ORAL HISTORY TRANSCRIPT

JEROME B. HAMMACK
INTERVIEWED BY MICHELLE KELLY
SEABROOK, TEXAS – AUGUST 14, 1997

KELLY: The following interview of Mr. Jerry Hammack was conducted on August 14, 1997 in [Seabrook], Texas by Michelle Kelly and assisted by Andrea Hollman.

KELLY: Mr. Hammack, can you tell me how you came to NASA and how you started working at Langley Field?

HAMMACK: After I got out of Georgia Tech, I received an offer from NACA [National Advisory Committee for Aeronautics], but I wanted to work for an aircraft company. I went to work for Douglas Aircraft Company. But then they wanted me to come and be at Langley field. They wanted me to come and be with NACA. I was getting drafted and I was going to be put on duty with the Army Air Corps. They wanted to assign me to Langley. So that's how I ended up, because of the military, being drafted and put on duty at NACA Langley. I worked there for over two years, two years and ten months, something like that before I was discharged. The war was over by then. I was discharged. I worked on airplanes, propellers, and various airplanes to make them faster for the war effort and so forth.

Then after my discharge, I thought I was going back to Douglas Aircraft Company and I received an offer to come back, but I was pretty much involved with the work. I had pretty much become a citizen of Virginia, and I stayed.

KELLY: Was that the reason why you stayed, because you enjoyed Virginia?

HAMMACK: I enjoyed the work.

KELLY: What types of things did you perform? What types of things did you do?

HAMMACK: I was a flight test engineer. I was an aeronautical research engineer doing flight test work on propulsion aerodynamics. I got involved with making airplanes go faster. In those days, the way you make airplanes go faster is a combination. The propulsion system has a lot to do with it. I designed a series of transonic and supersonic propellers. I had a test vehicle that was a jet, turbojet penetration airplane, and we mounted a turboprop engine in the nose so we could test the propellers that we designed on this in free flight.

KELLY: What kind of plane is this?

HAMMACK: That's a McDonnell F-88. McDonnell F-88. It was built in St. Louis. Only two were built, and we got both of them. We used one for spare parts. This plane went on to become an attack, a penetration fighter for the Air Force, but it got bigger. It was called F-101 then, but the name of it, Voodoo, stuck. It was the F-88 Voodoo. This is called the XF-88B, and with this plane we were able to test propellers in free flight up to Mach numbers 1.1, and we were able to show that propellers could be just as efficient, if designed properly, at those speeds as they were subsonic, and turbojets were very inefficient, very inefficient.

KELLY: How are they more inefficient?

HAMMACK: As far as the ratio of the speed to the exhaust velocity to the forward speed. When you put all that air through a pure turbojet, it comes out at a great velocity and the difference in those velocities has to do with the efficiency. They were very inefficient, but

everybody loved them. They were not the vibration problems you have with propellers. So you could not stop the head-long rush to jets.

So what we did, we brought this to a conclusion. But what happened over the years is you got a marriage of the turbojet with the turboprop, and it became a turbofan, where you have a very high bypass ratio of the air not all going through the engine. If you've ever seen a 747, you see it pull up, a lot of the blades are outside the engine. That's called a turbofan. That was a marriage. And I have to agree that that was the best.

But what happened to me? I was the expert on propellers, but we closed down the propellers, so I had to find something to do. That's when I got in the space business.

KELLY: How did that research lead you into the space business?

HAMMACK: Well, as I say, we closed down the project. Nobody was interested in propellers anymore, so I had to look around. I heard about a guy over across the way in the Pilotless Aircraft Research Division [PARD]. I was in the Flight Research Division. I had been on the same committees with him in the area of propulsion aerodynamics, a guy by the name of Max [Maxime A.] Faget. He had some idea of a manned ballistic satellite. I said, well, maybe I can go and work and help them out a little bit.

So I went over to see this guy come to see Max. I said, "Max, what's going on?"

He said, "Well this thing, it's is a good idea. We're going to launch this thing and eventually get it up to orbital velocities."

I said, "Do you need any help?"

He said, "Yes, I need somebody to work out the landing system. Can you do that?"

I said, "Well I don't know anything about parachutes, but I'll work with it, and we need to do some aerodynamic testing of this thing. I'll put together something. We'll take it up in a C-130, and take it out of a C-130 and measure its characteristics in a descent mode."

He said, "Good. Let's do it."

That's how I got involved.

KELLY: Did this then become the Mercury Program?

HAMMACK: That became the Mercury Program.

KELLY: What exactly did you do throughout the Mercury Program?

HAMMACK: Well, starting out, it was obvious that we needed to find out something about it. And lo and behold— [Referring to documentation] This was written October 13, 1958, how we could bring it out of a C-130 and how we could measure its characteristics as it came down. So I did. We got a boilerplate capsule and I designed the parachute recovery system. We took it down to Fort Bragg. I painted the capsule olive drab in case we had any problems, so it wouldn't look like a NASA thing. But it came out and it worked fine.

Pretty soon, the program was accepted, as you know, and they renamed it Project Mercury. We had a group of people that started working on it. As I say, I had gotten involved with that. So they decided to get some people together to pursue the project, and the Center director put together the people, thirty-five or thirty-six people that started what some called the Space Task Group.

KELLY: Can I ask you what these memos that you are showing me exactly are?

HAMMACK: This memo here is my proposal for doing a gravity drop of the satellite to see what its landing characteristics were, the operation of the parachute, to test out the system. Because the landing phase of anything, as you know, is very important, the landing phase of

an airplane. It would be to check out the capsule parachute activating system, to measure the dynamics of the landing, to see how that worked in the final phase of the flight, because although the problem is to launch it up into space, you've got to bring it back down. And if we're going to put a man in it, you're going to have to have that all worked out. So that was the purpose of these tests. Those were the things that I did.

KELLY: What did you find was the most challenging throughout this program?

HAMMACK: I think what was challenging was having to pay very careful attention to all the details. Everybody was enthusiastic, but various things could happen. For example, putting all together the mechanism for the parachutes, finding out the details of the opening characteristics of the parachute. We were in a mode that we were not used to working in, and it became apparent very early that if we were going to be successful, you were going to half to watch all the details. For example, the switches, the barostat switches that activate the drogue chute, that actuate the main parachute, those things had to be checked out, had to have high reliability, would have to be safe. Those were the things that we had to watch, and that was the most challenging, in my mind.

KELLY: How were you provide feedback, as far as working these systems went and developing them?

HAMMACK: We were small then, and we had people that we knew could do work. For example, the design of the parachute system, the mechanisms and all that, we laid that out. A man that I know who is a very thorough and capable guy, by the name of Caldwell [C.] Johnson, we got him to work that. So I guess we'd provide each other feedback.

There were only, like I say, about thirty-five or thirty-six at the time. We were getting support from various places. In those days, we were in a research-type thing, where we had our own shops. We had very few contractors in those days. I am a contractor now, and there are more contractors here at JSC [Johnson Space Center] than there are civil service. But we did it all, and we knew each other. You probably couldn't do that now. You have to have a better system. I'm a proponent of a better system, because, as we talk, you'll find I gravitated towards the safety, reliability, quality [area], where you have dedicated people to assure that, that assure what you just said, the feedback. You do need the feedback. You can only get adequate feedback if you're a very small organization. Other than that, you have to have a structured environment for it.

KELLY: You worked with some really interesting people in the space program. You mentioned Max Faget and also Caldwell Johnson. Who did you admire the most and who did you work with most?

HAMMACK: It's hard to say. It's hard to say. I guess the person that I admired the most was Bob [Robert R.] Gilruth. He was the top of the heap. Bob Gilruth is the father of manned space flight, and we worked closely together. I guess I admired him more than anybody else.

I also admired Wernher von Braun. In later years, when I became chief of the Landing and Recovery Division—we're jumping, but that's all right—I worked a lot with him. He was a very charismatic-type person and he'd do things that would excite you and so forth. I admired him a lot.

Another person who I admired a lot was Jim [James A.] Chamberlin, who is now dead. He was more—how do you put it? A little different. Didn't follow the same tune that a lot of people do. A lot of people didn't understand him, but he was very inventive, very

capable, and it was his idea, the bridge between Mercury and Apollo with the Gemini Program, which I got involved with, with Jim.

So I would say those were the three that stand out in my mind. Of course, Max, he's a good soul. I like Max. Caldwell. Chris [Christopher C.] Kraft [Jr.]. Chuck [Charles W.] Mathews. Chuck Mathews was a very thorough person, very capable. I liked him a lot.

KELLY: Going back to the feedback question, when did the astronauts come into play, and did they help you in your research?

HAMMACK: Yes. Yes, they did. They did. You know, once we got going, once we got all this done, the astronauts showed up. We put together the specifications for the Mercury capsule. By then they named it Mercury. At one time it was called a manned ballistic satellite. This is what it says. I didn't even have a name. [Reading from documentation] "Drop test of manned ballistic satellite." It's a wonder that hasn't faded out. And this is Caldwell's old drawing of it. You've probably seen that. There's a manned ballistic satellite. It had a different retro rocket situation. Caldwell is a genius. He still is. He's still working, too.

What we had to do is put together a request for proposal, I guess you'd call it. We put together a request for proposal which had very little to do with the actual—this capsule, this is the one we got a patent on here, which is basically the Mercury capsule. There were seven of us that have a patent on it, mine mainly having to do with the landing system. I wish we could have patented something useful that we could sell a billion copies of. But we got a little money out of it. I spent mine going on a skiing trip.

But it was a question then of getting the thing built. All of us put together what the requirements were and I put it down in infinite detail. In those days, research engineers, we did it all. I mean, we didn't [have] contractors. We put too much. We had to cut it back.

But we put together a request for proposal. My part in it was mainly to put the landing system, the parachutes, the this, the that, all that, then put it out to bid.

Well, by that time, things were going then. All of a sudden we had money, and somebody in headquarters named it Mercury. Oh, man, we were going. They moved us over to an older part of Langley, had wood floors. You walked around, the oldest buildings there. But that was fine. Occasionally we'd pick up two or three more people. Started out, we had thirty-five or thirty-six. Occasionally we'd pick up two or three more people.

So, one day they said, "Hey, we picked out the astronauts." I had nothing to do with selection of the astronauts. That was another bunch of people. They were going to be in the cafeteria. And I said, "Okay, we'll see them." I've forgotten what day that was. But we had put out for bid by then the requirements for the Mercury capsule. Of course, as we all know, McDonnell won it. It wasn't McDonnell-Douglas in those days.

John [F.] Yardley was the project manager. He was a neat guy. Now, that was a guy that I admired—John Yardley. He had come down. He knew what we were doing. They knew what we were doing. And like good marketing people and contractors, which I am now, you know, you check your customers, you keep in touch. So they had come down and made a proposal to us with some of their ideas. So they were ready and running when the thing hit the streets, so they won.

So, all of a sudden, the astronauts showed up, and they were flesh and blood. They were nice guys and they started working with us, and we just took them in. They just became part of the team. The original seven, they were just great people. We started working with them. They started living in various locations around. They got to be friends. We'd do things together. Wally [Walter M.] Schirra [Jr.] would drive too fast down through Denbigh and get his license lifted, and his wife would have to drive him to work.

I started working closely—I wish I was home, I could show you some pictures. I gravitated towards Gus [Virgil I. Grissom]. He'd come over and bug me about this. His two

sons were the same age as my two sons—Scott and Mark and mine, Chuck and Pat. And we got to be good friends. His wife was good friends with my wife. We still deal with her. My wife Adelin was just talking to Betty yesterday, as a matter of fact. Betty still lives here. Let me show you something here. [Referring to photograph] They were waiting on a flight. That's Betty Grissom. So tend to gravitate.

Each one of them had their specialties, though. They would work with us. They just didn't stand off over here. They worked with us and they were real engineer pilots. They were not just pilots; they were engineering test pilots. Every one of them was most capable. I was very impressed with every one of them. So, we started operating. We started operating. We'd go places together.

My first job after this was to coordinate the research and development tests, to continue on with the drop tests and other testing and so forth, but very soon they got me involved with the very first project, as the project manager or project engineer on the very first flights, the one that was going to involve the Redstone, the Mercury Redstone. So we had to go backwards and forwards to Huntsville [Alabama]. In those days, it was not NASA; it was beginning ABMA, Army Ballistic Missile Agency. It was part of the Army. General [John B.] Medaris was over the whole thing. We had a person who represented General Medaris that I worked with. We're still close friends. He lives in my neighborhood—Marty [Martin L.] Raines.

We'd go backwards and forwards. The astronauts would go with us. Gus would go on a lot of the trips down over there. That's where I started dealing with Dr. von Braun. It was his idea to set up coordination groups, panels and so forth. He had some good ideas. A lot of our folks, you know how people have little internal rivalries and all, a little of that, but don't pay any attention to that. A great man. The project manager, a guy by the name of Jack [Joachim P.] Kuettner, he and I interfaced together.

As the capsule was being built, we'd go up. Gus and I would go up. I was involved with the Redstone part of it. We'd go up to McDonnell. Gus and I would fly up there a lot. Everything was going on down the road, and then we started flying. Of course, Gus had his experience with his capsule. That always bugged him.

Then we started getting involved in the Gemini Program. I got pulled out of the Mercury Program to get involved with the Gemini fairly early, because the first part of the Mercury Program had to do with the Redstone, and we finished up that. My job was to develop the Agena, the target vehicle, and the launch vehicle and the mission activities, and so the astronauts were very involved with that. We'd fly around a lot together and do things. This one thing just kept going on, kept on going. The Gemini Program was a very fascinating program.

KELLY: What exactly did you do in the Gemini Project?

HAMMACK: In the Gemini Program, I was the manager for the launch vehicle, the booster for the target vehicle, and the target vehicle, and the mission planning. That was my job.

KELLY: I remember hearing about some problems with the Agena early on. Can you tell me a little bit about those and what you did to resolve those problems?

HAMMACK: All right. Yes, let me tell you about that. Let me tell you about that, because by the time that happened, the manager that I had on the Agena went back in the Navy and I had to do an additional duty to take over that.

We had a project manager around here that had an old saying, that the better is the enemy of the good. And never was an old saying more true than in this case. The Agena was a perfectly fine stage. It sits on top of the Atlas right there, and it was used for various things.

The Air Force used it. It was an Air Force-developed thing. But it had a kind of imprecise cut-off. The oxidizing and fuel, according to what kind of lead you had, it would drivel off. It wasn't as precise. And by making a change in the lead of the propellants, we could make it more precise and improve it and make it better.

Well, the very first flight—oh, we had then the beginnings of the safety group, just the beginnings of the safety group. There was a guy by the name of John Conlan, who had to do with propulsion and engines and all, and worked in the safety groups. He visited me. He said, "Jerry, you know, you can have a problem. You haven't tested this thing high enough because propellants can exist in a different phase. It can be ice, in a solid stage at very high altitude. You need to test it more."

No one wanted to do any further test on it. His ideas people thought were more theoretical. Although I worried about it, but I didn't do anything. I didn't stand up and say, "Unless we do this, I'm going to—" I didn't do all that sort of thing. I guess probably we should have, all through the program, more of us should have done that. So we didn't do any further testing. We thought we had tested it enough. But we had an improved cut-off method. Better.

So the time came to launch the Agena and the launch vehicle, the Gemini launch vehicle, was going to launch from another pad and they were going to rendezvous, you know, do the things the program planned to do. So on the very first launch, I was the acting project manager on it. I will go down in the blockhouse right with it for the launch. That's the worst place to be. That thing launched, and then all of a sudden, nothing. Nothing after the big roar. We didn't know what was going on. Nobody could find anything. No tracking, no nothing. I couldn't hardly converse with mission control. I don't know where they were at the time. They were probably back here then, Gemini IV, somewhere in there.

What had happened is just what John was concerned about. With the difference in lead, you had gotten in the situation where you had ice crystals in the oxidizer. And when it

hit, it exploded into smithereens. Complete loss of the Agena. So the program came to kind of a standstill.

What to do? Well, we've got to find out what caused it. We resurrected that and said, "When can we get that tested to check that out?" So it turned out, the Air Force had access to the Tulahoma Test Facility down in Tulahoma, Tennessee, the Arnold Research and Development Center down there. And I want you to know, we absolutely duplicated exactly what had happened up to the point where we over-tested. We didn't mean to go quite that far and have another explosion. But it absolutely proved that that was the problem.

Then the question was to go back and redesign the cut-off system and all. And about that time, old, foxy John Yardley at McDonnell said, "Hey, I'll build you something. You don't need that Agena. I'll build you a target docking adapter." He was going to put together a bunch of junk with the docking ring and launch that, and not use the Agena. I said, "That's no good. You're going to try to rush this thing. That's no good. We're going to accelerate our program to fix things."

So I went over to Larry Smith, who was the project manager out in Sunnyvale, California, with a big picture of this drawing of this target docking adapter. I hung it over his desk. I said, "Look. That's your adversary. You've got to beat that dog-gone thing."

But before we could get the Agena corrected, they got that thing built and launched it. But they didn't check out everything like I said, didn't get the right feedback, didn't have the Caldwell Johnson and all. And when it came open, it couldn't completely come open. This shroud hung up with some wires and straps, and that's when they called it the Angry Alligator. So it didn't work. It didn't work. [Laughter] They could not dock with it.

So then we came in with the Agena and then had the successful docking and all the good things that we provided with the Agena.

KELLY: Was that Gemini VIII?

HAMMACK: It seemed like it was Gemini VIII. Maybe it was Gemini VIII, because in Gemini VIII is when we had the problem with the thrusters and they thought it was the Agena because it was new, and it was the thrusters on the spacecraft. They undocked with it.

KELLY: And how did you feel when you heard about those problems?

HAMMACK: I didn't think it was the Agena. I was in the control center at the time, and I knew the Agena wouldn't do that. I knew it wasn't that. It was the thrusters on the spacecraft.

KELLY: At that time you said you had just moved out to Houston.

HAMMACK: We'd moved out to Houston a little bit earlier than that, in the beginning of the Gemini Program. In fact, as I took the astronauts, we chartered an airplane and we took the astronauts all around on tour of all of the facilities where all of the Agena stuff was being built: Aerojet in Sacramento [California], the engines for the Agena out at Sunnyvale [California], and the Atlas down at San Diego [California]. We had a good time traveling all around together. And they moved out.

It was kind of a tough thing. I had just put in a new air-conditioning system in my house, and not many people had central air-conditioning then. I put in a new system and all, and when I tried to sell my house, there was five inches of snow on the ground in Virginia. I told the guy about it, and he said, "I don't care about air-conditioning!"

Anyway, we all moved down here. There was a development coming up about the time we all moved down. I moved down to be reasonably close to a friend of mine. A lot of the astronauts settled in that same little subdivision over here, the one they call Timber Cove.

Gus was across the street from me, Wally was over here, and John [H.] Glenn [Jr.] was over here.

KELLY: I used to live in Timber Cove with my grandparents.

HAMMACK: Well, you know the situation. My youngest son would take Wally for a ride on his go-cart and Wally would come back and say, "Let me tell you, no rocket's that rough." probably And then we'd go riding with Gus in his Corvette. Mark [Grissom] would say, "Dad, do 100!" Vrrooom! Later, [unclear], "My God, Wally said his daddy actually did 120." But we had a good time in Timber Cove.

By then we were all down here, working here. And after about Gemini 8 or 9, somewhere, or 10, in there, the program was going good. Jim [James A.] Chamberlin, this inventive guy that I admire a lot, he even had ideas we could use if the Apollo's slow, we could take the Agena, of the Gemini Program, to the moon. He had sketches for that.

KELLY: Can I ask what happened to that idea?

HAMMACK: Well, nothing ever came of it, because the Apollo Program was moving fine. It was going to be a precursor to it. It's always good to have a backup plan.

The Gemini Program was run by a small group of people because so many of the Mercury people had gotten involved with the Apollo, and so it was not many people working on the Gemini Program. So with the Gemini Program, it was a smaller bunch of people, very close-knit, worked closely together, and we had a good time with the Gemini Program. As it as starting to come to an end, I wasn't all that wanting to move over to the Apollo thing, because I had not worked much on anything to do with it, and I almost left the agency then. I got a nice offer out at California, and I was about to move out to California.

KELLY: What changed your mind to make you go into the Apollo Program?

HAMMACK: Two things. Two things. Two things. One, when I found out how expensive the houses were there, I wasn't going to be able to live in the same kind of house. And then they made me an offer of a new job that sounded very fascinating. What they offered me was to take over the Landing and Recovery Division and be in charge of recovering the astronauts and the spacecraft. And that sounded like a challenging job, so I said, "I'll stay."

KELLY: What exactly did you do in that division?

HAMMACK: Well, in the Landing and Recovery Division, you have to develop the various techniques, here again, somewhat similar to the original thing there. You actually have to put that in operation. You're involved in the landing phase of the mission, and you have to plan out how you're going to cover all possible landing points in the world. You have to have the proper equipment to handle the capsule and the crew. You have to do testing in the beginning to make sure you have the operations worked out. You have to develop the proper beacons. You have to do all that prior to the mission.

Then the deal had been worked out that we'd get DoD [Department of Defense] support to actually do the work during the mission. So what the requirement was then was to lay out what was needed, put out a book, a document, for each mission, on what our requirements, what kind of carrier you want. We essentially rented the carrier, the airplanes and so forth. We didn't have to pay the salaries of the people. We paid the operating costs. We put our requirements in. We'd lay out the recovery plan. It ended up that you would want to be able to recover within an hour or two hours any kind of emergency that came up. So you would put the primary ship where you think you're going to come down in either the

Atlantic or the Pacific. And then the secondary ships, three other secondary ships. You have two ships in each ocean. Then you'd have C-130 aircraft that could come for contingency recovery. You work all those details out. Then you deploy all your people in the division to train the Navy and Air Force people in those things.

KELLY: It sounds very extensive.

HAMMACK: It was. It was a lot of fun. I enjoyed it. I would assign myself one of those operating jobs every now and then. I mainly would stay in the—we had our own room. We didn't get the publicity like the people out in the MOCR [Mission Operations Control Room]. [Referring to photograph] Wait a minute. That is not the recovery room, is it? Yes, it is. Here it is. This is it. We'd have our own recovery room. Generally there was a guy who was picked out of the Department of Defense who was a DoD commander for manned spaceflight support. Then he'd have a staff of people. This man here, this colonel here, generally ran the office and they were located down at Patrick [Air Force Base].

We'd stay in communication with all the ships. The man that stays in communication with all the ships is a communicator, and we called him Osborn. "What's this Osborn?" I think the first communicator, one of great note, was a man by the name of Osborn. So the communicator in the Navy now is always called, he's the Osborn. He's Osborn. And they'd communicate. Here we're all worried about what's going on. This man here is Vince Houston, General Houston. Royce Olsen. This is a fellow here that had to do with all the C-130 search aircraft. He was a very fine fellow. This fellow was from the Navy. This group under the heading by this man could communicate with all Navy, Army, Air Force all around the globe. During the Apollo 13 thing, we communicated with all kinds of ships, including Russia, for aid and assistance. We could have had a ship anywhere we came down, working with that.

KELLY: Was that a difficult thing to arrange?

HAMMACK: With the system we had, it worked very smoothly. It worked very smoothly. We had the system in place.

KELLY: Can you tell me a little bit more about the actual recovery of Apollo 13?

HAMMACK: Well, we had a ship off the coast of Africa if it had come back in a free return. There were a lot of people that wanted them to come back in a free return because they didn't want to change things too much. They didn't want to complicate things. So I was prepared. I had an engineer that would be there at the splashdown. We communicated with him, with the ship. There was a ship of opportunity over there that we could arrange. So we were going to have someone there.

The decision was made to go ahead and make the burns so that we'd come down in the primary area, so we moved that ship into that area. If it had come down in the originally planned area, it would have come down close to the Equator. It would have come down off of Christmas Island. We were getting so precise with landing points that we actually started moving the carrier off of the impact point, because it was so precise. So what we were doing, what we were trying to do, is to put it close to a land mass so that we could fly over, get the astronauts in an airplane, and bring them back more quickly. So I had selected that as a point to come down in. I had nothing to do with the trajectory, but I could choose the situation as regards this direction.

So we would have come down just a few miles off of Christmas Island, which is close to the Equator, but with the burns, we had to move that. It was in a different location, but

within the carrier's steaming distance. So we had the primary ship there with no problem. It all worked out.

KELLY: It was very successful. I bet that was a real reward for you.

HAMMACK: Yes. These were some of the scenes for landing. We'd go out and get them, bring them in. The Navy would have a great deal of fanfare with them coming in. This is Dr. [George E.] Mueller, who was our head man in Washington. I think I took him out with me on Apollo 12. I think it was Apollo 12. We flew to Samoa, and a small airplane would take us on deck, the carrier from Samoa. He enjoyed that. Dr. Mueller enjoyed that.

This is Apollo 11, when President [Richard M.] Nixon come out. And this is Admiral [John] McCain. And this is "Red Dog" Davis. It was funny how Admiral McCain addressed him. "Red Dog!" such and such. He was a two-star admiral. Admiral McCain was Commander-in-Chief, Pacific, CNCPAC. You know the military has all these things. CNCPAC. The man who is CNCPAC is almost as big as God. He commands all of the Pacific military forces—Army, Navy, Marines, Air Force, everything. And it happens most of the time he's an admiral, because I guess it's a lot of ocean out there. But he has aides that are like major generals. When he travels around, he travels in a big jet and he has a suite in there with cryptographic machinery, and all this.

I flew with him back from Samoa to Hawaii. I was asking his general aide—his name was John somebody. "John, what is all this material?"

He said, "Well, when Admiral McCain leaves Pearl Harbor (that's where his office was), he doesn't leave his job. He's always CNCPAC." He operates as Commander-in-Chief of the Pacific wherever he is, so he needs all this equipment.

I often accuse Mike Hernandez—Mike Hernandez is the president of our little company—when he goes around, he's always calling back.. He always, you know, just

getting out the door, saying, "Jerry!" So I say, "Mike, you know, you're CNCHEI." [Hernandez Engineering, Inc.] You don't really leave me in charge. You're always in charge!" [Laughter]

But he was a fine man. His son, you know, was captured in Vietnam and put in jail, put in prison there. John McCain is a senator now, you know. They wanted to know, did he want to be relieved of duty, and he said, no, he didn't. He said his son would want him to proceed and so forth. A wonderful man. I held him in awe. He's a little wiry guy. One day he said, "Jerry, my name is Jack. Call me Jack." I said, "Admiral McCain, I could never in my life call you Jack!"

He visited Apollo 13, like a good admiral. He visited. He went to see the wives. He went out to see Marilyn Lovell. I took him out to Marilyn's house. They lived on the street in back of us, you know, on the street back on the canal. He went out and talked and with them, said, "I have good confidence in all my people. They're going to be ready." She was a good Navy wife and he was a good admiral.

On the way back down on Kirby Road, you know, where you turn around and see all those apartments, he turned around and said, "Jerry, what is that? Is that a prison?" Those were apartments. He didn't think much of those apartments over there. [Laughter] He said, "Is that a prison?" I said, "No, Admiral McCain. Those are apartments."

KELLY: That must have been very rewarding for you, to have people like the President and this admiral coming to see your work.

HAMMACK: That was fun. We had some good times then, we really did. We really did. We felt like that would go on forever. It was certainly surprising to all of us that the interest waned as quickly as it did, because after Apollo 12, we were out in 13, 14. Then people started losing interest, and it was around those days that we started looking more to the

future. We wanted to get a space station and a vehicle to go to and from the space station, but we're not able to do it. We were able to sell the Shuttle without the station and get by the best we could.

There were some of us, as we went into that phase and we closed down the Landing and Recovery Division, they got me involved with the Future Programs Division. We tried to come up with various new areas. One of them was what we called in those days the IRDM [International Rendezvous and Docking Mission], became ASTP [Apollo-Soyuz Test Project].

KELLY: Can you tell me a little bit about that project and how it developed?

HAMMACK: The first I knew of it, I moved over to the Engineering Directorate at the time with Max Faget. They lumped three groups that they had working together to form what they called a Future Programs Division. There was one of the projects that was interesting. We had several projects, one of them having to do with a polar orbiting satellite which was picked up by another center. We did a lot of work on that. The one that I was very much interested in was a lunar colony. We did a lot of work on that, and Dr. Gilruth was in favor of that. That was not followed.

But the one that was picked up, that they were already working on when I got there, was this International Rendezvous and Docking Mission, IRDM, where you were involved with the Russians and so forth. A lot of work was done on that. That was picked up and they made a project out of it. When they made a project out of it, they moved it into a project organization, and only one of our people went with it, only one person. They picked up a project manager to run it. But we were really proud that that was going on.

Somewhere along about that time, I guess I spent a couple of years, we were doing work with payload integration, payloads and so forth. And with my preoccupation of safety

in the Recovery Division, I spent my last years running the safety organization. They created a division called the Safety Division, and they put me in charge of it. So then I could say, "We've got to be safe."

The person who was always on the same side of the table that our Safety Division was on was a man by the name of George [W. S.] Abbey. He has always, he has always been interested in safety. By the time he was head of the Flight Crew Operations, or whatever at the time, we could always count on support from him when we tried to get better tires on the Shuttle, stronger windshield, things of that type. So my last fourteen years in NASA was working with safety. So I put all these things that worried me all through the years to good use, and perfected systems and techniques to assure safety.

KELLY: Speaking of safety, I'm actually looking at this picture from Apollo 11 again. Were you involved with the development of the Mobile Quarantine Facility?

HAMMACK: Yes.

KELLY: Can you tell me a little bit about that?

HAMMACK: Yes. Yes, I was. Yes, that was developed within our division. That was an interesting project. I'm glad that you brought that up. A lot of the scientists were worried about lunar pathogens, you know, all these bugs that were going to come down here and so forth. They said, "We can't just bring those astronauts back down here. You've got to quarantine them."

So our job was to develop a quarantine place on the carrier and put them on the carrier. So we said the cheapest thing to do was to get a—whats the name of the big trailer outfit? Airstream. What we did, the basic vehicle was an Airstream trailer, and we modified

it with the proper filters, etc., etc., etc. We did an excellent job. The chance of having lunar pathogens was remote, but no one was going to stand up and say, "There are not going to be any lunar pathogens." And so we did an excellent job of putting that together. We put some of our best engineers on designing it, putting it together, but trying not to spend a lot of money either. And then they built a quarantine facility over here.

We worked out the details of how that quarantine facility would mate with our Mobile Quarantine Facility, put it up against that, a good seal there, and then we took it out on Apollo 9 to do some tests with it and so forth on board the ship. As a matter of fact, on that particular mission we were in a round-bottomed kind of a boat. We didn't always use CVSs.

KELLY: CVS is?

HAMMACK: CVS is more of a real carrier with catapults and all that. These ships were less substantial. They had a round bottom and they just did helicopters. So you would get some rolls. I flew from Bermuda and as soon as the helicopter touched down, I knew I was in trouble because that ship was going like that. Oh, golly Moses. So the first thing they did was to take me to the officers' mess. You live real good out on a carrier. The Navy, they have all kind of cooks from various places. So they took me into the officers' mess, and the first thing, I sat down and they were going to give me some soup. Fortunately they had a big linen napkin. The soup was in kind of a shallow soup bowl, and that ship came up and dumped it in my lap.

Chuck Filly was our recovery team leader. I said, "Chuck, where is the center of gravity of this ship?" Because I began to feel terrible. He said, "That's where we've got the MQF," the Mobile Quarantine Facility. I said, "Take me down there." So they took me down there, and I sat there for the next twenty hours, I think. The only thing I had was soda crackers. [Laughter]

But what we did, we brought it out there to see how the systems would work, see how it would all work, and so forth. There were some people, in fact, that wanted to test it out with people and all that, but we just worked with the systems and so forth. So it worked very well.

By the time we actually went into a recovery mode, I personally became concerned about the area we were going to land in. We made some modifications. At one time the capsule was going to be lifted up with the crew intact and brought it and butt up against the Mobile Quarantine Facility. I began to worry about that because of the humidity, the heat. I thought it was more of a safety concern to do that. You've got to worry about the safety of the crew. You've got to worry about the lunar pathogens, but you've got to worry about the safety of the crew. What's the tradeoff?

So with my efforts—and I got criticized for this, by the way, and I don't know how it all ended up, I don't know who would say what—but I objected to it strenuously. I got the backing of Dr. Gilruth, and we came up with a different system where we would go with the same system we were using, put a curtain in the helicopter, and spray down with betadine as they'd get out. Not as good. A lot of the scientists didn't like that at all. Then you would bring them on board the carrier, get everybody away, walk through a tunnel to the MQF.

I insisted on that, and I got a lot of static. I hurt myself in several ways on that question, but I could not—what they wanted to do, the last straw was, they wanted to seal up the capsule. Didn't even want the filter to be working. They wanted to seal it up for a limited period of time. I know it wasn't long. But that was going to be entombing them out there, and so that's when we started objecting. I got support from Dr. Gilruth on that, and so it all worked out.

After a while we realized there were no lunar pathogens, but who can say. Who can say. There could have been.

KELLY: When was it discontinued?

HAMMACK: It was discontinued before the end of the program.

KELLY: Getting back to working in the Space Shuttle and working in safety, can you tell me a little bit about what you did?

HAMMACK: When they moved me into the Safety Division, I tried to integrate the work we were doing, tried to come up with various systems for the proper analysis of possible hazards, created a document that would give more or less an assessment of each flight, worked with the payload safety. We built the Shuttle as a vehicle that would take up all kind of payloads, all kind of experiments and payloads. It was your responsibility, if you have a payload you want us to fly, it's your responsibility to make it work, but your payload has to be safe. That's the only thing we require. It has to be safe. It can't hurt us. It can't hurt the other payloads.

So we put together a document, kind of a bible, called NSTS 1700.7, of what you have to do. Within the division, Bobby Miller was the branch chief involved with that. He was more or less the architect of that system. He worked it. I recognized him as a very talented young man. I put him in charge of that. And it's in use today. He set up a system where you have a group of peers to review how have you met those requirements. Those meetings are going on right now. I attend those meetings from my position over here now, and we go by that document. So that was one of the best things that came out of that division.

Then the documents on how you evaluate hazards, what is the risk involved. You can't operate without some risk. The only time you're completely risk-free is to be in a tomb and you're dead then. Life is full of risks. But what is acceptable risk? And those are the kind of things we work with. I find that one of my most fascinating jobs, working in safety.

When you're in the safety business, you're involved with everything. You're a systems engineer. You get involved with the whole work. I enjoyed it very much. As a matter of fact, when I retired, they wanted me to come over here and work for about a year to do a safety job. Well, that was ten years ago. One thing led to another. So that's the way it goes.

KELLY: What happened after the Challenger accident and how did it affect your job?

HAMMACK: Let me say that. At the time I was becoming chief of the Safety Division, either before or right at the early beginning, I attended a class by a man by the name of Vernon Grose, who made a big impression on me. He became a member of the National Transportation and Safety Board [NTSB] in later years, and is somewhere in Washington now. But he quoted a man who was head of the Bureau of Aviation Safety in NTSB, made a big impression on me. He said, "To get things fixed sometimes is hard in the name of safety." And what this guy, C.O. Miller—he's still around, a consultant somewhere—he'd keep these things he wanted to get done in his desk drawer, and when an accident happened, he'd pull them all out and try to get them done. That's exactly what I did after the *Challenger* accident.

We had a book, *Mission Safety Assessment*, that we would put out for each flight. This is the document I was telling you about. In that *Mission Safety Assessment*, there are various accepted risks, but they are still risks. They're still risks. Like the windshield is not as strong as I would have liked to have seen. The tire situation. Various things that I would have liked to have seen better, but they were acceptable. [Reading from document] "[unclear]. An accepted risk is a residual hazard that both the program and the safety group have bought off on." That's the definition of an accepted risk. But I dumped those back out on the table after the accident and we did the best we could to eliminate as many of those as we could. That was our first reaction.

I'll never forget that day. We were having a meeting. We had the television on. We had done all we could do at that point, and everything was going along pretty good. I watched it happen in real time on the set, and we were all in a state of shock. Fortunately, we had our accident investigation documents close at hand. We started pulling that out, and we went into immediate session.

So those were the kinds of things we did. And some of those things, a lot of those things we got done. Some of the things were just prohibitive to try to get done, and very costly. You try to get the things that are highest risk, the least costly done, but some of them we got done, some of them we didn't. That was our reaction.

Then I had planned—I had enough years in to leave by the time of the accident, but the head of the SR&QA [Safety, Reliability and Quality Assurance] Directorate asked the gray-haired guys to stay until we got going again, which I did. We put together better systems after that. We had a group to come around and review all of our materials and so forth. We got help from various people. We had experts who would come in and talk to us about probabilistic risk assessments, which utilize numbers. We had tried to stay away from that and use a qualitative approach. Numbers sometimes can fool you. We didn't like the numbers.

There was an old fellow that came in here, who wore tennis shoes. He was from the University of California at Berkley. He'd drop names. He said, "I stopped by to see Jim the other day." Jim [James C.] Fletcher, Dr. Fletcher. So he told a story one day that got my attention. He said, "Just imagine, this technique that I'm talking to you about, probabilistic risk assessment, is something like a big conference room full of people talking, talking, all this noise. This system enables you to lower the noise level in the room. There might be two people saying something you need to hear." So he said you've got to use it in a relative basis.

So we did. I was assigned to review that, to get involved with that. We brought in a new safety and quality man, George Rodney—I respect him very much—to head NASA

headquarters, to help us with that. He had come in from Martin, had a lot of background in quality. Lanky old guy. I always liked George. He died of prostate cancer about a year ago.

So he came in and he said, "Let's put together a committee to look at that." We brought in experts from all over the place to each us that and work with that, because we wanted to learn. We improved our techniques. The way we put in analyses was different in each one of our centers. As we were the lead center, we had some oversight of that. Me running the safety group, what we called Level Two Safety Group, but I didn't demand that, but by that time George Rodney said, "I think we ought to do it. I think it out to be uniform." I said, "We'll do it." So, with his help we were able to get a uniform way of doing that.

So those are the kind of things that came out of it. As far as the probabilistic risk assessment, the jury is still out on that. They did two, and I don't know that they showed that much. I had gotten interested in it very much, but people stopped working with it very much. But it turns out, Dan [Daniel S.] Goldin is interested in it and has funded us, our little company—well, funded Marshall, and we have the support contract for Marshall. Our company does safety work all over. We have contracts in all the centers. I was down there the other day, and we have some bright young people, a young lady is one of them, she has a Ph.D. in statistics.

And we are doing probabilistic risk assessment. That came out of the accident. I think they're useful. I think they're useful. They're expensive, but in certain areas they can be very useful. So that came out of the accident. The uniformity of doing safety analyses brought people closer together, and our safety committee got strengthened. It's a real action committee now. It used to be called Systems Safety Subpanel. Now it's Safety Committee or something. It's a stronger committee now and it's run by the chief of the Safety Division. They don't call it Safety Division anymore, call it Safety and something else. Dave Whittle [phonetic] runs that now. That strengthened. So, everything was strengthened after that accident, many things.

KELLY: So you're still very much involved in the Space Shuttle and its operations. How about the Space Station?

HAMMACK: Yes.

KELLY: What do you do with the Space Station now?

HAMMACK: My job here as director of engineering, I worry about all of our engineering activities. I no longer oversee directly—I'm, I guess, the resident safety expert, but we have various safety projects. What we do now is we do the safety and reliability and quality activity at Langley Research Center. I was happy to go back to Langley to get that contract, by the way. I had a lot to do with getting that contract. We are working on the supersonic transport support, payloads. Langley has payloads. And general aviation stuff. So I get involved with those people. This is at Langley Research Center. This is at Goddard Space Flight Center. A lot of payloads. Goddard builds many payloads, and our engineers get involved in the safety analyses of these payloads, come down here and stand before this committee. We have the same thing, safety reliability, at Ames. So they were just here. I go to these various places, review the engineering products. We have the SR&QA activities at Marshall. We also have the institutional safety here at Houston.

KELLY: So your career has really spanned from NACA all the way through the Space Station and the Space Shuttle. Can I ask you what you think the most challenging aspect of your career has been?

HAMMACK: Well, just keeping abreast, keeping abreast of all the techniques and the new things, the ways to do things, the tools, all the tools. And there are all kind of new tools out there, these computers, for example. A neat thing to do on investigating hazards is what we call a thought tree. You start out with the top the thing you don't have to have—an explosion, a fire. Then you branch out from that. What causes that? There is various software available to do that on computers. You can assign cut sets, mathematical subsets, using binary algebra, which you can do with software.

I think the challenge really is to keep up with the technology. You can't just say, "I went to school at Georgia Tech." I did go to school at Georgia Tech and graduated in aeronautical engineering. "I got my degree and now I'm all educated." That's not so. I have my master's degree here from the University of Houston in futures technology. I learned things over there. Keeping up with things. You have to keep up with things. You do it various ways.

KELLY: Can I also ask you what you think was your most significant contribution to NASA?

HAMMACK: I really think in those early days when we created the Mercury thing. We got a patent on it, at least. I think in those early days, although there were a lot of good things that came after, that was key to get that thing going. I think it could have been done. If I hadn't been living and Max hadn't been living, somebody was going to do that, because really it was a competition of who got it. The Army wanted something, the Air Force was pushing, and NASA. And the only reason we got it, I think, was because of President [Dwight D.] Eisenhower. President Eisenhower didn't want to concentrate that industrial stuff in the military. He was afraid of that over-emphasis, and he wanted a peaceful, a non-militaristic group to do it. The Army had something called Project Adam, I think. They could have done

it. They could have found out about the parachutes. We just happened to luck out. [Laughter]

KELLY: Finally, what was the most rewarding aspect of your career at NASA?

HAMMACK: Well, I think I earned more medals and commendations during the recovery days. That was a lot of fun. The recovery stuff was a lot of fun, dealing with all of that, going all over the world, going on board the ships and all that. That was probably the most rewarding. That's when I was promoted to a supergrade in those days. You had to go up and meet the President and get some medals. I have those in my family room, those things. That was the most rewarding.

But some of the most satisfying was slipping around up in the attics of the airports in the Gemini Program. That was kind of an offbeat thing. We didn't have much office space. We had to meet the Martin people and Lockheed people, because we were supposed to be dealing through the military, and that was cumbersome. We had to sometimes deal directly with those people. We were moving swiftly, so that was very rewarding, doing that.

KELLY: I'd like to thank you for your time. I appreciate it.

HAMMACK: I enjoyed it. As I told you earlier, I live in the present now. I stay busy with this little outfit.

[End of Interview]