

ORAL HISTORY TRANSCRIPT

JOSEPH W. CUZZUPOLI
INTERVIEWED BY SUMMER CHICK BERGEN
KIRKLAND, WASHINGTON – 19 JANUARY 1999

BERGEN: Today is January 19, 1999. This is an oral history with Joseph Cuzzupoli in the offices of the Kistler [Aerospace] Corporation in [Kirkland,] Washington. The interviewer is Summer Chick Bergen, assisted by Carol Butler.

Thank you so much for allowing us to do your oral history.

CUZZUPOLI: Well, I'm very honored, very honored to be part of giving you some history of what happened here as far as my career and my involvement with NASA and how I look at things from the contractor aspects of the program.

Many years ago—and this is going back to the early parts of 1960—I was in the United States Navy and I was launching Regulus missiles, and I started in the missile business. I joined General Dynamics [Corporation], and at General Dynamics I was assigned to Vandenberg Air Force Base, instructing the Air Force on how to launch Atlas missiles.

When [John F.] Kennedy, our President, announced in the sixties that we were going to go to the Moon, there wasn't much experience out there for engineers. We'd been recruited by North American Aviation [Inc.] to come down to California to be interviewed to work on the Apollo Program. At that time, I believe it was 1962, I joined North American Aviation and had a wonderful career for about eighteen years, which I enjoyed tremendously.

In the early parts of the program, there was a tremendous amount of chaos, because the hiring of engineers, young engineers, old engineers, about 36,000 of us were formulated in one facility in Downey, California. At that time North American Aviation had two major contracts. One was the Apollo Program, which was building the command and the service

module [CSM], which I was assigned to, and then the Saturn II Program, which was located in Seal Beach, California.

At that time the president of the company was Harrison [A.] Storms. "Stormy" was the greatest person that I've ever worked for. I know there's a lot of controversy about Stormy and his relationship with the NASA people, management, at the time, but I can tell you he was a dedicated American trying to do the job. Let's put it this way: at that point in time, I think we had a lot on our plate, trying with both of those programs, 36,000 people coming, trying to get off the ground, changes in the system by both NASA and North American Aviation at that time, caused a lot of confusion.

As a test engineer, I started working, checking out the Apollo Program, and did the earlier boilerplates. I had a wonderful experience. The program was sort of broken into where we did boilerplates which we had, that we sent to White Sands [Missile Range, New Mexico]. It's called the Little Joe Project, which checked out the escape system on Apollo. And we had the boilerplates that were sent to the Cape [Canaveral, Florida], and they were used for the verification on the Saturn Program. Well, we just had a lot of difficulties in building those vehicles, and it took us considerable more time than the scheduled allowed us to.

As I progressed in that program, I went up Management Row, and I guess the fellow that really helped me through that process in becoming all the way up to a vice president was Charlie [Charles H.] Feltz and also George [W.] Jeffs. Those two individuals, with the help of Harrison Storms, and at that time he turned over the reins to a fellow named Joe McNamara, who became president, and finally then George Jeffs became president.

In the Apollo Program, I was the assistant program manager on about four vehicles. The first one would be Apollo 6, which was an unmanned vehicle. The fellow that I dealt with in NASA at that time, my counterpart, was a fellow named Kenny [Kenneth S.] Kleinknecht, and Kenny Kleinknecht worked for George [M.] Low. Now, I would be visited

by George Low, Kenny Kleinknecht, and George [W. S.] Abbey. As far as what the status was, they wouldn't believe anybody but myself, and I would tell them, "Here's where we are." They felt like it got filtered in the system about the real status of the program. Also, the program manager at that time was Dale [D.] Myers. Dale Myers was program manager, Charlie Feltz was the deputy program manager.

Finally, NASA, in their way, said, "We need a focus, have management focus on each one of these vehicles." So they came up with this concept of system program manager, which worked directly for Dale Myers. Again, I was on Apollo 6 and being opposite of Kenny Kleinknecht. He was a very excited person, but he was really down to earth. I mean, he was a very direct person. He got his message across very clear. It was obvious the direction he gave me was, "Get this done and get it done right, and as quickly as you can and within cost." Well, we successfully launched Apollo 6, and that was basically the step necessary to go forward with Apollo 7.

I want to go back a little bit and tell you a little bit about Apollo 1. Apollo 1, I was in charge of checking it out prior to shipping it to the field. It was a tough job, again, because of the changes in the system, and we had a considerable amount of rework that we had to do to the vehicle. And we had a lot of pressure on this schedule, but it did not get us away from the fact that we didn't do a good quality job. But when the vehicle left Downey, California, it was not complete at all, and we shipped it under the understanding that it will be complete in the field. There was considerable amount of changes yet to be done.

When the incidents occurred, I was put on a committee on procedures and how we did things, how we checked it out, and I was assigned to the Cape for about two or three months, being part of the committees that worked for the board that was evaluating exactly what caused the fire.

After that, we got into a redesign. Of course, there was a lot of rumors at that time that they were going to take the contract away from North American and give it to some

other contractor. We worked on the redesign in Houston for about three months, and at that time I became very, very close with George Low and George Abbey, who, as of today, probably can quote you every change that was made on that vehicle. And he had a memory that would not quit. I mean, we would talk to him on a day-to-day basis and have a change control board, and he had a record of everything that was discussed. If it wasn't written down, he had it in his head. We used to go to him as a library and say, "Hey, George, what did we really decide in that meeting?" So that's where my relationship with George Low and George Abbey became very, very close.

Then we were all saddened by what happened, and it wasn't North American Aviation anymore; it was "We're a member of a team to get the job done to get to the Moon." And badges became academic; there were not any badges anymore, as far as I was concerned.

So we finished with this what I called the Block I, which was the old spacecraft version. We'd now gone into Block II, which started with Spacecraft 17 and Spacecraft 20, which, in turn, were Apollo 5 and Apollo 6, Spacecraft 20 being Apollo 6. Very successful on those two flights. Then we started to work with Apollo 7.

At that time, our assistant program manager on Apollo 7 was John [P.] Healey, and John worked very close with Wally [Walter M.] Schirra [Jr.], Donn [F.] Eisele, and Walt [R. Walter] Cunningham, who were the astronauts. We had a very difficult time at that point because the astronauts pretty much wanted what they wanted in the vehicle and we had to give them what they wanted. I mean, if they wanted the procedures written a certain way, we had to write them a certain way. It was a very tough time arguing with the astronauts on a daily basis about, you know, where should things be stowed in the crew module. Wally made himself known all the way through, and it was real tough. George Low intervened many times and tried to get that sorted out.

Now, prior to George Low coming in the act—I'm going a little bit back—we had two other fellows: Dr. Joe [Joseph F.] Shea and a fellow named Dr. [Rolf W.] Lanzkron. I

don't know if you all have been—but Joe Shea was a great program manager as well. Whatever happened happened, and he no longer was there, but George Low stepped in and we had a transition. We were kind of rocky getting our directions from NASA. It started smoothing out with George Low. He was a manager, manager over managers.

So my involvement, again, on Apollo 7 was to help the first vehicle get through the process. It's sort of like the first olive getting out of a jar. It's very difficult to pull out. The rest will come out after that. So we focused a lot on Apollo 7. Then I became the man in charge of Apollo 8, working for Dale Myers and Charlie Feltz. My interface again was with NASA. I also had Apollo 9, which was—Apollo 8 at that time was a rendezvous, and that's all we were going to do is Earth rendezvous process. Apollo 9 was, again, going to be the first lunar module rendezvous.

Around Christmas—no, it was later than that. I think it was February of the year that we went to the Moon with Apollo, I think that was 1966 or '67.

BERGEN: Apollo 8?

CUZZUPOLI: Apollo 8.

BERGEN: '68.

CUZZUPOLI: '68. The decision was to go to the Moon, and the fellow that made that decision, the recommendation came from Dr. [Christopher C.] Kraft [Jr.] and Dr. [Robert R.] Gilruth. I was part of that process only from the standpoint of what will it take to modify the vehicle. The decision-maker was George [E.] Mueller. There was some other politics in it about trying to beat the Russians and all that, but at my level I was just only interested in what it would take to modify the vehicle.

There was a considerable amount of changes we had to make, but we said we could do it in a reasonable time and we can get it going. Well, again we got only certain of the modifications done in Downey, California. The rest had to be done at the Cape. I left with a group of fellows from California and we went to the Cape and we finished building that vehicle in the Cape.

My interface down there with NASA was very interesting, because I now dealt with a Dr. [Rocco A.] Petrone, who was a pretty strong individual as far as a manager whose demands were into a very detailed level about what was going on. I can tell you, frankly, there was a lot of problems with Dr. Petrone versus what was happening at Johnson Space Center as far as their management and [Marshall Space Flight Center] Huntsville [Alabama]. Sometimes you get thrown in the middle of that, you know. The politics between NASA dribbles down to the next level and it dribbles down to everybody knows that when you've got some problems on the interfaces. It wasn't easy, but we got through that. I became a friend of Dr. Petrone in one way or another. He may not have liked the decisions we made, but I'm sure that if he would be interviewed today, he will tell you that it wasn't an easy job, but we got it done.

Apollo 8 gets launched, and, of course, the success of it was great. My first thrill on that was Frank Borman calling me up and thanking me. The second is telegrams that I received from the crew.

We had some problems during those days. Again at North American Aviation, I recall one of the events that we had is a baseball game between the astronauts and the North American people, contractor. Played hardball. The story goes, and history, that Dick [Richard F.] Gordon and Pete [Charles C.] Conrad [Jr.] were the ringleaders of the baseball team. Both of them played college baseball. Now, I go to the field and I'm going to watch these guys practice. The astronauts are in good physical condition. They're out there running

every day, you know. They're in great shape, and here we are, a bunch of engineer and not very good shape.

So I said, "We're going to get beat." Now, they're going to have a stadium filled with about 10,000 people in Southern California. This is hardball. There's going to be a party. At that time the president [of North American Aviation, Inc.] was Bill [William B.] Bergen, who replaced Harrison Storms, and Bill was trying to keep motivation within our troops, so he supported this baseball game. We have pictures of this game like you wouldn't believe, and little kids autographing—the astronauts autographing the kids' hats and balls and everything.

Now, I said to myself, "I'm not a very good loser. I don't have good fielders. I don't have good hitters. How could I win this game? Because I'm not going to make them win." Well, we recruited a pitcher from Puerto Rico, and I hired him as a quality control fellow, and he had some quality control background, but not much. He can throw a ball, make a screw ball go one way, a fast ball going the other way, and a drop going the other way. I hid him from practice so nobody knew. The astronauts knew nothing about what was going on.

Well, the game starts, and they are expecting me to get up there and pitch. Right? And they're all dressed up in uniform. And here comes out Julio, and Julio starts throwing these balls at them, and it was a riot, because they're missing the ball and they're yelling across the field that I cheated and all that. Meantime, we've got 10,000 people in the stands. [Laughter] Well, of course we won the game, and afterwards at dinner or at the banquet that we had that Bill Bergen sponsored, we had a lot of laughs and had a lot of beer.

Again, it was the morale that we were trying to motivate there, because here we are, a lot of people saddened by what's happened, trying to recuperate. A lot of bad press still going on in the paper. The astronauts realize that their life depended on us to do a great job on the vehicle. There were other things that we did as far as motivation, but that one there sticks in my mind as one that we had a good time.

Well, the next thing on Apollo 8, of course, is the landing. Everything went well on that, and we went further with Apollo 9. I left the Cape and went back to Downey, California. Meantime, we had Apollo 10, and you all know the history of [Thomas P.] Stafford. I became very friendly with General Stafford, and I worked on his vehicle as well, in Downey. As of today, I'm a very good friend of General Stafford and am on his committee on the Shuttle-Mir. We talk regularly, and he's, again, a great NASA friend, trying to help during the tough times, either political or with Russia. He has a relationship with Russia that you won't believe, and does a good job on keeping us out of trouble there.

After we landed on the Moon, I went into the Shuttle proposal program, and I was the vice president of all operations. What I mean by operations, it was all the manufacturing, all the field sites—White Sands, Mississippi Test Facility [now John C. Stennis Space Center], and Edwards Air Force Base, Palmdale facility—and we won the Shuttle Program. The day before the announcement on the Shuttle Program, we were told that word got out that Grumman [Aircraft Engineering Corporation] had won it. Of course, we were all upset, but it turned out that was a major rumor.

At that time within NASA, being in a proposal stage was very difficult for us hardware people, I mean, to transfer over to hardware, but we figured that NASA would not give us the contract unless they had people who had done the job before. So a lot of us got into the writing business, and that's difficult when you sit there in a proposal and fight over words rather than—it's a different ball game than designing hardware and building hardware. It's very, very stressful.

Counterparts that I had within NASA at that time was a fellow named Andy [Andrew] Hobokan, who, again, worked from the NASA side, was the fellow who was going to evaluate our proposal from the standpoint of operations. Again, a gentleman that came from—I knew I had to win him over because he came from Grumman. He was the NASA [representative] in charge at Grumman, and I had to win him over from our side, and that was

not an easy job, but I heard afterwards in the orals, or the debriefing, that we got like 100 points for 100 points, so he really gave us a good mark.

At that time there was Aaron Cohen that was put on the Shuttle Program, and Aaron was mostly a project engineer on Apollo and had all that experience, so making him the Shuttle Program manager at that time was a great move on NASA's part. Our counterpart to him at the time was George Jeffs.

NASA, in the seventies, really controlled and really said what they wanted as far as management. If they didn't want somebody, they would just say to the president of, at that time, North American-Rockwell [Corporation], "I want that guy. I don't want that guy, so get rid of him." The first guy that they managed to move out was right after we won the proposal, was the program manager, Buzz [unclear], and replaced him with George Jeffs. George came from Apollo. They want the Apollo people put on the program, that they were used to working with on a daily basis. Any new faces, they were sort of reluctant to have on board.

So we went through a transition again, you know, satisfying NASA's requirements of who's going to be there. I don't think they do that much now. Okay? They may move one or two people, but they were really—you know, they went down to manager level and they said exactly what they wanted. And that, again, is a tough situation when you think somebody else is doing a good job. So, off we go on the Shuttle Program.

Meantime, the Apollo Program is winding down, and as we can, we were pulling the Apollo people off and putting them on the Shuttle, but you had to be very careful because you still have these flights, like Apollo 16 and Apollo 17, that were still going through the manufacturing process and checkout process. So we built our team again and went on the Shuttle Program, and struggled for months and months on preliminary design, what we're going to have.

The fellows at that time who really helped Rockwell were Dr. [Christopher C.] Kraft [Jr.] and Aaron Cohen and his engineers. Another fellow that we had an interface with at Johnson Space, who really was a chief engineer at that time, was Max [Maxime A.] Faget, and Max would be one that you could not predict, from meeting to meeting, what he would have to say or what he would come up with, but he was a dominant player in getting the Shuttle configuration to where it is today.

We started off the Shuttle Program with Dr. Mueller's goals to making it totally reusable, both the first and the second stage. We were teamed with General Dynamics, who were to build the booster, and the orbiter was built by Rockwell. Turns out the cost of that was just fantastic, and NASA at that time did not have the funds to support a fully reusable [spacecraft], and Max Faget and, I believe, with some study program with Northrup-Grumman, came up with a design of solid rocket motors with the external tank.

But the dream to have a fully reusable vehicle is what we're working on here, and if NASA really had their way today, they would prefer fully reusable. As you know, they're moving ahead with the Venture Star Program, which is supposed to be a fully reusable vehicle.

So, Shuttle started, and our first vehicle was the *Enterprise*, and it was going to be used for practicing the landing system at Edwards Air Force Base, piggyback on a 747. That's again another interesting situation where none of us believed that that was the right thing to do because we were worried about hitting tails and how that whole separation system would work. So we worked our way through that process. No one believed that we would meet the schedule on that program.

At that time I was the vice president of operations and worked with a fellow named Ed Smith, who was both program manager and the chief engineer on that program. Aaron and Dr. Kraft, like I say, were the NASA counterparts. Dr. Kraft, even though he was the director, was involved on hands on, on the program, and knew the status at all times.

We got into the development and building of that. Like I said before, the schedule was very critical. No one believed that we could meet that schedule. History will say that that was one of the most successful program to get that first vehicle in the air and successfully separate and land three times without any big glitch. I was very proud of that program. I was also the flight director for the Shuttle and gave the "go" from Palmdale [California]. That "go" went to Houston, and Houston gave the final "go" for separation.

Then the episode on the next vehicle to put all the tiles on and get the tiles off, and I became now the program manager on that program and went through some very hard working days on tiles. At that time NASA, from Washington, took over pretty much what was going on, and that was under [John F.] Yardley.

We couldn't get all the tiles built in time out of Lockheed, out of Sunnyvale [California]. The real story of this goes this way. So they wanted to schedule—we proved that we could get in orbit quicker if we put the tiles on at the Cape, that Lockheed would machine them and get them done quicker, and it could be done parallel to the other activities that they're doing at the Cape. So I had maybe one third of the tiles on. So you can't go fly with one third of the tiles on, not on top of a 747. So we had to add foam tiles. They were actually fake tiles. We had to get them painted, because from the rollout that was coming out of Air Force Plant 42 down there, with the bands playing, you can't have them brown, you've got to have them white, because people are going to ask questions why they're brown and white. You can imagine asking that question, answering that question.

So we did that. We transport that vehicle after a big ceremony. Transport that vehicle out of Palmdale, went to Edwards Air Force Base, and we loaded on top of the 747. It was on a Saturday morning, and I'm out there with a crew of guys from Rockwell and NASA. A decision was made a couple of weeks before that I participated in, that we ought to have sort of a trial flight before it goes on its way to the Cape, make just one trial, one turn over the field and come back down. Well, we're at the end of the runway and the 747 ramps

up and starts rolling down the field. I was looking out of binoculars. I'm saying, "What is all that white stuff coming off? What's on the ground?"

The vehicle gets in the air and it comes right back down, and there on the runway lied all the good tiles, but all the fake tiles are still on. Now, at that time I call in and I'm calling in to Houston and to Aaron Cohen, and I'm giving Aaron a rundown exactly what happened here. At that time John Yardley gets on the line. It's now a major mishap. Someone asked—I believe it was John Yardley asked me how many tiles I think came off, and I said, "Well, I'll answer it this way. There are more tiles on the ground than there are on that vehicle."

So that got into the major problem of tiles. Seeing that we were there already at Edwards [AFB] and we could not solve the problem on tiles just that fast, we had two choices: either go back to Palmdale or continue back to the Cape, go to the Cape. Well, to go to the Cape, I had to put on more fake tiles. So we still had a case, a mixed case of good tiles and bad tiles. Not all of them came off, though quite a few.

We got it to the Cape that way and then went through a major review and investigation of exactly what happened, went into a redesign, and that made the Shuttle as late as it was on that program. Finally got all the tiles on, finally got the flight, and it's probably, as of today, the most conservative system that we have, because we really swung the pendulum all the way over to the right, and those tiles will never come off again. The weight of the vehicle is probably pretty high because of those tiles.

Then, of course, the first flight, the success of the first flight, and then I left. I felt that that was enough, and joined a real estate firm in sort of semi-retirement in Orange County. And in 1988 I got a call from George [W. S.] Abbey. I left in '81 or '82, whatever it is. In '88, I got a call from George Abbey asking me to—that they had just had a major explosion on a plant in Las Vegas [Nevada] that builds ammonium perchlorate, which is the oxidizer used for solid rocket motors, and when the plant blew up, it actually hit about 4.0 on

the Richter Scale, and those casinos down there, glass broke in some of the casinos, a lot of damage to property, two people died and about 100-some-odd people got injured from that blast.

Well, that only left one manufacturer of ammonia perchlorate, and that was Kerr-McGee [Corporation]. That was not good for both DoD [Department of Defense] and NASA. You know, most of these missiles, these defense missiles, have ammonia perchlorate, and our Shuttle uses ammonia perchlorate, uses about, oh, close to a million and a half pounds of this per booster. So without any drawings, because those drawings blew up, and the people in Las Vegas didn't want that building there, NASA, with the support of that company, bought a piece of property in Cedar City, Utah, where I went down there for a six-month period of time to come back out of retirement and help out, and was a program manager and did that. Cost us 100 million dollars, NASA money.

Then after that, I stayed with the company and built a couple more chemical plants. Then Aaron Cohen and George Mueller asked me to come up here [Kistler Aerospace Corporation] about two years ago, and that's about all I have to say about my career.

BERGEN: Great. Nice overview. If it's okay, I've got some specific questions to ask you.

CUZZUPOLI: Sure.

BERGEN: We'll start back when you worked at General Dynamics, because I think you did some interesting things while you were down there that really helped lead up to the manned space program. You worked on the Atlas, is that right?

CUZZUPOLI: Atlas.

BERGEN: What exactly did you do?

CUZZUPOLI: Atlas had what they called Atlas D, E, and F, D being a concept of just the vehicle in a horizontal position—vertical launching. E was what we call a coffin; it rised up this way out of a great big block wall, block doors up on top, opened up. And F came out of a silo. On the Es and F, I worked in the maintenance facility and helped them check out everything prior to going out to the launch pad. What we were doing for General Dynamics is instructing the Air Force, to teach them how to launch the vehicle as well as check it out.

After we checked out, we went to the field site and actually launched them, and then we turned the whole facility over to the Air Force after we had a successful flight. So we instructed them and we activated the site, and then we sold the site to the Air Force. At that point in time, I was in charge of both hydraulics and pneumatics, and that was my specialty there.

BERGEN: Were you aware at that time that a form of the Atlas was going to be used for manned space flight?

CUZZUPOLI: Well, back in Kerney Mesa in San Diego was the Mercury Program, and, yes, I was aware. I did work on some of them, too. I was sent down specially to check out a couple of the boosters. I remember the Mercury decals we used to have to put. Anytime we checked anything out or anytime we opened anything, after it's been perfectly checked out and ready to go, we had to lock it up and seal it with the Mercury decals so that if anybody got into it, those seals had to be broken. Yes, I worked on those. I don't recall which ones were John Glenn's or whoever, but, yes, I did.

BERGEN: Since you did work on missiles early in the development of missiles, you had a unique perspective, and in 1960 President Kennedy, in the election campaign, talked about the "missile gap." At the time, what did you think about his concept of the missile gap that we had with Russia, or supposedly had with Russia?

CUZZUPOLI: Well, that was there. I mean, we knew we were far behind on the Russians. The Sputnik Program really threw us for a loop, you know, and at that time—oh, I'll tell you, we were blowing them up all over the place. The way I got involved, of course, at General Dynamics you would hear it all the time, and we were doing our share of blowing them up at Vandenberg [Air Force Base]. Oh, we were—I would say maybe one out of three were successful.

I mean, they either—as a matter of fact, my children—my wife would come out and say, when I was launching sometime, "Maybe Dad would give us some fireworks tonight," because we would do night launching. Living in Santa Maria, California, being dark, you can see we were launching out of Lompoc, out of Vandenberg, you can see the contrails and you can see the vehicle go up. You also can see it blow up. There was many times when those things blew up.

So we knew at that time we were far behind, plus the Navy wasn't doing good and the Air Force wasn't doing—the Vanguard and all that. We were wondering if we were ever going to catch up. But I'll tell you what happened. Hearing history about World War II and all that, I knew that we would overcome that, only because I saw all of us working the extra hours. I mean, I don't think anybody was working for overtime money; they were working just to see if they could close that gap. Their little piece of closing that gap was very, very important.

Down in the floor where I was, on the board, working the details, my counterparts were always understanding that we had a race going on, and we were motivated to win that

race. We didn't know how we were going to win it. We didn't have a picture, the big picture in our mind how we were going to get there, but we knew that the resources of funds would be supported to it. But it took a while for us to really move as rapidly as we did.

But after we got through, I would say going around the Moon was the turning point. At that point in time in Apollo 8, I knew we had them, because you're not hearing much what was going on in Russia. I didn't know what was going on. We said at that time, "We got 'em." But not until then, because, you know, you never knew what they were going to pull next in Russia, and we had no [unclear] to what's going on, nor did we really want to know what's going on, because we're scared that they were going to beat us. So it's just like sort of looking over our shoulders. We didn't know where the hell they were. So it was exciting.

I'll tell you one thing that's very important. Our families, when our kids were growing up, and our wives are the ones that are the heroes during those days, because we really did not spend any time at home. I'm very surprised. I mean, when someone asks me how these kids turned out so well, I say, "Well, I tell you what. You'd better talk to the wife, because I had nothing to do with it." And that's a true statement.

It's different now. It's different now as things go by. What I do today, if I try to tell an engineer that we've got to do this and we're racing this way and racing that, I get some response out of some of them, but most of them—if you want to say—and if I try to live with myself and say the family came first or the program came first, I've got to say that it was even. It was an even thing. And I'm not proud of that now that I look at it, but that's the way we—and I think there were a lot of us that did that. We were always thinking of how we're going to get there from here, because we thought it was so damn important for our children that we get there.

And I think this program is another thing. I'm not waving the United States flag, but what we're doing here, yes, sure, it's commercial. Sure, it's all that. But again you're doing

this and we'll benefit. We'll all benefit. Our children will benefit, the government will benefit, and hopefully I benefit, too.

BERGEN: I think that's an important point to make. Sometimes I think the part that the wives played in making the space program a success is probably overlooked.

CUZZUPOLI: Definitely, because it's a fact. They're the ones that are the heroes.

BERGEN: It's nice to hear that. If we can go back again, you mentioned just briefly how you went from General Dynamics to North American, but did you go interview for a position? How did that come about?

CUZZUPOLI: Well, first of all, the system was very close. I think what happened is, I received a phone call from a fellow from North American Aviation who was either a supervisor or a manager at that time, who used to work for General Dynamics, and placed a call and said—well, actually, they were trying to get about a handful of us up there that had been checking out missiles, working on missiles, and I think there were about twenty of us, and they went out and tried to recruit and offered quite a bit of money to go join North American.

And also there was a couple of other things. Getting out of the wind in Santa Maria, California, where there was sand all over the place, it's 110 degrees normally, and going to work in Los Angeles or in Southern California was one hell of an advantage for us, intriguing and all that. So that, coupled with the fact that we're going to work on the moon project, was going to be—now, what on the moon project? I didn't even have a clue at that time. What did the command module look like? What did the service module look like? I had no idea. We were building boosters, you know. Concepts were in magazines and that's all the

knowledge we had. But I think the challenge to do this, to work on the moon project, and the fact that the location and all those, money, the whole thing.

BERGEN: So when you joined North American, how far along were they in the process?

CUZZUPOLI: The process was in real preliminary design. There are basically two big reviews in normal program. One is called Preliminary Design Review and one is called Critical Design Review. They did not even complete the Preliminary Design Review when I joined. So they were in the process of getting that. There was no hardware being built. Everything was strictly on the drawing boards.

I've got to tell you, 35,000 people in this area, there were trailers. This facility could not hold 35,000 people. That was both facilities. I don't know how many were in Downey of the 35,000, how many were Seal Beach, but there were trailers. There would be people in trailers, bosses that wouldn't know that they had people in those trailers to work for them. See, there were incentives of how many people you can hire in a month, because they would look at the schedule, NASA would look at the schedule and say, "You're slipping schedule because you don't have enough engineers on board." So you were motivated to hire engineers. So a lot of engineers were—I mean, we were trying to get them from all places.

And we would get lost in this facility. They would have red lines, green lines, yellow lines painted on the asphalt or on the sidewalk, and you would know where you were going. Red lines would say you're going to the cafeteria; yellow lines says you had to go over here to medical; green lines, you went—I mean, it was just chaos, total chaos. I'm not proud of that, of course, but I'm giving you history of what it was down below, to say that we had a difficult time of rapid growth of the rate that we had, were forced to get into, because it was tied to the schedule and, therefore, a lot inefficiency was going on in the early days.

But to answer your question, very preliminary.

BERGEN: You talked about working on the boilerplate command and service modules. You said that you had some problems. What type of problems did you have with those boilerplates?

CUZZUPOLI: Well, most of the problems we had was wiring and getting requirements—well, first of all, getting requirements really hardened. Requirements would move around which would cause changes to electrical wiring, and again, processes, internal processes when in North American of learning how to get proper people trained, how to handle wiring. So, design changes, manufacturing skills, checking out the vehicle and not knowing exactly how you're going to check it out, and process of learning.

So, the first two boilerplates, they had them number one through whatever, but they got deleted as you went. The first boilerplate we built was Boilerplate 6, and then went to Little Joe, then went to White Sands [New Mexico]. That checked out the launch escape system when the Apollo—to pull the capsule away. Then we had Boilerplate 12, which again was another verification of the launch escape system. It got better as you went, you know. Boilerplate 12 was sort of a little better than Boilerplate 6, and had a little bit more capability.

The fellows at the Cape, the NASA fellows at the Cape actually went to White Sands and did all that, so they got some experience before they went to the Cape. A fellow named Wally [Walter C.] Williams and Ted Sascine [phonetic] and Gordon Turner. I remember a lot of these names, fellows that are no longer with NASA, but were in the early days.

Then finally Boilerplate 13, which went to the Cape, got better in 15. But their problems, again, were requirements, getting the requirements hardened, because changes really messed up the vehicle, and then learning how to build the vehicle.

BERGEN: You mentioned the NASA people who were at Downey. Those were the resident Apollo Spacecraft Program managers?

CUZZUPOLI: No, there was a resident Apollo, but what we had was, NASA instituted a process where they send the fellows from the Cape to the manufacturing facility, to assist in the check-in and out and learning how the spacecraft works before it went to the field, and then they took the vehicle to the field and did their checkout prior to launch. So those were those NASA fellows.

We had some good thinking going on at that time to try to get as much learning upstream as possible and not wait for the vehicle just to show up at the field site and turn out—"Well, what does this look like?" You know. "I didn't know this." Trying to make sure that they had lessons learned in the manufacturing process and adapting it to the launch operations.

BERGEN: Talking about lessons learned, were you involved, or was North American involved much in talking to McDonnell [Aircraft Corporation] about lessons they might have learned through Mercury and Gemini?

CUZZUPOLI: There was none that I know of. There was more animosity there than there was trying to learn from what they did on Gemini. That's sad, too. But, you know, if there was, it was a passing remark that we did some of that. But the Gemini Program and Apollo, switching over to Apollo, where the lessons learned were mostly within the NASA organization, and they got some benefits out of that.

As far as the contractors concerned with Rockwell, I mean, we had a difficult time of talking to McDonnell-Douglas. I was trying to get some of that lessons learned, and the only way I could get it was through NASA. NASA would tell us, "This is the way it is."

McDonnell-Douglas was not going to help us. They wanted us to fall flat on our face so they can get the contract back. When you look at it, you've got to think how in the world did NASA make that decision to go from Mercury Program, to go with McDonnell-Douglas, Gemini Program going to McDonnell-Douglas, and all of a sudden bring an outsider in, like North American Aviation? That was something that they never expected, because it would have been a given to give them the Apollo Program because they had all that experience. And I don't know why that decision was made, but that was made. And I'm glad they made that decision.

BERGEN: I wanted to talk a little bit more about the Apollo 1 fire, if we can. After that was over, North American received a lot of criticism. Did you feel most of that was warranted or did you feel that some of it maybe you didn't deserve?

CUZZUPOLI: Well, let's say at the time where I was, at the level I was at, we were totally aware of the discussions and arguments that were going on between top management, both North American Aviation and NASA, but we at North American Aviation were partially responsible for what took place here. Did we deserve all of it? No. But the system doesn't work that way.

BERGEN: Sure.

CUZZUPOLI: We are the contractor. NASA is the government and the customer. It's been on any program I've ever had or any involvement I've had, that the contractor is the one that's in blame, so we are used to accepting it, taking your blows, and go with the flow. Otherwise, if you sit and argue about it all the way through it, you're not going to get anywhere. So what we tried to do down in our level—and that's what I'm talking about, middle management and

down below—we kept our heads down and kept saying, "Okay, lessons learned. Now what are we going to do different?"

I've got to tell you, at that point in time we were learning better. We had a lot of things that were in the system that were much better than what we did on Spacecraft 1 in the manufacturing process and in engineering directorates. But, again, it was a little bit too late.

BERGEN: You talked about the efforts that were made to improve morale at North American. Do you feel that those efforts that Bill [William B.] Bergen made or other people in management were effective? How do you think North American did as far as changing morale?

CUZZUPOLI: It was a tough one to turn the company around. All the motivations that were done in either customer relations relative to posters on the wall or speeches that were given or putting together management clubs, it all worked. The quality improvement programs, communications with all the employees, stand-up sessions, most of them all worked. I think we would have been in trouble without them, because communications really was very important at that time. You'd read the newspaper and you'd get one angle of it; it was always the bad things. So you were subject to that.

So, yes, it did, and I say NASA participated in that, too, big time. They came in and the astronauts would go around and give speeches, you know, go to elementary schools within our Downey area, participate in all events. Then the NASA people came out and helped us, NASA engineers. So it was pulling together at that time. "Let's get out of this hole that we're in," and it was jointly NASA and contractor. Now, that had to be done—not only at North American Aviation, but it had to be done at the other contractors as well that were working on the program, because the problem we had did also wander through the rest

of the contractors. So there was a big effort to get the morale up, and NASA played a big role in doing that.

Again, the *Challenger* and what happened there and what happened afterwards with the motivation programs, you know, with everybody shutting down, people out of jobs, worrying about what's going to happen in the quality of work, losing vendors, changing vendors, that's a very serious thing when we have an incident of how we recover from an incident, and one has to say that there always should be a contingency plan. You just never know when something's going to happen. You should have a plan in place, get you right back on your feet.

BERGEN: And North American did recover. Really, I guess a triumph for North American was Apollo 8, because that was your part getting to the Moon, right?

CUZZUPOLI: Right. That was the turning point. If you walked through the halls, after every flight, by the way, we used to have the astronauts show up at the helicopter port, and we had an emblem of their logo painted, a big one, painted on the helicopter pad. They would arrive and we would have everyone out in the parking lot when that helicopter landed. We had a podium and some speeches were made, but the astronauts would return from quarantine, or whatever they went through, and immediately showed up in Downey and thanked the people. And that started—well, started with Apollo 7 with Wally [Walter M.] Schirra [Jr.] and that group. And it continued throughout the program. That was the first.

Then, of course, they had to make two stops after the lunar module, so they would not only stop at North American or Rockwell at that time; they would also stop at Northrup-Grumman in Bethpage [New York] and thank the people. They felt like they wouldn't be there unless for what they had done. So we had those motivation things that were very helpful.

BERGEN: Do you remember watching the Apollo 8 mission and your memories of the mission as it actually occurred?

CUZZUPOLI: Yes, I was at the Cape. I was in the blockhouse at the launch. Then after the launch was up and going, I was transported by NASA to Clear Lake, to Houston, and I was in Houston until the landing. It was in the back room. Then, finally, for the actual—let's see. When we went around the Moon, I think I watched that from my hotel room in Clear Lake, but the landing I watched from the glass-enclosed area behind the old control room, and we sat in there with General [Samuel C.] Phillips and George [M.] Low and, of course, Dr. [Christopher C.] Kraft [Jr.] was on the console. We sat there. We all smoked our cigars. Then after that, there was a ball that was held in Washington, D.C., a black-tie affair that General Phillips sponsored at that time.

But going around the Moon and listening to Frank Borman and the speech and reading from the Bible was something that I saw from my hotel room.

BERGEN: Still a memory.

CUZZUPOLI: Oh, yes, absolutely.

BERGEN: A significant memory.

CUZZUPOLI: But I remember his phone call afterwards. "Thank you very much." We got some very nice—oh, and the astronauts, when they came back, they always brought back either some coins for us or an autographed large picture, specially, and then I tried to trickle

that down to the employees down below. We gave awards all the way down to some of the key fellows and ladies that worked on the program, and that got some more motivation.

BERGEN: Did you work on the spacecraft for Apollo 12? Was that one of the ones you worked on?

CUZZUPOLI: Right.

BERGEN: I was wondering how you felt about that mission after the spacecraft got hit by lightening and if you had any specific concerns.

CUZZUPOLI: Well, I think the words that came out of my mouth were not those I want to put on this recorder, but it was worse than what Pete [Charles C. Conrad, Jr.] had to say. You know, when you lose everything off those buses—actually, what happened is, I believe the two buses were dropped off and they were on what they call the essential bus when that happened. What was going through my mind is, oh, no, we're going to abort, we're not going to go all the way. But, again, the flight crew, the flight controllers, what they did on the vehicle, recovered quickly and away we went.

Lightening protection—I don't think we had really a system for lightening protection. Obviously we didn't. ... But it's something that we worry about. What we have learned from that is that you need to protect yourself from lightening, protection. Airplanes get hit with lightening every day. Actually, I was on an airplane where it got hit on the nose, but you actually can see the discharge of it come out on the end of the wing. You just hear the bump. But it happens.

But on Apollo 12, I guess the only thing is, I was so happy when they got back on the line and said everything was—but I was at that time in Downey, California, and we used to

have our own Mission Control in case the problem in Houston, they wanted to know some details of what was happening on something, they would ask us because we had all the drawings. They'd have all the drawings. They were sort of backup. I was in the room when that happened.

BERGEN: Speaking of being in the back room and dealing with problems, did you have any involvement with Apollo 13?

CUZZUPOLI: Yes, I did. I ended up going to Beechcraft [Beech Aircraft Corporation]. I think at that time it was called Beech Aircraft. No, it was Beech something. I went to Boulder, Colorado, and worked with a fellow named Carl Bowman, and both of us worked on the redesign of that tank. I was sent out by George Jeffs to make sure that redesign happened.

Now, what took place on that failure is not widely known. Fellows like Dr. Kraft knows what happened. What was reported is different than really what happened there, and it's a combination of—I'm not doing a—let me just say it was a poor job of systems engineering and a mess-up or screw-up in the ground prior to launch. And that's all I'll say about that, but there are some people who know all the details. But it just wasn't a thermocouple problem; it was more than that.

But, yes, I worked on the redesign because we fixed the thermocouple somewhat to withstand an increase of voltage.

BERGEN: Were there any other events in later Apollo missions or preparations for those missions that stand out in your mind?

CUZZUPOLI: No. You know, it became routine. It became routine, routine from the standpoint of success in program. I mean, we had constantly requirements that changed and different crew equipment and different experiments and things of that nature, but it was pretty stable. There was nothing else that I recall from 15, 16, and 17. I know Dave [David R.] Scott, Al [Alfred M.] Worden, and I know [unclear] real well, and we had Gene [Eugene A.] Cernan. They always came in and always participated in Downey, in checking out before it left, but it was basically routine.

But I think after Apollo 13—and George Mueller will tell you that it didn't happen on his watch because Apollo 13 happened on Dale [D.] Myers' watch. So I don't know if Dale has told you about that. And I won't talk about the failure. But I'm sure when you talk to Chris Kraft, he'll tell you really what happened there. [Laughter]

BERGEN: How did you feel, and maybe the people you worked with at North American, as Apollo came to an end?

CUZZUPOLI: Well, you see, what happened is before it came to an end, we won the Shuttle Program. So it would have been different if we didn't. It was a look-forward program. All this talent, we lost a lot of talent. We were very concerned, like every other contractor is, that there will be no program after Apollo. The Shuttle that came by was good, so we went through a nice transition. Okay? The only thing that wasn't there was that there wasn't a major goal objective that we were trying to do. "What's a Shuttle? What's a transportation system?" And everybody said, "Oh, wow. I mean, you just came off the moon program. You went to the Moon and now you're transporting?" At that time it was like, "Well, that's great. What is all this?"

We were looking forward to going to Mars. If they would have spent the money that they're doing on the Space Station right now, millions and millions of dollars, and put it

going to Mars, they would have been better shape, including the technology that you get. NASA should be in the business for technology. They should be pushing the frontier for everything. Their spinoffs are tremendous. I can't explain everything that I've gotten out of the spinoffs.

But I'll tell you, not going to Mars was a major mistake on our government, and I think that it was not NASA, really. I'm sure NASA would have loved to have gone to Mars, but the government just said, "You know, we're going to cut back." And when you think about only one penny of your dollar going to the space program, at least when I remember it was only a penny, maybe two pennies now, I don't know what it is, let's just say it's a penny and all the other money going to welfare and everything else, you've got to sit and wonder what's wrong with this system here. I think the fact that we only had X amount of money so, therefore, they came up with the Space Station. Got to come up with different ways of getting with the Space Station. Why it's changing and changing and changing is beyond my means of understanding what's going on, but going to Mars was—and something that will happen. It will happen in your lifetime, but not probably mine. It should have happened. We'll pay for that, because it's going to cost more in the long run.

BERGEN: When you began your work on the Shuttle, the Shuttle's gone through lots of different design changes. Was North American involved in some of the changes in the design through development, or was that mostly done by NASA people?

CUZZUPOLI: No, that was done jointly. That was done jointly. When you talk about design changes, there are two kinds of design changes that we have. One is "make work." I mean, it just won't work unless you make that change. Definitely I was involved with those. And then those that were mission oriented for some reason, they were made by NASA, and we just implemented those.

But all those changes go through a normal Change Control Board that's headed up by NASA and then is headed up by Rockwell, sort of like two Change Control Boards. They would make a decision to make a change. We had to take that and evaluate and see what the impact was to make that change. Then we made our own changes because we had to make something work. We notified them and told them that we had to make that change.

BERGEN: What were some of the differences, or if you could compare North American as it worked on Apollo versus North American as it worked on Shuttle? And even NASA, because I'm sure NASA changed during that time, too.

CUZZUPOLI: That's a very good question. Tremendous question. Because there was a difference, a big difference. The difference was the fact that the attitude of the fellows that I believe on Apollo were more to get it done and get it done fast, in Shuttle it was get it done, but get it done cheap. And that was a major difference. That was one level.

The second was, I think the Apollo Program was—and I'm not speaking for myself; I'm speaking for the people who used to work for me—were so oriented for the good of the country on Apollo, on Shuttle it was sort of like, "Well, I've got a job." So there was a big switch there. So, getting people motivated, even though they had a job, you would think that that would be enough to motivate anybody. But there was an attitude change, a big attitude change. I could motivate easily on Apollo. On Shuttle it was very difficult. "What could you do for me? Are you going to pay me overtime?" Overtime was never discussed on Apollo. "You want me to work, I'll work."

And again, I think from above down, there was not a major objective, you know, and if you went to a fighter plane program right now or any other program, it was basically the same thing. People are there saying, "I've got a job." I don't know how—it was a different tempo. It was more relaxed on Shuttle on at least the people end of it. Some of the

management, of course, we didn't miss a step. We just went from one to the other. To get people motivated was a tough job on Shuttle.

BERGEN: What were some things that you learned from Apollo that you were able to apply to Shuttle?

CUZZUPOLI: Well, a lot of things. Learning to look at both ends, the good and the bad. I think on Apollo we tended to—well, if we were going to make that change, we just went and made that change. We found out that when we made that change, we may affect something else. So I would say on Shuttle we got better systems engineering and integration. We did a better job than on Apollo. On Apollo we were focused on just—"They want that? Boom! We'll do that." Then we learned that that was making a mistake. Looking at changing a relay to get something done here or changing something here and now looking at a relay and saying, "Well, it not only changes here, but it changes something here, here, and here, you know, all the way around." So I think we learned to do better systems engineering that was applied both to Apollo to Shuttle.

I think on the manufacturing end of it, okay, we learned how to do better work planning, so the work planning was much better. In mean, on Apollo it was a capsule. You went inside. You only put four guys in there, five guys in there, and there are certain areas. Shuttle was a bigger aircraft, okay, and you plan things out. We learned that in planning out activities, you can do more things parallel, so we learned a lot of things in the manufacturing.

On the quality end of it, I think we learned to put more responsibility on the manufacturing people rather than have somebody look over their shoulders. I think for every manufacturing person, could you imagine, for one person doing a job, writing his name on a piece of paper, there was a quality guy from Rockwell, a NASA guy from NASA signing off, and probably three more signatures.

I mean, paperwork on Shuttle, for an example, right now is tremendous. And I don't understand that. I think if you do away with the paper, you probably can get the job done in much less time, which we're applying on this program. We just don't have all that paperwork. The paperwork I do have, I have a hard time with George Mueller already. I mean, he argues with me. I say, "Geez, I think we've got to tell them what to do." "Don't tell them what to do, Joe, just give them the requirements. Let them figure out how to do it." Well, that attitude, that drives the cost of all these programs. What I'm trying to tell you is, on the Shuttle Program, we got into trying to do away with the paperwork.

BERGEN: How was the relationship between NASA and Rockwell during the Shuttle development?

CUZZUPOLI: It was a joint team. The relationship was very close. I had a job of being a program manager. I spoke to Aaron Cohen, my counterpart, on an average of seven to ten times a day. All the way up until about ten o'clock his time till eleven o'clock his time at home, he knew exactly where we were at all times, and I knew exactly where he was at all times, as far as planning process. We communicated on a monthly basis on what we call an OMAR, which stands for Orbiter Management and Review, and we went through the whole program review, and Dr. Kraft would visit us on that, and Yardley would come to these reviews. Communications was extremely good and tight, and relationships were good.

A little area that I would say there was tension on was award fees. When the time came to give you a grade and some money for award fees, that's when things became a little sensitive. When you were graded somewhere lower than what you expected, and therefore it affected the money tree, then tension would get into the system.

The other points were any of the IG [Inspector General] investigations relative to travel or something happening where you're spending money where the IG is thinking you're

ripping them off. False cards, because you got multi-businesses in your factory and somebody put the wrong number on the time card, that would cause an investigation of some type. Now, our NASA fellows would not touch that, would not get involved in that, because the Inspector General or the NASA investigator was always—so you had these people looking over your shoulders all the time. You're trying to get the job done, hoping that you've got the best controls, but you know people are people and they tend to make mistakes.

But on the overall, I would say that our NASA and North American—or at that time, Rockwell—relationship was very, very good, and if it wasn't, we would have never gotten through that process as well as we did. I think it's changed. It's not as probably as good as it was before. I think it's more business oriented, probably. I'm not too sure how George Abbey would respond on that question from the standpoint of how it is to get along with Boeing. I'm not too sure whoever the program manager is on the Shuttle, how he would respond to that from the contractor side of it.

The difference in the things that are happening now, you've got USA [United Space Alliance], which is a different ball game. I don't know how it is today. I'm not in contact with that, but I imagine it's changed more into a business. At that time we really did not—it only came about during the award fee, that's when the business thing maybe had gone off track a couple—a few times.

BERGEN: The Shuttle Program differed one significant way from Apollo, because it seemed like Congress was always cutting back the amount of money that they would give NASA to work on this. How did this affect North American as a contractor?

CUZZUPOLI: It affected us. You know, it trickled down right to us. One day our plans would be totally redone and we would have to go to our contractors and make changes to him. It affected morale. You know, laying off people, hiring people up and down, it's very costly.

Getting back to building the Shuttle a little bit, I can tell you that one of the methods that was used by NASA and Rockwell that was very, very effective, and if I would ever have to do that again I would do it the same way, you can't do it today. You can't do this today, and I'll tell you why in a minute. But what would happen is, Dr. Kraft and Aaron Cohen and a few others would get on an airplane with Rockwell people, and we would fly a Rockwell airplane and we would do maybe three contractors in one day. And we would fly in places that were really tough to get into. You wonder how the hell, landing here, why you're here. But upstate New York and different places.

We would hit maybe twenty contractors in one week, go to the vendors, touch and feel the hardware, see exactly what they're doing, just penetrate the whole system. And Chris would do this with George Jeffs, and we would have to go along because they were my contractors, because I was responsible. And you never know what the hell they're going to say, you know, but you know it's the truth that's going to come out somewhere in the system. But that was probably a management tool that really, really paid dividends. There's some people like Sam Michabelis [phonetic], who ran the B-1 program, and a few others will tell you that if you're going to get burnt on a program, it's only because of your subcontractors. It isn't because the major contractor is doing something; it's something down below that you're not paying attention to.

So I guess one of the things I would have to say, if I ever had a major program like the Shuttle again, if they can find a way to get an aircraft, whoever is funding that aircraft, and take the trips around to the contractors, it's important. Now, what we do here, because we don't have an aircraft, we're a start-up company, I'm out there all the time. Okay. But when you start going commercial, you get one contractor, you're lucky. Right? Because if they had an airplane here, it's [unclear]. But NASA really instituted that and it really worked.

BERGEN: You talked about one of the technical problems on the Shuttle was the tiles. What other technical challenges did you encounter when you were building the Shuttle?

CUZZUPOLI: Showstoppers of any type, I've got to say that that aircraft, that vehicle came together pretty smooth. Avionics was complicated, but I would say the software development was a challenge. That would stick in my mind. Tiles, like we mentioned, is a second thing. And then propulsion. The fact of the SSME [Space Shuttle Main Engines] engines that Rockedyne built, with those turbines and the high-speed blades in there were a big challenge, developing those engines. I had nothing to do with that. That was done by Rockedyne. But those are the three things. I think the external tank and the SRBs [Solid Rocket Boosters], or what it was, but on the Shuttle itself, the orbiter itself, I would think avionics and tiles were two challenges that we had.

BERGEN: You completed the Shuttle and it's been used for many, many, many years. What's your overall view of the Shuttle?

CUZZUPOLI: It should go another twenty years, and NASA would be crazy to do anything else and try to put another transportation system, so you get the benefit of these 100 missions per vehicle. It's designed to do that. Probably designed to do 200. Should use that program and Shuttle forever and ever and ever and not try to—I think anything about going single-stage to orbit is a dream that won't happen in our decade, and that the Shuttle—you may improve it by having flyback boosters and things like that, but that concept that they have in that Shuttle orbiter is good for many more years than what they're planning. You spent the money; you need to get the return on your investment. And the taxpayers ought to get the return on their investment.

Now, if NASA is interested in going to Mars, then they ought to go to Mars. And that may be another way. But you're going to need a transportation system to resupply the Space Station, microgravity experiments. There are a lot of things to better the Earth resources. Space Station is there. Why make a change when it's working good?

BERGEN: Great. Before we close, I want to see if Carol has some questions for you.

BUTLER: I do. You mentioned that you've been working with General Stafford on the Shuttle-Mir. We have done some interviews for the Shuttle-Mir Program. I was wondering if you would share with us some of what you've been doing with that or have previously done.

CUZZUPOLI: Okay. I've been on the Stafford Committee for, I guess, three years now, right from the beginning, and I went to Russia twice. And I don't want to go to Russia again. What we do, and right now we're doing an International Space Station, we went from the Mir to the Space Station, but what we did was give it the okay for our crew to go fly on Mir.

So what we looked at is the status of the Mir before each flight, before we put somebody up there. Of course, our source of information was twofold: one from Russia, one from our own NASA people. We would evaluate what the failures were, what the effects would be. We looked at the leaks of the Mir and all the problems they were having with their computers, the damage because of the incident, of the *Progress*.

All those things we looked at and made a call and had to write a letter to [Daniel S.] Goldin to say that, "This independent evaluation has been done and we feel that it's safe—safe—to send our astronaut up there." And that is the purpose of the Stafford Committee. There's another committee called the Young Committee, and they do almost the same thing. I'm not sure what they do. But that's what we do.

If I was to take this book, *The Dragonfly*, and read it from end to end, there were a lot of things in this book that did not come to the attention of our committee, and I voiced a concern about that, that maybe the information we were getting to make evaluations were somehow not given to us. I don't want to open that discussion up. I think that discussion probably will be opened up by General Stafford. But I think we were successful. We've had great—no major incidents. And I think we have learned a lot that will be able to be applied to the Space Station.

There's over hundreds and hundreds of these lessons learned that will help in the operations end, and I think an independent evaluation of what's going on is good and bad. There's a good side and bad side. One is, I wouldn't like to have anybody looking over my shoulder all the time. On the good side, maybe another way of getting another opinion. But that's what goes on.

There's about, I think, twelve or fifteen of us that are on that committee. General Stafford is a great man whose relationship with Russia is unbelievable. I went to go see a Russian launch. I went to Baikonur in Kazakhstan, and it was minus twenty degrees and I couldn't see the launch pad. I'm standing there with some Russian Army guys, and I'm wanting to know where this thing is going to lift off from. The wind is blowing, snow all over the place. And all of a sudden this thing lights up and goes, and I said, "My God! Why am I so close to this thing?" Because now the heat is hitting us from the flame bucket.

But, oh, it's a different world over there. I mean, the poor people are really taken back. But I've got to tell you, they do great work. Great work. And you know they were heading to the Moon. I have their hardware here now that was built in 1964, I'm using all their engines that were going to their moon. They were actually putting thirty-six engines on their first stage and going off. We have gotten those engines over here. We have bought those engines. Those are the engines that Kistler is going to be using for their program.

BERGEN: I didn't know that.

BUTLER: Are you continuing on the committee now, on the International Space Station?

CUZZUPOLI: Yes, we are.

BUTLER: I think that will be a good follow-on, from everything we've heard. Looking back over your career, especially at your time with North American, what, to you, was your most significant happening, and what was your biggest challenge?

CUZZUPOLI: Well, I would say going from being a technical person to being a manager. I mean, that's a difficult process, where now you're managing—I mean, you manage yourself and the job, and then all of a sudden you've got 5,000 people working for you, and your experience there, you've got a whole different set of problems. You're now dealing with not just how things are working. You'd like to go back to working that valve or working that electrical problem. Now you're working these personal problems. Adapting to management was my biggest problem, and that's a big question. I mean, that deals with day to day, how do you deal with their family problems. I mean, you think you're sitting up there and you've got all sorts of things. Not only that, budgets. Laying off people. I mean, you sit there and you're dealing with a human life. To sit there and just play numbers, boy, you're going to lay off twenty here and thirty there, or forty, and every time you're writing these numbers down, you're affecting people's lives. You go home and you think about that, and you say, "How in the hell could I do that?"

So I think that was my biggest challenge, was to work that, and I don't think I was successful, because I never could make the hard decisions that we're going to cut all these people. So sometimes it got me in big trouble. But that's the way it is.

I think my biggest success story, the biggest thing that happened to me, was getting, believe it or not, the Shuttle in the air, because there I controlled many things and I made more decisions. I wasn't just in the process, you know. In the Apollo Program, I had a boss and a boss and a boss. On Shuttle, it was me and the boss, so I made more decisions. Happy to get that program.

BUTLER: And that definitely was a success.

CUZZUPOLI: Yes.

BUTLER: That's all I have.

BERGEN: Before we end, can you tell us what you're currently doing with Kistler and what your goals are?

CUZZUPOLI: Well, here I'm the vice president and deputy program manager. I'm responsible to making sure the contractors get the job done. I'm responsible for the engineering. I have been blessed with Dick [Richard H.] Kohrs, who works for me. He's my chief engineer. And then I'm blessed with a good boss. Two good bosses. One is Dan [Daniel C.] Brandenstein, who is a very understanding man, very good, leaves me alone. And then the second one is George Mueller, who doesn't leave me alone. So I'm very pleased with that. I don't think I would be here if I had a problem. I've been retired a couple of times. I don't need to—you know, what I'm here for, again, is the challenge. Of course, they're going to financially pay us well if we are successful. If we're not successful, we're not going to get paid well.

But I have all the contractors. I have all the what we call here is LRU personnel who work for me, like the propulsion, the avionics, the structure. I'm responsible for all the cost and all the schedule. Now, the real program manager is George Mueller, and he really calls the shots. I'm sort of maybe one of the lieutenants who go off and do things, but he calls all the shots. I'm the one that knows what's going on in all the contractors. I run all the program review meetings. He runs the Change Control Board, I don't. But all the program review meetings are mine. I have a good cost manager system with Jack Kennedy. He has nothing to do with Apollo or Shuttle. But Dick has been very helpful—Kohrs—as our chief engineer.

Now, there's only about thirty of us up here. We had 1,400 people working for us under the contractor role. We're doing things different. I have a tendency to do it the NASA way, and George lets me know about it. So we're not doing as much testing as we did on Apollo, but we try to understand the rationale why we're not doing it. If this program happens—and we're constrained by funding. I mean, I have stopped and go, stopped and go twice already, and funding is a problem. Now they're clearing that. They're telling me they're clearing that. But it's a problem with us here.

We're building five of these vehicles. We're going to be launching out of Australia and eventually launch out of Nevada. This program is very good for NASA. You will probably hear within a very short period of time that this vehicle will be used for NASA. It's got its advantages. There are many start-up companies like us in the system, but we're way ahead of everybody else with hardware. We have hardware all over the place. It was just like the Shuttle. I mean, we've got things all over. It's just a matter of pulling it together and they ran out of money. Hopefully money will come in here soon so we can finish it off. We're shooting to get this thing in the air by January of next year, and if they do what they said by April 1st.

Now, so that you know, I brought a majority of my North American Aviation fellows up here, the ones who worked on Apollo and Shuttle. We have twenty of them, and they're all key guys and they're all consultants. We call them the "gray beards," and we mix them up with the young guys. So that's another thing that George says, is that we really call ourselves Rockwell North. But there's about twenty, and right now they're working on many parts of the vehicle. It's working wonderful with these younger fellows. They're getting so much experience, and our older guys are picking up on these computer stuff and saying, "Geez, wish we had this technique back there."

You know, another thing, for an example, I'm used to seeing drawings, work off drawings. We're not working off drawings; we work off the computer. You want to see a three-dimensional thing? You want to look at this side of the part, that side of the part? My God, what's happening to us. It's amazing. It's great. It's great, great for us. But sometimes it isn't. Sometimes you say, "I wish I had a drawing to really understand what this is all about." So what George Mueller has done is taken some of the older, some of the younger, mix them together, got a blend, and we done that with the contractors, too.

BERGEN: Great.

CUZZUPOLI: We will have the Apollo and Shuttle up here. There's fellows here today that will tell you what they done on the Shuttle Program or what they done on the Apollo Program.

BERGEN: Wonderful. Is there anything that maybe I didn't ask you about that you wanted to be sure and mention? I don't want to overlook anything.

CUZZUPOLI: If I didn't say NASA was the best of the government agencies around and with intelligent people, and without NASA this country wouldn't be anywheres, let me say it now. NASA is the top, top of the line, and they do things—you know, they may make their mistakes, but generally speaking, thank God to heaven NASA's in our system, and if anybody's thinking of doing away with NASA, they ought to be shot. Okay?

BERGEN: Thank you. It's been wonderful talking to you.

CUZZUPOLI: Well, good. I'm glad you stopped by.

[End of interview]