolerance for impact accelerations was, and one of the most probable problems, the most prominent problems that you had in the impacts like this are spinal injuries, and I was still nursing my spinal injury.

I know that when we were at the crew debriefing for Apollo 7, I had, of course, made a lot of noise about this problem and about getting it fixed. Wally Schirra said, in the crew debriefing, "Where's Charlie Haines? He was telling us we were going to have a hard landing, and we hardly felt anything at all." When we went to the crew debriefing for Apollo 8, Frank Borman said, "When we landed, when we hit the water, we were stunned." So, you know, it's just a matter of what the impact conditions were, how the spacecraft met the wave.

End of that story.

RUSNAK: Most of the problems you've been mentioning have been with the command module. Do you remember any significant differences from your perspective between the Block I and the Block II spacecraft, even before the Apollo 1 fire?

HAINES: It was a huge design change in every respect. The control display panel was completely different. The Block I command module control system was what we termed at the time "subsystem select." You had a primary system, the primary navigation and control system, that was developed by [Charles Stark] Draper Labs at MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts]. Then you had a backup control system that was developed. The stabilization and control system, it was called, developed by North American. To oversimplify this, you selected a primary. If it didn't work, you went to the backup.

The astronauts, being test pilots, they didn't like this at all. They wanted to be able to get down into the system, each of the systems, and select the parts of it that were still working, rather than just having one mode decision. Use PGNS [Primary Guidance and Navigation System, pronounced "pings"] if it's working; use backup if it's not. So we completely redesigned the control displays and all their fingers into the subsystems. It affected not just the control display panel that you could see sitting in the spacecraft, but it affected all the wiring and the access to all the subsystems. The astronaut that I remember working with most on that was Ed [Edward H.] White [II].

We had lots of weight-reduction activities getting to Block II. Of course then many changes came out of the Apollo fire. The hatch, for example. The Block I hatch was a monster. The first mockup review we had where we had an astronaut trying to do an emergency egress, he broke the hatch. It was so complicated. That was Jim [James A.] Lovell [Jr.], I believe. But again, we couldn't foresee.

Let me start over a little bit here. I'm getting off your question. But we had talked about fire in a 100 percent oxygen atmosphere. We talked about it, we thought about it mostly from the point in being in space where you were at 5 psi at total pressure and zero gravity where you didn’t have the normal convection acceleration of fire. Let’s see. When was the fire? Early ’66?

RUSNAK: '67.

HAINES: ’67, February of ’67. Probably in 1966, then, early on, the boss of the Apollo Spacecraft Program Office was Joe [Joseph F.] Shea. He had received a question about fire, and he asked me to go talk to the Gemini Program Office, get their view on the fire hazard, which I did. They were like we were; they were thinking of it from the point of being in space. They weren’t very much concerned about it. A big mistake on our part.

I don’t know if you’ve had a chance to interview a man named Howard [John H.] Kimzey. I think his first initial is J, but his name is Howard Kimzey. He was the one that was raising the flag of the fire hazard. But it just didn’t come across to anybody at that time that it could be as bad as it was. So we spent a hard year recovering from that. A year and a half, I guess.

RUSNAK: What were some of the changes then, aside from the hatch, which you already mentioned, that were made?

HAINES: Mostly in materials, getting rid of flammable materials, and in testing. We tested every material. I wasn’t personally involved in that, but several of my friends were personally involved in selecting and developing new materials. Of course, we weren’t actually developing them. We were developing for this application. We had a lot to learn about things like beta cloth and how we could really use it. But getting rid of a lot of flammables and running tests on all the nonmetallic materials, and in the full-up spacecraft, boilerplate spacecraft flammability tests.

RUSNAK: Certainly the command module they ended up with was very successful in all respects, I guess, without any of these sorts of significant issues.

HAINES: Yes, it was astounding how well things went after that.

RUSNAK: One thing we haven't talked about at all is the lunar module and any work you might have done with that.

HAINES: Yes. I worked somewhat less with Grumman than with North American. For example, on the malfunction procedures and on the spacecraft schematics, we did those for the LM [lunar module] as well as for command module. Early years, I was deeply involved with Grumman on setting up the engineering simulation program for the lunar module and crew requirements, crew equipment, crew integration for the LM as well as for the command module, but just somewhat less than command module.

RUSNAK: Did you find significant differences between working with Grumman and working with North American?

HAINES: Oh, yes, they were different. Grumman, their entire history had been working with Navy aircraft. They were very good engineers. They had less experience in what they'd started out to do than North American did. But their big handicap was weight. The numbers are not real sharp in my mind, but it seemed to me that when we let the lunar module contract, we had a weight budget for the LM of 11,000 pounds, and before seven or eight months were out, the weight estimate was 22,000 pounds. Whoever had done that was just severely optimistic.

Of course, Grumman had another problem. They started perhaps a year and a half or two years after North American did. But that job was underestimated, and I don't think it was Grumman's fault. I don't think the delays were Grumman's fault. I think the job was just underestimated, the time, the schedule, the weight. That cost a lot of money to get weight out of the [lunar] module, and, of course, we never got back to that 11,000-pound budget.

RUSNAK: Some people have suggested that the lunar module design or the concept for the lunar module was underestimated from the very beginning. As soon as they chose the lunar orbit rendezvous method, that the weight estimates were optimistic.

HAINES: Yes, I suppose that's so.

RUSNAK: Out of curiosity, were you around when they still hadn't yet made this mode decision or was that before you came?

HAINES: The lunar orbit rendezvous was before my time. I'm sure that was a very traumatic decision. I don't think anybody ever second-guessed it, though, after the decision was made. I think it was the right one. It proved to be.

RUSNAK: Certainly the fact that it got us to the Moon and back seems to validate the decision that was made then.

HAINES: Yes.

RUSNAK: You've mentioned both North American and Grumman, the major contractors, but earlier on you had suggested that working with support contractors was a little bit of a learning experience as well. Can you share some of your thoughts on that?

HAINES: Well, the first thing we had to learn was that we were going to do it. I think a lot of us thought, "We don't need any help." Certainly we learned how to work with support contractors just as though they were civil servants. There were very many valuable people, very many good friends came out of the relationship. It was a way to overcome our shortages when we needed somebody, some skill we didn't have, we could usually find it through a contractor.

RUSNAK: Like what kind of work, for instance?

HAINES: Well, for example, the schematics that I was talking about. I didn't have anybody in our shop that could have done what those people did, that six- or seven-man group did.

RUSNAK: A lot of the original Space Task Group members and people that became the core of MSC were these people who would come out of the NACA [National Advisory Committee for Aeronautics] and were research engineers who they, themselves, didn't have a whole lot of experience working with contractors, so it was kind of a new experience overall. Did you find yourself fitting in with these groups of people?

HAINES: In that same way, yes. My background, I didn't need support contractors, and they had come out of the same kind of environments. I may be overstating this, but we had a hard sell. After a couple of years, no one would have thought to go back to trying to do the job without them. They were too much ingrained in everything.

RUSNAK: I guess, for them, both Mercury and Gemini were steps towards Apollo in this respect, getting the larger and larger programs where you get more activity that you need these kind of contractors to do support.

HAINES: One of the things that's interesting, I don't know if you've come across this in your studies, but the relationship of Apollo to those earlier programs. We had a hard time working with the other programs. We didn't have time to mess with them, you know. We were so busy, involved in what we were trying to do, we didn't have time to go talk to anybody else. We did. Not often. Not as much as we could have.

Well, every time we tried—for instance, the Gemini docking system. We were having trouble with the Apollo docking system, development problems. So a group of us went to talk to the McDonnell-Douglas, who was developing Gemini, to talk about their docking system. Their docking system was so massive and heavy, they did not have the weight constraints we had. We simply couldn't use any of their design.

The other problem we had with the command module LM docking system was we were trying to over-design it. I believe they were trying to design for an impact of contact velocity of, I believe it was something like four feet per second. I remember suggesting to the engineer in the Apollo Program Office who was most responsible for this—he felt the number was a little high—I remember suggesting to him that he go home that night and drive into his garage at four feet per second and see what it looked like. The lesson was that no pilot could stand such a contact, could stand driving in at such a speed.

I think we proved with the simulations, which was another hard sell, we proved with the simulations that we didn't need anything like that, we could take a lot of metal out of the docking system and didn't have to have such a massive system.

RUSNAK: Some of the people we've talked to have suggested that Gemini was more useful for the operational experience.

HAINES: That's very true. That's very true. While we in the program office didn't have a lot of interface with the Gemini Program Office, some but not a lot, the people in flight crew operations and in flight operations, they were the same people working the two programs.

In operations, it was vital what we learned, especially in Gemini, rendezvous, docking. There were a lot more crew activities in Gemini than in Mercury, you know, extravehicular activity [EVA], for example. We learned a lot from those activities.

RUSNAK: Did you find that, for example, the Crew Systems people, the astronauts were applying their experience from Gemini to how they—

HAINES: Oh, definitely. You know, the astronauts—I'm sure it's the same today—the astronauts have always been our toughest inspectors. Those guys are good. They were smart. They were accustomed in those days—they were also test pilots—they were accustomed to having their hands involved in things and asking questions, and none of them were going to get in a spacecraft that they didn't really, truly understand and know why it was built the way it was and to fly a mission that they didn't understand and why the mission was constructed the way it was.

As I mentioned before, they would train, train, train. They were not going to be the one that made the mistake.

RUSNAK: As far as training went, then, did you help manage the things like training schedules and such, or what was your involvement with that?

HAINES: Well, in the Crew Integration Office, we had people that worked on nothing but simulators, in the Apollo Spacecraft Program Office that worked on nothing but simulators. I was never that deeply involved just in simulators, but always involved in training, because in training we learned things we had to go fix, a lot of things we had to go fix.

Then later, as I mentioned earlier, after I moved out of the program office, I was full-time training, trying to operate the lunar landing training vehicle, which was an exciting program. It was the scariest thing you can imagine. Again, the thing was suspended in free flight by a jet engine. If the engine failed, the thing fell out of the sky very rapidly. The pilot had an ejection seat, and it was used three times, successfully.

The vehicle was very complicated. It was built on a severe budget. We had a hard time getting it to work, and we just about worked some people to death. I remember probably in the training cycle for Apollo 13, no, probably 12, one of the engineers came to me one Friday and said, “I understand we’re working again this weekend.”

I said, “Yes.”

And he said, “Do you know how long it’s been since we’ve had a day off?”

I started thinking about it, and I said, “Cancel the work this weekend." We'd worked weeks on end without a day off just trying to get that thing working well enough that we could put an astronaut in it.

RUSNAK: Why did you make the change from this crew integration job to the LLTV Program?

HAINES: The guy that was running the LLTV wanted to get out of it, get back to the mainstream.

I mentioned earlier that I had known Deke Slayton at Edwards. He was a test pilot on a project out of an office I was working in. I was not working directly with him, but I knew him from that. I had some experience, some interfacing with him at JSC when he was head of Flight Crew Operations. The LLTV came under Flight Crew Operations. He needed a new manager. He thought of me and offered me the job. It sounded like a step up.

RUSNAK: You mentioned you came on board right around the time Neil Armstrong was finishing his training. You were, first, deputy and then head. This was also in the period after there had been the two crashes, one with the lunar landing research vehicle [LLRV], and then the second one with the first LLTV. How had the office gotten through these issues, and what sort of status was the LLTV Program in when you joined?

HAINES: When I came on board, it was a maximum effort, and, of course, I wasn't much help to them, being new. They had made fixes to accommodate the problem that caused the second crash. It was a maximum effort to get the vehicle modified and tested and back in service in time for Armstrong's final training.

Neil had flown the LLTV quite a bit. In fact, he had been one of the ejectees, due to loss of control, which was not a pilot problem, it was a vehicle problem. So he had the advantage that he had quite a bit of LLTV experience. He got exactly one weekend of training before he flew. In June he got one weekend of training. I think he got seven or eight flights in one weekend. It was really a good effort.

The maintenance and operation of the vehicle at that time, the maintenance at least of the vehicle at that time, was the responsibility of Bell Aircraft, who had developed and built and vehicle. One interesting thing about that, probably in 1968, my boss in the program office came to me with a question, who's going to be the commander of the first lunar landing flight? I can't remember why we thought we needed to know that, but we did.

I dug into it a bit and came back to him and said, "It's going to be Armstrong. And the reason is, nobody else can meet all the training requirements by the time." Mostly, in my mind, it was because the LLTV, I had a very bad opinion of it at that time in regard to its reliability and its ability to function and be operable. and I felt like Neil had a big step up on all the other competitors because it was going to take so much time to get that many flights in the LLTV. Nobody else had flown it. Nobody out of the Astronaut Office had ever flown it. And then, of course, I don't know that that's exactly the reason he became the first lunar landing commander, but I believe it was part of it anyway.

RUSNAK: That certainly gave you some indication of who it might be ahead of time. Did he give you any feedback in terms of how well the LLTV simulated the actual flight of the lunar module?

HAINES: Yes, in fact, we debriefed all the crews. They all said the same thing: it was very valuable training. We thought it did a very good job of duplicating the characteristics of the Moon, specifically the 1/6G and the lack of an environment, which affect the way a vehicle flies.

Of course, LLTV training had two real purposes. One was to teach the pilot how to control the aircraft in that weird environment, no aerodynamics to slow you down, for example. The factor of 1/6G means that you've got so little thrust, you've got less thrust than you're accustomed to flying a helicopter on land. You have to tilt the vehicle much, much more to get the same lateral acceleration out of it because you're only tilting one-sixth of the thrust that you would be tilting if you were in a helicopter or a vertical flying machine on Earth.

So we taught him how to fly that machine in a real environment, something that's a little different than flying a fixed-based simulator or even a motion-based simulator that's glued to the ground.

But the other really important aspect of LLTV training was, it was scary. Once you went through that, you know, you were a little calmer in the LM, and I think it helped in that regard, too. It was a conditioning exercise.

But the pilots were all serious. They would not give up. There was several times when Dr. Gilruth seriously tried to question the LLTV. It was just too scary. And I speak of that as the program manager. We had a tough time operating it. There were several times when he seriously raised the question, "Why can't we get rid of this thing?" And the pilots wouldn't hear of it. They felt like they had to have that conditioning. Again, they weren't going to be the ones that made the mistake.

RUSNAK: Did the lunar module pilots have a chance to fly it as well?

HAINES: No.

RUSNAK: Just the commanders?

HAINES: Yes. Originally, it was planned that they would fly it, but we had a hard enough time meeting the requirements for one man per mission. [While we did not let LM pilots fly the LLTV, *all* backup commanders did receive LLTV training.]

RUSNAK: That was then sort of a maintenance and upkeep issue and time scheduling rather than a safety concern?

HAINES: I think safety was a big part of it, too. The risk, if you're flying the lunar module pilot, is the same. The payoff is not as great because he's not that likely to get that call to take over the LM.

RUSNAK: Several times you've mentioned how scary this program was. Could you imagine something that could have improved the program or perhaps an alternative flying machine that would have given a similar experience?

HAINES: We could have started over and redesigned it and improved it. But that's true of anything, isn't it?

RUSNAK: Yes, I suppose so.

HAINES: But that's totally impractical. There was some things about the design and the electronics that I never agreed with, and we seriously talked among ourselves about a major redesign, but never could convince myself that the improvements we would make would really pay for the development risks of going through it.

RUSNAK: You had mentioned that there was a third crash, and you were left with one LLTV for the rest of the training. What happened in that third instance?

HAINES: Lost electrical power. It was one of our staff pilots, Stu Present, one of the Aircraft Operations Division staff pilots, not an astronaut. It was a vehicle checkout. We had been through some maintenance program, and he was doing a functional check flight. He lost electrical power, and without electrical power, nothing worked. The vehicle started going out of the control, and he ejected successfully.

The vehicle was designed so that if you lost electrical power, there was an immediate switch to a backup system, which used a different power source, used a battery rather than a generator, the generator driven by the jet engine, of course.

It took us a long time to figure out what happened. We couldn't figure out why the vehicle did not switch to backup power. Of course, when we lost electrical power, we lost our telemetry. We had no data on what was happening, but we tested the vehicle and tested the vehicle and tested the vehicle, and we always got the switch. We finally figured it out. I don't know if you're interested in going into this kind of detail.

RUSNAK: Yes.

HAINES: We had some glitch which we could not identify, and it could have been anything. A short somewhere in the system caused an electrical pulse that kicked the generator off line, which is fine because now we can switch the backup battery and bring the vehicle in for a safe landing. However, what we finally learned was that when you cut the exitation power to the generator, the generator is still turning because it's being driven by the jet engine. The residual magnetism created enough electricity to keep the relay that was supposed to drop out from dropping out and switching to the battery.

Once we hit on that "eureka," we ran the test, demonstrated that that would create exactly the symptoms we saw, redesigned the vehicle again, and got back in operation in time. I can’t remember if that was before Apollo 16. Probably. Probably before Apollo 16, maybe 15.

RUSNAK: I guess I hadn’t realized that you guys did have telemetry from these yet. Was that something for all the flights, too?

HAINES: Yes, we had real-time telemetry. We had a little control van with a five-man flight control team monitoring the thing, controlling what happened.

RUSNAK: Is this something they had from the very beginning, so they had it for previous accidents as well?

HAINES: They had it from the beginning, yes.

RUSNAK: In retrospect, it seems like a good thing to have included in the program.

HAINES: Oh, yes, yes.

RUSNAK: Do you remember any of the other comments from other pilots flying it, some of the later Apollo commanders, for instance?

HAINES: I remember a joke, it really happened. We had a twenty-year reunion of the lunar landing training vehicle people, and John [W.] Young was there. Of course, he was one of the trainees. One of the men told John, he said, "I never understood why you always called it the LTV, John, and not the LLTV. Why did you do that?" And John said, "Well, lunar landing training vehicle, I was pretty sure I was going to get some training, but I was never very sure I was going to be able to land that son of a gun."

No, the pilots, their post-flight responses were always that it was valuable simulation and that we couldn't do without it.

RUSNAK: That joke sounds like typical John Young.

HAINES: John is a character. I hope you've had a chance to interview him.

RUSNAK: We haven't just yet. We certainly intend to, but he's still a very busy guy, still working over here at JSC in Mr. Abbey's office, so one of these days we hope to get him to sit down and talk with us for a while.

HAINES: It will be an experience.

RUSNAK: So I understand. Obviously, with the Apollo Program having a limited number of flights, eventually you knew it was going to end with 17, what kind of future did you see for your program or what kind of things did you see moving into?

HAINES: Shuttle Training Aircraft [STA]. Being in Flight Crew Operations Directorate and having my background, I was tagged to be the project manager for the Shuttle Training Aircraft. Started working on it, I guess, 1973, maybe late '72.

We went through a Phase B contract with Lockheed, who had proposed the JetStar, and with Grumman, who proposed the Gulfstream II. I don't know if you're familiar with this, but Lockheed had built a flying simulator, a variable stability aircraft from a Jet Star. They had done this for the NASA Flight Research Center at Edwards. So they had some very good experience in how to make one airplane fly like another one would fly.

Grumman had a very good proposal. Their primary advantage was they could use in-flight reverse thrust. It turned out to be vital. There was just no way we could simulate the Shuttle drag aerodynamically. It would have taken a drag chute to do that, and that would not be practical to do.

So we went to a Phase B contract, study contract, with Lockheed and Grumman, awarded the contract to Grumman, primarily because we were convinced that we had to have the in-flight thrust, that every time we got a new aerodynamic data package on the Shuttle, the lift-to-drag ratio was going down, down, down, and looked like the end was not yet reached, and that we had to have a way to simulate a vast amount of drag, and that the only way to do that was with the in-flight reverse thrust. It turned out to be true. We had development problems with in-flight thrust, in-flight reverse thrust. They were ameliorated. They didn't go away, but they were resolved well enough that it did become a very useful training.

RUSNAK: Both those aircraft are generally in the same class. Was there any consideration of a completely different type of aircraft, something smaller or larger or something completely new?

HAINES: I don't think we ever considered anything new. We did talk about smaller aircraft, for example, a fighter would have had some advantages over what we ended up with, the Gulfstream II. It would have been stressed for a higher G level. It would have been cheaper to operate. I'm not sure it really came out to be true, but we felt like we needed something of the size that somewhat approached the Shuttle. I think that the way the Shuttle ended up, that became less important than we thought in the early days, but we thought we had to have something a little larger than that, than a fighter would have been. We also liked the idea of having an instructor pilot side by side with the trainee.

RUSNAK: You also mentioned receiving updated data packages in terms of the Shuttle's aerodynamic data, lift-to-drag ratio, these kinds of things. How did you go about picking a simulator for something where the design is not even finalized yet?

HAINES: Yes. You have a good question. Well, there were some difficulties that came out of that. We had two development problems in the STA, the one I mentioned earlier, the use of in-flight reverse thrust, and we can talk about that more if you want. The other one was flight control system response. The flight control people that were advising the source selection board convinced us that the Shuttle flight control system response would be so slow that the Gulfstream II control system could keep up with it. That's not true. That didn't happen that way.

Of course, all we were interested in was the final descent and landing, from 40,000 feet down to landing, down to touchdown. The Shuttle is a delta-wing aircraft and it exhibited some of the characteristics that I had grown up with on the B-58, which is a delta-wing aircraft. It’s a short-coupled control system. The elevons that control pitch are pretty close to the center of gravity. They're not way back on the end of the fuselage with a long control arm. They, therefore, have to be very large. They're right on the end of the wing, and they are very large.

The pilot, for example, pulls back on the stick to increase lift, rotate the aircraft up, the first thing he feels in the seat of his pants is not a lift, but a dropping. He pulls back on the stick, the elevons go up, they kill the lift. They not only create a moment to rotate the aircraft up, which eventually will give you more lift at a higher angle of attack, but they also instantaneously reduce lift. So the first thing the pilot feels is a sinking sensation.

If you put a pilot in a critical situation such as a landing where he’s very busy and very interested in doing a good job of getting this thing on the ground, he pulls back on the stick, he wants more lift, he pulls back on the stick, he senses that he’s losing lift, he pulls back too far. He pulls back farther. Then the aircraft has rotated, he starts to feel the increased lift, he corrects forward, and he gets into what we call pilot-induced oscillation [PIO]. If the dynamics, the frequencies, are such of certain range, he’s going to get into an oscillation where he’s just following the aircraft. This was a problem when teaching the early Shuttle pilots.

In fact, the first Approach and Landing Test [ALT] where we dropped the Shuttle from the back of the [Boeing] 747 [Shuttle Carrier Aircraft] at Edwards, the pilot got into a PIO. What I’m getting at now with respect to the STA is that the Shuttle flight control system turned out not to be that passive. It was a pretty dynamic system, and we really had to work hard to make that Gulfstream II commercial jet aircraft control system come up to that speed. We didn't do it by changing out all the hydraulic systems and everything, we did it just by optimizing the control laws, the digital computer control laws that were driving the system. It was a big push. Cost us a lot of time and some money, as well as the in-flight reverse thrust cost us time and money. This was early and that was one of the problems, one of the difficulties, of being the head of the program.

Another difficulty that I personally experienced, being the head of the program, mine was the first project that went into cost overrun because of the two technical problems that we had that we had to solve. They stretched out the program. I got a lot of attention because of that cost overrun. Mr. [George W. S.] Abbey would be very familiar with that.

RUSNAK: You were under the Shuttle Program office, is that right?

HAINES: That's correct.

RUSNAK: Did you get any attention from the likes of Bob [Shuttle Program Manager Robert F.] Thompson?

HAINES: Well, I got to know Mr. Thompson very well.

RUSNAK: I'm sure they could at least understand some of the problems that you were facing, given the development curve of the Shuttle and these kinds of things.

HAINES: Yes, and we had foreseen both of those problems. We had gone back to the Engineering and Development people, [the] Guidance and Control Division people, and talked to them about the control system response and got assurances that the performance of the Gulfstream II system would be adequate.

We had arranged a wind tunnel test program at Langley to investigate this in-flight reverse thrust thing. We ran a wind tunnel test program up there, got good answers out of that, which turned out to be optimistic. When we went into reverse thrust in the Gulfstream in flight, we got some bad surprises. The Gulfstream II was certified for use of in-flight reverse thrust at idle speed. You know, a commercial FAA [Federal Aviation Administration]-certified Gulfstream II could use reverse thrust in flight at idle power for descent.

What we needed because of the Shuttle L-over-D [lift over drag] going down, down, down, what we needed was high powers, up into the 90-percent range. I believe we ended up limiting it at 92 percent of RPMs [revolutions per minute]. Really used a lot of thrust. If you can envision what a Gulfstream II looks like, we were getting the reverse thrust exhaust impinging on the horizontal tail. We got a lot of vibration. It was a fatigue problem. We called in experts from all over NASA, propulsion experts, trying to figure out what can we do to make this go away.

I had a very bright engineer working for me at the time named Royce [L.] McKinney, who came up with the answer. He didn't do it overnight. I mean, we were into this for several weeks, maybe a couple of months. I don't remember. But he came up with a very clever idea of splitting the exhaust plume into numerous small plumes, which doesn't get rid of the energy, but it causes the frequency of the energy to go up, got it out of the range where it was interacting with the structure so highly.

So I'm sure they're still worrying about fatigue and replacing components periodically, but it's obviously been a very successful simulator.

RUSNAK: Since they still use it.

HAINES: Yes.

RUSNAK: You mentioned wind tunnel testing, and I was curious to see what other sort of testing regimens you had to put the Gulfstream through to get it certified for flight.

HAINES: Well, of course, the flight test program was run by Grumman, with our participation. We had one of our pilots was on board for all the flights. We had engineers and quality inspectors at the Grumman plant during the test program, but went through a full-blown flight test program with them, and it was run very well and was a good program. It just had too many problems, more than we would have chosen.

One of the difficult things, one of the challenges was, again, it was a conditioning thing like I mentioned on the lunar landing training vehicle, teaching the pilots, conditioning the pilot to come in at this extreme angle, descent angle, and flaring an unpowered vehicle at the last moment. Of course, the Shuttle training aircraft is not unpowered, and with just this little single switching action, the instructor pilot can come out of reverse thrust and go into forward thrust very quickly and recover from a bad landing. But it's an awesome view looking out the window with the ground approaching when you're coming down at about 18 degrees flight path angle at 280 knots or so. It's an awesome view. You get down to 1700 feet or so, and you're ready to pull up. But it works.

First, we had an astronaut assigned to the Shuttle training aircraft development program, Joe [H.] Engle. Joe is one of the really good stick and rudder people. A lot of good experience, X-15 pilot and so forth. He was finding the PIO tendencies as well. Before the ALT incident, he was seeing that. We had a hard time working with him, proving that it was a valid simulation, because if you fly the fixed-base simulators and the motion-based simulators for the Shuttle, you don't have a PIO problem.

We developed some interesting data about that, that I think explained it very well. We looked at control stick activity from the various simulators that were extant at the time. Fixed-based Shuttle simulator, a motion-based Shuttle simulator, a simulator we used sometimes out at Ames [Research Center, Moffett Field, California] that was in a huge hangar several hundred feet high that actually traversed hundreds of feet in a vertical descent. The pilot really got a terrific sense of the real motions from that simulator. And then, lastly, the Shuttle Training Aircraft.

We showed that as you went up in that sequence from fixed-based to motion-based to this free vertical simulator, it was not a free-flying simulator, but it had a lot of free motion, to the Shuttle training aircraft, the pilot's control stick activity went up higher and higher and higher. It's very rational. When you're in a fixed-base simulator, things look a lot different than when you're in a real airplane running at the ground.

We finally convinced the community that the Shuttle had a control system PIO problem, and worked with some very good engineers out at the Flight Research Center

[Edwards, California] who developed a fix for that that we had some problems selling, but basically what it did was sense the pilot's control stick activity and cut the gains accordingly. If the pilot's gains going up too high, if you understand what I mean by gain, if he's too active on the stick, it damps, it mutes his output, the output of the stick. So he's maybe working a little harder than he should, and the control system is recognizing that and working a little less.

Of course, the classic cure for a PIO is just to get off the stick. When the pilot recognizes that he's in this thing, and an experienced test pilot can do that, will recognize that, that he's in a PIO, he just relaxes, tries to just control the large amplitude stuff, and leave the short period, quick oscillations alone. Let them go. Let them go. Again, that's a problem we had on the B-58, trying to teach the pilots to fly the B-58 at mach 2 with the yaw damper off. It was a similar problem. You could make slow inputs, keep the wing sort of level, keep the nose sort of level. You try to do more than that, if the yaw damper failed, you tried to do more than that, you were going to get into a huge oscillation and lose the airplane. As long as the yaw damper was operative, it was a sweet flying airplane at mach 2.

RUSNAK: Well, if we can stop for a moment to change out our tape.

We've been talking for a while now about the Shuttle Training Aircraft and what you've had to do to modify this Gulfstream to simulate the Space Shuttle, at least in the last 40,000 feet. If you could run us through the flight profile that this goes through, how it simulates the Shuttle flight as it's coming down ,and what's going on to actually train the pilots for the Shuttle.

HAINES: It's been a while. Let's see how well I can do it. Of course, the instructor pilot is in control of the aircraft, climbs to initiation point, whatever it might be. I suspect they're still doing what we were doing in the early days. Most of the time we were doing descents from, say, 12,000 feet to landing rather than going all the way up. That's the one where the pilot really needs most of the training that's he's getting in the real airplane.

But the instructor pilot [IP] sets up the initial conditions, the right altitude, the right speed, the right position in respect to the runway, sets up the simulation and switches over to the simulation mode, turns control over to the training pilot, who is in the right seat, who has not the control wheel column that the IP has, but just the hand controls that the real Shuttle has. They're actual Shuttle hand controls and so forth. Many of his displays and controls are actual Shuttle instruments or duplicates, simulations of the Shuttle instruments.

Also he has screens on his windows so he only has a limited view. He doesn't have the full view that the Gulfstream II provides. He has a view that more closely simulates what he would see out of the window of the Shuttle, the actual Shuttle. So he's flying a profile that brings him down and controls his energy and position and brings him down onto the glide path. It seems to me they enter the glide path at 12,000 feet. I'm not sure of that. It's been some years. He flies a then constant glide path of 17, 18 degrees, down to the initial flare point. What he's trying to do in this glide path is just keep his position and his energy and his speed so that he can get to the flare point with the right energy, the right speed, and the right position with respect to the runway.

The flare point is, I believe, around 1,700, 1,800 feet. He does a controlled pullup to flare just off [above] the runway, drops the gear, and he's using speed brakes to control his air speed as well as the hand controller for the attitude of the aircraft to control his air speed.

While he's doing this, and he hopefully thinks he's flying a real Shuttle, the STA controlled by digital computers—all of his commands are going to digital computers, which then control the flaps, the ailerons, the rudder, the elevators, and the reverse thrust, to make this airplane move as if it were a Shuttle. The original STA had two surfaces underneath the fuselage called side force controllers. This gave us, with the flaps, the reverse thrust, the ailerons and the elevators and the side force controllers, gave us full six-degrees of freedom, in every degree of freedom, three motions in rotation and three motions in velocity, gave us full six degrees of freedom of control so we could duplicate anything, any motion the Shuttle did.

What they found is that the pilot, after we got the Shuttle control system refined in the ALT program and got the training refined and so forth, what we found was the pilots were able to control the Shuttle well enough that he doesn't get a lot of wild gyrations. We really didn't need the side force controllers. The kind of motions, the kind of control activities that would create large lateral accelerations are the kind you don't want in an airplane anyway. If you're able to control it pretty well, you don't get enough lateral accelerations to justify having the side force controllers on there.

They're a bit of a safety issue, because if you ever had to land gear up, those things were mounted in a fuel tank. The wing, of course, is a fuel tank in most airplanes. They were mounted right in the root of the wing. So those were taken off many years ago. I don't know if you've seen pictures of the STA with the side force controllers on. They're pretty big devices.

As I said, the digital computer is interpreting the pilot's commands as well as the aircraft response and changing the commands to the control system, the surfaces, and to the engines to duplicate what the Shuttle would do under that exact same circumstance. It's got modes in it to allow you to simulate turbulence. I don't know whether that's still in use or not.

RUSNAK: What kind of preparation would an astronaut have to go through before he'd get behind the stick of the STA?

HAINES: Well, of course, he's been through the ground-based simulators and knows the Shuttle inside and out by the time he gets in the STA. In his first flights in the STA, in the days when I was in the program, and I left in 1978, by the way, his first flights didn't go all the way to the simulated landing at ground level. We'd do flares to simulate a runway at 2,000 feet or so, so that he would get to ease into the problem of coming…down this pretty severe glide slope.

The other thing, and I suspect it's still in use, is we had modified some T-38s with high-drag devices so that they could simulate that same glide slope. Now, of course, that T-38 doesn't have the control system characteristics of the Shuttle, but he could fly the trajectories and familiarize himself with the way the runway looks at various points in the approach and how to control the trajectory. So he's done those things before he gets in the STA. I have no idea what the current training syllabus is, how many flights it is and what modes they look at and so forth.

RUSNAK: I'm sure we can find out if we need to.

You mentioned you left the program in '78. Why did you transfer out of there?

HAINES: I'd been working very hard a long time, looking for something different. I went back to the program office, and this time the Shuttle Program office. Operations Integration, I believe, was the office name. Doing some of the things I'd done back in Apollo, crew integration kind of activities, although from this point it was more budget and schedule stuff rather than hands-on engineering work. Of course, budget and schedule were big things at that time, very big things.

The only big technical activity I had in the Shuttle Program Office was the investigation into the Shuttle control system with regard to this PIO that we talked about earlier and with regard to understanding the aerodynamics uncertainties of the Shuttle and how the real vehicle was going to react during reentry and landing. I had some very interesting times working on that problem with the engineers at JSC, the engineers at Rockwell, and again, very capable people out at the NASA Flight Research Center.

You may be aware that they had flown a series of test vehicles, lifting body vehicles, we called them at that time, investigating the aerodynamics of a Shuttle kind of vehicle. I can't remember what they were, but they had three different vehicles, manned vehicles that they flew where they simulated a great part of the Shuttle reentry and landing. We learned a lot from those people.

RUSNAK: Do you mean specifically in the realm of flight control and these types of things?

HAINES: Basically, two areas. One is flight control, piloting control, in both the short period control and the trajectory control. And the other one, understanding the aerodynamics of the

Shuttle. You know, the Shuttle had gone through an extensive wind tunnel program. Wind tunnels are not perfect tests. One of the big issues we had leading up to flying the Shuttle was making certain that we could tolerate the uncertainties that might exist in our understanding of the aerodynamics.

We had a huge program going of playing with the variables, trying to decide for each variable, for each of the aerodynamic variables—and there are many—what might our range of uncertainty be and how should we combine this uncertainty with other uncertainties to discover how best to design the control system to tolerate those kind of surprises that might occur.

It's turned out, I believe, that Shuttle aerodynamics were predicted pretty well. They went through a big effort and did a good job of predicting them. There were some few little surprises, but things went pretty much like it had been predicted.

RUSNAK: You mentioned some of the changes that were made to the control systems, such as where the pilot, if he got into something like the induced oscillation, that the control system would dampen the gain, as you said. Were there other ways of circumventing these kinds of problems that were inherent in the way the vehicle would respond?

HAINES: Well, in the ALT Program, the Approach and Landing Test Program, the pilot—I hope I've got this correct—the pilot had a switch that was not standard Shuttle, where he could cut the gains in half. When he got in the airplane, they came loose from the Shuttle Carrier Aircraft and if he discovered he had control system problems, he could do things like cut the gains in half. Perhaps he could also double them. I don't think so. You know, to react to control system problems he was having. Didn't have to use those kinds of things. But, as I said, the first landing, there was a bit of a PIO. If you've ever seen the video of that, it's pretty obvious.

RUSNAK: I think he responded to that problem in the way you had suggested, just let go of the stick and let the aircraft recover.

HAINES: Actually, the co-pilot sensed it first and called to him to get off the stick.

RUSNAK: We've heard about that from a few different people involved with the program, not only from the Flight Crew Operations side.

Were there other issues when you were doing the operations planning, these kinds of things, in the Shuttle Program Office that you remember being particularly significant?

HAINES: Oh, I don't know. Let's see. We spent a lot of time on simulators. We spent a lot of time on the tracking and data system. Spent a lot of time and money on that. We spent a lot of time and money trying to develop and trying to get the GPS into the Shuttle even in those early days. We could show numbers how we could save money if we could get the GPS, Global Positioning System, to replace all this ground tracking network, but didn't have the money to put in to make the investment to get it. Then the Air Force GPS Program lagged significantly, so it wasn't nearly as early as they had proposed it to be. Those days in Shuttle, time and money, that was what we worked on. Time and money were nonexistent, almost.

RUSNAK: How did that compare with your days in Apollo when you were working similar kinds of activities?

HAINES: Time was the pressure. Money was never an issue. I always said, if we had a problem, we threw money at it to make it go away. I don't remember any pressure on money. There were some things we didn't do because they cost money, but they were not important.

RUSNAK: So it was just something else you had to learn to deal with as you went along.

HAINES: Yes. And the Shuttle, as all our programs are, was optimistically conceived.

RUSNAK: In the face of these kinds of problems, how well do you think the Shuttle in general, and the areas you worked on in particular, came through and were able to overcome these?

HAINES: Well, it's a successful program. Twenty years ago, we conceived of the Shuttle as a completely reusable vehicle that was going to fly after a two-week turnaround or some such thing, with a few thousand man-hours of work to turn it around and fly 65,000-pound payloads and fly 66 times a year and things like that. Very optimistic.

As it turns out, of course, not only could we not operate the Shuttle that well, that cheaply, that frivolously, but the market didn't exist either. Sixty-six missions, or sixty missions, I guess it was, they don't exist. We were very optimistic about the future of manned space flight. Still am, but now I think of it in terms of centuries rather than years.

RUSNAK: Is that a change you developed through your years in working with the space program?

HAINES: Oh, yes.

RUSNAK: Not too long after the Shuttle Program was up and flying, you left NASA. Why did you want to leave the space program?

HAINES: I wanted to go sailing. Something I'd always dreamed of, and I did. I left NASA in the end of '83, and in '86 my wife and I went off on a long sailing trip. We did it again in '93, '94, '96, '98, and this year. So I left NASA so I could have the freedom to do that kind of thing.

RUSNAK: So have you kept in touch with what was going on in the space program?

HAINES: Well, I stayed active. Between my various retirements, I stayed active. I worked for Eagle Engineering, which was a small company, mostly of retired JSC people. Worked with them until '86 and then from '86 until…when I came back from my trip in '86 until they were taken over by Muniz Engineering in, I guess, 1995. It was a great effort. I had a great series of jobs at Eagle. Worked on a lot of things, most of which were space program, not all of which were space program, and not all the space program things were NASA.

RUSNAK: To look back at all your involvement with the space program, the twenty years, who were some of the key people that you worked with and really had an impact on you personally?

HAINES: Well, I thought Robert Gilruth was a god, one of the real gods. I was afraid of the man. I'd never have considered calling him by anything other than Dr. Gilruth. That's interesting. All the other center directors, not because I had less regard for them, but they were just a lot more approachable, they were Chris [Christopher C. Kraft, Jr.] and Gerry [Gerald D. Griffin] and Aaron [Cohen] and people like that. But Gilruth was always Dr. Gilruth, just about to everybody. He was an awesome person.

I enjoyed working with Deke Slayton. He was a force, a good solid man, worked hard. Everybody liked Deke. Joe Shea, the early program manager for Apollo, he was a real character. I enjoyed working with Joe Shea a great deal. He had a characteristic that if he trusted you, there was no end to what he would do or let you do. If you ever made one mistake, you were never going to get anywhere with him. I know a lot of people that, you know, were good capable people that had some booboo in front of Joe and were never able to get an audience again. But as long as he trusted you, he would go to the end of the world to let you do what you needed to do.

Of course, he was replaced after the fire by George [M.] Low, and certainly George Low did a remarkable job, but I personally was never able to get the personal relationship with Low that I had with Shea.

There were so many people. I've got so many good friends from NASA, I'm not going to try to go into that anymore.

RUSNAK: That's all right.

In the same period of time, you faced a lot of challenges and had a lot of issues to deal with. If you had to single out something as really the greatest challenge you faced, what would that have been?

HAINES: The greatest personal challenge I ever had was the STA schedule and budget problem, and because of the way the management—again, I was the first Shuttle project that started into an overrun. Management really gave me a lot of attention because of that.

RUSNAK: Well, despite that, it's obviously become a very successful program, given that they still use it today.

HAINES: It was still a bargain.

RUSNAK: I wanted to give Rob and Carol a chance to ask some questions if they have any, if you don't mind.

HAINES: I'd like to bring up one other thing. When we were talking before this interview started, I brought up the fact that I'd worked with the Russians some. This is in my Eagle days. In 1992 I was working with NASA, the NASA ACRV Project, assured crew return vehicle, which was conceived as the Space Station lifeboat. We got direction from the Senate, actually, to talk to the Russians, rather than develop our own spacecraft, talk to the Russians about using their Soyuz. Of course, you know how that's evolved. But it was a very interesting time. We were a small project office, had a lot of grand ideas about how to run the perfect project, and didn't want to go play with the Russians. We wanted to do it ourselves.

But we did. We were directed to go talk to the Russians and in 1992, '93, got to go to Russia five times. Several times those people came over here. It was very interesting, getting a view of how their technical process works compared to ours. It is different, although it is similar in many ways. Getting to learn how to work with Russians, which is not like working with U.S. engineers. They are very slow to come to trust you, very slow to give up secrets. Everything is a secret. Very slow to give up their secrets, but once they get to know you, they are wonderful people and wonderful engineers. I think that's one of the highlights of my career, getting to experience that different culture, even though I went into it kicking and screaming.

RUSNAK: Since then, the involvement with Russians obviously has grown quite a bit. We are using the Soyuz lifeboat, but only until we get the crew return vehicle, now ready in a few years.

HAINES: Right.

RUSNAK: I was looking back at my notes, and one of the things that we didn't talk about at all were the actual missions themselves, the Gemini or Apollo or Shuttle flights. Do any of those stick out in your mind as memorable from a personal perspective, or did you have any specific involvement with the flights when they were actually going on?

HAINES: Well, I was the program office representative in the control center during flights. Let's see, I left around the eighth flight of the Shuttle. Shuttle, those flights all went pretty well. I remember the first flight, we were very nervous when the flight crew, through the TV, noticed the missing tiles on the back end of the spacecraft. Those tiles themselves were not critical, but it made us worry about tiles in critical places that might also be missing. I think the Shuttle has proven to be a little more robust and more tolerant than we had known it would be.

We got kind of nervous on Shuttle flight two when we lost a fuel cell. We were worried we might lose another, but we didn't. STS-8 was memorable because it was our first night landing, I believe. I had some guys in my office that were very key in developing the night landing capability. So we were very nervous about that and very pleased when Dick [Richard H.] Truly, the pilot, the commander, came back and said the Shuttle night landing was "underwhelming." That made us feel pretty good. And I left the program after that.

RUSNAK: That was all the questions I had. Were there any final comments that you'd like to make?

HAINES: No. Enjoyed it.

RUSNAK: I'd like to thank you for sitting down and talking with us today.

[End of interview]