ORAL HISTORY TRANSCRIPT

JOHN W. AARON
INTERVIEWED BY KEVIN M. RUSNAK
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RUSNAK: Today is January 18, 2000. This interview with John Aaron is being conducted at the Johnson Space Center for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Carol Butler and Rob Coyle.

AARON: I could just do one of those "in the beginning" kind of things. I grew up in a very rural community, a ranching and farming background. I grew up in a large family. My mother was a minister. My dad was a cattle broker and farmer. I have seven sisters, and I was near the youngest in the family. Most of my sisters, as well as my parents, were tremendous examples of work ethics for me, because they were always older, they could always outdo me, and most of them went on to very professional careers and very successful careers. So the stage was kind of set that I grew up in that environment, would come to NASA eventually and work night and day on the programs, because to me it was just kind of like being on a farm and ranch, because that's basically all we did, was work.

I went to college, again from a very small school, and when I'm talking about a small school, I'm talking about a very small school. There was nine people in my graduating high school class. I went to college and decided, almost with not much high school background, that I wanted a degree in physics and a degree in math, with the intent of becoming an educator, because most of my sisters were education people. They were teachers.

I went to a small school, started off at a church school, Bethany Nazarene College around Oklahoma City area there for a year, and then went to school at Southwestern State down in Weatherford, Oklahoma. The interesting that was I became so enamored with math and physics, I never got around to taking my education courses, and when I got to about my junior or senior year, I forget exactly what, I could tell what was about to happen. I was going to have to go another year in school in order to get my education courses.

And, of course, being a person of a very meager background, working my way through school and working summers on the farm and ranch to support myself, the next thing that happened to me was some people that had graduated from my physics class before me, primarily Richard Bates, who worked in the Shuttle program for a number of years, is now working over in SN [Johnson Space Center Earth Science and Solar System Exploration Division], put out the word that they were hiring people at NASA to work in the space program, which I didn't know much about, being from rural southwest Oklahoma, I didn't know much about in 1963 or whenever this was.

RUSNAK: Did you recall having heard about Sputnik and then the early days of the space race as a teenager in college?

AARON: You know, I guess, looking back on it, I'm not exactly aware of how aware I was of that. I was not aware to the point that it invigorated me to come and work for NASA. I think I was so focused on what I was doing, trying to get out of school, and I had my career, I was going to be a teacher, I wanted to be a teacher and I thought, well, I can make enough money teaching to get into my real profession I wanted to be, which was to raise cattle, which is a very

capital-intensive, long-horizon kind of thing, and I needed a way to support myself while I was raising cattle, building up a herd.

Richard Bates sent us a note that they were hiring people at NASA just based on people's particular skills they were looking for, but also based on people's personal recommendations. So, on a fluke, I sent out a Form 57, I think it was at the time. I filled out one of those Form 57s, thinking, well, I might get an interview or something.

And lo and behold, I didn't get an interview; the next thing I got was a telegram from Miss Kazmierski, I believe, who was the hiring person. I hope I'm saying that right. Mona Kazmierski, I believe was her name. A telegram and it was not an interview; it was a job offer for more money than a country boy had ever seen. I'll never forget what it was. It was 6,770 a year. And I thought—this is how kids think, you know, and I was a kid at the time. "Well, you know, I'm broke. I'll go down there and do that a couple of years and then I'll come back and raise Herefords." That was my—

RUSNAK: That was the plan.

AARON: That was my plan. Of course, you can tell I never got back to raising Herefords, and it's probably a good thing. I would have probably starved to death in the meantime.

So that's how I got to NASA, and as you can imagine, I came from that kind of a background, a very conservative rural background, and I showed up down here with another gentleman from my same college, and we reported in to the Stahl & Meyers building down there on Wayside, where Oshman's had a warehouse after that. We got there and it was in the summer, June, the air-condition was broke, and everybody was walking around with their ties

off and almost their shirts off, and we walked in there with our black suits, you know. We were all dressed up in our real dark suits. The first thing the supervisor said to us, "You guys are interesting-looking. You look like a couple of IBM salesmen." And, of course, we didn't know what that meant at the time.

So it was a brand-new world. I mean, I walked around for days kind of in a fog because I didn't know exactly what all was going on. They were speaking a foreign language. They were speaking in acronyms I had never heard of. I mean, I thought, "What have I got myself into? This is a different place."

In fact, the thing that made the whole thing successful was that I got into a group. My first line supervisor at the time was Arnie [Arnold D.] Aldrich. I take that back. Ted. Ted. I lost his name. But my second was Arnie Aldrich. So I was blessed in that. When I first came to NASA, I had some very good mentors, I think who realized the background that some of us were from, certainly realized that what they were trying to do was totally brand new. There was no blueprint for how to do it. And so the thing that was really important to me, coming from that environment, was I had some very good mentors who looked out for me and we had a lot of Dutch uncle kind of talks and kind of steered me in my career and got me over the transition. So that's kind of how I got to NASA.

The next thing that happened was, I was assigned to the Gemini program. The Mercury program had finished.

RUSNAK: Starting off?

AARON: Right off the bat, I got assigned to the Gemini program. We had not yet launched Gemini II, but we were trying to get ready. The organization I was in was the operations organization. I came into flight control division and went into the Gemini systems section.

They were trying to prepare themselves for the Gemini program, to launch and operate the Gemini program, and I was trained to be a flight controller with the responsibility for what I call the utilities of the spacecraft, the power system, the life support system, the communication system, and so forth. They called me EECOM: electrical, environmental, communications officer. I was being trained as a remote site flight controller.

In those days we didn't have the high-speed networks that we have and everything, so we deployed flight control teams around the world to view the spacecraft for six or ten minutes as it came overhead. Except for going to a remote site that was to participate in a big network simulations, called NS-1, which they called network simulation 1 for the Gemini program, or some people called it NONSUCH 1, but it was actually network simulation 1, except for going to Hawaii to participate in those activities, my management migrated through the Mission Control Center.

So except for that one tour of Hawaii as a remote flight controller, I spent the rest of my time in Mission Control Center for the next ten years, starting off with the Gemini II launch, which the Mission Control function was controlled out of the Mission Control Center at KSC [Kennedy Space Center, Florida]. I guess it was called Canaveral in those days; it was on Cape Canaveral island. And then Gemini III and then Gemini IV and beyond, through the Skylab, I was the mission controller here in Houston.

I pretty much was delegated to the launch team. We have very different kinds of teams. We used to have them color of teams in those days, white, green, gold, and so forth. But for

some reason they stuck me with a launch team. I guess that's where they wanted me to be, so I pretty much specialized in the launch phase in terms of my flight control duties at Mission Control, but I worked on each of the manned flights from Gemini III through the end of Gemini XII, then picked up on Apollo.

I had just transitioned over to the Apollo program as a flight controller when the fire happened, the AS-204 fire. In fact, I wasn't there the night the fire happened; we were conducting a test, as you know, in Florida. But the Mission Control Center here in Houston was monitoring. So I was the EECOM on duty when that happened here that night, and I don't think I'd been on the program but a week or two when that happened.

So I was mission controller for the resulting—when we redesigned the command and service module and then Apollo 7 through the whole series of Apollo 17, and then picked up with Skylab. Skylab started in about the '72, '73 time frame, and also the Orbiter and Skylab program were starting development here. So Skylab, I was an EECOM, head of the EECOM section by then and trained the EECOMs for the Skylab mission, and that's where I made a transition in my thinking as to what I would do next in my career.

I had worked by then in Mission Control, got a lot of—probably the best system experience I'd ever gotten because it turned out that my background in physics, which, from an engineering standpoint, gives you probably a more generalized background across a lot more subjects than if you specialize in a particular field of engineering, my duties in the Mission Control Center being all the subsystems that I mentioned, you know, power and environmental control and cryogenics and instrumentation and communications, required a diverse set of knowledge. The physics training that I had in school fit that well, plus it fit what I was really interested in at system-level kind of work. So that was a good ten years of experience.

One thing I found in Skylab was, though, I tended to get a little bit complacent, because once we got that vehicle stabilized and got everything in operation, I began to lose interest in watching it go around the Earth, because I had all the EECOMs trained, and I went back over to the office and got some material, and I was sitting over in Mission Control Center reading about this new Orbiter we were going to build for the Space Shuttle program, and that's when I made the decision that, well, they'd transition me over and start working on the Orbiter.

The interesting story about how I got involved in the Orbiter—and I'm giving you a very top-level overview here, and we can go back and dive into any of this—how I got involved with the Orbiter in the way that I did, the Orbiter was the next-generation vehicle that was going to be much more software-intensive than previous vehicles. On previous vehicles, the software concentrate was primarily focused in the GNC, the guidance, navigation, control subsystem. The rest of the vehicle control was done with traditional logic—relays and so forth. It wasn't under central software control.

The Orbiter was a vehicle where the transition was to be made to a very software-intensive controlled vehicle that was beyond guidance and navigation. Since I had worked on the instrumentation, I'd developed ground monitoring techniques, because that was what you do if you're a ground controller, you're working on a lot of techniques about how to do monitoring of a spacecraft remotely, my management's theory was, "Well, John's developed all these techniques for ground control monitoring of these vehicles, and the Space Shuttle Orbiter is supposed to be a more autonomous vehicle, we need to get him over in the software side of the development house in Orbiter" so that I can incorporate the techniques that we worked out on what works on the ground.

I went over for a six-month tour of duty to another directorate that was in charge of developing the Orbiter software and never came back. It turned out to be the next set of experience that was very important. One of the things you'll find about my background is, fortunately, I have been moved around enough to see the space program from a lot of different perspectives, because I spent ten years in operations, so I knew what the end result of a vehicle needs to be. Then I moved into the development side of the house, then got indoctrinated in development, how to build stuff, what's important, what's important aspects of project management, [unclear] control, all the projects and program aspects as opposed to just operations.

Started off working there as kind of a subsystem manager of software in a particular area of systems monitoring, and progressed in responsibility in that organization to the point that I became the project manager for all the software. And we're talking about a very large effort. It was a GFE project, government-furnished equipment, so we had a major interface with the prime, called Rockwell at the time, because they were building all the Orbiter and the hardware. It turned out, in today's dollars, probably 300 or 400-million-dollar project.

I wound up managing that and doing the software development. That took me through about '84. Very, very complex, risky development of flight software for the Space Shuttle Orbiter, in that it was the first fly-by-wire multi-flight computer voting system that had ever been flown before, where the voting was done strictly in software. Had five computers, and hardware-wise they were all identical, but the thing that made them unique was the way the software worked and the voting. There were a couple of years there in the throes of all that, that we weren't even sure that was possible to be done.

In '84—and I'm still giving you the broad brush—in '84, I got a call from the center director here, Gerry [Gerald D.] Griffin, to come over, and he told me that I had been proposed as the deputy program manager for this new thing called Space Station. It had just been announced in President [Ronald] Reagan's address to Congress that January, and this was like in March.

I thanked him for his consideration, but since it would have to be approved in headquarters by the administrator and so forth, it wasn't likely I'd be approved, so I went back to Building 30, kept working on software, didn't think much about it.

Well, as it came to pass, he called me later, and I figured that was a consolation prize, and I wound up being the deputy program manager for Space Station, in the formative years of Space Station. I'm talking about a time frame of starting up Space Station program as a formal program in April of '84.

We put together a 200-person skunk works here from over in the Nova building. I don't know whether you've run across that chapter in our history or not. But we had about a 200-person skunk works of people, civil service, from across the agency, and our job was to find the program both technically as well as what the configuration was, as well as to find out how we were going to manage the program, because it was going to be a multi-center endeavor involving the development efforts of four major centers to pull this program off.

So I worked that problem as a deputy to Neil [B.] Hutchinson, who was named the program manager, from '84 through '86, and as a result of the *Challenger* accident, the agency made a decision to move the program management and program office to Reston, Virginia, at which time we packaged the program up and tied it off at the end of Phase B, we call it. We had

program Phase A, B, and C. So at the end of Phase B, my team tied it off and handed it over to Reston.

Then Aaron Cohen sent me off to JPL [Jet Propulsion Laboratory, Pasadena, California] to form a joint venture with JPL on a thing called a Mars sample return mission, so I spent some time building and merging the skills of the Johnson Space Center and the skills of JPL, because that was a very large program to return sample of the moon, and JPL knew they would need some extra help to do that. So I merged that relationship. Some aspects of those initial seeds that were sown are still growing today with respect to JSC's involvement in the exploration of Mars.

That got me involved in the unmanned exploration side of the agency that I had never been associated with, and that was a very interesting challenge which led to, when Sally Ride—one of the criticisms of NASA, as part of the Challenger accident, one of the offshoots of that was the criticism that NASA didn't have a vision of where it was going long term. I think you probably know Sally Ride put together, in the '86, '87 time frame, an ad hoc team across the agency to plan what NASA should do longer range with their programs.

That was accepted in principle by the agency and the supporters of the agency, so it was time, when Sally was to move on, to turn it into an ad hoc study approach and to make it a formal organizational structure within the agency. I got my arm twisted to go to headquarters for two years and work directly for Dr. [James C.] Fletcher, who was the NASA administrator at the time, to lead the agency's efforts for Mars and lunar exploration. Again, a very challenging assignment and put me in an environment I had never worked in before, which was the very top-level program planning, and building a constituency within both the agency as well as outside

the agency, with Congress and the White House, as well as international partners potentially to put together this endeavor. I did that for a couple of years.

Then with the change of administration and with Jim Fletcher retiring, I just made a decision to return to JSC here, and shortly became the manager of JSC's efforts in the Space Station program again. By then the Space Station program had gotten into the Phase C, had a major set of contractors, primarily which was McDonnell-Douglas [Corp.] on the West Coast at Huntington Beach. So it was like a 4-billion-dollar effort comprising some 60 percent of the total Space Station program, which was JSC's piece. So Aaron asked me to manage the JSC aspects of the program, and I did that from '89 to '93.

In '93, the program got in cost overrun issues, and Senator [Robert C.] Krueger called for my resignation in '93. Of course, that's a long involved story all by itself. But from there I moved over to the engineering directorate, which I currently head up the engineering office here.

Now, shortly after they called for my resignation and I had to be moved aside, that was like in January, first part of February, and also the administration made a decision to totally redo the Space Station, and so the whole redesign efforts happened from the February through the June time frame, where once again, having been taken off of Space Station in February, I found myself back on the redesign team, having a primary role in a thing called Option C. We had an Option A and Option B and Option C. Option C was the large single-launch vehicle. I don't know whether you're familiar with that concept or not.

I worked that from February to June. I worked that locally here with, again, a skunk works kind of environment over in Building 17, and Chester [A.] Vaughn was in Crystal City [Washington, DC] and, of course, he was my counterpart in Crystal City. So it did not get

selected in June, but we can talk about that for a whole other tape. Option A got selected, and then the next thing that happened was the administration and the agency made a decision to involve the Russians as an international partner in a major way. So I had a team of people here that continued on, on Option A, to refine the design of the Option A, to incorporate the Russians, so we had a major part of that activity here.

Then in October of '93, the program office formally moved down here and established headquarters in Building 4, and that's the point at which I turned over and merged the skunk works personnel in with the program. Then I dropped back into being a support role, which is where I have been since '93 to today. My job within the directorate, the engineering directorate, is to integrate all the support that we have across our 700 or so engineers that support Space Shuttle and Space Station, integrate all those issues as they go forward.

That's a fifteen-minute bird's-eye view of my career. I have been fortunate enough to move around a lot. All those moves were good, in retrospect. I approached each one of those moves with a standard amount of trepidation, but after having made each one of those moves, I found the job equally challenging on the other side, and I found that by moving around, I could bring a different and enriched perspective of how to view things, because there's lots of ways to view the space program or any enterprise that's large, and that proved to be beneficial to my career, my own personal satisfaction, and I think it probably was beneficial to NASA, because I've seen these programs from lots of different angles, a lot of different disciplines, and the view fits my mental psyche in terms of what I like to do and what I'm challenged by.

RUSNAK: Certainly in your thirty-five years here, you've covered quite the spectrum of responsibilities.

AARON: Yes. I spent ten years in operations, ten years doing software development, probably ten years doing program or project management, two years doing Mars exploration, and almost ten years now doing systems engineering for the Johnson Space Center. So it's been a good career for me. I tell people that as a young person—I know my own kids, they tend to fret so much about getting started in their career, about trying to map out their career to the most infinite detail, and their horizon, you're always too close to your horizon to see everything, and I tell people, try to tell my own kids you've got to take one decision at a time. Don't try to get all the dominoes lined up for the next twenty years, because you can't predict what's going to happen.

I believe that the key thing with NASA was, I had some early mentors who kind of looked out for me. I didn't have to plan my career. In fact, probably if I had planned my career, I'd have screwed it up. My philosophy was that I always tried to do a good job and I always just worried about that, and I didn't have to worry, fortunately enough, about what gains may or may not come as a result of doing that. I just always tried to do the right thing, do a good job, and then seemed like I got off to where the gains always came in the right direction or the degree that I needed them. I didn't have to worry about the gains; I just focused on doing a good job.

RUSNAK: The other things will take care of themselves.

AARON: And they came. Now, I know that was then and this is now, but I still believe that mentors are a very important aspect of your career growth and contributions, particularly at NASA.

Now, where would you like to go next? That's the bird's-eye view.

RUSNAK: Well, I guess I'd like to start back at the beginning with NASA. When you mentioned showing up at the door in your dark suit and such, how did they train you to be a flight controller? How did you learn about the systems and procedures and that kind of thing?

AARON: The training was a lot of self-instruction, classwork, some classwork, and a lot of OJT [on-the-job training]. I think a key aspect of particularly flight control in those days, the thing that they did, they put you in a situation, gave you some coaching, gave you some material to study and so forth, but it was kind of up to you. It was kind of trial by fire.

Now, it's hard for me to remember back thirty-five years, but that's a thing that I remember. We spent a lot of time, just among ourselves, learning the subsystems, asking ourselves a lot of "what if" questions, because our job was to react and be able to handle the things that weren't supposed to happen. The things that were supposed to happen you could write a procedure for and say, "If this happens, do this. If this happens, do this," the thing that our contribution was, to be there when things didn't necessarily happen the way you expect them.

A key part that was important to me being successful in that environment, and I think I was successful, without blowing my horn too much, we had a number of major incidents that you may or may not be familiar with, for which I made a contribution. The Apollo 12 launch phase during the lightning strike, you probably know about that story. Apollo 13, you probably know about my contribution or what I thought I contributed there.

Skylab was a program that we don't put in the Apollo 12 and Apollo 13 kind of class, but when I look back upon that, what happened to that vehicle right after it launched, and the fact that it went through a major structural unshucking, we were flying that thing by the seat of our pants and creativity for at least a month, because they left two teams on the console and managed what's going on in space problem, because that's a major problem to orchestrate, as well as took two teams off and planned how they were going to launch a command module and try to salvage the vehicle. So Skylab was a place where all the training and research I had done on all the space systems really made a difference.

I think the thing I remember that really made a difference to me was, I was, just by my nature, I can't stand to be around anything that I don't know how it works. I'm always intrigued by knowing how it works or why it works. I will tend to dig into anything until I understand it. So it's that natural curiosity with why things work and how they work, coupled with the fact that that was kind of my job here in NASA when I first became a mission controller, caused me to be able to dig into something like the command and service module, the Gemini vehicle, and understand it top and bottom, and the cross-cutting effects.

You know, complexity comes in not so much in terms of how you handle it, not so much with what you know about a single subsystem, but these spacecraft are highly integrated. What I mean by that, each subsystem depends on the other. It has to work as an integrated unit. So if you picture the depth and knowledge in a particular subsystem which you normally assign to engineers, like, "You're going to be the power person," "You're going to be the environment control person," "You're going to be propulsion," and they go off and learn all they can about those subsystems, if you're not careful, they'll kind of get a silo view of that and not understand how when power goes down, what it does to the propulsion system and what happens to the

guidance system, the propulsion system in there to honor the commands. It's the cross-cutting horizontal effects, is where the real intrigue comes in, because it's those interactions.

I was just naturally curious. Natural curiosity is a thing that probably motivated me to go understand these vehicles to that level, so that when lightning strikes Apollo 12, I mean, we had never simulated that before. Our simulators were not even sophisticated enough that if we had, would it have necessarily produced the exact signature that I saw. So only just by your research and "what if" and contemplation and thinking about things and try to think of all, do you prepare yourself for that kind of event.

And luck plays a part. I'll give you an example on Apollo 12. Apollo 12, when the lightning struck the vehicle and caused a major power outage, you would think, well, normally the parameters that are powered would go to zero and just kind of read zeroes. In fact, in the simulator that we were training to, they did read zero. If you cause the kind of power failure that we had during Apollo 12 launch, they read zero.

The way luck played into that was, again, luck and curiosity. I happened to be on the third shift one night watching a test of the command module that they were performing at Kennedy, and due to the fact that the operators on the third shift at Kennedy were not all that—you know, they weren't the A Team—they had gotten themselves in a sequence where they dropped power on the vehicle. They dropped all the power on the vehicle to go on battery. These numbers of the way the system reacted to that, this pattern of numbers came up and I was intrigued by them, because they didn't go to zero. They were at 6.7, 12.3. I mean, some squirrelly kind of numbers.

So I did aid the technicians at KSC to get the spacecraft reconfigured such that they were back in a safe condition and we didn’t have loss on one battery. But I drove home that

night, thinking where did those squirrelly numbers come from. And the next morning I came in the office and I sat down with Dick Brown, who was a Rockwell [International]—it wasn't Rockwell then. It would be North American [Aviation, Inc.], wouldn't it? North American engineer that worked in our office. We sat down and went through all the circuitry to find out just how does this thing work. Why would those pattern of numbers have come up? Well, never thinking that when lightning struck the vehicle on Apollo 12, that exact pattern showed up. So it wasn't that I understood exactly what had happened, I recognized a pattern and how to get out of it.

Now, it was not only luck that at a pad test I saw that, an inappropriate sequence was being executed in a pad test, it was also the luck that it would happen during the launch phase and that I was the flight controller. If you had had any other EECOM there, they didn't see that pattern. But it's digging in with that kind of curiosity of why things do what they do and how things interreact was the motivation for why I think I became a good flight controller.

RUSNAK: Did you have much of a chance to get your hands on the hardware particularly early on?

AARON: We did, but not to the extent that the flight controllers have today, an opportunity, because things were moving so fast, it was hard to get around and get all that hands-on hardware experience, because we're talking about programs it didn't take very long from start to finish.

The other thing I was always curious about watching was not only just the technical aspects of systems and what makes them work and what makes designs work, I was fascinated by NASA. I was fascinated very early by how an organization could manage a program as big

as these programs were, so I was always interested in how the dynamics of management worked, how people interact, what verbal communication skills worked and which didn't, which people were good at verbal communications, which were not.

Of course, in a program the size of the Apollo program, you can't build anything bigger than what you can integrate. What I mean by that, the efforts. How do you get the efforts and designs of thousands of people to work together? I became very intrigued about how to interact with people and how to communicate with people within their own language. And I think that curiosity later paid off as I moved into program management.

It certainly paid off when I made the transition from hardware subsystems being in mission control work to software development. I found that I could learn about the software world, which a lot of hardware subsystem people were not versed in, in the seventies. Since I came from that world, I could explain the software, what I was trying to do on the software side, in their language.

RUSNAK: That makes sense.

AARON: So it was a natural bridging way to get with the hardware people that didn't necessarily understand software, talk their language, and from that, distill what the software needed to be. They got to where they would always come to me because I could talk to them in their language. And I think that had a lot to do with how to get the right software built to serve and manage their subsystem. I was just always curious about how people work, as well as subsystems work.

I know someone pointed out to me one time, I was sitting in a meeting, when I sit in meetings, you know, you always go into a meeting early and maybe some other subject being presented that I had nothing to do with, and the person told me one time, "You know, John, you listen just as intently to the subject that you knew that's totally out of your expertise, as you did to the discussion we had about your subject." That was interesting. But I'm always curious as to how other things work. So that set me up to be able to make these transitions from mission controller to a software developer, to a program manager, to all the various fields that I've worked in.

RUSNAK: It certainly has served you well. Let's go back to Gemini for a little bit. Let's talk about the first mission where you're at Hawaii on the tracking station. What was that experience like?

AARON: When I was at the Hawaii tracking station, of course, we were simulating a mission, but in terms of my training, it was just like a mission. I was the Gemini systems mission controller, and I think we had a canned set of tapes, you know. The way these simulations worked in those days, the tapes were cut in the simulation and they were canned, and they would play them with the tapes. So once the simulation was set, depending on what action you took, it didn't necessarily get taken. So it required quite a bit of improvising when you would ask the spacecraft to do something for you, to correct some anomaly, and, of course, that wasn't in the script. So it didn't necessarily happen.

RUSNAK: Not a lot of flexibility.

AARON: One of the things I remember. The thing I learned about in Hawaii was that we were not only trying to get ready to control the spacecraft and mission, but also we were in the shakedown cruise on the ground system. So I spent as much time learning about the ground system and how it works and what its idiosyncrasies are as I did being trained on the spacecraft. In fact, that's probably more what I learned.

In addition to just the overall setting of what our mission was going to be about, a lot of what I learned uniquely with that Hawaii trip was the ground systems, because I became attuned very easily that unless you understood the ground systems, you had to be very careful interpreting what came from the spacecraft, because the ground system's idiosyncrasies and failure modes could make it look like you had also failures in the spacecraft which weren't real.

One of my disciplines that I worked when I wasn't a mission controller was instrumentation and, of course, the ground system processing, the telemetry system and command systems, was something that I not only had to understand the spacecraft, but had to understand the design of the ground systems and drive those ground systems in terms of what kind of systems that we needed.

I think the other thing that I got attuned to in that remote environment was being part of a small team. I mean, we basically stayed on top of the mountain, lived in a cabin up there in some state park that we read, and so with a dozen people living very close together day in and day out for about three weeks, that kind of tests your ability to do the job also, is to be in a very close environment, closed environment, with a small number of people.

RUSNAK: We've had other people tell us that there were worse locations than Hawaii to be assigned. On one of the ships, for instance.

AARON: Yes, there were. There's stories after stories about—I probably had it cush compared to certainly the guys who pulled ship duty.

RUSNAK: Was that just random chance, where they were assigned?

AARON: It was random chance how I got assigned, at least on the first simulation, NS-1. I think it was random chance where I got assigned. Later on, I think certain crews, subcrews, got kind of set as to which manager was going to which location, and therefore they started kind of picking which team they wanted to take with them. But it was random.

The thing that happened, of course, I then came back to Mission Control Center in Houston and spent the rest of my career there, so I never deployed after that.

RUSNAK: Talking about coming back to Houston to work at the control center, what was your first mission there?

AARON: First mission I worked in Mission Control Center was Gemini IV, if my memory's right. We controlled Gemini II out of Florida, and I was there. Controlled Gemini III out of Florida with Houston, I believe, in a parallel mode, not active but parallel. In fact, I think they had a power failure right in the middle of the launch here in Houston. Do I remember that right?

RUSNAK: I think so, yes.

AARON: And then Gemini IV we controlled strictly out of Houston, and I think I was the second shift EECOM on Gemini IV. Dick [Richard D.] Glover was the prime EECOM. He did the launch. I believe I was on second shift there. Gemini V through Gemini VII.

Now, along about Gemini IX, we kind of pared it down, if I remember, to just a two-team operation, because we started flying short missions, and a lot of the people went off to work Apollo. I stayed on Gemini and went through Gemini XII. Of course, those were where we started doing the very active rendezvous missions, EVA [extravehicular activity]. That's when we rediscovered EVA was difficult. In Gemini IV, we got fooled. It's just a piece of cake. You just get outside.

It was Gemini IX, I believe, before we did an EVA again, and that's when we found out, ah-oh, this is something you've got to pay a lot of attention to in terms of both the hardware subsystems support, cooling of the astronaut as well as the planning of the EVAs and the training of the EVAs as well as the vehicle accommodations to give you mobility as you crawl around in the vehicle. We learned all that the hard way on the Gemini program. And it was a good thing we learned that, because that certainly served us with some experience that we needed down the road.

The thing I remember about the Gemini program, it was a fun program to work on because it was a small organization. That program was pretty much put together, based on my memory, of John [F.] Yardley and his team at McDonnell-Douglas in St. Louis, and Chuck [Charles W.] Mathews and his team here. It was a somewhat small, but very cohesive team, very special contractor-NASA relationship that was formed on that program. A very tight team.

It was quite a transition to come from that environment out into a program that is much, much larger than that, called the Apollo program, which not only was a lot larger, but didn't have that kind of—the program wasn't small enough that two people could manage it. I always say that Gemini was the kind of program that was small enough that Chuck Mathews and John Yardley could manage it. Apollo was a different kind of program, much larger, much more diverse.

The Apollo program, the thing that I worked on to get my real teeth cut on Apollo program, was Apollo 7, and that was with [R. Walter] Cunningham, [Donn F.] Eisele, and [Walter M.] Schirra [Jr.]. When we were flying Apollo 7, being a systems flight controller, it was kind of a systems flight controller's dream because it was about systems test. So we got to interact a lot in exactly what the flight plan was and how to do all these thermal tests and power tests, communications tests, and so forth. It was kind of a systems man's mission. Now, that didn't really merge in what Wally Schirra wanted to do, because he was a stick and rudder man, so that caused a little conflict in flight, as I remember.

We had no idea when we were flying Apollo 7—at least I didn't and most of the team here—that there was also a plan to take Apollo 8 to the moon if we were successful. We were totally in the dark about that, because there was a small group off planning that. When they announced Apollo 8, I just couldn't believe it, but we were all over George [M. Low] to go try it, because we were young enough to try anything.

To me, Apollo 8, if you just had to plot a graph of the pinnacle of the exciting part of my career, that was probably the peak, more so than the landing on Apollo 11. Now, that probably sounds funny to say that. Well, two reasons, I think. One, just the boldness of it, that it was announced over such a short interval. In my case, being a command and service module

systems person, systems flight controller, it was the vehicle that I watched when I had the prime stage, and the fact that it was first and it was going to be done over Christmas, I mean, looking back on it, that was the pinnacle.

The lunar landing, the actual landing on Apollo 11 ranks right up there, and I don't think I'm unique there. You ask people like me. I think they'd probably say Apollo 8 was kind of—

RUSNAK: I think in our project we've had at least as many people say the same thing as you, that Apollo 8 was more their highlight than Apollo 11 was.

AARON: I was very surprised on Apollo 8, because I had helped make some calls to correct a couple of anomalies with both the command module on the way out to the moon, and so I was very surprised when they came around the moon and started naming off craters and they named one after me. It bowled me over. I would have never had thought they were going to do that. So that was a big surprise.

RUSNAK: Wow.

AARON: And then the other big surprise, of course, because we were all sitting there with our fingers crossed, because we were in lunar orbit and we couldn't wait to get out of lunar orbit, I remember that, but when the crew came around the horn from the far side of the moon and started reading from Genesis, to watch the reaction in the Mission Control Center, because here we are, you know, totally concentrating on our technical job, and for that to happen and then the onset, it just didn't occur to us, because none of us had any clues that was going to happen. And

it took us a while to realize what was happening, the significance of that, and—wham!—it hit us. I mean, looking back on it, nothing could have been more perfect of a thing to have been said.

RUSNAK: Absolutely.

AARON: I think it not only impacted everyone in Washington, but it particularly impacted the mission controllers, because they were sitting there doing this highly technical jargon-oriented job, and then just the transition from that to a reading from Genesis, that was the big surprise.

Apollo 8, of course, culminated a lot of things, because we had spent so much time redesigning the spacecraft, it seemed like a lot of time then. In today's world it doesn't seem much time at all, because what we do now in years we judged then in months. But we just completely redesigned the vehicle, had one test flight on Apollo 7, and then made the decision to go to the moon, and it was highly successful, not only the spacecraft, but the Saturn V. I mean, we forget sometimes the shaky start the Saturn V had. We had 501 and 502, and those were not anomaly-free missions. Had major anomalies with the boosters on those two unmanned flights. So it was a bold move.

RUSNAK: But one that proved spectacularly successful.

AARON: Oh, yes. It set the stage to do it.

RUSNAK: If we can pause here for a moment, it's four o'clock.

AARON: I've got some more time, but you may want to collect your thoughts and understand what you want to zoom in on, because we have not touched on particular facets of sort of my perspective of what makes things work at NASA and what doesn't work, and I can comment about that technically as well as management systems, and you may want to save that for another day.

RUSNAK: Again, depending on how much time you have, if you think it may take longer than what you have, you know we're more than happy to come back.

AARON: One of the things I would think that you'd want to capture as part of the history, because a lot of the stuff we documented here about Apollo and the flight control business, Apollo 12 and Apollo 13, are well documented.

The most challenging thing that I was involved in, that is probably not well documented, is the history of the early days of Space Station in terms of the decision process, both management and technical, about how you take an integrated vehicle like Space Station Freedom or any configuration of Space Station, and then go through the technical and political and management process of dividing it up and giving it to four centers to build the pieces of that is managed by one organization, whether or not it be Reston or at Lead Center like Houston, and then have each of those centers' contractors do the work and have it all come back together and be integrated into a single monolithic space ship without being a white elephant.

The subset of history that I was in the middle of from early '84 through the '87 time frame, that I got reengaged in and when I came back here in '89, '90, that is something that

NASA needs to develop a blueprint for, because as we go forward, we were blessed in the Apollo era in that we either could hand pretty much a holistic technical problem to a center and say, "Do it," or you could divide and conquer.

What I mean by divide and conquer, like we did in the Apollo program, that was integrated. You just kind of sawed the stages up in pieces and have everyone go solve their unique problem in their own unique way. It turned out to be something that from an integrations standpoint and a management standpoint, that's pretty efficient, because you could go take your problem and solve it and just worry about the interface.

The down side of that particular way of doing business is you wind up developing unique hardware for common functions. An example was, everybody needs a computer system function. Well, it may wind up being a unique computer in every module, every vehicle, every stage. So how to divide programs up and get a very efficient design where you have common hardware doing common functions is something that I think I can truthfully say NASA has not mastered. In fact, I suspect it would be judged as making a pretty good mess out of it. That's probably something I'll be capturing in the history, whether it will be captured in this book or somebody else's book or somebody else's archives. So that's the one thing that I worked on for a number of years and I never felt we totally successfully did it.

RUSNAK: That's one advantage of our project, that we're not working towards a specific book or whatever like most people who do these types of interviews. We're looking to collect the reflections of people so that it gives you a little bit more flexibility in what you want to talk about and look back on.

AARON: The interesting thing would be, because this is really just an archive, the interesting thing would be, because everybody sees the problem from their own perspective, and I'm as guilty of that, because we're all a product of our experience, right?

RUSNAK: Of course.

AARON: It would be interesting to interview Neil Hutchinson, who was the program manager at the time, interview Aaron Cohen, you're interviewing myself, Gerry Griffin, John [D.] Hodge, Phil Culbertson. I don't know whether you know Phil Culbertson or not. He was the associate administrator for Space Station when all this got started. And then try to piece the story together as to what was our decision process that caused all that to happen.

RUSNAK: And it's only through talking with the people that were involved that you really do get a sense of that decision process. In reading meeting minutes or whatever other documents doesn't really give you an idea of the true process behind these things.

AARON: So the Space Station you see today still has heritage to some of those early decisions. Some were good and some were not so good. That's protracted its technical efficiency to weigh more, take more power than it probably should have as a monolithic design, and certainly cost more. Now, the reason that's important is because that's the way of the future. We're not going to return to the world of Gemini, where you write a one-page summary of a space ship and just have one organization monolithically build it. We're in the business of how to farm out work to

international partners, probably anybody that will take it, right? Because I'm convinced going to Mars, no single country is probably going to do that.

RUSNAK: I think a lot of people agree with you on that.

AARON: We have to come up with a way that we can divide up the work and not cause the integration overhead to bring it together to be more than the value of the work that you gave people to go do. Otherwise, you're in the law of diminishing returns. So we'll save that for another day. I'm going to be here for at least another six weeks, and maybe you can take what I've said here today and figure out which way you want to penetrate.

RUSNAK: Okay.

[End of interview]