ORAL HISTORY TRANSCRIPT

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INTERVIEWED BY ROY NEAL
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NEAL: Gene, by way of openers, how did a jet jockey like you wind up being a Flight Director way back when?

KRANZ: I was in the flight test business. I was doing some flight test engineering in the early jet bombers out of Holloman Air Force Base, New Mexico. [We were] in the process of developing the Decline missiles and the various offensive systems they have. I happened to open the *Aviation Week* magazine and there was an advertisement in there that said they were forming a Space Task Group [STG]. I sort of put that up in the corner of the desk, and every day I'd come into work I'd look at that. The Space Task Group; just the words sort of captured my imagination. Finally I took it home to the wife and I said, "Marta, what do you think about making a change? Getting out of the aircraft business, maybe going into the space business?" And she said, "Well, where are we going to go?" She was very good about this. I said, "Well, they've got options at the Cape [Cape Canaveral, Florida] and at [Hampton] Virginia." And she said, "Oh, go to Virginia; they've got good schools there. You've got to get your education, and I know the government will pay you to go to school. So, let's go to Virginia." It was that straightforward.

NEAL: What year was that?

KRANZ: That was in 1960.

NEAL: So there you were, back in 1960, and you applied, answering the ad, and you came over to the brand new organization known as NASA [National Aeronautics and Space Administration]. What happened next?

KRANZ: Actually, I was very disappointed. We drove in to Virginia—I was used to the high desert out in New Mexico—and we drove into Virginia in one of these Fall dreary, wet days. The town just didn't have the appearance of the desert, and I was just really sort of down in the mouth, and then I went to report into work the following Monday and nobody seemed to know what was going on. You know, you didn't feel the discipline, the structure, those kinds of things. It was just an aura of confusion in the Space Task Group.

I got pointed out to a set of offices and went in and to meet a bunch of guys—Chris [Christopher C.] Kraft [Jr.], John [D.] Hodge, Paul [L.] Havenstein, Sig [Sigurd A.] Sjoberg—and none of them even seemed to have the time to talk. It was Hodge who finally said, "Well, let's just sit down here; and we're glad to see you." But the first few weeks were very difficult for me because I'd come in from a military structure into a civilian organization, and I just seemed to be the odd man out there.

I think the real turnaround came about two weeks after I'd been on board. I knew nothing about the space business, and Kraft came up and he said, "We're getting ready to launch the Mercury-Redstone 1 [MR-1]. I want you to go down to the Cape and write me a countdown and some mission rules. When that job's done, give me a call and we'll come down and launch it." And I said, "Uh, uh, uh okay." Having been in the military, I saluted

and I packed up my gear, and climbed on the airplane. We had a whole bunch of rickety old Martins and Convairs—East Coast Airlines used to go back and forth between Langley [Research Center, Hampton, Virginia] and the Cape.

I ended up down at the Cape, and I didn't even know in which direction to go. I ended up at Patrick Air Force Base. I didn't even know which direction the Cape was from Patrick. While I was walking around the ramp at Patrick, feeling very confused, up drives a guy in a Chevy convertible with a surfboard in the back. And he obviously looks at me and realizes I don't have the slightest clue; I'm the new guy in the block. And he said, "Where are you going?" I said, "I'm going out to the Cape." And he said, "Climb aboard. We'll drive out there. I'm going out there, too." About halfway through Cocoa Beach, the guy introduced himself, "Hey, by the way, I'm Gordo [L. Gordon] Cooper [Jr.]." This was sort of my introduction to the space program, and it was that, catch-as-catch-can throughout the entire first year.

It was just really—you just wanted to get time to take a big gulp of fresh air in your lungs before you dove back in again. And you just never had that chance. It was constantly go, go, go, go; drive, drive, drive, drive, drive. That was probably the most rapid year of my entire life.

NEAL: From the sound of it, you started at a fairly high level in the original hierarchy though, since they wanted you to do a countdown and write mission rules right off the top.

KRANZ: [*laughs*] Well, the process of doing the countdown was funny. I got out to Mercury Control [Center], and there was a young engineer that I think I owe my early career to; a guy

by the name of Paul Johnson. Paul Johnson was one of the employees of Western Electric, and Kraft must've called him, or somebody called him, and said, "There's a guy by the name of Kranz reporting him in; show him the ropes."

Although Paul was about my age, maybe a little bit younger, he knew his way around the Cape. He seemed to know everybody. He seemed to know *everything*. When I arrived in Mercury Control he was sitting writing the job descriptions for all of the people that would work there. I had been tagged as a guy called "Procedures." Well, Procedures is sort of a gadabout. He's the only guy in Mercury Control who really didn't have a job. His job was to listen to what was going on and write the messages that would go out on the teletypes that would brief the network on the mission. So you sort of had to learn to anticipate what everybody was going to ask for, what they were going to do. I had to know the telemetry, the command. I had to know what the mission was about. I had to be able to anticipate everybody's call. So it was interesting sitting back, almost like one of the guys from the Press. You know, writing the story as it's going on, only trying to stay just a few minutes ahead of the story, so that hopefully my teletype messages would get to the remote sites before the spacecraft did, so the people at the sites would know what was going on.

Anyway, Paul Johnson was one of the philosophers, one of the people who put all the pieces together. He introduced me to what a countdown was. And I thought, "Hell, a countdown can't be too difficult. It's just a set of procedures that makes sure everything's ready before you go to launch something." That was the easy part. The mission rules, I had no concept what they were. In aircraft flight test, we had a set of go/no-go criteria we used for instrumentation and for the aircraft before we took off. But in flight you just relied upon the pilot and his procedures to make the decision about what to do if things went wrong. So

all of my mission rules talked about what happened before we launched. None of them talked about what happens if things go wrong *after* we launch.

Well, the Mercury-Redstone was where I broke into the Control Center business, and I'd never seen a launch. I'd never seen a rocket launch. I'd fired some [rockets] off airplanes, but these are little piddling things compared to these great, big things that were out on the launch pad. We were in the Mercury Control Center, and the clock finally got down to zero after so many holds and false starts and all that kind of stuff, and all of a sudden you hear this liftoff, and there are only two TVs in Mercury Control. One was at the Capcom's [capsule communicator] console; the other one was over at Kraft's console. I was sitting right next to Kraft's console. So it seemed everybody in the room developed a really long stretched neck, because they wanted to see this rocket launch in these TVs. I was looking at it, and this thing just took off and just went straight off. I mean, it just moved out faster than anything anybody ever expected. And *Kraft*, you know, was sort of surprised. Everybody was sort of taken aback by this thing.

Then this camera came back down, and the Redstone rocket was still on the launch pad. Now out of the top of this thing here you get all of the chaff, the tin foil they use for tracking, and then comes the drogue parachute and the main parachute, and the dye markers and all this. The parachute's hanging off to the side, and very slowly this thing starts to inflate. Everyone was wondering, "Is this going to pull this whole rocket over on the launch pad?" We had no command control, no communications about it, etc. Then was when I wished I'd done some thinking about this mission rule business. Because now it's time for them.

By the way [*laughs*], the Redstone engineer started speaking in German to the blockhouse during this particular activity. Kraft is *frustrated* as all hell because nobody's talking to him. The people from Marshall [Space Flight Center] are talking to the blockhouse, but nobody's talking to Kraft! So he goes over and grabs a hold of the booster engineer by the back of his neck and says, "Will you please *talk* to me, and talk to me in English?" The guy wasn't used to this kind of a chain of command. He was responsible to the Marshall chain of command, not to the one that existed in Mercury Control in those days. So we sat and went through a lot of interesting options.

One of the first options was to get somebody to try to plug the umbilical back in; but it had been pyrotechnically separated, and there was just no way they could reinstall the umbilical. Plus the fact it was pretty hazardous out there on the launch pad at that time, because this rocket was still pressurized. It was ready to go. Then they went through a long search for a cherry-picker in the Cape, and they were going to get some pruning shears and cut the risers off of the parachutes. They decided that wasn't a good plan. So for the next plan—and I think this came in from the blockhouse—somebody started talking about shooting holes in the tanks with a high-powered rifle. But they said, "No. This whole structure is going to collapse. We don't know what's going to happen after that." Pretty soon the first rule of Flight Control was written: "If you don't know what to do, don't do nothing."

So we just sat there and waited until the batteries died. In fact, *we* left. The blockhouse people stayed and waited until the batteries died; and then all the relays, by design, returned to a safe position. The rocket vented. It was now safe to approach the rocket. So we hadn't lost anything except a lot of our innocence. And it separated very

quickly over the next several months. But that was my first introduction to the fine art of space rocketry and mission control. I came back somewhat chastened, humbled, and I now figured out where I fit in. I was going to have to be the guy who stayed ahead of what was happening in the mission; and, being a military fighter pilot, I decided I hadn't been flying Kraft's wing very well. I was going to become his wing man and make sure that I covered his tail for everything he was doing.

NEAL: So you carved a niche for yourself, as it were. You finally figured out what you were going to do within the framework of the early days of the Mercury Program. What title did they give you?

KRANZ: Well, it was still Procedures. Over the length of the Mercury Program, Kraft moved from Procedures into Assistant Flight Director, because I think he sensed the need for somebody to crosscheck what was going on. Somebody he could turn to and say, "Does that sound right?" I think Kraft and I, and myself and the people that I called Assistant Flight Directors, were the only two who operated in this particular mode all the way through the early space program. Because I always liked somebody looking over my shoulder; somebody protecting my tail. And I think Kraft was pretty much of the same nature.

The business of flight directing, the business of growing up, was really prone to error in those early days. It was principally a judgment call. There was very little technology. We had very limited information on the spacecraft and the systems. In fact, I was surprised, working the Mercury Program, that I had less information in Mercury Control than I had as a flight test engineer working out at Holloman. It seemed that almost they had taken a step

back from a standpoint of the technology of command and control when we moved into the Mercury Program. It was only in Gemini that we had what I'd say was a big step forward in the kinds of tools that we used in the Control Center environment.

NEAL: Well, let's take a look at that. Let's take a look at it from the perspective, first, of Mercury, when you developed the requirement for such guidance and control and how you gradually phased it in with Gemini and, of course, that brings us to Houston [Texas] as well. So, could you phase that for us just a bit?

KRANZ: Well, actually, the Mercury spacecraft had about 70 telemetered pieces of information. Most of the information that came down in telemetry was associated with clocks and accelerometers. We had measurements from a standpoint of the control stick position. But from a standpoint of the life support on board the spacecraft, we had oxygen pressure, we had temperatures, we had a very rudimentary set of information; and virtually every piece of information that we had on the ground was also displayed on board the spacecraft. There wasn't anything new. There wasn't anything unique that Mission Control could bring to the Mercury picture, assisting the crew in space, other than access to the designers, the testers, the people in the plant, and maybe putting the trends together. So what the crew was seeing, we were seeing on board the spacecraft in Mercury.

It was only as we moved into Gemini that we recognized the need to move deeper into the spacecraft system. Part of this came about as a result of the John [H.] Glenn [Jr.] mission. Because in John Glenn, we were stuck with a very difficult decision. Did his heatshield deploy or did it not? We had a single telemetry measurement that indicated that

the heatshield had come loose from the spacecraft. Now, if we *believed* that measurement and the heatshield had come loose, we had one set of decisions that involved sticking our neck out [by] retaining the retrorocket package attached during the entry phase. We didn't know whether it would damage the heatshield. We didn't know whether we had sufficient attitude control authority. So if the heatshield had come loose and we believed that measurement, we'd go that direction. But if the heatshield had *not* come loose, that measurement was wrong and we wouldn't do anything different. So it was a very difficult decision for Kraft in Mercury Control.

I remember this one very clearly, because the engineers would come and say, "Nah, the heatshield can't have come loose!" And Chris would look at them, and he'd say, "Well, how about this measurement we're seeing? What's the worst thing that would happen if it had come loose?" And they'd always end up in a position that says, "Well, maybe John Glenn isn't going to make it home." "Well then, what are we going to do about it?" So, because of Kraft, this entire business of ground control, I think, really came into being on the Mercury-Atlas 5 [MA-5, Enos], when we made the decision to come down an orbit early. And because of Mercury-Atlas 6 [MA-6], with John Glenn, when we had the heatshield deploy problem. So the business of being able to look *deeper* into the systems really came about as a result of some very difficult decisions we made with inadequate information on Mercury.

By the time we moved into Gemini, we now had several hundred measurements in this thing. We could look within the guts of the system and see the things that the astronauts couldn't see on board the spacecraft. We had data at a much higher sample rate; we now went to the point where, instead of getting 1 sample a second we'd get 8 and 10 samples per

second. So we could look at the characteristic signature of the systems on board the spacecraft. And we got to know what a proper operating fan looked like and an improper operating fan looked like, just from the signature of the system. We started doing pretty good detective work, looking into the systems, and we were able to stay ahead of the problems and, to a great extent, prevent their occurrence. Or if they did occur, we were able to very quickly identify the source cause and what we were going to do about it. So the *technology* of flight operations made a very *rapid* leap forward from Mercury, where we had only three computers working for the *entire manned space effort*. We had two [computers] up at Goddard [Space Flight Center] to process our radar tracking information, [and] one out at Bermuda with a team there, because we'd launch eastward.

Well, by the time we moved into Gemini we now had computers in Mission Control. And this was the big breakthrough. The only problem was, none of us had ever worked with computers before! So this is when the young people started coming into the program. We went out to the colleges and universities of our nation and brought in the young people who were working with computers in laboratories. To try to find people with computer experience, we'd go to the Army Missile Command at Fort Bliss in Texas, because the Army was using computers in their ground-to-air missile program. And, boy, soon as the Army would discharge somebody with computer experience we'd just gobble them up put them on the Gemini team! So computers really started making our job not only easier; they allowed us to stay ahead.

You know, the spacecraft moves 5 miles a second; and with this guy moving 5 miles a second, your thought process has to come to grips with this incredible change in dimension. In aircraft flight tests, we were moving the airplanes 5 miles a *minute*. And in just one

stroke, we moved that so far forward that our thought process just wasn't adequate in Mercury. With computers, we now started getting ahead of the game. So the real breakthrough, I think, occurred between Mercury and Gemini.

NEAL: That was the time, too, that *this* Control Center—the Manned Spacecraft Center, as it was then—was fired up and control moved from the Cape to Houston. Was that a good move in your book, by the way?

KRANZ: Well—I came from a flight test [background] and I always believed that you ought to be where the hardware is. I think many of the engineers felt this was not the right thing to do. But, looking at it with the longer perspective several years later and looking at the very rapid growth, not only in the space program but in the need for bringing young people into the program, I believe one of the early decisions to locate Centers near sources of young people—what you call "feeder universities"—was really a right decision. Marshall [Space Flight Center] had its sources. They have a whole bunch of great universities in the Georgia-Alabama-Louisiana complex there. Here within Texas you've got [Texas] A&M [University], you've got the University of Texas. And we picked up young people from Purdue [University], Notre Dame [University], and [University of] Wisconsin. Three of my Flight Directors were from small colleges in Oklahoma. So basically, we had a source of young people, and that was really the fuel for this space fire that Kennedy had built. I think that the location here in Houston didn't seem to make sense to me in the early years. But by the time we started the search for the raw talent we needed to go to the Moon, this was the

right decision because we could go to universities and we'd bring in entire graduating classes.

NEAL: There was more to it than that, too, in as much as you were able to put the computer complex here, bringing it home as it were. You were able to build a Mission Control Room that was really operational.

KRANZ: Yeah. We had a marvelous linkage between the Mercury and the Gemini Program; and the Control Center was—One of the English engineers—he was actually a Welshman—who came down from AVRO [A. V. Roe Aircraft Inc., Ontario], Canada, was Tec [Tecwyn] Roberts; and he was our first Flight Dynamics Officer. Tec Roberts was one of the few people who really understood the potential of the computer and its application at Mission Control. So at the midpoint of the Mercury Program, Tec Roberts was replaced by Glynn [S.] Lunney because the technology just in these few months had now allowed us to start remoting data from Bermuda, so we didn't need a team out in that site anymore. So we could *focus* the talent that was in the Bermuda team, combine them with the talent that was in the team out in Mercury Control at the Cape, and then send Tec Roberts off to build the next Mission Control Center.

Roberts basically had the responsibility to bring the system on line; and it was a *marvelous* thing. Here we move from a system with virtually no computing capability, totally analog, only two systems console with couple dozen meters, and two TVs to now where—miracle of miracles!—we had TVs on all the consoles. We could look at our data on television. All of the computers we had were large, centralized systems at that time because

the desktop-systems, small computers we use nowadays just did not exist. But, the systems that we used now allowed us to process data, to string the data together. So we had in Gemini the merging of two worlds. We had this new world of the Mission Control Center, Houston, but it was still tied to the old world of the network. Because worldwide communications didn't exist at that time, we still got tracking information by low-speed teletype, and we got summary messages. If you can think about this, the controllers would sit down, they'd write down what was happening to maybe 30 parameters on board the spacecraft, they'd pencil this out, it'd be put in on a teletype network, and it'd then be sent in to Houston, where it would be processed, digested, by the computers here, and put on our displays. So we were really marrying the old technology of Mercury and the remote sites with the new technology of the Control Center. Now the challenge was to build the worldwide communications which would allow us to get the data directly without human intervention out at the remote sites. So this became the challenge of the Gemini Program. And it was really essential to the next big step, which was to move into Apollo.

NEAL: You know, that's remarkable because I'd never really thought that what was taking place behind the scenes was as important as what was happening out in space during the Gemini Program.

KRANZ: Oh yeah. Yeah. Another takeoff on this goes back to these young people at the universities. Because most of us coming out of Mercury had grown up in flight test. We were classical engineers. We weren't aware of cryogenics. We weren't aware of fuel cells. Bi-propellant rocket systems were sort of new in the block to us. Computers were entirely

new; something we were unprepared for. So the older folks had the challenge of learning these new technologies and adapting the technologies of Mission Control to systems we didn't fully understand; systems that had just emerged from laboratories. So then we had these new, young kids coming in who understood all about cryogenics and computers, and it was this marvelous merger of the cultures of the young and old that really gave us this youthful exuberance.

You know, these were the Kennedy years. These were the Camelot years. And for a period of time, you believed that this Camelot really existed. And it did exist! It was just a magical time. And it was magic for a variety of other reasons: We were working with what I'd consider a very enlightened Congress, a Congress that was used to risk. They were used to technology. The Cold War was very real, so you had that support. You had a professional media. You had dedicated reporters, journalists, tracking the space program. So, to put it bluntly, they were harder than hell to work with; but they were fair. They were objective. They didn't make the story; they reported the story. It was just that you had a chemistry between all of the players that was great to grow up in.

NEAL: During that period, let's talk about flights that you remember directly; flights that perhaps you were flight directing. We'll start with the Gemini period and then we'll go directly from that into Apollo.

KRANZ: Well, the unmanned missions, Gemini II and Gemini I, there was nothing, nothing to it. It was just an unmanned test of the Martin booster really. Gemini II was memorable for a different reason because at launch all the lights in—We were launching still out of the

Control Center at the Cape at this time, and at launch all of the reporters in the room turned on all the lights so they could view the control team in there. As soon as they put the power in the system, everything went black! We had a blackout there. And our only job in this mission was to send a series of backup commands. Well, I had a whole bunch of stop watches I had to work, and with the lights out I couldn't read from the stop watches out to the controllers, and with the lights out they couldn't send the right commands! So this taught us to keep the media and all the lighting and all the equipment they bring in to the Control Center completely isolated from building power.

Gemini III was interesting because this was a key mission in establishing the culture of the Flight Control team. We still had the control teams going out to the remote sites. And, basically I had the responsibilities now for sending the teams out. We sent very capable, very strong individuals with Mercury experience, and we understood the business of Flight Control. At the same time, Deke [Donald K.] Slayton would send astronauts out at the very last moment to all of the sites that were generally good locations to go to—Bermuda and Hawaii and California and Australia. I had a control team in Australia, led by a gentleman by the name of Dan Hunter. Hunter was a very strong, feisty individual who liked to take total charge, total command control. Well, out to the same site arrives [Charles C.] Pete Conrad. And Pete Conrad has Deke Slayton's mandate that *he's* going to be in charge of the site. So we had two very strong individuals vying for control as to who was going to be charge of the Australian site.

At this time, we're in the process of transferring control from the Cape up to Houston. So Kraft and I were down at the Cape and we were rooming together. We'd spend enormous amounts of time down there, as you know; so basically we had a small efficiency apartment:

two bedrooms, a nice sort of lounge area, and a little breakfast area. About 2 o'clock in the morning we heard pounding on the door! Somebody was raising a racket. We heard somebody say, "Chris, we've got problems we've got to work out!" Well, I got up and by this time Kraft and Slayton were nose-to-nose in this area there. And Slayton is saying that there's a battle that had developed out at the remote site between Conrad and Hunter.

We agreed the next day to write a TWX [teletype wire transmission] out to try to clarify the situation as to who was really in charge. And we wrote the TWX up, and I sent it out to my Capcom, and with the whole world listening. Hunter comes up and he says, "You know, that doesn't do the job. That is probably the most weasel-ly encrafted" (Kraft was the principle author) ". . . that was probably the most weasel-ly worded message I have ever seen. When I get back to Houston, I'm going to frame it and I'm going to hang it in my toilet." Well, the whole world was now listening. And Kraft, you know, Kraft was just madder than hell at this thing here. And the control team had sort of taken up sides. It was us versus the crew.

Well, that evening we went over to a party at the Lifehouse, and you know the mood, the temperament of the control team had not improved any. I saw one of my controllers, John Llwellyn, who was now getting ready to mix it up with Alan [B.] Shepard [Jr.] until finally I—I had the responsibility for these guys—just decided we would quit the party. This bad mood sort of carried all the way down into the area where we parked the cars. But finally we got everybody separated and home without any major to-do. Well, this carried over into the mission. This same basic antagonism between crew and ground really left sort of a bad taste in everybody's mouth.

So when the control teams came back, I got them all over into the auditorium here in building 30 and said, "You know, this must never happen again. I mean, this is absolutely inadequate. We're going to screw up. We're not going to do our job." We created the first star in the badge we wear, which is discipline. "Okay. You're always going to remain focused on your mission. You will never lose sight of what our job is out there, no matter what happens in this thing." This became first of the four stars in our badge: discipline, morale, toughness, and competence. But anyway, we're getting ahead of the story. So, Gemini III stood out as a result of that.

Gemini IV was to me probably one of the most exciting of the missions. Prior to [Gemini] III we were trying to set our own space records. We wanted to be the first to have an extravehicular operation; put a man out in space, free from the spacecraft. I got tagged to work with the team here at Johnson [then the Manned Spacecraft Center] in building that [Extravehicular Activity] EVA plan. And we were very imaginative; we called it Plan X. We'd finish our work here during the day; we'd go home, we'd eat, and then all the Plan X people would come back in and we'd work generally from about 6 or 7 in the evening until 1 or 2 in the morning, building the equipment, validating it in the altitude chamber, developing mission rules, etc., etc., etc.

And this was to me very exciting because I was one of those who believed in the space race. I wanted to beat the Russians. I didn't like Russians. I'd seen their airplanes over in Korea; I'd seen them over the Formosa Straits. And, to put it bluntly, it was a battle for the minds and the hearts of the free world. So, space was not just something romantic to me. It was the battleground with the Soviet Union at that time. I really wanted to set this first space record. Well, the unfortunate thing is, the Russians had already accomplished

extravehicular operations. But, the neat thing about this was, we now knew when they had this enormous lead on us to begin with that this lead was now down to mere months. When they were doing their EVA, we were within striking distance of that EVA. So work on the EVA was really it. And when Ed [Edward H.] White [II] stepped outside the spacecraft—So there were two things about Gemini IV: That was my first flight as a Flight Director; and secondly, I was one of the key members of Plan X. And I was just proud as all hell that we'd closed this gap with the Russians. So that was Gemini IV.

NEAL: It also was the time that Mission Control in Houston came into being.

KRANZ: Yes, yes.

NEAL: First one from here.

KRANZ: That's a good point. Gemini V was interesting for an entirely different reason. Kraft is a very perceptive individual. In growing his Flight Directors, it's sort of like he had to kick them out of the nest. It's sort of like a bird that has to learn to fly. Well, [with] Gemini V we had a variety of cryogenic problems shortly after we had launched. And I was following Kraft in the shift. And the pressure—cryogenic pressure—was below the minimum inlet pressure to the fuel cell at this time; and we really didn't know whether the fuel cells would keep working.

I was waiting the replacement of Kraft to get on shift, and in the Flight Director business, you keep a log. At the end of each shift, the previous shift Flight Director sort of

summarizes the status of the system and gives a sense of direction. Well, Kraft had neither summarized status nor given a sense of direction. And I wanted to know what the hell he wanted to do with this mission, because we were now going 16 orbits where it was not obvious that, if these fuel cells shut down, we would be able to get around to appropriate deorbit point the next day. So I wanted sort of a game plan from Kraft. Well, Kraft wasn't about to give me one. I said, "Chris, what do you want me to do?" And in a very disgusted [fashion], he gets up, looks at me, and says, "You're the Flight Director. It's your shift. You make up your mind." And this was, to me, the day that—from then on, it was a question of trusting my own judgment, making my own calls, using all the resources available.

But I think I needed that nudge from Kraft; that was really essential there. And Kraft had a way to do this. I mean, he was very direct, but he was a damn good teacher. And it was exactly that. Every teacher knows there comes a point, like a pilot when I was taught to fly. The guy sitting in the back seat one day decides it's time for [you] to solo. So he gets out of the back seat, and you're on your own. Well, I think every teacher realizes that there comes a point where the student has a capability to do it. And part of the process of saying, "Okay, I'm going to get out of the back seat" is to leave you with the confidence that you're going to pull it off. Kraft was exactly that kind of person. I mean, just great. That was Gemini V.

Gemini VII/VI was interesting just from a standpoint of a gutsy management decision. It was when the Agena went in the drink, and we were left with needing to stay on schedule and demonstrating our ability to run with two spacecraft. I think stealing the page from the Russians of launching two spacecraft out of the same launch complex in close proximity to each other was the grand stroke. And I think that, to me, the decision to do that

and the way that launch team responded was more edifying than the fact that we rendezvoused. I mean, I just liked the way that we seemed capable of taking adversity and turning it to our advantage in those days. We could take dire circumstances and find some way to find some sunshine in it. There's a sunrise every day. And to just grab these situations that seemed as setbacks and turn them to your advantage was one of those things. It created a feeling within the team that there is no surrender. We will never surrender to anything. We're going to look at it and, son of a gun, we're going to find a way out of this thing! We're going to stay on track. And it wasn't buying into major risk; it was just using your brain to find options and alternatives and then having the guts to select that one which seemed the best and then go do it. I always liken the Gemini VII/VI option to what it must've been like to be in Patton's Third Army, when you were actually marching east and all of a sudden you just wheel this entire army and turn it 90 degrees and go up to relieve Bastogne. You know, this is a modern-day history to me. I like Pattons and MacArthurs and Chesty Pullers, and Moshe Dyans. This was the equivalent in the '60s of the stuff that the great leaders did back in the '40s.

NEAL: Isn't it remarkable that, after the experience of VII/VI, you had Gemini VIII?

[*laughter*]

KRANZ: Yeah.

NEAL: Tell us about that one.

KRANZ: Well, Gemini VIII was interesting. We were now to the point where operations reached its peak from a standpoint of manning in the early Gemini Program. So now we're moving into late Gemini. Still got a lot of work to do to get the knowledge necessary to go to the Moon, but we've now got to start separating teams to start working on the upcoming Apollo Program. We've got to get on top of the spacecraft, support the designer, you know that type of stuff. Well, in Gemini VIII I think I made, and we made, a bad decision. We decided that, from now on, we were going to two-shift all remaining missions so we could move teams over to Apollo. So for Gemini VIII, we were two-shifting, myself and Hodge. Hodge was launching and I replaced him after completion of the rendezvous and docking. That was the game plan. And we'd two-shift all remaining missions. Well, we got rendezvoused, we got docked, and everything looked like it was going by the numbers. And then—a little bit of history on the Agena spacecraft.

We had lost the Agena on the Gemini VII/VI mission. There was a general lack of trust between Lockheed Company and the Air Force people and NASA on the Agena operations. Every time I'd go out to a meeting at Lockheed, they'd put a tape recorder out on the table so they'd know *exactly* what I said. And it was not one of the best—It wasn't the kind of professional relationship I was used to when I was in the Air Force and also when I was working with McDonnell [Aircraft Corporation] on the spacecraft.

Well, this trust carried over into some of testing down at the Cape. The tests just weren't performed well. We had an Agena—I think it was 5000 . . . or 2001 or 5001—that we used as one of our test vehicles that never seemed to perform well. There was just not a good taste. Bottom line was, we really did not trust this target vehicle as a Flight Control team and I think from a crew standpoint. So now you dock with this thing that you're sort of

ginchy about. And as the spacecraft passed over Africa and ended up in Zanzibar, passing across Zanzibar, we had uplinked a command load to the spacecraft, and, again, [the mission protocols were still emerging and we were still learning about them at Mission Control]. We left the crew with an incomplete transmission as the spacecraft passed by. We said, "We've had some problems validating the command load we just uplinked. But we think . . ." and that was the end of the transmission.

Now the crew goes across the hill, and on board the spacecraft they're noticing their eight balls in the spacecraft are not showing the attitude they're supposed to be in. They're offset. And the crew very rapidly takes control and moves this guy back in. Again they offset. So they're saying, "Hmm, we could have some attitude control peculiarity. Some jet somewhere is firing. It's probably on the Agena, so let's shut off the Agena attitude control." Well, now it moved from a steady-state offset case to the point where the spacecraft started rolling. The crew is now thinking, "Well, gee, something's wrong out there in the Agena. We turned off the attitude control. Something's stuck on. The thruster's stuck on somewhere. Let's undock from this spacecraft."

Well, when they undocked from that spacecraft, all hell really broke loose, and this relatively slow but accelerating roll rate now sort of accelerated very rapidly to the point where they were on the verge of losing consciousness. Now here's where the command pilot—Two things happened here that, really, I find remarkable. First thing is: Dave Scott, when they undocked, had the presence of mind to send a command over to the Agena that would allow us to exercise ground command of the Agena. Instead of thinking survival, Scott sends the command that's now going to let us troubleshoot the Agena. At the same time, Neil Armstrong comes up with the idea, "We've got a hung-up thruster. It's now

obviously on our spacecraft. Let's pull all of the circuit breakers in this thing until we figure out how we're going to get it." Well, the crew finally regained control of this; but in the process of doing this they had used a lot of their reentry fuel.

I got the job of bringing the crew back home because Hodge was at the very end of his 12-hour shift. And it was a lot of work that had to be done to get the spacecraft, to get recovery forces set up, [to] get the recovery procedures in place, etc. The bottom line was that, in debriefing the mission, we looked at a lot of the mistakes that we'd made. The first thing was this teaming business just wasn't good. When you've got crises that show up in spaceflight, you'd damn well better have as fresh a team as you can have in place to start addressing them. The second thing is, if you don't trust a spacecraft, don't fly. But the third thing is, and it's something that I think applies very much to this Russian International Space Station we're flying, when two spacecraft are docked together, you treat them as an integrated system. We did not have integrated troubleshooting procedures available to this crew. We had procedures for an undocked Agena and an undocked Gemini, but we never had procedures that we had developed for integrated troubleshooting procedures for the configuration when these guys were parked.

So this was this entire process of growing up and learning in Flight Control because we had this learning curve that was so steep that every time we flew a mission, we learned something. Sometimes, like on Gemini VIII, we were just lucky. And luck's got no business in spaceflight. So we had to eliminate the luck component. We now looked differently, and the Gemini VIII was good from a standpoint of downstream missions, because we had so many missions we would fly docked, that we now started thinking integrated. When two spacecraft are tied together, you don't have two electrical systems; you've got one. You've

got basically two docked manned spacecraft, but you've got one life support system because the atmosphere's mixing air. So we started thinking integrated here. But the core was, if you don't trust it, don't fly. Think integrated. And then, let's go back in and think about how we assure that we've got as fresh teams as possible available in case we've got problems. So that was Gemini.

Gemini IX was the first time I really had a big-time flap during a mission with NASA management, because again we had lost the Agena. We came up with this angry alligator, the ATDA [augmented target docking adapter]. We tended to suspect the shroud had not released on that guy, and when we got the crew in place—yea verily, that was it! Now, I was probably the most knowledgeable of the Agena and Agena systems for a variety of reasons. I lived right across the street from the controller who ran the Branch, but it was also the unmanned stuff that we were flying had a lot of similarities to the types [of] experiences, the kinds of things that I had flown when I was back in my flight test days at Holloman. The other thing was that the responsibility for the system to a great extent came out of our Branch.

So, as I got to know the Agena, I was dead set—Let me start off. At the time that was Lead Flight Director in that thing, I launched the thing, the crew got up there, we had done the rendezvouses, we had said, "Gee, there's no way we can dock with this thing today. Let's go back and think about it tomorrow." So we sent [the crew] on this stand-off rendezvous, where they'd come in and close, this time from the top, the following day. So that was the position and I also had an EVA we had to do that mission. So I had set a series of decisions that, "We'll finish the rendezvouses tomorrow, then we'll separate again and do the EVA the subsequent day."

I went off, went home, got showered, came back, and—we had sleeping quarters in the Mission Control at that time. I came back in to the sleeping quarters, all set to go to bed, and I find a big NASA management meeting up there. George [E.] Mueller and Chuck [Charles W.] Mathews and Deke Slayton and Chris Kraft and Sig Sjoberg and all these people are in there, and what they're going to do is: they're going to perform an EVA the next day to cut the lanyards on this shroud that's hung up. Well, they asked me for what my opinion was, and I told them. I said, "There's a hell of a lot of energy still stored in that shroud. And the only way you're going to approach this, if you're going to do an EVA, is you're going to have to do it. You've got a spacecraft that's got an attitude control problem. You're going to have to station-keep but not be able to dock with the other spacecraft. You're going to send a guy . . . This is crazy! This is a (quote, unquote) . . . This is a dangerous and unnecessary stunt. You're going to kill somebody!"

Well, the long and short of it was after debate they didn't want my—They weren't interested in my input at this time. They had listened to it, but they decided they were going to go ahead with the EVA. And I said, "This is the wrong thing." They said, "Do it." This was the first time in my—This was a new experience for me, to be directed to do something that I didn't believe in. It also sort of tested the Flight Director's mandate; that is, is he really in charge of this mission or not kind of thing. So anyway I went through this—You know, you get mad. It's a bit of an ego problem saying, "No, no, no!" And Kraft saying, "Yes, yes, yes!" And I said, "Okay, goddamn it, Chris, this is going to be the last time I ever fly here! You know, this is dumb. I've been involved in this business before. You don't risk lives for no gain."

Well, the bottom line was, the next day they voiced this information up to the crew. They'd finished the rendezvous, and the crew, I think, sort of came to the same conclusion I had. "This is dumb." But they were able to put it nicely. They said, "You know, we're pretty tired up here. We're pretty bushed" (I think were the exact words they used) "We don't think this is a good idea." So I was saved from having to take my early retirement from NASA. That was IX. Then I went over to work the Apollo Program, and Glynn Lunney and Cliff Charles [Clifford E. Charlesworth] covered the final [Gemini] 10, 11, and 12. I would come back in and do nightshift for them. So that takes us up through the Gemini Program.

NEAL: And I think it's time that we really rolled on into Apollo.

KRANZ: Okay.

NEAL: As we move on into Apollo, well Apollo 7, Glynn's problem-child . . .

KRANZ: Actually, [I'd like to] go back to Apollo 1.

NEAL: Okay, let's do it.

KRANZ: Because myself, Kraft, and Hodge were the three Flight Directors who were tagged to do Apollo 1. At this time the, Chris was the Director of Flight Operations, so he basically had management responsibilities. And it was obvious that he was becoming one of the *dominant* figures for basically not only assembling the mission but basically articulating the

mission forward, establishing policies, and then carrying these policies forward to the conclusion. The Mission Planning Analysis Division, run by Johnny Mayer and Carl Huss, did all of the trajectory design work. But what was maybe even more important, they did the conceptual design. They started to look at the elements in the spacecrafts, the pieces they had to work with, and they started conceptualizing this entire program plan for Apollo. And, Kraft then would carry this message forward into the arenas up in Washington where Marshall Space Flight Center had some very great flight design capabilities. They had great people there. So Kraft was, to a great extent carrying the experience that we had had in Mission Control coupled with the flight design to build the best family of options for the mission. So he was pretty much tied up articulating and carrying the program for it.

Hodge was Division Chief for Flight Control. And he had the responsibilities for all of us. He had the Mission Control, he had the spacecraft system responsibilities, the real-time trajectory people, the training, etc. So he had a pretty good job. And I got tagged as Hodge's Deputy during this period of time. I moved from Branch Chief up to Deputy Division Chief at that time. So the status, moving from '66 to '67 at the time of the Apollo 1 fire, was all of us were pretty busy with management responsibilities. When I came off Gemini, I was, I won't say frankly appalled, but I was really shocked by how far we had yet to go before we could pull together a coherent Apollo operation with the same quality that we were now experiencing in the Gemini operation. And this was particularly true in our relationships with [North American] Rockwell. Rockwell is a very good contractor, but they hadn't been flying in space before. All of our experience had been with McDonnell. And Rockwell was used to building fighter airplanes, rolling them out of the factories, etc., and they weren't about to listen to anybody that wasn't a test pilot. Okay? And so the astronauts

were able to influence, to a great extent, Rockwell; and we had virtually no influence, you know, out at Rockwell on the next system.

In fact, with McDonnell [we employed] one of my flight test experiences; namely that "The people on the ground got to know the aircraft we're flying." Well, I carried this into the Mercury and Gemini Programs, and we finally got McDonnell to agree where basically we had a small detachment of McDonnell people; and they got us the blueprints, the drawings, the wire bundle assemblies. We built our own schematics. We built our own documentation. Well this wasn't believed credible by North American [Rockwell]. *They* were the only ones who understood how to fly the spacecraft. *They're* the only ones. So it was almost a *battle* over how we were going to run this program. And we got into this, "Well, I can't give you any guarantees." So this was sort of the status when I moved from the Gemini [Program] into the Apollo Program. So we had just a long ways to go.

Now in the middle of this thing, we're trying to run a test of Apollo spacecraft. And this friction in January, I think, led to the disaster that we had with the pad fire. The fact is that we really weren't ready to do the job, and yet we were moving on. And this is again one of the times in my lifetime in Mission Control, and this is where the "tough and competent" part came into our motto. We were sitting there that day, running the test. I had done the shift prior to Hodge before the fire, and things weren't right that day, and I *knew* they weren't right. And yet I continued on. I think everybody that was working that test knew things weren't right. We weren't ready! But nobody stood up and assumed the accountability and said, "We're not ready. It's time to regroup." And I think this was one of the very tough lessons that came out of Apollo 1, that we said, "From now on, we are forever accountable for what we do or what we fail to do. It is up to us! It is up to every individual within this

program, to make things right." And I think that the Apollo 1 fire was really the key to the successes now we had downstream, because it created not only a different working environment; it developed a firmness of mind that I think was essential to making the right decisions. They were still risky decisions, but pick the right path when you came to that fork in the road.

NEAL: It has been said that the Apollo Program could not have gone very far ahead without Apollo 1.

KRANZ: [*nods agreement*]

NEAL: And I think that's what you're saying.

KRANZ: Yeah; yeah; yeah.

NEAL: Well, Apollo 1's lessons were learned. And in a remarkably short time they were ready to fly again.

KRANZ: Yeah.

NEAL: And when fly they did, they had quite a crew, didn't they?

KRANZ: [*laughs*] Let's say I'm doing a book. I'd pick the headline from one of the newspapers that talked about "the grumpy commander." And this is really it. Because we grew up with Wally Schirra. Wally's in fact—to this day, I get the controllers together, and we've all mellowed a bit. We all look back now with a bit longer perspective. [Schirra] really wasn't on us as bad as it seemed, etc., etc., etc. And Wally—if I would run a poll of Flight Controllers, in Mercury and Gemini, they would put Schirra right at the top of the list. They think he was the finest of the test pilots; they think he was the finest guy to work with. We liked his attitude. And I think that was one of the things that was such a shock to us during the Apollo 7 mission.

This badge that we have right here [*points to his lapel*], it's got the sigma from Schirra's spacecraft, Sigma-7. This badge pulls together the history of everything that we learned in Mercury, Gemini, Apollo, and it ties it together for the future generation. But this pulling together of the team represented by Wally Schirra in naming his spacecraft Sigma-7, I think he was the first of the astronauts who really recognized the changing nature of the role between space crew and ground crew. And I think that Schirra had a feel for it well before any of the other astronauts ever came on line with this same feeling. So it was . . . working with Schirra, it was—take where we are right now. We're in mid-'68 and we've got roughly 18 months to fulfill this lunar landing within the decade. We've got one flight to test the command and service module; we've got another flight to test the lunar module; and then we've got to be ready to go to the Moon. So it means that you're going to pack a heck of a lot into each one of these missions. And I think that the ground team really had focused on, "Get as much of this mission out." Remember, we had flown the 201, 202, 501, 502; we had flown the Apollo 5, the LM-1 mission; so the ground team was pretty doggoned proficient in

the command and service module, launch operations, those kinds of things. So we were in some ways operating at a higher plateau than the crew was when they flew their first mission. So you had almost this experience incompatibility. We were going for broke and using every second we had. And this didn't fit Schirra's frame of mind when he came up with this head cold that he had. This showed up right from the very first part of the mission. Bottom line was, even with a grumpy commander, we got the job done as a team. The job got done. We qualified the command and service module. And now we were ready to go into Apollo 8.

NEAL: And that was some decision, wasn't it?

KRANZ: Yeah, that was. It was interesting. And I have a different twist on how this thing got started. I've researched it pretty thoroughly, and I've talked it over with some of the flight designers and [looked at it] from the flight dynamics aspect. Most of the people give the credit for Apollo 8 really getting kicked off by a decision in August where George [M.] Low came down and said, "Hey, you know, I think, in order to keep this program on track—we've got problems in the lunar module; it's behind schedule, it's overweight, there are software problems there—I think that we've got to go to the Moon."

Well, if I go back into the March/April timeframe, Kraft at one of the staff meetings was concerned about the same types of things. And we had what we called an E-mission. It was one where we were just taking and putting a very large (it was a 4,000-mile orbit) mission into this package. And this was going to test the command and service module and lunar module, but in a very high elliptic orbit. I don't think anybody in the program thought that made much sense, but it was there. So Kraft started playing games with this mission.

He kept saying, "Well, Johnny, how big could we make that orbit?" And Johnny Mayer'd say, "Hell, we could make it so big we'd go around the Moon if we wanted to!" And Kraft said, "Gee, we ought to develop some kind of an alternate for this E-mission." He said, "Johnny, I . . ." (and I've got the notes from the staff meetings that proceeded from then on) "Johnny, why don't you look at it?" So that was in the April timeframe.

Come May, Johnny Mayer and—Mayer loved to have work for his conceptual flight planners. You know, the conceptual flight planners were sort of like the mobile strike force; they were sort of the eggheads in a very eggheady division. But boy, the one thing they could do is figure out how to do difficult and complex things in a trajectory sense. In May, they now came back in and provided a series of briefings. And in these briefings now, this 4,000-mile orbit had grown to encompass the Moon! But it still had a CSM [command and service module] and LM [lunar module] in it.

So now comes June. Kraft says, "Look, what happens if the LM can't make it? What do we get out of it?" And the obvious one, "Well, gee we figure out whether all of our navigation works, our tracking works, and all these kinds of things." The bottom line of this thing was, I really think it was either Kraft planted the seed very strongly in George Low's mind or George Low had some good mission staff engineers that knew what the mission planners were doing. And I think if you really think about it, that's a very short turnaround to come up with such a monumental decision, to have all the data on the table ready to go. Okay. This data had originated before. So anyway, I think it started back in the staff meeting with Kraft, but to me that was again indicative of the kinds of leadership where they take a look.

Everybody says it was a risky decision. It was a risky decision because [it was] only the second mission. But if you take a look at balancing the risk across all the missions, it really *reduced* risk for the downstream missions, because now we knew we could navigate out there. We could track out there. We knew the S-IVB worked. So this entire process of making risk-gain decisions was very skillfully done. George Mueller's part of this thing here, because Mueller never relented on his all-up (you know, this all-up concept he had). We had this disastrous Apollo 1 fire and a lot of people wanted to go back in and start taking baby steps again, but baby steps weren't going to get you to the Moon in the next two years. And Mueller says, "No, we'll all-up." Very high gain if it works, but if it doesn't work you got a lot of very expensive space *junk*. So it was. When you're working from the top down with gutsy decisions there, you can make gutsy decisions at lower level. It [was a] spectacular mission.

NEAL: So it all went together?

KRANZ: Yeah.

NEAL: And "In the beginning" came back to Earth on Christmas Eve.

KRANZ: Yeah.

NEAL: And after that it was time for—

KRANZ: One thing. You know, the thing that there's some—the beauty of the thing for me is, I was Division Chief at this time. And I came to the point where running the Division and flight directing, I couldn't do everything. Well, as it was, I was lucky because if I had been a Flight Director working on Apollo 8, I couldn't do my job. I was so absolutely mesmerized as that spacecraft went around the Moon. It was—I was just—and then the crew starting reading from the book of Genesis. I mean, I was so emotionally tied into that thing, I couldn't have made a decision if I needed to.

NEAL: In a peculiar way it was great that that was the crew that followed Apollo 7.

KRANZ: Yeah.

NEAL: On [Apollo] 7, Wally had his problems. And on [Apollo] 8 they made up for them in spades.

KRANZ: Yeah, yeah.

NEAL: Didn't they?

KRANZ: Yeah.

NEAL: But, of course, all of that was wonderful scene-setting. You had achieved escape velocity.

KRANZ: Yeah, yeah.

NEAL: We knew that could be done. But you still had that LM to check out, and you had an engineer like [James A.] McDivitt to fly a mission for you.

KRANZ: McDivitt was one of my favorite of the Apollo crews for a variety of different ones. [All the] crewmen we had ever worked with through Mercury and Gemini were almost clones of Slayton. Whatever Slayton said, they did. McDivitt was the first one that broke this mold. Slayton and Kraft were very strong, powerful individuals, both with powerful organizations. Slayton continued with this test pilot attitude [and said], "Boy, controlling the procedures that we have on board the spacecraft is *my* job because it's those procedures that have got to be perfect. They've got to be right!"

Well, to put it bluntly, these procedures were built by their contractors. And their contractors generally came out of, I won't say the Tech Service Divisions, but basically they weren't engineers writing the damn procedures. It was their service divisions who were writing the procedures. So they'd try these procedures in the simulators. The crew would burn up enormous amounts of simulated time making these procedures *right*, but they still had flaws in them.

My guys studied the systems from the ground up. We built the schematics. We'd write the mission rules, mission strategy. So we had this argument going on between the two players. It was so petty that Slayton would never give a flight set of procedures to the controllers on console. So we were always wondering what the crew was carrying on board

the spacecraft. When it came time to execute something, we had our set and their set. Well, McDivitt looked at this and said, "This is ridiculous!" So McDivitt got a hold of his crew procedures people, broke ranks with Slayton, and made sure that every controller, including the Flight Director, had a set of the on-board crew procedures. And from that day on, we never had a problem. But it took McDivitt to break this mold in here. And it was a very important one. Because if you go into what happened on the subsequent missions, [Apollo] 10, 11, 12, 13, 14, 15, this collaboration between the two elements was essential. And McDivitt was the guy who started it.

[End of Interview]