NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

JAMES E. HANNIGAN
INTERVIEWED BY SANDRA JOHNSON
SUNRISE BEACH, TEXAS – 28 FEBRUARY 2006

The questions in this transcript were asked during an oral history session with James E. Hannigan. Mr. Hannigan amended the answers and a few questions for clarification purposes. As a result, this transcript does not exactly match the audio recording.

JOHNSON: Today is February 28th, 2006. This oral history is being conducted with James Hannigan at his home in Sunrise Beach, Texas, for the Johnson Space Center Oral History Project. The interviewer is Sandra Johnson.

I want to thank you, Mr. Hannigan, for agreeing to interview with us today.

HANNIGAN: Thank you. That is no problem.

JOHNSON: I want to begin by asking you to briefly tell us about your background and how you first became interested in the aeronautical engineering field.

HANNIGAN: Well, I've always been an airplane lover from the earliest days, even back when I grew up in Miami, Florida. My dad would take me down to where the World Airways seaplanes used to come in, and I'd love it, I love the airplanes, watch them. We'd go to the airports, so I've been an airplane lover all along.

So I ended up taking aeronautical engineering at Georgia Tech [Georgia Institute of Technology, Atlanta, Georgia], and when I left there, I pulled a couple years in the [United States] Air Force. Before that I had worked for Boeing [Airplane Company] one summer.

That's where I met Peggy [Hannigan] in Seattle [Washington]. So I went back to Boeing for a while in Seattle. And after I got out of the Air Force, I went to Lockheed [Aircraft Corporation], Marietta, Georgia. I was a flight test engineer, on the C-130 Hercules, and would fly on test missions, not as the pilot, but as a flight test engineer in the back who operated all the instrumentation that recorded the data for whatever we were testing.

Marietta is just north of Atlanta [Georgia], it's really a nice place, but I got a chance to get a job down at Eglin Air Force Base [Florida], and I took a civil service position down there. Again, it was in a flight test engineering slot, and I spent three years there. We moved to Fort Walton Beach [Florida] and liked it. I was a project manager on a [Lockheed] QF-104 drone program, which was an unmanned target for the BOMARC [Boeing and Michigan Aeronautical Research Center defense] missile. It was a big thing in those days, and was a lot of fun. We spent three years down there.

Then one day, I saw in the paper, during the spring of 1962, that NASA was coming through on a big interview trip. So I signed up to be interviewed, and I went to their location. As a matter of fact, it was right about John [H.] Glenn's [Jr.] flight, and I was pretty excited about that. The interviewer and I talked a long time, and I got pretty excited about joining what was then called the Manned Spacecraft Center.

We pulled up stakes again and moved to Houston [Texas], and weren't too impressed with Houston and all the traffic after living in west Florida. But we stayed there until we moved up here.

I joined JSC [Johnson Space Center, then Manned Spacecraft Center] in those days in the spring of '62 and stayed with them until the summer of 1981 when I retired from the government. Then I went to work for Lockheed for a while down there. We went after a bid for

Johnson Space Center support for Mission Operations. I think McDonnell Douglas [Corporation] won the contract. I helped put that bid together with a bunch of other fellows and with another guy that was from JSC then, Jim [James W.] Bilodeau.

I did a few others things there. I also worked for Eagle Engineering, Incorporated, but when the time came to leave, we left.

But we decided to terminate all my work and we moved up here in early 1992, January. So we've been here in Sunrise Beach ever since.

JOHNSON: Well, let's go back to 1962 when you saw that ad in the paper and you applied to MSC. Can you talk about that interview process and who interviewed you?

HANNIGAN: Oh, I don't have any idea who it was.

JOHNSON: You mentioned John Glenn's flight and you were aware of the space program, but did you have any idea what you were interviewing for? Did they tell the positions?

HANNIGAN: Flight controller.

JOHNSON: And you were aware of that since you had that background in the Air Force?

HANNIGAN: Well, not in the Air Force, but it wasn't too far different from my background in flight test engineering. It helped because you had to be pretty much of an engineer to solve some

of the problems we had as a flight controller during Mercury, Gemini, and Apollo. So it was a smooth transition.

And I always liked getting out of the office and doing things. Like flight test engineering, you get out and do things instead of sitting on a drawing board or sitting in an office all day with a slide rule. The flying and doing test work was always fun.

But anyhow, we've been here a long time in Sunrise Beach.

JOHNSON: Well, in Gene [Eugene F.] Kranz's book, he mentioned that he hired you and Mel [Melvin F.] Brooks.

HANNIGAN: Yes.

JOHNSON: You were the first two engineers that he hired, and one of the reasons he wanted you both is because you were a little bit older and you had more experience.

HANNIGAN: I guess that's right. Mel came in from Lockheed on the West Coast. We both hired in the same week, I believe, and Gene had just started building up what became the Flight Operations Directorate or Mission Operations Directorate, beginning with the Flight Control Division. He was my next-door neighbor, by the way, for all those years. We were, and are, good friends, and so were our wives. Gene was a great guy, one of the smartest people I've ever seen, and a good leader. He'd get on your tail pretty easy sometimes. You better be right when he asked you a question.

Gene, a Flight Control Division Chief, worked for Chris [Christopher C.] Kraft, who was our Directorate Chief, and, boy, he was really something. You felt like you were going on stage when you went into his office. You better have everything right or you felt like the old hook would come out and pull you out off the stage. So I almost had the fear of God in me by Chris Kraft, but he was a nice guy, too. Two totally different people. But anyhow, all those years with those people were great fun and great. A lot of hard work, those missions.

JOHNSON: When you first arrived, it was the same time as [M.] Scott Carpenter's Mercury 7 flight.

HANNIGAN: Well, it was slightly before that. I interviewed around MA-6, which was Glenn's flight. MA-7 was—MA is "Mercury Atlas"—was Carpenter's flight.

For my training, I went to our training site in Corpus Christi [Texas] for that mission and sat on the console in the control room. That was our flight controller training site, as I said. In those days, Flight Operations consisted of sending teams out to every site for every mission. The voice and telemetry weren't remoted to Houston. The voice and telemetry from the spacecraft had to come over landlines because we didn't have any communication satellites. Therefore, we sent people out to each site, and that was a pain going to every mission, going somewhere in the world.

But we were sure happy in Gemini when they remoted everything to Houston Mission Control. That was just the best thing that ever happened. We got to stay home for a change.

JOHNSON: On the manning lists, we saw that you were in [Kano] Nigeria [Africa]. Was that just for Mercury 8?

HANNIGAN: Yes, that was MA-8, Wally [Walter M.] Schirra's [Jr.] flight.

JOHNSON: Can you share with us some details about that flight?

HANNIGAN: Well, it was a six orbit, six rev [revolution] mission, and it was pretty exciting. We simulated for three weeks. It wasn't all that exciting being in Africa. Finally we launched, and it was a great mission. It was the longest mission up to that time. The previous ones had only been three revs. This was six revs. And Wally was a fun guy to work with. The flight controllers got to know the astronauts, pretty well, because you had to communicate with them and know the sound of their voices and know and try to detect when they were having problems and maybe would not tell you. Many times you could detect something was not quite right. Plus, you had to know the spacecraft systems also.

We remoted the data in on some—I forgot what flight on Gemini, but there was only one more mission after that MA-8.

JOHNSON: It was [L. Gordon] Cooper's, [Jr.] flight on 9?

HANNIGAN: Yes, Gordon Cooper, that's right, MA-9. And I did not go out on that mission.

JOHNSON: You didn't work that mission?

HANNIGAN: No.

I was hoping to go out to the Australian site on MA-10, which was scheduled at one time, but they cancelled the program because the Gemini Program was progressing well and they didn't want to overlap.

JOHNSON: Well, back when you were in Nigeria, you said you simulated for three weeks.

HANNIGAN: Yes.

JOHNSON: Was that in Nigeria that you were simulating?

HANNIGAN: Yes, in Kano. The site was out of town about ten miles in the boonies, so we, our team, had three people on site at a time. I was the CapCom, "Capsule Communicator," and I was the team leader. I had a Mercury Flight Systems Specialist and I had an Aeromed, a doctor, who was there for recovery purposes, since that was one of the recovery sites, in case of a launch abort. So we had three people on the console, and we had a backup team with us, three other people.

After three weeks of intense simulations with the Mission Control Center, (MCC) at Cape Canaveral, the training people in Mission Operations, really threw it to you. That was the first communications, by the way, that we had with the Cape [Canaveral, Florida] from the remote site. So I remember Dr. Kraft, who was the CapCom at Houston, talking to me as in the spacecraft before and after the spacecraft would pass over my site in Kano. And like I say, with

Chris you had to be right the first time, and we got along well, and I thought I did pretty well with that.

I never went out on another mission, because when Gemini came along, I was starting to get involved in the Lunar Module, the early work of the Apollo. We actually had a time when all three programs overlapped Mercury, Gemini, and Apollo. I remember in 1962 going to North American Aviation, which is now Rockwell, in Downey [California], to attend a preliminary design review on the Command and Service Module, and that excited me very much to think about that, going to the Moon!

But, after Mercury, I had a section which later became a branch that worked the early Lunar Module planning. Grumman [Aircraft Engineering Corporation] built that vehicle, and I and some of my people would go up to Bethpage, New York, where the factory was, and our purpose in doing that was to ensure that Grumman was building and designing a spacecraft compatible with the flight operations concepts and procedures and that it met our requirements. We weren't designing the spacecraft, but we would check during the different design reviews to see if they had redundancy in certain systems. My guys, both in that early section that I had, Agena/LEM [Lunar Excursion Module Section, later the Lunar Module (LM) Branch].

JOHNSON: When you were the head of the LEM Section in Flight Control?

HANNIGAN: Yes, and then the branch also. Our job, before the missions, was to prepare the early mission rules, prepare the system mission rules and crew procedures, particularly the system malfunction procedures, what the astronauts would do for certain system failures.

JOHNSON: And you were preparing these procedures at the same time that it was being designed and built?

HANNIGAN: Yes, generically, not detailed stuff, because the design wasn't that far down in the detail yet, but generic concepts of overall flight procedures.

JOHNSON: Had you had experience writing flight procedures and mission rules?

HANNIGAN: No. The only thing was at Lockheed as a flight test engineer I wrote the flight test plan, what we were going to test and what the procedures were for me as a flight test engineer. But that was all new. It was all new to everybody, Mercury and Gemini.

JOHNSON: While you were preparing and, as you said, writing those basic generic plans—

HANNIGAN: Procedures and rules, yes.

JOHNSON: —and procedures. If you will, describe that process of beginning to write those types of flight rules and procedures and handbooks for a spacecraft that hadn't flown yet and one that was still in the design phase and with really no one having those previous experiences. What type of process did it take to get those things written?

HANNIGAN: It was kind of difficult. First of all, I had the advantage of having assigned in what eventually became the Lunar Module Systems Branch, up to nine Grumman engineers, and they

had direct connections back to Bethpage, so we had to have a good knowledge of the systems of the spacecraft, and they provided that information to the NASA people. They also helped to write the rules.

A lot of times we didn't know that much about the systems. We went to the preliminary design review, which didn't have enough data available there to do much detailed mission rule writing, but other than say that you abort the mission after so many failures of this or that or the other. You couldn't go much more into detail than that. But then we went to the various design reviews from there on down to the final design review which was really important. But they delivered the spacecraft to NASA and then it was taken to the Cape. So that was the last review we would have with the Grumman people at Bethpage. And by the end, of course, all the systems were designed and installed. There was not much we could do once they designed, built, and tested them.

But we would go to these early reviews and the preliminary design review and write RIDs [review item dispositions], which were paperwork that we would write our concerns and ask Grumman about why this was designed this way or can they answer this question or we recommend you change this. That was what we called the RID process. And then the board would meet, either at Bethpage or at Houston, and NASA would chair it. And we, Flight Operations, were part of that board. We would throw in our inputs via RID to what we had reviewed and studied. That's pretty basic, but there were a lot of things like that to look at. So we did a lot of work before the mission flew.

But in the meantime, as you got closer and the spacecraft was delivered to the Cape, the training people at JSC, MSC in those days, would throw simulations to the flight controllers. They would get a lot of systems information from my branch, or my section early on, and from

the Grumman guys, on what the failure modes of the Lunar Module were, which is one of the things that we were interested, what were the failure modes of the various systems on the vehicle, and could we see that on the ground and identify it so we could get to the astronaut with the recommendations on what to do. And then we based mission rules on that kind of information.

Of course, the mission rules, or flight rules they call them now, they were actions based on various failure modes. And we had a final mission rule review chaired by Chris Kraft in those days, and the flight directors were part of that, and we would review those. And once everybody agreed, then they were published for that mission. We had a generic set early on, but from there on for each mission there were individual mission rules, based on the specific spacecraft. Once you got them approved at that board, you couldn't make a change without turning in a formal piece of paper requesting a change to the mission rules. And you had to go through the board again for the change.

So there was a lot of research done by my people on the various system failure modes, in order to write those mission rules, and learning the systems. Any load we could take off the astronaut was what we were after. If we could solve the problem on the ground and let him fly the mission and do his science or whatever, that was good.

I had, in addition to the Grumman people, one Hamilton Standard engineer assigned to my branch there in Houston, and Hamilton Standard built the backpack, which was the EMU, the extra mobility unit the astronauts wore. As I remember, it had seven channels of telemetered data coming out of it. There was his health, heart rate and blood pressure and other things like that that the doctors in the Mission Control Center, the Aeromeds, would monitor. Oxygen and water remaining were telemetered from the EMU, so we kept track of the consumables and how

fast he was going through them. We would project ahead how much time he had left based on the rate of usage as he was out on the lunar surface, or in the spacecraft, too. So consumable monitoring was part of that flight controller job, not just crew procedures and so forth.

We just couldn't get enough data to the ground to satisfy everybody. But there were hundreds or so telemetered parameters from the Lunar Module. I've forgotten exactly, since it has been a long time. And the EMU had, I think, seven or eight. So I had this Hamilton Standard guy, and he had some NASA people assisting him, so we had essentially two spacecraft that we were monitoring at the same time. When the men were out walking on the lunar surface during Apollo, we "house kept" for them the Lunar Module as it was sitting by itself. My engineers would be "minding the store," seeing if temperatures were okay, if there were any leaks, if oxygen flow was constant. So we were pretty busy.

That vehicle was a great vehicle; Grumman did a good job on the Lunar Module, and we had very few problems.

JOHNSON: Well, before we get into that, let's go back to Gemini. At the end of Gemini, when you were working—

HANNIGAN: I worked on the Lockheed target vehicle before we flew Apollo.

JOHNSON: Yes, you were Assistant Branch Chief of the Agena/LM Systems Branch.

HANNIGAN: Mel Brooks was the Branch Chief. I was still working Lunar Module also. I was really getting active in that. But Mel, even though he was Branch Chief, and others did all the

real-time Agena work, and I never sat on an Agena console during Gemini. So I didn't do any real time work on the Gemini Program other than occasionally in the SPAN [Spacecraft Analysis] room just to monitor.

The Agena was a very successful vehicle. It was unmanned target vehicle for Gemini.

JOHNSON: Did the flight controllers at that time that were working under you in training for the LM, the LM controllers at this time, did they ever work in the MOCR [Mission Operations Control Room] backing up or just to get the experience?

HANNIGAN: Yes. We made sure every one of them had Agena experience during Gemini, and in the front room, in the MOCR. The sections heads were generally the—I had eventually in the branch four sections heads and they all were senior people and had a lot of experience. They would be in the MOCR, and then the other people in the branch would be in the staff support room, the SSR, and they would report to our man in the MOCR. So each mission, we had an Agena console position in there, which was carried on into Apollo, the same concept.

The SSR people all specialized in the different systems of the vehicle. This was true on the Command and Service Module [CSM], also. Arnie [Arnold D.] Aldrich was the Branch Chief of the CSM flight controllers, and he had the same responsibilities as I did with the Command and Service Module, so we always had two separate groups of people in the SSR reporting to the two people in the front room. There was a Guidance Navigation and Control [GNC] Officer for both vehicles, and a TELMU [LM Telemetry, Electrical, Environmental, EVA and Mobility Unit Systems].

JOHNSON: The EECOM?

HANNIGAN: It was our version of the EECOM, because the EECOM was a Command and Service Module name, and we couldn't use the same name. So we called it TELMU, and the EMU part was the backpacks.

JOHNSON: Well, you mentioned you had some people from Grumman and Hamilton Standard working with you.

HANNIGAN: Yes.

JOHNSON: Were you still going back and forth to New York at that time?

HANNIGAN: Not very often, but we did for program reviews. But I sent guys up there occasionally, but I tried to use the Grumman people I had to be the intermediaries between us and Grumman design people. That's what they brought to us was their design information from Grumman, and that was why we spent money on hiring contractors to sit with us in the backrooms. And Arnie Aldrich had Rockwell people, in those days it was North American Aviation, in the same way.

JOHNSON: How did that relationship work? We've heard different people describe it as badgeless, as far as having the contractors in there with you. Was it a good relationship?

HANNIGAN: Well, it was. We didn't put them in the MOCR, which was a decision-making position of recommending things to the flight director. That went through the NASA people. They would monitor the console in the SSR and make their inputs to the NASA person sitting with them on the backroom console. They brought us a lot of information that we used. They turned out to be a good and valuable group of people.

I even had some Air Force people. The Air Force had sent some officers over to Flight Operations, and I had about five in my branch. There were about sixty or sixty-five total in the branch. The level would change a little here and there, but that was mainly during Apollo. So there was NASA, there was Grumman, one guy from Hamilton Standard, and then Air Force officers. Quite a mixture!

But the contractor-NASA relationship, I thought, was quite good with us. I've heard people complain about that, but we never had any problems. They fit right in well with us and sat right with our guys in the office, which I think might have violated government rules. But we didn't care. Our bosses let us do that, and that's the only way you could really learn and prepare for a mission was to be in the same room together so you could talk together and be a homogenous group. It worked out great.

JOHNSON: You mentioned simulations earlier, and were you simulating for the lunar flights during Gemini at the same time?

HANNIGAN: Oh, yes, early, early simulations.

JOHNSON: How did that work out as far as getting time in the MOCR?

HANNIGAN: Oh, boy, it was busy. We overlapped the programs, and we were actually flying—I say we—NASA, they were launching unmanned Apollo missions from the Cape on the Saturn, Saturn IB and later Saturn V, while we were flying the latter part of the Gemini manned program. So we were changing hats all the time from one program to another. There were times I didn't come home for a long time. Simulations would go sometimes all through the night if you had a long-duration sim [simulation]. But during the mission, it was pretty regular. Apollo 13 was different because we spent a lot of extra time on the console. I hardly went home that whole week.

I need to tell you a little bit about the SPAN console. The word SPAN stood for Spacecraft Analysis, and it really was more of a management room rather than technical room. We had contractor personnel in there, along with program office people, either Apollo or Gemini. In Apollo they were Rockwell and Grumman, and during Gemini they were McDonnell Douglas. And we NASA people, as well as some contractors were on the consoles, we had our own consoles in the SPAN room. In the middle was a Flight Control Division representative sitting in the middle between us.

The SPAN room was kind of a political room. That was where decisions were made that could affect the contractor. The contractor would lose points for failures during the mission, and points meant dollars to them. They would get more money if everything went well than they would if they had a lot of failures. They were anxious to make sure the flight controllers did the right thing, and so we talked with them a lot during the missions.

The SPAN room contractors had a direct line to their people back at their company, both at Rockwell and at Grumman. If the flight controller in the MOCR made a certain move or

decision and recommended to Flight [flight director] certain things and the Grumman or Rockwell didn't agree with it, we would call them, either the flight director or the systems engineer in the MOCR, and say, "Hey, Grumman doesn't agree with that." And so we [NASA] would hash that out sometimes. Then they would write SPAN chits, which were documented questions from them to us, that we would submit to the contractor to answer certain questions that they didn't know during the mission. It worked very well.

But Apollo 13 was the mission I believe that the LM people really stood out, and I could move into one of the answers to one of the questions here. We had in the LM Branch a set of crew contingency procedures that had been prepared before the flight. They were procedures set up that just in case of an onboard problem, we could pull them out quickly and implement. Contingency rules and procedures. And we did that.

My Assistant Branch Chief was Don [Donald R.] Puddy. A year before Apollo 13, during one of the mission simulations for Apollo 10, the training guys had a failure that they put in which was almost exactly what actually happened on Apollo 13. After Apollo 10 I assigned Don the job of preparing those contingency procedures after that simulation. I said, "You know, if that happens, we need to have a set of off-the-shelf procedures ready to use." The flight directors pooh-poohed the idea of that being a problem, because they said it took three failures to lose three fuel cells.

If you lost an oxygen tank, that is a single failure that wiped out all three fuel cells, and that's what happened on 13. So we pulled those procedures out, dusted them off, and updated them to what the real mission situation was at the time and used them. And the crew did not know that we had those procedures ready, and it was not publicized much afterwards, but those

contingency procedures sure did work. And I ended up giving Don Puddy a NASA medal for leading that effort, saved the guys on 13.

JOHNSON: You mentioned that part of what you did when writing procedures was look for failure modes.

HANNIGAN: Yes.

JOHNSON: And then you began the simulations. That group of people were throwing things out to give you that experience of working through those possible failures. Did you have a relationship with the people controlling the simulations?

HANNIGAN: Oh, yes. Yes, they got most of the information from us. They had some contractor people with them, too. We had most of the system knowledge of the spacecraft, and so we worked very closely with the training people, and they did a good job of simulating. Sometimes we thought they went a bit too far! There would be many of them, sometimes two or three weeks of them; simulating launch aborts, on-orbit and entry failures. Without those simulations, we wouldn't have had any experience in what to do, so they were very necessary. The training simulation people were a very necessary part of the flight control team.

JOHNSON: Working up to the Apollo 1 period of time, let's just talk about that for a minute. Were you actually onsite when the Apollo 1 fire happened?

HANNIGAN: We didn't have a Lunar Module on that mission, so I wasn't assigned on it. None of my people were. However, they monitored the mission, as I did. At times I came in and sat on the LM console in the front room and listened and watched the data, but we had no part of that mission.

JOHNSON: Where were you when you heard about the fire?

HANNIGAN: When the Apollo 1 fire occurred, Gene Kranz and his family were out at a restaurant, and I heard it on the radio at home, and I called in to the guys at the Control Center and they confirmed it. They closed down the communication to and from the Control Center. When we had an accident or some kind of a severe problem, they would pull all the telephone plugs. The flight director would say, "No phone calls."

But then Gene came home from the restaurant, I went over next door and had to tell him about the Apollo 1 fire and that three astronauts were killed, and he immediately ran out and jumped in his car and went to the Control Center. It was a terrible thing, but, again, there was no LM on that mission, so I had no official position on that flight.

JOHNSON: Were any changes made to the LM because of the fire? I know so many things happened as far as getting flammable materials out.

HANNIGAN: No design changes were made. The flammable material removal was the big effort. One of the problems on that fire was that the ground crew had left some flammable material in the cockpit during the test. It was not flight hardware, and it burned in the spacecraft.

But it was a terrible day; one of those guys was a particular good friend of mine. We were lucky from then on, and we were able to not have any serious problems during the missions that we couldn't fix. And, again, it was due to simulation, training, and the efficiency of the flight control people that I had in my branch for the Lunar Module and the engineers in the other branches.

JOHNSON: When you were talking about Grumman and their people that you had in the SPAN with you, talking back to the other Grumman people—

HANNIGAN: They talked with Grumman people at Bethpage.

JOHNSON: —at Bethpage, did they have their own control room at Grumman?

HANNIGAN: They could monitor the LM data and the crew voice communications. It was the same with the Rockwell people in the SPAN room and at Downey for the Command Module, so they could keep up with the mission.

We worked with Skylab after Apollo, and I had the Corollary Experiments assigned to my branch. I personally did not have any participation in the Corollary Experiments activities per se, but I had a section that did that work. We also were doing some advance work on the Space Shuttle, early designs, like with the early days in the other spacecraft when they were just conceptual designs. I had half of my people working early Space Shuttle activities while we were flying the Skylab. The corollaries were just one of several kinds of experiments on the Skylab Program. We did not have any of the Skylab systems assigned to my branch.

JOHNSON: Let's go back to the Apollo 5 mission, which was the first—it was unmanned, but it did have the LM involved. Do you have any memories about running that mission?

HANNIGAN: On Apollo 5 we had LM propulsion troubles. There was not Command and Service Module on this mission.

JOHNSON: I think in some of the research I saw that there was a problem in LM descent engine.

HANNIGAN: We had the LM descent engine shut down early and my people sent backup commands to restart the engine. We burned both the descent engine and the ascent engine, attempting to simulate the lunar profile. We ended up getting the data, but the mission didn't go right.

JOHNSON: The MOCR, as far as the relationship between the SPAN and the MOCR, you've described that a little bit. But as far as assigning controllers, and I know that all the flight controllers had their teams, like the white team, their different colors.

HANNIGAN: Yes.

JOHNSON: Was part of your duties, or did you have any input into assigning which controllers would be working with which team?

HANNIGAN: Yes, working with the Flight Directors. I tried to stay out of that arena as much as possible, but if it got into a management problem, I got involved. But I had four good section heads that were able to handle that pretty well.

During a mission, I had one of my Grumman engineers sit with me back in the SPAN room, as he didn't have a position otherwise in the Control Center. He was a good person to help me interface with Grumman. The Command and Service Module SPAN engineers had a Rockwell person sitting next them on the console, also.

We had very few problems that required a lot of really tough work. We had a lot of minor problems that bothered us, keeping up with the consumables and things like that. But we got through them all. Simulator training guys helped us get through all those problems with the simulations.

One of the questions was about the ALT Approach and Landing Test Program. I didn't have any direct mission involvement in that personally. As I have indicated, the Shuttle systems people worked for me, but they were assigned on the console, not I.

One of the questions is my memories of the first Shuttle flight. I was in the SPAN room for prime shift during the flight. That was an exciting mission, being an aeronautical engineer, and to have a spacecraft with wings that landed using aerodynamics. I remember leaving the Control Center after the landing, as was Chris Kraft—everybody had left but Chris and myself, and I said, "Chris, I can't believe it. It was so perfect. The landing was so good."

He says, "I can't believe it either. It just blows my mind."

And John [W.] Young, by the way, was commander on that flight, and he was a roommate of mine at Georgia Tech.

JOHNSON: That's what I read.

HANNIGAN: Yes. We were both in the Sigma Chi fraternity.

JOHNSON: How long did you room with him?

HANNIGAN: One year.

JOHNSON: Did you keep in touch in between college and when you both ended up with NASA?

HANNIGAN: Yes, up to a point. He was from Orlando [Florida], and he went back down there. John was not a big talker, but he was smart. He had closest to a 4.0 grade point average at Georgia Tech than of anyone I know.

JOHNSON: Well, let's go back to Apollo again for a second. Apollo 8, you were on the manning list, but there was no LM on Apollo 8.

HANNIGAN: No. That just allowed me to get in the Control Center.

JOHNSON: Okay. Do you want to share your memories of that flight? It seemed to be an important flight to so many people that we've interviewed because, one thing, it wasn't planned and there were some delays with the LM, and so they shifted the flights and then flew Apollo 8 instead at that time period.

HANNIGAN: Yes. They had LM delivery problems from Bethpage.

JOHNSON: Do you want to talk about those for a minute, or do you have any memories?

HANNIGAN: Grumman was having test and checkout problems. It slipped their delivery and the LM mission was delayed, so they threw in Apollo 8, which carried only the Command and Service Module. I just came in and monitored in the SPAN room just to keep up, as a Branch Chief, just to keep up with what was going on. I'm sure I remember my guys were in also on their consoles, watching the Command Module data.

JOHNSON: Were you working on Christmas Eve?

HANNIGAN: On Apollo 8? No.

JOHNSON: On Apollo 8 when they read Genesis?

HANNIGAN: I cannot remember that, honestly. You know, it's just been so long ago.

JOHNSON: We interviewed Dave [David W.] Whittle last week.

HANNIGAN: Oh, yes, he was one of my section heads and a great engineer.

JOHNSON: And he said that the pictures that came back from Apollo 8, being so close to the Moon, that people were just "eating them up" as soon as they would come in. Do you remember seeing those first pictures?

HANNIGAN: Well, they had some TV [television] pictures when Apollo 8 orbited the Moon without a LM, and that was the first time we had gotten close to the Moon and everybody was anxious to see what it looked like up close. And the real time TV was just very impressive. Not really high quality, but the photographs after the mission certainly were. Yes, that was exciting to see the Moon close up in real time, and it was also nerve-wracking, particularly during the mission when they went behind the Moon and we lost contact for about two hours. And we were always anxious when we came to the point when voice contact was scheduled. We were waiting on the crew to say, "Houston, this is Apollo 8," and "Oh, you made it, made it behind the Moon."

JOHNSON: Let's talk about the first mission, the manned LM mission.

HANNIGAN: That was LM-3 on Apollo 9. It was a manned Earth orbit mission. It was the hardest mission we ever flew because they undocked the LM, manned, but we didn't have constant contact with it because we didn't have a communication satellite in orbit in those days. It would go in and out of coverage between sites, and it was kind of a disjointed thing. We didn't have a continuous flow of data like we did during the translunar coast mission. During a lunar mission, we had data all the way to the Moon and back, so the only time we lost data was when they were behind the Moon. But we had data constantly during the landing.

But Apollo 9 was a headache because of that problem, and we had some LM problems that we got through all right with our mission rules, our procedures and so forth.

JOHNSON: You mentioned that your mission rules changed for each flight.

HANNIGAN: To a very minimum. We tried to keep changes to a minimum. We tried to hold everything as constant as we could, and only changed them if the spacecraft design or systems changed a little bit here and there, or maybe it was something we learned from a previous mission. The same thing applied to the crew procedures. The crew would take our first crew procedure work, and then they would massage them in their simulator. But they would run those procedures through and then make changes as they checked them out to find out where or how good they were. And sometimes they were changed quite a bit, and at other times they were not.

But by the time we got to the launch date, the rules were approved and the procedures were submitted and "in concrete" before the launch, and they went into their flight handbook. Everything had been checked out pretty well on what to do if this failed or what, that kind of thing.

We got along well with the crews. We tried to make it work that way on purpose.

JOHNSON: Let's go on to Apollo 11 since this was the first time that the LM landed.

HANNIGAN: Yes. We had very few minor failures on the Lunar Module. We almost came close to calling an abort during the lunar landing, however, because of the descent engine. My people were monitoring the descent engine tank pressure, and when they landed, the heat soak back

came in on the helium pressure tank. The descent engine was pressurized by helium to make the propellants flow into the engine. And then the helium tank started going up in temperature and pressure right after touchdown. The temperature causes a rise in pressure in the tank, and we were sweating it out in the LM team. And I could see us calling Flight and saying, "Abort, Recommend Abort," because we had a mission rule that we would abort if the tank pressure got at a certain level. If the thing blew up, we were all in deep yogurt. The pressure came up, but it didn't reach that point, and it peaked and everybody went, "Whew," and that was right after landing. And that never got out. As far as I can remember, it never got out to the press.

But otherwise, that was an outstanding mission. The Lunar Module worked very well, the crew did well, and I think we got most of the mission objectives. As far as I'm concerned, I think they got them all. We were all tense to see the power descent go well and the ascent, rendezvous, docking. It was very exciting, and it helped a lot to have everything work right on both spacecraft, believe me. But we didn't take any chances. The guys were monitoring very closely the flight.

JOHNSON: Bob [Robert L.] Carlton.

HANNIGAN: Carlton was one of my sections heads, and he was one of the MOCR operators. We called his position "LM Control." It was an equivalent to the Command and Service Module Guidance, Navigation and Control, "GNC."

JOHNSON: He shared with us the experience of having the stopwatch, counting down for the landing and having only a very few seconds left on that stopwatch.

HANNIGAN: He was on the powered descent team.

JOHNSON: Was that a tense moment waiting for that landing?

HANNIGAN: Yes. We were all very tense, but it worked out very well, except for that helium overpressure after landing.

And I remember that one of the LM propulsion controllers saying, "Whew," when the pressure leveled off. Apollo 11 was almost a picture-perfect mission, as far as I'm concerned.

JOHNSON: Well, as far as the ascent from the Moon, that went well.

HANNIGAN: Yes.

JOHNSON: Was there anything about that aspect that you remember?

HANNIGAN: The ascent engine ignition had to work or the crew was stuck on the Moon. But it ignited and they had the normal abort stage, pyrotechnics went off and separated the ascent stage from the descent stage, and the engine was working and up she went. The flight dynamics officers had calculated the right timing and everything, and it just was beautiful. It really was. All the Apollo flights went that way, as far as I'm concerned, except 13, during which we didn't land. But all the landing missions were really good.

The program had a block two LM starting on Apollo 15, 16, and 17. Those three missions had a more advanced Lunar Module, and it all went so well, with few, if any, problems.

JOHNSON: Well, I know Apollo 12, other than the lightning strike at the beginning, but that didn't affect the LM at all, did it?

HANNIGAN: No, it didn't bother the LM. We looked hard for anything. No, they didn't have anything, any problems with it.

The block one LM numbers: LM-3 was Apollo 9. LM-4 was Apollo 10, LM-5 was Apollo 11. LM-6 was Apollo 12, LM-7 was Apollo 13, and LM-8 was Apollo 14. Block two LM numbers: LM-10 was Apollo 15, LM-11 was Apollo 16, and LM-12 was Apollo 17.

Incidentally, Grumman had another LM ready to ship to the Cape. I do not remember if it was shipped or not. But it was built and they were testing it. We had planned to fly another mission, Apollo 18. But the people in Washington [DC] cut the money out from under us, and Apollo was over. That program ended, and it was too bad, because we had a lot of trained people that knew what they were doing after all that experience, and NASA had another vehicle built. And we had two or three Command and Service Modules remaining, one of which we used on the Apollo-Soyuz Test Project.

JOHNSON: Well, let's go back to Apollo 13. I know we've talked about it a little bit, but if you can, maybe we can walk through that for a few minutes, that flight. Were you in the SPAN room when the accident happened?

HANNIGAN: Yes.

JOHNSON: If you can, just walk us through the events and how they unfolded.

HANNIGAN: The Lunar Module did not transmit any telemetry during translunar coast since it was powered down. So the Command and Service Module engineers were the ones that were watching their spacecraft, and that's when the problem came. The CSM oxygen tank blew and they lost electric power. That is when the LM people started getting pretty active. One of the first actions was to pull together a team. Gene Kranz called it together. I remember meeting with him, and he called it a contingency mission planning team to figure out what we were going to do next.

So that is when the LM lifeboat cases, we called them, that Don Puddy with this guys had prepared the year before, pulled those off the shelf as part of that contingency team and checked them out. There was a lot of work, lot of work. Not much sleep during that time. We powered up the LM and using these contingency procedures that we had prepared, because the LM was never designed to be a lifeboat. But it worked well. They shut down. The crew left the Command and Service Module, sealed the hatch, and the three guys got in the LM. Since the LM was only designed for two, it got pretty crowded in there.

Then as they approached entry, they opened the hatch and went in the Command Module, powered it up, closed out the LM, and jettisoned it. We hated to see it go because it entered Earth orbit and, of course, burned up. I remember one of the crew saying, "Goodbye, Aquarius. You saved us."

JOHNSON: Were you part of the group that was working on the oxygen and the carbon dioxide buildup?

HANNIGAN: No, those were Command and Service Module people.

But we did have an engineer working with them, just to know what was going on.

JOHNSON: Of course, it was a relief when they did land.

Are there any other memories about Apollo 13 that you'd like to share? I know part of what you did, and you mentioned Don Puddy's group was looking for the contingency plans.

HANNIGAN: We had a special team that was pulled together that took those old lifeboat procedures, massaged them, brought them up to date, and sent them up to the crew.

JOHNSON: Were there any other types of contingency plans as far as using the LM in other types of emergency situations?

HANNIGAN: No.

JOHNSON: Just that one because of the simulation?

HANNIGAN: Yes.

We never simulated that exact failure, but the year before, they failed three fuel cells, and the flight director said, don't worry about it, that's three failures. But we worried about it, thank goodness.

JOHNSON: It's a good thing you did.

HANNIGAN: Yes.

JOHNSON: During Apollo 11, of course, there was a lot of attention from the world. Apollo 12, not so much. By the time Apollo 13, it wasn't quite getting as much attention until the accident happened. Were you surprised or were you aware of the amount of attention? Since you were onsite so much during Apollo 13, were you aware of what was going on as far as the world following this?

HANNIGAN: No, not much.

JOHNSON: Were you surprised that it got that much attention?

HANNIGAN: No, I really wasn't. I was pleased that the public was concerned about our mission and what we were doing. The failure happened on the way out to the Moon, so we had to go to the Moon in the LM and circle around it and come back. You just couldn't turn around and come home, because we didn't have enough propellant in the engines to get a retrograde firing to come directly back home. So we just had to continue on.

The Command and Service Module was separated from the LM. Both spacecraft went around the Moon separately. Everybody had their eyeballs glued on every parameter that was telemetered on the CSM when it came around into view. Apparently, there were a lot of people interested in it all around the world. But we didn't have time to think about that. We were too busy with the vehicle.

JOHNSON: Well, on Apollo 14, part of our research shows that an abort switch lit up on the panel, and there was a situation where, I believe, it was a flight controller was told to tell the astronauts to hit the panel. Do you recall that instance?

HANNIGAN: To jar loose a relay or something? Yes. I don't remember the results of that, because I don't think the switch had failed.

JOHNSON: No. It was just a thread or something.

HANNIGAN: Yes, and ascent went smoothly.

JOHNSON: The rest of the Apollo missions went fairly smoothly.

HANNIGAN: Very good.

JOHNSON: Some changes had to be done to the LM as far as carrying the Lunar Rover and for extended stays on the Moon.

HANNIGAN: Yes, that was the "block two" LM that I mentioned previously. It was heavier, and carried more fuel, the LRV, Lunar Roving Vehicle, and the ALSEP Apollo Lunar Surface Experiments Package. The crew set up the ALSEP on the Moon. That was a very heavy vehicle, starting with 15.

Watching them set up and assemble the Rover, not assemble it, but "unpackage" it, get on it, check it out, and ride it was pretty exciting to watch. But I didn't have anything to do with that vehicle at all. The EMU [Extravehicular Mobility Unit], the backpack, was all, the only other thing besides the LM that we had in my branch.

But those were excellent missions, 15, 16, 17. I wish we could have finished the last three missions.

JOHNSON: Do you have any specific memories of any of those missions or instances or anecdotes that you recall as far as during the missions or simulating for those missions?

HANNIGAN: I wasn't involved in most of the simulations. I only sat in on a few of them. But I can't recall anything that's worthwhile talking about. I just remember that everything went so well, amazingly well, for the intricate technology and the systems, and the flight planning effort that went into it, the trajectory work. Everything was done so well.

JOHNSON: Well, after the flights, and I know it started with Mercury and Gemini and continued with Apollo, after the flights, it was somewhat traditional to have splashdown parties?

HANNIGAN: Yes.

JOHNSON: Do you recall any of those or did you go to those?

HANNIGAN: I did not go to all of them, but most of them.

Of course, we didn't have Agena on some of the missions. It was Gemini 8 when we started flying the first Agena for rendezvous and docking flights. I remember Gemini 76 had two Geminis in orbit that rendezvoused, and I remember how excited we were. This was before the Agena started flying. I went in the MOCR, even though we didn't have an Agena, I was monitoring it, to see on live TV taken from one spacecraft to the other and seeing the other one up close to it, that was very exciting. The first rendezvous we'd done. Gemini 76 was the name that we called the mission, a contraction of Gemini's 6 and 7.

I was pretty exhausted half the time. My family never saw me much during simulations and during the Apollo 13 mission. I was not exhausted on all missions because most of them went so well. I assigned myself to the shift where most of the action was going on. It seems like the teams were tired all the time.

We didn't realize what we were doing relative to the world, or the political aspects of it. We were too close to it, but I just remember one night towards the end looking up at the Moon and I said, "Golly, you know, I got a couple of friends walking around up there."

And the controller I was with said, "Yeah, one of the astronauts' wives came outside with me the other night, she looked up there, and she said, 'My husband's up there walking around,'" and he got a different perspective, you know, thinking about that and the implications of what we

did, of going to another heavenly body. But we were so close to it, and busy, that we didn't think about that at the time.

JOHNSON: You mentioned how much time you spent in the MCC. It was also pretty tumultuous time in the nation, late 1960s. How aware were you of what was going on outside the Center? We've had other people say that they felt somewhat insulated.

HANNIGAN: Oh, yes. I don't remember much of what was going on in the world most of the time. If we weren't on the console, we were busy in the mission rules review or something else, or sleeping. You're right. We were somewhat insulated. I should say "isolated," maybe is a better word, from everything else.

JOHNSON: You lived in Dickinson [Texas] next to Gene Kranz, and there were different areas that seemed to be a large concentration of people that worked at NASA living in areas together.

HANNIGAN: Yes, but Dickinson didn't have that many.

JOHNSON: There were communities built up and, as you mentioned, a lot of the men were gone so many hours and a lot of the wives in the communities kind of picked up and shared those duties that maybe some of the men would have been taking part in if they hadn't been working such long hours. Do you have any memories about the community feeling or anything that was going on during that time?

HANNIGAN: No, we didn't have many astronauts and NASA people in Dickinson where I lived. A lot of that was going on up in Clear Lake City [Texas] and adjacent to the Johnson Space Center.

JOHNSON: Why did you choose Dickinson when you moved in?

HANNIGAN: Oh, when we first moved to Houston, we bought a house with very few trees in the southeast part of town off the Gulf Freeway [Interstate 45] in the city limits and stayed there a couple of years. But in 1964, we were looking around and we wanted to get out of the town. We had gone down to Dickinson because somebody said, "Hey, that's where you ought to look." And so Peggy and I went down and toured the town and looked at different areas and found a delightful street that they were starting to develop. It had trees, which we didn't have any where we were living in Houston. They were big trees, and just seemed like a neat little town. Lots of trees!

So we bought a lot and we built a house down there. In the meantime, Kranz lived on the same block with us up in Houston, and I said, "Gene, let me take you down and show you a good place to look at." And by golly, he bought the lot next door to us and built a house, too, and so we ended up living adjacent to each other from then on.

But Dickinson was just a nice little community to live in. It wasn't very far from work. I went up State Highway 3 to work, and no traffic problems, especially if you were on a night shift. We stayed there until about 1991. We sold that house and lived a year in an apartment in League City [Texas] before we moved up here to Sunrise Beach in January of 1992.

Dickinson was a fine little town, fine little community, and it was difficult to leave it after being there so long.

JOHNSON: Well, let's stop for a second and take a break and I'll change the tape out, and then we'll come back and maybe talk about some of the buildup for Shuttle.

HANNIGAN: Okay.

[pause]

JOHNSON: When we stopped, we were going to talk about your involvement in the Shuttle. You mentioned that you didn't have a lot to do with the ALT Program?

HANNIGAN: No I did not. I had the Shuttle systems people in the branch, but I was on the SPAN console on STS-1. And it was such a good flight. There were a lot of concerns with failure modes, but they didn't happen. We had a superior crew that knew what they were doing, and it was just one of the most exciting flights I can ever remember, as I said, because it had wings, and I liked that!. Having studied aerodynamics, I liked the airplane with wings on it. STS-1 began the whole Shuttle experience.

JOHNSON: Well, during that time between the end of Apollo and the beginning of Shuttle and, of course, there was ASTP [Apollo-Soyuz Test Project] and Skylab.

HANNIGAN: Skylab and then ASTP, yes.

JOHNSON: And you were working on some of the mission rules and procedures and everything for Shuttle?

HANNIGAN: We were already working on the early Shuttle flight rules and mission rules and procedures as we did on Apollo. My people were in the Shuttle systems early and were making trips back and forth to California, while still working on the latter part of Apollo and ASTP. But the Shuttle, it was a lot of development time on that program, because it was a much more complicated vehicle.

JOHNSON: I was going to ask you about that. Considering the LM, which obviously was a complicated vehicle, but then going—

HANNIGAN: Nothing like the Shuttle.

JOHNSON: —going to the Shuttle, which was so complicated, and having to develop all those procedures and rules.

HANNIGAN: Yes, very complicated. In fact, the program was too expensive, too complicated. The checkout took too long at the Cape. We didn't fly that many Shuttle flights, I don't remember how many.

One of the questions you were asking, was about what led to my retirement, decision to leave NASA. It was just retirement time for me. I had the right number of years with the government, and I retired and went to work for Lockheed, then Eagle Engineering there in the Johnson Space Center area. But it was a retirement time for me, and frankly, there wasn't anything coming. We had no new program coming at that time.

Congress had not allowed us to fly any more Apollo missions, and Skylab was a long mission, and after that, they had another Skylab vehicle, but that was not flown. And after STS-1, I concluded that it was time to move on.

JOHNSON: But you still worked in the area for different contractors for NASA?

HANNIGAN: Yes, after retirement I worked for Lockheed to do the STSOC (Space Transportation System Operations Contract) proposal, but other than that, I did not go with another major contractor. I joined a small engineering firm, Eagle Engineering for several years.

I did the Lockheed proposal in support of Flight Operations, which was awarded to McDonnell Douglas.

JOHNSON: Can you share memories of that?

HANNIGAN: Proposal work was hard work, and I did some of the hardest work I'd ever done because I'd never done a proposal before. I worked with Jim Bilodeau, who had been Division Chief of the JSC Training Division in Flight Operations. He worked with me on the Operations

part of that proposal. And I can't recall how long it was, but it seemed like it was years! McDonnell Douglas won the contract, and I left the company.

JOHNSON: Well, during that time you were working for Scott Science and Technology.

HANNIGAN: I worked for Dave [David R.] Scott after Lockheed, and it was working Air Force programs, the classified programs that the Air Force was going to use the Space Shuttle for. They were paying us at Scott Science and Technology to use our background in manned space flight, because at that time the Air Force was going to fly several of their missions on the Shuttle. As it turned out, they had only one Air Force mission, a classified one.

JOHNSON: In 1986, when I believe you were working for Eagle Engineering at that time, is when the [Space Shuttle] *Challenger* [STS 51-L] accident happened.

HANNIGAN: I remember that day! I was in the Ford Aerospace Building, which is not onsite. Several of us from Eagle were working with Ford Aerospace on some work at Eagle.

We weren't monitoring the mission, but we had the capability, so they turned on their voice loops and we heard what had happened. So I was not able to monitor much real time activity when that accident occurred.

JOHNSON: Well, you mentioned during Apollo and before you worked closely with the crews.

HANNIGAN: Yes, during simulations.

JOHNSON: During simulations and that sort of thing?

HANNIGAN: And the mission rule meetings and, particularly the crew procedures meetings. We would prepare most of the procedures. Some of the procedures were pretty obvious what you did, but there were a lot of them that were kind of subtle, and so that's how we got to know them very well by working so closely with the flight crew.

JOHNSON: In 1978 when the first Shuttle class came through, did you have any interaction with the Shuttle pilots and Mission Specialists?

HANNIGAN: Some minimal interaction with the Shuttle pilots. Not with the Mission Specialists, just always the commander or Shuttle pilot. Mission Specialists were more science-oriented, but we worked with John Young and his copilot, Robert L. Crippen.

JOHNSON: At some point you went to Germany and worked in Germany for a while.

HANNIGAN: Yes, for Scott Science and Technology. I was providing them the same type Shuttle experience and information the Air Force wanted. Germany had a Shuttle flight dedicated to their science experiments, STS-9. It was basically an all-scientific mission and it was European, but Germany was the leader of that activity. So that was in 1981, I think, Peggy and I went over. I went over four times to Germany, and the last time, I took Peggy and my daughter Mary and we stayed over there three weeks. During the weekends, we would drive all over in a rented car.

That was a fun program to work with them and give them my experience. I helped them work in preparing the procedures for their experiments, and what to do in case of emergencies, etc.

JOHNSON: You also worked on some of the preliminary plans for Space Station Freedom, while at Eagle. Do you have any memories of working on those first plans? The first Space Station?

HANNIGAN: I have very few memories of that activity.

I did some work on a program that was never implemented. It was a proposal for a crew entry vehicle that was planned, and I worked with another guy on developing some early procedures and things like that. It was called a CERV, crew emergency rescue vehicle. But it never went past the talking stage, but we did provide help, two of us at Eagle, on that program.

JOHNSON: Well, looking back over your career with NASA, is there any time period of any accomplishment for you personally that you remember that you might have been the most proud of?

HANNIGAN: Well, I still think that Apollo 13 was probably the highlight of my career, because my branch had been forward-thinking enough to concern itself with the problems that happened on that simulation the year before and to do something about it, in spite of what the flight director said. And to end up using them on 13, which was almost—it was uncanny. The Apollo 13 accident occurred at almost the same elapsed time during the mission that the same event

occurred on the simulation where they failed three fuel cells going out on translunar coast. I think that mission capped it all off for me for the LM.

I didn't see that many Shuttle flights before I left NASA. Bob "Crip" Crippen was a great pilot, and they couldn't have picked two better people for the first flight as far as knowledge of the vehicles and flight capability. They both had excellent backgrounds as pilots.

JOHNSON: Well, is there anything in your career that you would consider the most challenging? I know you mentioned Apollo 13 as a challenging time. Was there anything else that was challenging as far as being able to accomplish what you set out to do?

HANNIGAN: Well, of course, it was challenging when I first got there to learn to be a flight controller and what we had to do. During the Gemini Program when I first started taking on the early Apollo Lunar Module work, that was exciting! Thank of going to the Moon! I think all that work that contributed to the success of Apollo was pretty exciting, pretty challenging. I don't have any one outstanding moment or anything, except for the Apollo 11 and Apollo 13 incident.

I was concerned about the Shuttle because it was far more complex than the previous spacecraft.

JOHNSON: You mentioned the redundancy that you kept in the Shuttle, also.

HANNIGAN: Yes, we had a lot of redundancy.

JOHNSON: As we talked about at the beginning, when you and Mel Brooks were first hired by Gene Kranz, one of the reasons was that you were both a little bit older. The average age working in the MOCR during Apollo was, I think, twenty-six or something really young like that.

HANNIGAN: Mel and I were in our early thirties, at the time.

JOHNSON: How was that, working with such a young group of people, or do you feel that maybe the energy level was different?

HANNIGAN: No. I never considered that aspect at all. I didn't see any adverse effects either way. I only know that Gene hired us because he was looking for some experience. I had it with Lockheed Georgia and then with the Air Force flight test work at Eglin, and Mel had it with Lockheed Burbank from working the Agena Program. He brought a lot of that experience into the Agena that we used on Gemini.

JOHNSON: Well, is there anything that we haven't talked about, any anecdotes that you'd like to mention or any people that maybe you worked with that we haven't talked about that you'd like to mention?

HANNIGAN: Well, we talked about SPAN, Spacecraft Analysis, which was somewhat a misnomer. I mean spacecraft analysis; everybody did that, all the systems people.

JOHNSON: Is there anyone else to mention or anybody we haven't talked about? I know you mentioned Gene Kranz and Chris Kraft.

HANNIGAN: Kraft was our Directorate Head and Gene was my Division Chief and I was a Branch Chief under him. Early on, I was a section head, and everybody got elevated up one level. I made a lot of friends, a lot of good people, spent a lot of time with them in work and simulations and planning meetings and working during the missions.

We kind of had an adversary, we thought, at the time, which was the Program Office, whether it was Apollo or Shuttle. They didn't want any changes made to any of their spacecraft designs, because it meant spending money. And during these design reviews, we would come up with some changes that we proposed for certain things, more redundancy perhaps in certain areas maybe, and it was kind of an adversarial relationship on occasion, but not too bad. It only showed up a few times.

I'm glad I didn't work in the Program Office. I don't think I would have liked that job. But being a flight controller with Flight Operations was great, and Gene Kranz made it that way. We could have had another guy, it would never have been as successful as Gene. He was an incredible flight director. He knew everything that was going on, was smart, and having been an F-100 pilot, he knew radio discipline and how to speak over the loop. He was very crisp on the loop. When he spoke, people moved.

JOHNSON: In your position, I'm sure you worked with lots of different flight directors.

HANNIGAN: Yes.

JOHNSON: And a lot of different personalities. Are there any other ones that come to mind?

HANNIGAN: Well, Glynn [S.] Lunney was, I liked him. He was a flight director as well as Chief, of the Flight Dynamics Branch. And I didn't know the newer flight directors that came after I left. Don Puddy, my former Assistant Branch Chief, became a flight director, and he was good.

JOHNSON: Well, if there's not anything else that you want to talk about.

HANNIGAN: I honestly can't think of anything.

JOHNSON: Okay. Well, we'll get you through before noon.

HANNIGAN: Yes.

JOHNSON: Well, I appreciate you talking with us today.

HANNIGAN: You've come a long ways.

JOHNSON: Well, I enjoyed it. Thank you.

[end of interview]