NASA CULTURE STUDY

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INTERVIEW WITH

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(THIS TRANSCRIPT WAS PREPARED FROM A TAPE RECORDING.)

McCURDY: Just the basic facts. You joined NASA in 1960 as we have it?

KRANZ: I would imagine that's correct. (LAUGHTER).

McCURDY: Okay.

KRANZ: Because it was very early when we were still part of the space task group.

McCURDY: Did you spend time at Langley?

KRANZ: Yes, I did. I was there about, gee, about two years, but the majority -- at least half of that -- I'd say a third of it was TDY down at the Cape, because we were Operations and we were launching and flying out of Cassidy and we just had extended periods of time when we would stay down there on flight operations.

McCURDY: Okay. And you were Chief of Flight Control Operations. Then you would have had that position both there and here? That is, Langley and --

KRANZ: Yes.

McCURDY: The Manned Space --

KRANZ: Yeah, it was really a branch level organization at that time, that I held through until it must have been around 1967, I think, when I got the Flight Control Division.

McCURDY: Yeah. Uh-huh.

KRANZ: And at the same time, I was also a Flight

Director for the Gemini Program.

McCURDY: You were also Flight Director for Skylab and one of the Space Transportation --

KRANZ: No, none of the STS missions. I was what they called Flight Operations Director at that time. There is a difference. The Flight Director is the guy who is directly responsible for the Flight Control Team. Flight Operations Director provides what I would say is the bridge, the interface into the mission management teams, those kinds of things.

We basically try to keep the Flight Control Team so they can focus, concentrate on the missions, the mission decision process, that type of stuff. And basically I do their brokering from the operating team into the management structure, both institutional as well as the programmatic management structure.

McCURDY: Uh-huh.

KRANZ: I did that for the majority of the early missions and then picked two individuals to work, because that was becoming a full-time job in addition to running the organization, and picked Don Putty and Tommy Holloway doing that job.

McCURDY: And in 1983, you took your present position, which is Director of Mission Operations?

KRANZ: Yes.

McCURDY: Under which you have all of these things which you used to work on?

KRANZ: Which I have all of these things I used to work on, and in addition, I picked up a lot of things I didn't used to work on. And that's pick up the majority of the facilities related responsibilities which came along when they made a major contract structural change.

McCURDY: Yeah.

KRANZ: Yeah.

McCURDY: Okay, you had been -- let me just get this straight. Your birthplace is Toledo, Ohio, right?

KRANZ: Yes.

McCURDY: Did you grow up there?

KRANZ: Grew up there, stayed in Toledo through the 12th grade and then left there to go to Parks College, St. Louis University. And then subsequently went to work for McDonnell Aircraft. See which Bio you've got. I think I may have -- See what the date is? Yes, that's close enough. Yeah. Okay, go ahead.

McCURDY: The question was, when you came out you majored in aeronautical engineering?

KRANZ: Yes.

McCURDY: Did you start in aeronautical engineering?

KRANZ: Yes, sir.

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McCURDY: Okay. When you came out it was 1954. There was a six year period where you were in the Air Force.

KRANZ: Air Force.

McCURDY: Jet pilot. And then you were working in the private sector before you decided --

KRANZ: McDonnell Aircraft.

KRANZ: Yes.

McCURDY: -- before you decided to come to work for NASA.

KRANZ: Yes, sir.

McCURDY: Unlike some people, like Max Faget, you didn't come right into NASA NACA.

KRANZ: In fact, I got interested -- how I got interested in NASA, I was always interested -- back in high school I wrote -- my high school thesis was on single stage rocket to the moon and it was based on the writings of Willie Lay at that time and Wernher von Braun. And I sort of lost the interest in what I would say, rocketry and space because becoming a pilot and an aviator was of more interest.

And my principal objective in going through college was really to get into the military as a pilot. It was really not that I wanted to be in aero engineering, or whatever it was, I just wanted to fly.

Once through Parks College, because Parks College was the only accredited aviation school in the country. And as part of your engineering degree you also completed the majority of the requirements for an aircraft maintenance license as well as you learn to fly.

So it was really when you graduated you could fly the airplane, you could design it and you could maintain it. And we had a very limited number of what I would say, in the classical sense, you would say liberal arts.

Virtually everything we took was engineering or engineering related, flying related, you know, instead of -- we were short on history and a lot of the others that in retrospect in later years I wish I had spent more time on. But it was basically to get that kind of a background.

Where I got interested and renewed my interest in space, in flying for the Air Force I was over in Korea in October of '57 when the Soviets orbited Sputnik and I had the opportunity to see the impact of that Soviet launch, but in particular of an orbiting satellite on people in that part of the world that bordered on, let's say, fear, superstition, you name it.

And then, you know, I was close to the time when I could finish off the end of the Air Force tour, the near term obligation, I still had a Reserve obligation, and then went to work of McDonnell in flight testing of some of their

missiles. Actually, launching it off a B-52. So, yeah I spent some period of time out on the outside. And it was beneficial because it helped me make up my mind that I wanted to go into government (INAUDIBLE).

McCURDY: Was it a hard decision to go from private industry to government?

KRANZ: No, no. It was, I wanted to be the customer rather than the contractor. I had seen enough and I respected McDonnell. I think they're very good, but to put it bluntly, I just wanted to be on the customer's side.

I think we had gotten to a point where we were working on an Air Force project where we were doing dumb engineering and the contractor was unable to turn the customer around and say, "this is dumb, you shouldn't do it." So from that day on I decided I would be in the giving of the orders rather than the receiving of the orders.

McCURDY: When you went to Langley, did you go right to work on space flight operations?

KRANZ: Yeah.

McCURDY: Because your background was in aeronautical engineering.

KRANZ: Yes. Well see at that time, the early history at Langley is very interesting because I was surprised when we went up to Langley.

First of all, virtually everybody that was there

had an aeronautical background. And about half the people that were there were English. They had come down from Avril of Canada after the Avril aero program had folded and so we all had a common background in aircraft and aircraft related operations, testing, design, you name it.

So the most curious thing to me was that we all answered the same ad. There was an ad put in Aviation Week which I answered.

And originally I wanted to go to Cape Kennedy, but Cape Kennedy was full up. It was Cape Canaveral at that time. The Cape was full up and I then got an offer from NASA at Langley and NASA Langley was, you know, not particularly -- they were the slowest people.

I had no idea about the government hiring process at that time. I was appalled at their inability to make a commitment in the simple thing like hire a rookie engineer.

McCURDY: When you got there to Langley, you were looking at what had been the old NACA, or at least the course field center for that. But, you were new.

What values do you think were being transferred over from the old hands at Langley to the new people who were now coming in and making it such a larger operation. What kind of an organization did you think you were joining?

KRANZ: This is real easy because I have a management seminar that I do a couple sessions in for the Seminar in Management Program they run down at Columbia Lakes.

And there, I talk about some of the elements of what I've learned from the various people that I have worked for. NASA Langley was very interesting. The Space Task Group was very interesting. Because here you had a Walt Williams who was more or less the pioneer in what I would say rocketry operations, manned rocket operations.

The X-1, in fact the entire "X" series of programs and the X-15 as it continued to emerge. So you had Walt Williams who was an extremely strong pioneering research manager -- research operations manager. You had a Chuck Mathews who was again one of the people with an English background who had come into the program.

And, he and Jim Chamberlain, which is interesting, who is up with Max Faget -- and Jim Chamberlain -- those two were very strong on what I would say, the research background, the research orientation, highly theoretical.

You had the Chris Kraft who had come from Langley, he was in the -- I believe in the wind tunnel area and in the fluid aerodynamics, you know, with that kind of a background, who is an American with a research background,

but, one who was more inclined to listen.

He was very strong opinioned, but he wasn't so theoretical that he was drenched with the theory. I mean, it was just, he was a listener and very capable, very articulate. Paul Havenstein was an interesting one. He was a man from the United States Navy.

And Paul Havenstein I could never figure out what his particular background was, but his specialty was in gluing operations together. Paul Havenstein was what I would say, today I would call an operations integrator. You could call him a planner.

It was an individual who could tie people together, recognize the values of procedures, had understandings of team structures, etc. Then there were two guys, there was Paul Johnson from Western Electric and John Hibbert from BTL, Bell Telephone Labs.

Paul Johnson was one of the, if I would sit down and say here was a guy who really made this thing work. He and John Hibbert, they worked together. One was more or less the concept generator, who was Hibbert and Paul Johnson was more the implementor. They had the concept of the Mercury control center. They had the concept of networks and network operations. They had the concept of how you would communicate from site to site. They had the concept of a team structure.

All of those things were sort of in place and graded really by Hibbert and Johnson and Paul Havenstein. Although they were also supported and facilitated by the Krafts and the Hodges and those fellows.

So basically, many of the early concepts of flight control and team structure and network operations, that kind of stuff, really came outside the agency, but they were working, you know, at Langley during that period of time. Very important.

And then right above us you had Bill Bland, Chamberlain was in the engineering side, Mac Fields, I think his name was, Max Faget, you had the Bob Thompson, who was in the recovery area.

One of the persons that I missed was Johnny Mare, who was more or less in the flight design trajectory part of it. There was a Tecwyn Roberts who was a Welshman, who was also in with the same group that had come over to the United States after the Second World War.

Actually went to Canada and then subsequently came to the United States. He was in the trajectory control area. And basically those were sort of the lead people, even though there were only about four or five years older than the rest of us that sort of glued the, you know, the younger folks together.

And I was -- gee, I can't remember. I was

probably one of the few that they were hiring during that period of time that came in with what I would say is any operational background. They hired Glen Luney who was straight out of college, you know, a co-op up at -- he came from Case. It was Lewis Research Center, I believe is where he was working. It was one of their co-ops.

So I came into a very interesting group of people and it was sort of like, okay let's now sit down and figure what a mission is about and how you patch a mission together. And your assignment, Kranz, for this mission is to write a countdown, and you know, figure out how to write a countdown.

And by the way, if you get some spare time, you know, write some Mission Rules. And you were asking, well you know, I can understand what a countdown is, but what are Mission Rules. You know, it was that, you know, rudimentary. And I remember on the Mercury Red Stone (INAUDIBLE), no it was M.R. I.

McCURDY: The Sam?

McCURDY: Mercury Red Stone I, when I think it was Kraft or one of those guys sent me down to the Cape and we used to use East Coast Airlines. Sent me down to the Cape from Langley, a few days ahead of the rest of the people and said, "Why don't you go and get the countdown written, you know, prior to the time the rest of the team

arrives that way we won't have to all sit around before we start training." Well this was -- I had only been on the job a few weeks and I didn't have the slightest clue what a countdown was, but I knew I was in deep trouble when I got down to Patrick Air Fore Base and didn't know which way to even go to the Cape.

And it was funny, it was because the person that we saw down there, there was an automobile, a Chevy Convertible with a surf board in the automobile, and I crawled off the airplane and obviously the guy looking at me, you know, recognized this guy here was sort of dazzled, didn't have the slightest clue which way even, you know, to go to up.

So, he introduced himself to me and he says, "Where are you going?" And I said, "Out to the Cape." He says, "Come on." He says, "I'm going out there too." And I found out that was Gordon Cooper. So that was my first introduction, you know, to Gordon Cooper.

But that was about the really level -- I mean, it was really a grass roots, you know, organization that they had put together. And there, you know, as time went on you started to recognize, you know, many of the people who were, you know, off on the periphery of the thing.

You got to know all of the astronauts. You got to know -- I'm trying to remember what the heck the name of

the Second Recovery guy was. His first name was Don, who was working for Bob Thompson at that time, who was absolutely a superior guy.

You're really amazed at the quality of these people, these extremely diverse backgrounds. And the perception, you know, you had never done this before, or you had never flown a mission before, you had never operated the space before. But, now close some of these people, like the Paul Johnsons and the John Hibbert's were to being right, you know, right from the very beginning.

That's rudimentary, you've got to be able to communicate, you've got to do this. But if you go back into, you know, much of team structure that we have in flight operations, even today in the Shuttle time frame, you will find that there is a Flight Director there.

You'll find that in Mercury we called them network, today we call them G.C. You'll find the consistency in concepts for how we accomplished trajectory operations.

We've got different technology doing it, but about the team size, it is about what it was in Mercury. We had two people in Mercury, we've got three today. You find out that the one area that they missed significantly in Mercury is they had really two Systems Controllers, but they thought life support would be the, you know, the real heavy

work load, where life support is turning out to be one of the easier work loads and we have a much larger systems team today.

So, you know, many of the very early concepts that we had, we're carrying through today. The concept of Mission Rules, we even call it the same thing. We used to call them Flight Rules then, we call them Mission Rules today.

Flight Plan, Crew Activity Plan, but you know, all the bits and pieces were done very properly by these people at Langley working on the Space Task Groups. The foundation that they built was pretty doggone good. It was a very interesting time from the standpoint of just the overall history of getting the program started.

McCURDY: You had worked for the government before, at least for the military?

KRANZ: Yeah.

McCURDY: Did this look like a government organization to you?

KRANZ: (LAUGHTER). It did look like government. Sure didn't look like a civilian organization. I remember the first time it was most interesting in that, and I didn't think about as government versus civilian.

Out at Holloman in flight test we had a bull pen with about 30 people into it. All of the engineers did

their own writing. You printed virtually everything you did. You did your own re-production and the secretary was a thing of great value and you used them very rarely.

You also dressed very informally out on the doggone flight line, etc. You were much more conscious of simple things like cost, and accounting, and times, and you know, those kinds of things which was, you know, private industry.

You had much more what I would say is a drum beat, pace, tempo. I mean here, I mean if you don't get this flight test today, tomorrow, which I think was the nature of aircraft flight operations.

So you walk into Langley and you find out that first of all everybody is in little offices, so you wonder how the hell you're ever going to get to know anybody else if all their office doors are closed, or whatever. And they would maybe have two or three to an office.

You find out it's got a much more structured, you know, organization and some boundaries. It seemed a bit stuffy. In retrospect today it wasn't stuffy at all.

But, at that time, you find out that they are very clothes conscious and you know, you get a lecture, you know, within the first week or two on, you know, you ought to put on a shirt and tie and, you know, those kinds of things.

Secretaries, they were all crying by that time because they wanted to do things for you. They felt obligated to do something and in the same thing I was trying to treat the secretary as a priceless commodity.

So, it's really a question of, you know, do it for yourself and that got me in trouble consistently, you know, as time went on because it was again the basic principle that we had learned out in industry and in flying was that you do for yourself.

You take care of yourself. You're expected to look out, you know, for yourself. So, from a government standpoint it wasn't what I considered traditional government, but it was sure a real culture. It was a different culture.

It was more what I would say the "researchy" type culture which goes back to, you know, where we had started, you know, in the beginning, as opposed to an operational culture.

Later it became what I would say is operational from a culture standpoint. And, that was when we learned our thought process in the early days, aircraft were, you know, had just cracked the sound barrier and they're moving about five miles a minute. The spacecrafts move five miles a second and our thought process in the early missions was demonstrated to be too slow.

Our anticipation was demonstrated to be too slow. Our lack of pre-thought out decisions was too slow. Those were the things that if I would say there was one surprise from the concepts that the Hibbert's and Johnston's and Havenstein's had put out is that they did not prepare us for the rapidity at which decisions were necessary in a space flight.

I think there was one of the major, major, major areas of change and once we recognized (a) the need to make the change, and then started to make the change. And then we started being a heck of a lot more successful in going about our business in space flight.

McCURDY: Did this research culture that you described disappear when you folks set up shop down here in South Houston?

KRANZ: I think it started to disappear as we spent more time down at the Cape. Because in the Cape environment, we would have a couple of people rooming together, we would go out and eat together, we would go play volley ball together, we would simulate and train together, and we would fly together. I think that this research culture was replaced by culture, you know, embodied mutual respect between all the players, but became more what I would say is an operational culture. And, I think Kraft was the real key in forming that.

Kraft was an individual that people naturally rallied around. He had the presence of command and he was the teacher, you know, all the way through if you go back into the one term that I think people used when they described Kraft. Pete Clements -- do you know Clements? Did you run across Pete Clements?

McCURDY: I don't remember.

KRANZ: Pete Clements is now working up at Fletcher's more or less as (INAUDIBLE), but Pete Clements has done that. But, he used to call him the teacher.

McCURDY: Uh-huh.

KRANZ: And I think that was the most appropriate, you know, description for Kraft. We didn't recognize him as a teacher at the time, you know, it was only years later we said, you know, how much of the stuff that we learned, we learned from him?

He had a bunch of trade sayings, where he would sit down and he would say, "If you don't know what to do, don't do anything." And yet that's one of our precepts, you know, in training of new people that we got today in operating in a control center environment.

So, this isolation, traditional, research culture disappeared very early in the program. I think we created our own culture as a result of it.

McCURDY: But, how would you describe the culture

now, jumping ahead a little bit? Is it still an operational culture?

KRANZ: Within my organization I think it is. And let's face it, we're guided by the emblem that we've got up there you see. If you go along, we've updated it now that we've got the Shuttle in the middle round of neapola.

McCURDY: Uh-huh.

KRANZ: But the rest, just the par excellence, achievement for excellence. You'll see that, you know, phrase consistently, you know, in our documentation, training materials that we give to our people. The discussions between people.

It's the central theme that the people feel and believe. The four stars down around the bottom stand for discipline, morale, tough, and competent. Those were words that were added to our vocabulary and then in '69 to our patch, because of disastrous, or near disastrous mistakes we made in the early days of the program.

McCURDY: Go through them again, would you?

KRANZ: Discipline, morale, tough and competent is what it is.

McCURDY: Tough and competent.

KRANZ: Discipline came about in Gemini (INAUDIBLE)I --

McCURDY: Uh-huh.

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KRANZ: -- as a result of a breakdown in the relationships between the crew and ground --

McCURDY: Hum?

KRANZ: -- that had allowed as a result of misunderstanding and lack of a decision -- pre-launch decision and policy in relationships. Discipline between the ground and air broke down during the course of the mission.

Fortunately it did not compromise the mission, but if we had had a problem it certainly could have. So, we had added that one in and said whatever problems we've got, we're going to resolve them pre-mission.

Or, if we find them during the course of the mission, we'll pick some direction and then de-brief the thing afterwards. Morale came about principally because we're always asking people, and this really comes from the contractors -- it came from the contractors in the early days, but it's very important today, is the morale came because we're always marching our contractors, and many of our contractors right up to the end of the programs. They had to work to perfection in the last mission of the program.

By that time it was too late to get on with the contractor for the next program to start. So we were asking people to sacrifice career for space flight. And, this was

particularly true for the Martin people we had in the Gemini Program, because the Apollo was off and rolling and there were many of the people who had the skills and could have jumped ship and gone to someone else, but they had a sense of mission to finish this thing through.

Morale also comes from a point where we recognize the value of training and recognize that you have to develop an attitude that is so positive, such that you believe in yourself and your team.

You believe that given a few seconds, you can solve any problem that can conceivably come about. Morale is important in 51-L, the recovery. Everybody comes down here and says, "How is morale down there?" I say, "It's excellent." They say, "But, weren't you affected by the mission?" I say, "Yes, we were effected by the mission, but what you would consider morale, we consider a problem in frustration and want to get back to flying.

We're frustrated at some of the stupid things we did. You have to recognize the distinction." We work on our morale consciously, daily, weekly, monthly, etc. It's extremely important. Tough and competent came from the Apollo I fire. Competence because we did not understand the environment of the space craft 100 percent pure oxygen, the materials flammability that we had put in there.

We didn't understand that some of the

characteristics about the hatch opening and the inability to vent the space craft to give the crew an opportunity for escape.

We didn't understand flame propagation in the oxygen environment. But, competence means we can never afford to stop learning; we can never take anything for granted. Toughness is ability to stand up and be counted. But, in particular, it says that in any one day, at any one time, you're accountable for your actions and you must follow through (INAUDIBLE).

That came from Apollo I, because many of us that were working in the compound that day could have said, Hey, things are gone, let's stop this thing, let's go back, let's re-group, etc., etc., etc.

We were seduced and to some extent we were sort of afraid to stand up and you know, say, hey this is not right, let us straighten it out. So really, the toughness goes back into being accountable. Recognizably accountability.

Sigma stands for all of us in there. Saturn, if you see the thing, is in the shape of a letter "I," which is "I" is an individual will, you know, to make the cut, will do these things, etc.

So, it's really a combination of finding a combination between the "I" and the "We" that is the balance

for our proper operating team. So when you ask the question about culture, we have one that is basically embodied in the insignia and the emblem. You'll see that dominant.

In every one of our conference rooms you walk into you're going to see the same insignia. You go over into the Control Center you will see it on the walls, upper right wall, on the crew patches. You will see it in our conference rooms. So it's really a continuous reminder of what I would say is the history of the organization, good and bad.

And, there is other elements in there from the standpoint of the symbols. But the key things is the culture. You will find other ones. You will see these same words to a great extent. The words up there in the plaque that's called the foundations of flight control, which will take and put that in words again for various people in the organization.

It's to give ourselves the ability to reflect and think back on what our job has been in the past, what it is now, and what we expect it to be in the future. So, it's really continuity, a linkage to the past. And in particular, the transmission there, the modifications, the adjustment phasing as we will move from past (INAUDIBLE).

We're in a period of transition right now. It's that transition which is extremely important. We're moving

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from a single to multi-program organization. We're moving into even more dispersed operations, internationals participating in this thing. I mean, you name it.

So the environment that we've got right now is one of our own creation. We believe in creating and then maintaining the environment for success. And that is the culture that we established and subsequently try to maintain.

McCURDY: What was the attitude toward failure back in the 1960's?

KRANZ: Now, you're in a different subject. It's a very interesting subject. When you say failure, why don't you see if you can be a little bit more specific on this thing?

KRANZ: Okay. Let me start with mission failure.

KRANZ: Mission failure, if you go back --

McCURDY: As different than individual failure.

KRANZ: If you go back into -- now, for a facial is somewhat of a dichotomy. Go back into the early days prior to John Glenn's launch; there were people who did not believe man could perform useful functions in space.

McCURDY: Uh-huh.

KRANZ: That he would become disoriented, that he would be incapacitated, that Christ knows he would have

every problem known to human kind. There are others who believed, based on aircraft flight, and these were the crews and the people who had been working aircraft operations, that man is a marvelously adaptable being.

And that since he possessed the faculties of the mind that he could overcome the effects of gravity to a great extent, at least in the near-term. We didn't even think about long-term effects.

We were just going to try to get up ballistically for a few minutes and get back down; or a few hours. So we believed in man's ability to cope. We recognized, and all you had to do was go down to the Cape in those days, and every time they launched Atlas it seemed the damn thing blew up.

You would go out and you would find failure after failure and then an occasional success. So it was really failures with random successes rather than, you know, vice-versa.

So you were very aware of what you were working on. You were working with propellants, highly volatile. You were working with rocketry which is really quite immature. You were working with guidance systems which had been invented only a few years before; so you were taking some relative immature technologies and putting them altogether and putting a man on top.

And you're doing it within really just the Second World War, Wernher von Braun's rockets; probably had about less than ten years to experience that. You're going from really the '44's and the '45's to the '54's and '55's when we weren't doing very well. So you had to have systems that had almost no gestation period, (INAUDIBLE) technology (INAUDIBLE).

Failure was recognized; it was never accepted, but it was at least recognized as being ever present. It was difficult to be complacent because we all worked down at the Cape and every time something was launched other than our own we would go out and watch it. And, we saw a lot of them blow up.

But everybody that was working in the program had come out of aircraft programs. Most everybody had. And, they had seen accidents. They had seen violence and trouble.

Sometimes we got them back, sometimes we didn't. So, the risk to the system and the man was part of our nature. We accepted that because of the very nature of the flight test.

We recognized we were in a flight test environment. And the crews recognized it because they had been experimental test pilots. Managers recognized it because Walt Williams had managed experimental test

programs.

Our administrators, even though they didn't understand it, recognized it because everybody else told them it was risky.

McCURDY: Uh-huh.

KRANZ: As we continued to move through the programs it was recognized risky to go to the moon because nobody had ever been there before. There were some of the same uncertainties about, you know, the surface of the moon, you know, was it made out of dust and Christ knows what else. So that risk was recognized.

You get into the Skylab Program, the risk change was recognized, it is what is going to happen to man after he's 90 days up in the space craft and is he capable of recovering?

We were worried about whether the guy would be incapacitated, or whether we would have to pull him out in stretchers from the space craft, etc. But at least there was a recognition of risk.

ALP risk was recognized because you were launching off the top of a 747. OFT risk was recognized because it was the first time we had ever launched an airplane into space and brought it back.

But then it seemed that the basic risk recognition was lost within a good portion of the NASA

segment. The only people who continued to recognize risk were the crews and the flight controllers.

And why did we recognize risk? Well, what we do is we train everyday over in the control center in launch aborts. We spend the majority of our time studying what happens if we lose. We build all of our malfunction and emergency procedures in case of, and we keep drilling this constantly into the heads of our people.

Every flight director who goes over there for a simulation or a launch realizes that when you're working with 7,000,000 oxygen and hydrogen, you've got a potential explosion. In fact, the entire process of launching a rocket is just the continuous controlled, you know, explosion.

What happened is that we had gone through several elements in management who didn't sit everyday in a control center, so they became -- they saw the successes. They saw some of the near misses, but they moved in the direction where -- they induced us, seduced us and we were seduced in the process to start cutting corners, now where did we cut corners?

We didn't cut corners in the fundamentals of certified people or controllers. We did cut back, and the thing that surprised us was the rapidity. Let me -- I'm off on a tangent, I'll come back to this one.

We didn't cut back on the quality of the people,

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or the quality of the flight plan, or the procedures, but we were being stretched dramatically.

I mean it was to a point now where as we went through 1985 we found less and less and less personal margin. Individual margins of controllers to go and research those "what if's," margins in the manager, margins in the flight controllers.

We knew that 1986 was going to be extremely difficult because we had Sentars and had space telescope and a variety of other interesting missions in there. The one thing that we were absolutely unprepared for was the rapidity at which, and it was only after the accident, is part of pulling the Rogers Commission thing. We would have found it out eventually.

We thought we were, I won't say coasting up on a decision to drop one of the missions in '86, but we knew something had to go and we knew it would probably be one of the Sentar Missions. But it was really a question that -- get into a point where you have an ironclad argument that you can lay on somebody and they would listen.

The one thing that we weren't watching and we didn't have any measurements in place -- we had measurements in place to watch changes and problems that were coming up. What we did not have in place was to look at the rate at which these problems were occurring.

dc/OMT

In fact, in the month of January is when the whole thing became unglued. December, the first symptoms were there, but in 30 days the entire training process had come apart.

And really the training process was the end of the line. It was all of the processes up front that were giving us the problem. We had the wrong measurements in place, and to put it bluntly we had concentrated a good portion of our government resources, our institutional resources to the flying mission as opposed to the management of flying the missions.

It was a question what we weren't managing, we weren't on top of those things that we should have been in to manage this change that was coming at us. The rate at which the problem was occurring was manifesting itself.

It just -- I mean just soared in the month of January. I mean our error rate was high. Our loss of training days due to other schedule problems. I mean it was just -- I mean just completely coming unglued. But it was only when you looked at the rate of change, not the fact that changes were occurring, it was what I would call adult adultous.

We were looking at what was going to be the training day for the Sentar Missions, the "F" and "G" Missions. What we didn't look is, on a daily basis, how

much time we were losing, which is the rate at which this whole process was now snowballing. And it was snowballing something fierce.

You ask the question -- go back into the very early beginning, the risk of failure, the system was never tolerant of failure in the early days. We can never be tolerant of failure. But we were allowing -- we were willing to allow people the opportunity to make small mistakes if we didn't make big mistakes.

It was sort of like bringing up the kids, what you want to do is when they are young you want to get them into the decision process. You want to give them the opportunity to exercise value judgments. You want to do those kinds of things. This gives you the ability to grow people and to grow people with confidence.

As the Shuttle Program started unfolding, we started people very concerned could be damaging to careers to run a person out on the field, or to make presentations to do these things.

We became very bureaucratic frequently. This may be the basic nature of government institutions, I don't know, this is the only one I've been in and been around long enough. I consider myself a very optimistic individual. But I finally got to a point where when I knew it was going to get sticky, and particularly in management forums, I

would not send one of my people there for fear that I would cripple a good person. We didn't use to do that before.

It was -- funny where it went, but that's sort of -- we developed a sensitivity -- overly sensitive to management. And I think, you know, I can't figure out why 51-L happened and how Marshall got in the problems they got into, but we had many of the same symptoms, many of the same warning signs, you know, in our part of the system. We could have flown another five missions and it could have happened as a result of something we had done here at JC.

McCURDY: Could --

-- (TAPE ENDED MID-SENTENCE) --

KRANZ: -- finished the -- most topics are not tough to talk about, but I just finished sort of like the Walt Disney people were in here picking my brain trying to come up with a theme. And they're very provocative.

McCURDY: Uh-huh.

KRANZ: What they're trying to do is, is they're trying to establish some kind of theme that's going to relate to the people in the family, those kinds of things. I mean, the people are going to come out here, the theme center, and after they've finished picking my brain then okay, we're back in similar type situations.

McCURDY: (LAUGHTER).

KRANZ: So, it's really I think I'm probably

going to peter out, you know --

McCURDY: That's okay, you let me know.

KRANZ: in some period of time, but let's press, okay?

McCURDY: Let me suggest two things and see how you react to them about causes of this.

KRANZ: Okay.

McCURDY: One is budget. Did you have all the -- I've been told you had all the money you needed during the 1960's. Was that true?

KRANZ: We must have. We must have. During the '60's, in fact I was talking to Christ Kraft, he was in here and, you know, we talked about it. When we were writing this history we didn't know about it. Okay, what we were doing, we're more interested in the next mission. McCURDY: Yeah.

KRANZ: And the next challenge. And, was the Lear filter going to work so we could navigate around the moon, etc. I can't think of anything that I wanted or needed that I couldn't get in support of the Apollo Program.

The one thing that became apparent in the mid to late '60's however, and we are suffering dramatically from it today, is that they had turned off the spigot of people. They had stopped hiring people about '60.

Other thing that was interesting is that we now

started looking at work around us for the Skylab Program, but that didn't hit us until the '70/'71 time frame, because we were in real fix, trouble over in the Skylab.

But, in the mid-60s, we must have had all the money we needed. I wasn't Program Manager. I wasn't even close to Program Managers.

I was flying missions and most of us were, but it was only when we got into the mid-'70's -- early '70's to mid-'70's, and I was on the Change Board for flight operations down working with Aaron Cohen and seeing the agony because even in the very early design of the Shuttle, you had to make a choice even in the conceptual phase, because you could only pursue one path. And that gets into everything from engine systems to design approaches and structural tests.

Just the amount of testing that was eliminated from the program was highly non-traditional. The agony of the program managers and the engineering people as a result of these early decisions, start making things work from the very beginning as opposed to exercising evaluations of parallel options, these kinds of things.

So I would be inclined to say there was a real deficit in funding. Let me give you for an example, and you know in retrospect, you think about things. But, I was in the process -- when I came out of McDonnell I was very

impressed at how they tracked and managed resources, knew what it cost to keep it clean in the field. And I brought in a system that I have had in place since the mid-60's, since I came over to McDonnell, where every engineer -- every engineer that I've got -- I've got a thousand of them, logs what he works on, how much time he spends, what programs, what space craft he's working on, what payload he's working on right on the line.

We call it the Time Charge Management System. This was showing problems in the time frame of accidents. We had been writing off on various -- I think I've got a copy here. (INAUDIBLE) off and each year I would write what we call a State of the Union, or identify -- anyway, we would forecast difficulties in there, but it was really a question of being able to prove it beyond a shadow of a doubt before you started raising, you know, raising flack. But, the data was there.

Then I thought back as a result of writing that, when I had the Apollo Program as a Division Chief, I had about 700 people and we were flying -- we flew one year of six flights and then the rest of the years one or two, and I had 700 people.

I was trying to fly 12 to 15 flights with fewer people in the Shuttle. So, technology had helped. Technology had come and given us several new capabilities

where we weren't as labor intensive as we used to be. But the bottom line was that we did have a much smaller resource base on a perf like basis under a previous program. Now, that was one of the objectives, was to achieve operational efficiencies.

McCURDY: Uh-huh.

KRANZ: I think that the operational efficiencies have to be an objective of every manager. It has to be an objective of the program. There is a degree at which they must evolve and when you move from Plato A OFT, you have to have -- you just cannot decree efficiencies you have to find some process by which you are going to achieve them.

And most of the time it is because you make investments. You're investing in technology; you're investing in this. And I think within the ground part of the system efficiencies were forecast to be accomplished and then the funding was withdrawn and most of it was withdrawn in '77 when the Program ran into it.

These investments were never made and yet funding curves to support the Shuttle flight rate decreed removal of people from the line organization, so it was a perfect "catch 22."

I think we spanned a similar chance today in the areas of the space (INAUDIBLE). That's why the Phillip's Committee, I think greatly recognized this and it had

proposed to recognize a separate AA for operations up at (INAUDIBLE).

I think the Phillips Committee recommendations are very valid in recognizing the need to establish an operations organization and a development organization very similar to what the Air Force does. They have the systems command and then they have the using command.

McCURDY: That's a fairly interesting argument. I've had, not inside NASA so much as people outside NASA suggest that the problem occurs simply because the technology is growing more complex. For example if you have the opportunity for what they call complex interactions or interactive failures.

KRANZ: Well, that's very interesting. You've got to look at it from both sides. If I would look at the Shuttle and the Shuttle is a flight system. Forget the SRB's, but just take a look at everything else.

McCURDY: Yeah.

KRANZ: See because if I would compare the Shuttle, say a command and service module NRLM -- I used to fly airplanes; I flew over in Korea and the one thing you always wanted in an airplane was one that could sustain a lot of battle damage and keep flying, or at least get you to a safe altitude so you could eject and get out.

The Shuttle is a magnificent flying machine. It

can sustain battle damage, I'll tell you what, it can lose APU's and systems and hydraulics and electrical power, etc., etc., etc.

I'll tell you a story about this one, because now you've got me off on an interesting track here. The Command Service Module was just the opposite. It was a very good, very high quality system, but you lose one of those guides, you damn well better be on the way back home.

Now the Shuttle is so complex, this is where the "catch 22" occurs, because they wanted a system that could deploy, it could retrieve, it could EVA's on, you could do sustained orbital operations, (INAUDIBLE), etc. So they built a system that is incredibly flexible. I mean, you've got the five computers playing into four strings; each string plays into MBM's.

Most of the components down at the end of the line, you've got three, sometimes you've got four, sometimes you've got five on. So generally, you've got to lose two or three of a thing before you think about coming home.

Well the system was so complex that in the first year of training for this mission, we could not make correct decisions. The instructor's batting average was 100 to 1 against us because we were incapable of managing the kind of space technology we had. So without knowing it and before the term expert system was coined, we had built what we call

the SCAP, Shuttle Configuration Analysis Processor.

We had built probably the largest and most complex expert system in captivity and had been using this thing routinely, but we didn't know it was called an expert system. It was amazing.

We sent one of our guys out to UCLA and he made a presentation out there. All of a sudden, the guys say, "Gees, we want to join up." So, we ended up in a cooperative activity at UCLA studying because they were in the process of starting the basic theory of that expert system. And they wanted to take a look at what we had done and some of these functional logarhythms that we had written, etc., you know, had started showing up, so it was very interesting.

But, the key thing was, is that in this case now, technology came to our aid because the computing horsepower was there. It was less expensive than it used to be.

So the complexity of the flight system was matched with the complexity of the ground system. Now all this did was allow us to cope with the technology problem that we were working with. It didn't allow us to cope with the flight rate problem. And so we had -- technology helped us on one side, but we were unable to make investments in the technology necessary to be very effective.

Now, let me put one disclaimer on this. If we

had had the money to make the investments in '77 -- they took it away. If we had had the money to make investments in '77 we probably would have put it in the wrong direction because we would have built for high flight rate very stable and inflexible system. So we would have built tools with that kind of a concept in mind. Highly repetitive missions.

The missions where the basic concept was, you don't work to continue the mission, you find a way to gracefully terminate them. Once the flight rate -- so, if we had made that investment '77, we would have had basic raw computing horsepower, but the majority of software we had would have had to be re-worked because we would build it in the wrong direction.

By about '81 -- I've written a paper that you may, as part of your thing, that I gave to the (INAUDIBLE) AA just prior to the 51-L Mission, which was contemporary. It tried to put the Shuttle in perspective.

Concept versus reality. And it wasn't saying that anybody was right or wrong, but what it said is before you called the new program concepts, you better take a close look at those things, because they tried to trace the flight rate implications and some of the early decisions made.

The decision when we built the Orbiter, there was no EVA in the Program. In fact, extra vehicular operations outside the Orbiter were purely in contingency. There was

not planned to be a routine EVA. And we were caught so far off base in this thing that my organization has to fly these missions didn't even have a section associated with the EVA. It was part of a task that had maintenance associated with it.

We have an administrator change up in Washington and that administrator and his deputy catch us completely off base. Now they're marketing EVA and we didn't have an EVA Organization.

It was "grab-assed" to get provisions in the payload bay and they were all bolt on after the fact, as opposed to being designed in things. The thing that -- if I would say there was one of the things that hurt us the most in the Shuttle program beyond the pure funding was the synergism between the funding problem and the complete change of philosophy in the program.

Here you went from a highly rigid, inflexible set of requirements and everybody had to fit this thing, relatively a low load factor, good margins in your systems was the concept that was built. And then almost overnight the extremely flexible fly with very low margins, make your engines do 109 percent rather than 100 percent, strive to accommodate every requirement from every constituency out there and overnight try to get organizations to fall in line. You couldn't do this in years.

And in fact, in some areas, some of the tools that we work with today in the Shuttle were built to the previous concept -- highly inflexible, rigid. And here we're trying to satisfy the needs of the program.

What happened is that as we went through administrations up at headquarters, the concepts changed. And they did not recognize the full extent of the work that had to be done -- the re-work that had to be done to accompany it.

If I would say there was a second lesson that I think is extremely important now is to at least maintain some consistency. Not that you've got to stay with old or obsolete concepts.

The one thing that is happening that is hopefully going to save us is at headquarters who is drying strategic planning. We have been strategic planning for year in our organization because we always have to work multi-programs.

Most other centers and organizations don't have to. So strategic planning is sort of a neat to do rather than a need to do. If we can truly come up with an agency-wide strategic planning then any new administrator that comes in the future is going to recognize that he is going to have to change something. He has to go in there and consciously change something; where before since there was

no plan in place, no set of given concepts, no real bench mark to look at, he quite frequently did a lot of these things unknowingly.

You know, Abramson came in and boy he thought EVA was the greatest thing since canned beer. We ended up in the first, I think, twelve missions we ended up with five EVA's and that wasn't even in the program. I mean, anything that could be doing what were they doing?

They were trying to capture the imagination of the American people. They were trying to demonstrate new space capabilities. All worthwhile objectives, but if the working level doubles we didn't even have enough suits to go around for the damn people we had down there.

We didn't even have a professional, what I would say, a cadre of EVA trained crew members large enough to pull this thing off. Everything really needed a crash basis. That's really not only to keep funding in balance, but maintain some consistency between concept and funding.

They could do all these things, it's just going to cost you more, or it's going to take you longer. If you want a highly dense, highly packed mission, highly tuned mission, fine.

Let us fly just a few less that year. If you want more missions you have got to be more standardized. I mean it's that -- for a given amount of resources. That

exactly what -- but, they didn't recognize that they had to exercise control over that part of the throttle.

McCURDY: Do you think you're getting into that on Space Station?

KRANZ: I think Space Station is, I won't say a disaster about to happen, because it is extremely important that we work on the internationals. It is important that we use all the assets of the agency to get the job done. That's fine when you build something.

When you have got to fly it though, the seconds, minutes, hours -- you can lose that station in a matter of minutes. Everybody says it's stable up there, but they weren't over in the control center on the night when we had a 300 amp short in one of our power distributors. And one of our power control assemblies burned up in the Space Lab, and I mean we had problems that -- you just couldn't see it.

It was a major brown out and we could have lost it that night. When I have the control moment gyro on Skylab, when that guy -- when those bearings seized in that control moment gyro, we were out of control and that whole space station was out of control. And we lost it subsequently several times, but fortunately through cruise and ground we were able to recover that time.

But those kinds of things happen. We lost our fluid system, thermal control systems, and we had to find

ways to puncture lines and re-service those things. So the Space Station is no less forgiving.

Anytime you have got people in a vacuum, okay -- the environment out there is very, very, very, very harsh. Anytime you've got a single national asset you want to put some pretty good insurance on the doggone thing.

McCURDY: Uh-huh.

KRANZ: And I worked Three-Mile Island and there was one statement that kept coming across from some of the Englishmen. They said high technology -- as long as the United States intends to live and expand its standard of living, it will require and place increasing demands on high technology.

High technology accidents are unpredictable and unavoidable. The best engineers can do is provide the largest possible margin in their designs, provide a back-up system, and then to manage the remaining risks, hire the best people you can and give them the best training.

And it was the best people and the best training at Three-Mile Island that was -- we really finally get down to the bottom line, that thing was recoverable for hours into that accident.

McCURDY: Uh-huh.

KRANZ: Okay, it was just that poor guy that was on shift at that day when he had his lost cooling accident

did not recognize that pressure could come from boiling water or a fully-serviced system. He just did not recognize the physics of what was happening in that reactor. So, you know, in the Space Station is the same nature.

It's high technology. It's a vital, national accident. You've only got one of those guys and the reconstruct to put that thing up there is years and billions of dollars. So, it's a question of how are you going to cover your investment.

You darn well better have good people and good technology cause you're going to have to keep that one plant running 15 years. And it's going to have to do a lot of things.

McCURDY: I know you want to go, but I've got to ask you one question.

KRANZ: Okay.

McCURDY: I'm doing a Space Station decision history right now with John Hodge and other people.

KRANZ: Uh-huh.

McCURDY: That's the project I'm finishing, not the one I'm starting. They tell me that what they want to do is to make that Space Station so self-controlling that you folks down here are not going to have to monitor it to the same degree that you monitored, say Skylab, 24 hours a day.

KRANZ: Uh-huh.

McCURDY: I assume that that also means that the people who are operating this station are not going to know everything they need to know to operate it necessarily. Is that going to work?

KRANZ: It can be made to work as long as you don't press the system to the limits. If you're going to demand the last thousand watts out of those solar rays and you're operating at a max efficiency. If you're going to provide pointing maneuvers to satisfy your customer requirements.

Are you going to be running your CMG's near saturation? If you're going to give the crew sufficient margins so they can do periodic maintenance as opposed to 100 percent, you know, performance out of that thing, you can do that. But that is again why we go back into what are the concepts. That's what ate our lunch on the Shuttle Program.

And managers -- what happened, people who are marketing programs will go out with this as their concept. Then the ads design space system comes in and instead of having 75 megawatts of power it only has 65 megawatts of power.

They told their customers they could have 40 megawatts and it takes 25 megawatts to keep the station

going. All of a sudden you're right up against it again. And that is the basic issue that we've got -- You'll never get away from the SRB's, but if we ever have an engine problem (INAUDIBLE) flight --

McCURDY: Yeah.

KRANZ: -- somebody is going to say, Jesus Christ, don't you recognize the entire power balance changes from 100 to 102 to 104 to 107? And why the hell were you running those engines? And we said, because we had to get another 2000 pounds of payload up into orbit, you dummies.

And they're going to say, but that was stupid to run the goddam things that way. And you're going to say, well son of a gun, good after the fact thinking. You can do it, but you have got to maintain.

Once you buy that concept, you have got to buy it for the next five, or eight, or ten, or fifteen years. Because what you're going to do is you're going to invest in putting that capability on board the space ship and you damn well better get it through. And that is where I was going to start saying that in funding --

McCURDY: Yeah.

KRANZ: -- okay, back when we were talking. Did we have enough for Apollo? Yes, we had enough for Apollo, but it was starting to run short for the Skylab Program. Because at this program here we had one of these big

efficiency gains and there was a little bit of technology and we didn't have quite the staffing we had for the Apollo Program, even though we had to fly continuously for a year.

So we started to cut corners on the ground system. Well, this ground system was not operational at the time we launched. In fact, some of the computing systems that we had to support us, we would seriously start figuring out how we would accomplish a de-saturation maneuver for our control moment gyros, we would start the processor going, go out and get a hamburger -- the back room guys over at the hamburger place over here -- come back and that processor was still going.

And this was an answer we needed to crank out roughly every six to eight hours. And, we were marginal. And sometimes we came to a point where we would have to stop doing things because we couldn't crank out an answer.

We would not be able to accomplish an earth resources fast, or we couldn't do a ATN series of observations, or those kinds of things, because our tools weren't working for us. We had stopped making the investments.

Now, these were investments on good concepts somebody had determined we needed. We need so many hours of this, so many hours of that, that kind of stuff. Well, you needed tools to pull that thing off. Well, that paper

you're working with John Hodge, John is -- I used to work for John.

He was one of the Englishmen that came over from the United States. I still have a lot of respect for him. But, I also feel he's off on a tangent in some of his station concepts. He's been out of this business for almost 20 years. He came back in and worked at headquarters up at the station, but he isn't aware of the traps that we have fallen into, etc. He was out to revolutionize the world, and we need blue sky thinkers, but it is important that they recognize that what they do, they should be accountable for many years after it is accomplished through various administrators that may not have agreed with John.

And that there is now people who have got to follow through to maintain the consistency in his concept. Because John's concepts would work. My concepts, (INAUDIBLE) concepts would. But it is -- you're talking about things that go well beyond my administration, or John's, or whoever's (INAUDIBLE) administration.

And (INAUDIBLE) is important for us and I think if there is a lesson -- although I don't think it was learned from 51-L, it is basically one of consistency.

When we were in flight test, we used to write a handle from shift, to shift, to shift. Because if you didn't pick up all the problems, you didn't work these

squawks, you may kill a problem. We do the same thing over in the control center. We will hand over, hand over, hand over. We'll hand over seven, eight, nine, ten days at a time in a routine Shuttle mission. A year at a time for the Skylab. Ten, twelve years of hand overs, all of which have got to be done right to get to the end of the station.

The thing that you need do is you need the consistency. You need almost a hand over process within the agency. There is no good thinking on succession. And, it isn't succession in people, but it's succession in concept. And if there is one thing that you need when budgets are tight is succession in concept.

McCURDY: Uh-huh.

KRANZ: Now this has to come across. It also has to be real, because it can be too damn conservative say don't do it anyway. It has to be real and recognized that politics also play in this. And to close the loop back is a standard in the very beginning.

The operators, the pilots, the astronauts knew the risks in Mercury. Webb understood the politics. So you have some real politicians with people who understood the risks and the balances. The ebb and flow of events and decisions in those kinds of things (INAUDIBLE).

I think we've moved into an environment where maybe the risks were overlooked in the relationship between

risks and political decision (INAUDIBLE). And I think we could have lost a man in EVA (INAUDIBLE).

EVA, to those folks who worked EVA -- and I worked a lot of EVA's during the program. I was (INAUDIBLE) and wonder if we would ever get that hatch closed because we had failed to anticipate the effect of the sun on that seal.

McCURDY: Uh-huh.

KRANZ: Or I was there when Gene Sernan ran across the doggone UHF stub and ripped open his suit. The thing is he got the outer thermal area, he just never got to the pressure bladder and he was lying when he did it. And we've seen several of the other folks in troubles out there. And so, EVA you don't do in a frivolous fashion. You don't do anything in space in a frivolous fashion. We were almost conducting EVA's in a frivolous fashion during the early part of the Shuttle. Abramson doesn't understand what EVA's are about yet. Those were the managers who made those kinds of decision, so it's important to recognize that politicians, they have very important roles. They have to market and move, they have to get the Congress of the United States, the President behind us.

But, it is time you recognize when their decisions end and the technical decisions begin. In the similar fashion, the technician should never try to do the

politician's decisions.

McCURDY: Uh-huh.

KRANZ: There is a need for balance between the two and I think that it's important to recognize the need to re-establish that. I think Congress is now in the 51-L time frame, now moving -- now they have over-reacted to the point where they're in a field where they can't cope. And I think they're going to make maybe some of the same bad decisions based on their assessment of the problem, that our own NASA Code B, the budget types do, because they became too much involved in the system.

McCURDY: Bad decision on the Shuttle or on the Space Station?

KRANZ: Shuttle. Shuttle. I think there were a lot of bad decisions on the Shuttle and we were all partners to some of them. Some because -- partners by omission, some by commission.

McCURDY: Uh-huh.

KRANZ: But I think that's very important that, you know, we really take a look and say have we learned what we needed to learn from the Shuttle from the 51-L accident. You've got an interesting (INAUDIBLE). I'm going to break off. I've got to get ready to move out here.

McCURDY: If I just give you a couple of factual questions.

KRANZ: Okay.

McCURDY: Your father's occupation?

KRANZ: My father was an insurance salesman. He died, god so far ago that was incredible. I think he died when I was seven.

McCURDY: Did your mother then go to work, or did she --

KRANZ: My mother ran a boarding house and we all grew up in a boarding house.

McCURDY: Hum.

KRANZ: She took our home and converted it and all through the Second World War and beyond the Second World War, she had all military people coming in on leave, those kinds of things.

McCURDY: Where was that?

KRANZ: It was myself and two sisters in (INAUDIBLE). Myself and two sisters grew up and learned at a very early age how to take care of house and cook and feed, and we all had jobs.

My sisters went into nursing. I did all of the house maintenance. I painted, you name it. It was really an experience and you know, even to this day you can tell stories, you can -- It was only a one bathroom house so you can always tell stories about what was happening in the bathroom.

McCURDY: (LAUGHTER).

KRANZ: Because we would have an average of three to four roomers at a time, or boarders at a time. And one bathroom with about 11 people, you know, you don't think you would make it today, but we had semi-professional basketball teams in here, we had all kinds of military personnel, we had steam fitters because we were right near a refinery, you know, that would come in there and stay there.

We had farmers in after the Second World War, in from the farm, looking for a job in the big city. I mean, you name it, it was really an interesting experience.

McCURDY: Did you work your way through college then?

KRANZ: Yeah. Yeah. Yeah. Yeah. I had gotten a -- I had saved up a lot because I had worked in A & P warehouses, I had newspaper -- I had morning and afternoon newspapers while going to highschool, worked at the A & P whenever I could get a chance there.

In between summers I worked at a electrical repair shop -- fixture repair shop, lighting studio is what it was called. And, worked at a steel company during college one semester. And, at the A & P again during college.

It was a variety of jobs, but I also had the -- my father was a deceased World War I veteran, so I had an

Elks Association Scholarship which -- it was really a scholarship loan. It's the kind of thing that the government does today, but the Elks did it during those days.

McCURDY: That's fascinating.

KRANZ: Very interesting.

McCURDY: Well, thank you very much for taking the time to do this. This is going to be a really fascinating segment to this.

KRANZ: How long are you going to be on it? I imagine years, which is very interesting.

McCURDY: Oh no, it's going to go pretty quick because I have a sabbatical coming up where I can spend a lot of time on it.

KRANZ: Okay.

McCURDY: We're doing 60 interviews.

KRANZ: Uh-huh.

McCURDY: Full scale interviews. They run from an hour to an hour and a half. And, that's going to form the basis of it. They're all with people like yourself, from the Apollo generation that held major positions, that's how they were picked. And then we're going to do a short questionnaire to take some of the propositions and to check and see if they check out with the great crowd of people within NASA.

KRANZ: Yeah.

McCURDY: So, I think that the data will all be in within a year.

KRANZ: Uh-huh. That's going to be interesting, because I've been trying now on my second -- I did 40 pages for World Book Encyclopedias on space in 1984.

McCURDY: Uh-huh.

KRANZ: And right now it's to a point -- and that was really a lot of fun, but I really did realize what a good editor -- I mean, they could really make you, you know, look good. And you get some good research (INAUDIBLE) to work on that thing.

Now we're in the process of updating that again. And, the thing I find difficulty though is really writing it for the average consumer of encyclopedias. So, it tends to be somewhat on the bland side, but it's really been a lot of fun. And it's now to the point where I'm going through the up-grading for the '88 book which is really to bring the tail end up in 51-L and some of the more recent space advances, that type of stuff.

McCURDY: Uh-huh.

KRANZ: Since it was written almost two years before the accident, and now it's two years after the accident. So, you've got to watch the hindsight, you know, kind of thing which gets to be very interesting.

dc/OMT

McCURDY: Well go --

-- (TAPE ENDED MID-SENTENCE) --