

ORAL HISTORY TRANSCRIPT

MARTIN L. RAINES
INTERVIEWED BY SUMMER CHICK BERGEN
SEABROOK, TEXAS – 20 AUGUST 1998

BERGEN: This is an interview with Martin Raines on August 20, 1998, in Seabrook, Texas, interviewed by Summer Bergen and assisted by Kevin Rusnak and Carol Butler.

We thank you so much for allowing us to come into your home and do this interview. We really appreciate the opportunity.

RAINES: I'm happy to have you and glad you're here.

BERGEN: Thank you. Let's start back in the 1950s, when you were in the Army working on rocket and missile development. That was before Sputnik. And then you learned about what we call the space race now and the beginning of the United States Space Program. What did you think about it at that time?

RAINES: Well, back before Sputnik, I had been working with the Army Ballistic Missiles Agency [ABMA] in Huntsville, Alabama. I was the Chief of the Engineering [Branch] of the Industrial Division.

It ends up that for a number of months, Dr. [Wernher] von Braun, who was Chief of the Development Operations Division, and General [John B.] Medaris, who was the commander of ABMA, had been telling the government that we were in a position to launch a satellite. For some reason or other, the Defense Department didn't wish to take advantage of that, and as a matter of fact, every time we had a Redstone launch, there was somebody down there from the Department of Defense to make sure that what we were doing was, in fact, launching the mission that was scheduled and not putting up a satellite. So we had the

capability of doing that well before the Russians. For some political reason, unknown to me, it simply was not done.

Shortly after the Russians put their satellite up, the mission was turned over to the Navy, and after a series of disastrous launch attempts, they finally came to ABMA and told General Medaris to go ahead and launch. I was there when he got the team together and told Wernher, he said, "Wernher, we've got (and I've forgotten the number of days. It was either thirty or ninety days to put up the satellite.) He said, "Let's go, Wernher." Within the time that he gave von Braun and the Development Operations team, we had a satellite up, working.

BERGEN: Wonderful. What part did you play in all of this?

RAINES: Well, actually, my part was providing whatever technical support in terms of parts and components and so on that were short. But in general, it was all ready to go, and I didn't have an awful lot to do with it. It was Dr. Wernher von Braun and his team of German scientists that had this put together. It was ready to go. So other than being a sideline observer on the front lines of the observation, there wasn't much else to be done.

BERGEN: What was it like working with Dr. von Braun and his team of German scientists?

RAINES: Well, when I first went to Redstone Arsenal, I was, after the things of World War II and what the Nazis had been doing in Europe and the V-1 and V-2 bombs, I was expecting to dislike that whole group. Wernher was, individually, a very, very charming individual. His immediate deputy, Dr. [Eberhard] Rees, was also of the same category. So despite the fact that I started out to dislike them, I ended up liking them, and we got along famously. So it was great.

BERGEN: You were selected to be the Chief of the Army Liaison Office for the Mercury Project. Can you tell us a little bit about how you came into that position and what you did?

RAINES: Well, I came into that position because General Medaris looked at me and said, "Marty, you're going to Langley Field."

Being in the military, you don't have that much option of what you are going to do. But as I say, it was getting towards the end of a three-year assignment at ABMA, which is kind of a normal Army assignment. He was looking around for something appropriate to get me placed into, and about that time the request came down from the Secretary of the Army, through channels, requesting that a liaison officer be appointed to the Space Task Group, somebody that was familiar with the Redstone missile, because the Mercury Program was going to start off with Al [Alan B.] Shepard's [Jr.] flight, a suborbital flight using the Mercury as a booster.

I'd been the Chief of the Engineering Branch, which was primarily responsible for taking the Redstone missile from its development stage and weaponizing it, as we called it, to put it in the active Army, and that's what the job was. So I was fairly conversant with the details. And so what the job was going to be was to integrate the Mercury capsule with the Redstone missile, and that seemed a natural fit. I liked the idea and was thrilled with the opportunity, and General Medaris said, "Go." So I went.

BERGEN: So you went to Langley. And who did you work with, mainly, in that position?

RAINES: [At] Langley Field, I really worked with some of the key people that then became key managers at Johnson Space Center. That included Bob [Robert R.] Gilruth, who was the head of the Space Task Group; Max [Maxime A.] Faget, who was kind of the key engineer

and was later in charge of development out at the Johnson Space Center; Chris [Christopher C.] Kraft [Jr.] in operations; George [M.] Low, who wasn't right at the Space Task Group, but was kind of managing the Space Task Group from the Washington headquarters of NASA. So all of these people I had an opportunity to work with closely. I had a deep respect for them. We worked well together. There were no big arguments. I enjoyed the tour completely.

The only reason I left, and requested leaving, was because about midway through that term, NASA took over Dr. von Braun and company from the Army and took the development operations away from the Army Ballistic Missile Agency and transferred them to NASA. So here I was, an Army officer doing coordination between two NASA directors, and that was an uncomfortable situation. So I asked General Medaris, "Get me out of this place," and he did. Again, I was still working for him, so he transferred me from there out to Kwajalein in the Pacific on the Nike-Zeus Antiballistic Missile System. So again, I was still working for General Medaris.

BERGEN: You said you were uncomfortable in that position because it was an awkward position to be in, but did you feel some regret about having to leave your immediate involvement with the Space Program?

RAINES: Yes and no. I did the request, and I did the request because I was uncomfortable in trying to be liaison from outside—you know, I'm an outside agency. And so I'm in the Army trying to solve problems between two directors of NASA, and it just seemed to me like that was a place that I would rather not be. Not that there was a problem or anything, but it just was awkward, that's all.

BERGEN: So then you went to the Nike-Zeus Antiballistic Missile System. Could you explain a little bit about that and maybe the connection with the Cold War during that period.

RAINES: Well, back during that time period in the late fifties, the threat was very real. The Russians—I shouldn't say Russians; perhaps the Soviets—had a capability, which was well known to everybody in the world, that they could hit the United States with a serious number of ICBMs, intercontinental ballistic missiles. Likewise, we had the capability of hitting them. So it seemed foolhardy to sit back and not do anything defensively for the country.

So the Defense Department started the Nike-Zeus Program. That was turned over to the Army, the Army Ordnance Corps, which I was a member of, and they were to develop a missile system which would take a missile that was being fired 5,000 miles away, pick it up when it reached the horizon—that is, the radar horizon, so that you could see it with an acquisition radar. You could track it.

A ballistic missile has characteristics [so] that you know exactly where it's going to go, and so once it gets up the speed and has an azimuth and so on, you can compute exactly where it's going. So the missile tracking radars, which we had out on Kwajalein, could then track the missile. Then they could track the incoming missile. We had computers, not nearly as sophisticated as what we have today, even in your laptop that you carry around with you, but they were able to determine an appropriate intersection, so that a nuclear blast from our defensive missile, way up out of the atmosphere, would neutralize the explosive force, or incoming ballistic missile, destroy the missile and the warhead completely, before it ever had an opportunity to touch the ground.

When I went out there, we were in the process of putting together all of the equipment. It's what you call in the Army, site activation... But putting all of this equipment together so that would operate satisfactorily. I was there for up to two years. The second

year, I was the chief of the operation. The first year, I was the deputy. And that's kind of the way we rotated people through that operation.

We had a great deal of success. They had a radar, which was located on Roi Namur, which was about 100 miles north of Kwajalein, which would measure the miss distance. So our miss distances were getting very close to what the performance required, so about that time people decided that—at least in the Defense Department—that it would be a wise idea to go ahead and deploy the system.

Of course, the Russians, who were also developing a system, and allegedly had partially deployed around Moscow their system, immediately said, Oh, no, you can't do that. This system, if you deploy it, we will consider it an offensive system. Now, how you can consider that offensive has always been bewildering to me, but leave that to the diplomats. But anyway, for reasons probably only known to the State Department, they prevailed on the Defense Department to not deploy the Nike-Zeus missile system.

Probably the reasons the Russians didn't want us to deploy the system is because they found, I am sure, that their system was not up to the capability of ours; and secondly, I doubt if they had the money to go ahead and make the commitment for all of the things which they had to do. As a matter of fact, that's the reason the Russians finally broke, because we spent them to death on arms and so on. I think this was one of the first steps.

That's what happened. I think the technological programs finally caught up with Nike-Zeus. One of the big raps against it was, nobody wanted to see a nuclear blast going off in the atmosphere, not in those days and not since. But I think I [was] gone by that time, left and gone to NASA.

But I think the reason for the final cancellation of Nike-Zeus was, technology just caught up with it. Computers caught up with it, propulsion systems caught up with it, and everything else. But never forget, you don't lose anything by going through that stage of

development, and a lot of the things learned there were used in subsequent antimissile systems, which don't use nuclear warheads. That's about the main thing out there.

BERGEN: Then you said by about that time you went to work for NASA, and if I recall correctly, Paul [E.] Purser contacted you about coming to work for NASA.

RAINES: Yes. I was working on a project in Washington by the name of Cloud Gap, and I hadn't heard from Paul in years. He was a good friend of mine that worked for Bob Gilruth in the Space Task Group and was his special assistant when he called me. [He] called and [we] chatted on the phone for a while, "How you been? Where you been?" and so on, and finally asked me if I'd like to come back to work for them again.

Of course, I had just graduated from the Army War College at Carlisle and moved to Washington, hadn't been in this new house over about six months. We still didn't have the pictures hung on the walls and stuff like that. And I said, "No thanks. I can't move again." We were moving, on the average, for the first twenty years, probably one to one and a half times a year, and this gets a little old after a while.

So Paul said, "Oh, no, Marty, that's not what we're talking about. We would like you to retire and go to work as a civilian out at White Sands Test Facility."

I said, "Well, that puts a little bit of difference on it, but you know I just graduated from the War College, and there's an obligatory tour of three years after you have gone to the college. I probably would have difficulty in getting out."

As a result of his conversation, I interviewed with George Low downtown at NASA Headquarters, came down here and talked to Dr. Gilruth and several other people here. The description of the job fit into just the things which I had been doing—site activation and testing and so on—and it was extremely interesting. Of course, the final cap on the thing was

the business of the moon program, and that was irresistible. So I really didn't have much of a problem in making a decision to take it. I said, "Tell me when."

But the big problem was getting released from the Army, and fortunately I was able to do that myself. I convinced them that I was going to White Sands Test Facility. White Sands is an Army proving ground. I would be working with the Army and so on. So they saw the light and let me resign.

BERGEN: So you went to White Sands Test Facility. Before you got there, there were like a three-person management system.

RAINES: Yeah. There was no problem with the people at White Sands. Whoever set up—and I don't like to criticize anything, but whoever set up the system out there, they had a manager, who took care of nothing but administration; they had an engine test manager, and he took care of nothing but engine testing; and then they had another manager which took care of flight operations. And when they didn't agree, they would call their bosses back in Houston, and their bosses back in Houston were spending an exorbitant amount of time, or more time than they thought they should be, in fiddling around with jobs that could be handled, or problems which could be handled on the site with no problem.

When Dr. Gilruth and everyone else assured me I would be the manager and I would report to Dr. Gilruth and no one else, there wasn't any question about it, and I thought, Gee, this is no big problem. It sounds like something that just needs a little clarification.

And sure enough, the folks out there all got together and pulled together, and I didn't have a nickel's worth of problem on that at all. It was really fun.

BERGEN: What were some of your responsibilities there, and what was White Sands responsible for?

RAINES: We were primarily responsible for engine testing on the LM [Lunar Module], the ascent and descent engines on the LM, the reaction control systems, the command and service module engine. That was all in the Engine Test Facility.

On the other side of the range—we were divided by a massive [mountain] range, and it was probably thirty miles over to the site activity. In the site activity, we were testing the flight of the command and service module, the parachute system, the escape system, and things like that. And that all went very well, so no problems.

BERGEN: What were some of the technical challenges that you and your people had to overcome in these development phases?

RAINES: Well, it was simply to get the engines to meet the thrust requirements, to make sure that after the completion of the test that the engines were still in good working condition and could be refired and refired again.

We really didn't have a lot of serious kind of accidents out there at all. The stuff was very well built, very well conceived. It was just a management problem of receiving the equipment, getting it installed, getting the test set up, getting the test run, and producing the test results and getting them back to Houston. I can't think of any major thing that we had out there at all. It was a pretty straightforward program, and I was glad to see that, you know. The worst thing in the world is to be in a test operation mode and find all sorts of development problems. That's not what you want to do. We found some minor things, but nothing serious at all. It was a very well-conceived and operated program from a propulsion point of view, and from the deployment of the chutes and the command module, all of that went very well.

BERGEN: Who were some of the key people that you worked with or worked under you at White Sands?

RAINES: Oh, gee. It's been a long time ago since I even thought about them. Billy Gants was the Chief in Propulsion Engineering. And if I am lucky and dig around in the attic, I might find some details on who some of the other people were, but if I start to name anybody, other than the chiefs, I'm going to miss some of the key people, so I'd rather reserve that and give it to you some other time.

BERGEN: While you were at White Sands, the *Apollo 1* fire occurred, correct?

RAINES: That's the 201 fire down at the Cape.

BERGEN: Right.

RAINES: Yes.

BERGEN: What kind of an impact did that have on people at White Sands?

RAINES: It shocked everybody, because Gus [Virgil I.] Grissom, Ed [Edward H.] White [II], Roger [B.] Chaffee had all been out there and visited us and toured the facilities six months before, something like that. As a matter of fact, Ed White and Roger Chaffee were over at our home there, and my wife had him out in the kitchen. We had one of those newfangled microwave ovens installed, and they'd never seen one. She was out there baking a potato for them, and they wouldn't believe it.

It was like missing somebody in the family. We knew the people and everything else. There were a lot of phone calls from the press. The Command Module was supposed to be an escape module. Why couldn't they escape? Well, it's one of those dumb questions you get asked. [The Command Module (CM)] was what was burning up. I mean, [if] you can [propel] it up in the air [then] you can escape [from a booster failure], but what was burning up was [the interior of the CM].

The other problem which I got involved in, Dr. Gilruth called me and asked, he said, "They're setting up a big inspection board and everything else, and we're getting ready to fly another Gemini shortly. I'd like somebody to go around and tell me what really happened and get back here in a week and give me a rundown on what the problems are and should we stop flying the Geminis." [This was] because the problem associated with the 204 fire, ... was [using] primarily ... 100 percent oxygen, which the Gemini was [using], also.

So I picked up a team, which, as I recall, included Dave [David R.] Scott, one of the astronauts; Jack Jones, who later became the Chief of the Inspection Division in the SR&QA [Safety, Reliability & Quality Assurance] Office; and three or four other people. We toured for a week and talked to everybody in sight, made a briefing back here in headquarters, which included most of the top management of NASA. But my conclusion was, after seeing everything, that there was bad wiring, some obvious ignition source that was sitting under Gus' seat, which was not unlike what they found out six months later, and that there was poor workmanship in that module and that's what contributed to it.

I said, "As far as I'm concerned, there is a danger, a very serious danger, in having pressurized oxygen. But if you don't have an ignition source, we're perfectly all right. So let's spend our time looking at any possible thing which is an ignition source."

So that's what was done. That report was made. They flew the next Gemini on time, and we had no further problems in Gemini.

BERGEN: The last few months that you were manager of White Sands, you were on a large number of special committees and things of that sort. What type of other things did you do during that time?

RAINES: I was chairman of a Safety Review Board for an environmental control system fire which happened out in Los Angeles. After the 204 fire, they set up what became known as a Rees time. Dr. Rees, at that stage he was von Braun's number-two man, and Rees, primarily for knowing me, said, "I'd like to have Marty Raines be my deputy and represent JSC [Johnson Space Center]."

So George Low and Dr. Gilruth went along with that, unfortunately, because I spent about three or four months out there, maybe getting back to White Sands for one day a week maybe every other week, something like that.

One of the things that we did, we started a list of a whole bunch of things which we wanted the contractors to do. We put those on a list, and it stayed on that list. Even though it was finally completed, it was lined out. So at the end of the term out there, we had close to 150 items, all of which were closed out and indicated why they were closed out, what names were responsible, so we could always go back and track. So that went on for an extended period.

One of the other things was, Dr. Gilruth, after that, wanted me to come down here and survey the safety and the reliability and the quality assurance activities of the Center and make any recommendations on reorganization. Well, all of this was split up. I mean, each little division and the project office had some reliability people, and the Fabrication Lab had some inspection people. Safety people were kind of scattered all over. We even had about a half a dozen safety people down at the Cape, which were doing fine safety work, but what they were doing was work which the Cape was responsible for.

So what I recommended was that they take all of this stuff and put it all together, take all of these people and assign them together, and that was a difficult thing for people to understand. You know, you're taking five or six people out of their operation, and all they had was the Center Director or the Director of SR&QA's statement, "Well, things are going to get better, and they're going to stay there and they're going to help you, except they're not going to be reporting to you and you can't cross off anything that they do. They're going to be reporting to somebody who reports to me, the Center Director." So that he always knew what was going on, where before, I'm not saying things were hidden, but they could easily be hidden, depending on whoever they were reporting to, and they were reporting to so many different people that there was no standard activity.

So I ginned up that plan and gave to him, and unfortunately it came back to bite me later on. But that was one of the things. Oh, let's see. There were a couple of other items that only were a matter of a few days. And being in the Army, I was used to doing things like that, so it really didn't bother me.

BERGEN: At the end of the time you were at White Sands, you were doing all these miscellaneous activities, and then you were asked to come to the Manned Spacecraft Center and take responsibility for the safety and reliability.

RAINES: Actually, when it first got started and they were going to take up all the things which I had recommended, it ended up that one of my neighbors up here, Aleck [C.] Bond, who was Max Faget's deputy at the time, was assigned to go ahead and implement these things which I had recommended.

Aleck did that for a few months, and I guess he didn't particularly like the activity and went back and asked for his old job back. So that's when Dr. Gilruth called me down here

again and he said, "Now I would like you to take over this, temporarily for about a year, to get all this thing organized and so on."

One thing about Dr. Gilruth. A fine, fine gentleman, and one of the finest people I've ever known, and I just couldn't say no to anything that he wanted. And plus, he was my boss, so how do you say no to your boss anyway? But regardless, even if he hadn't been, I would have done anything that he asked.

So anyway, I came down here and retained the title, although it was mostly in title only, of manager of White Sands Test Facility. I'd get back there maybe every couple of weeks for a day. [I] got started on trying to meld and pull all these people together, and that was a pretty difficult thing. Again, as I say, because people, when you're taking people from them in civil service, that's like pulling teeth, because they say, "boy, I'm losing some of my capability and I'm never going to get it back."

Actually, what we did, we utilized those people to find out what more they needed and gave them more support than what they were getting out of the individual people that they had me for. It was not that we wanted to take anything away. What we wanted to do was to supplement the capabilities so that we wouldn't have another 204 accident. All of the people that went into SR&QA on that basis, they were so dedicated and so much concerned that another catastrophe like that didn't happen that it really was not hard in convincing them. It was their ex-bosses that we had problems convincing. But we finally got them, too.

BERGEN: Let's talk a little bit about what involvement you had in the Skylab Project.

RAINES: Skylab was essentially the same as Apollo or any of the rest of the things. We looked at all of the experiments. We looked at all of the hardware which was being produced. We did safety analysis. We inspected the hardware. We observed tests on the

hardware. It was like any other program. It was just exactly like anything else. There was nothing different about it.

BERGEN: What about when they had the malfunction and they had to quickly devise the parasol to work on the Skylab? Did that situation add any complexity to your job or any extra involvement on your part?

RAINES: Yes, there was extra involvement in that we had inspectors over there in the fabrication lab where they were doing the work, inspecting everything that was done, making sure that there was a written procedure.

On space equipment, you just don't let people go out and change... All of the matters had to be recorded. You have to know who did what, what was done, because the most minute thing can be catastrophic. So we followed very closely and watched all the tests and everything else, but again, the people that ran that laboratory, the fabrication activity, knew exactly what they were doing. They were well trained by that time that they were going to have us looking over their shoulder, and they knew what was expected and they just heaved to and did it.

Engineers have a funny complexion. They have a tendency to complain about paperwork. And yet the only way that an engineer expresses himself to the fabrication people [or] to whoever's going to put this stuff together, is by drawings and specifications and pictures, things which are written down so that the man can follow them. So it's always been peculiar to me that they wouldn't want to write down who did what and what they end result was and so on. Paperwork is part of production. There's no way of getting away from it. If you don't have good paper, you're not going to have a good end product.

BERGEN: After Skylab, the next major project was Apollo-Soyuz. What kind of involvement did you have with ASTP [Apollo-Soyuz Test Project]?

RAINES: I guess my other answer just fits that perfectly—absolutely the same. It didn't make any difference on what it was going. The equipment had to be inspected. It had to meet requirements. It had safety analysis to make sure that there wasn't something obvious ... there, or even not so obvious to the inventor.

The design man, the average design man, has the concept to get it working, to get it working once, and then you have the problem of getting it to work every time and make it working reliable. So we looked very carefully at the docking module and all of that, but not any differently than we did anything else that was being produced. If you're going to produce something out at JSC, at least when I was there, it was going to meet all of the written requirements, and sometimes things that weren't written.

BERGEN: Were there any extra complexities in your job from dealing with the Russians?

RAINES: No, because I really didn't deal with the Russians. They had a group of people that dealt with the Russians, and we really didn't interface with them much. I think a couple of our inspectors that were a little bit bilingual had a little bit of an interface.

But generally, our equipment was what I was looking at. I was not looking at the Russian equipment. That's not my responsibility. Our equipment was looked at very, very carefully. The interfaces were told to us, and we met those interfaces. If the interfaces were wrong, I hate to say that's somebody else's problem, because if it becomes a problem, it's everybody's problem. But there has to be a limit as to where you go. You can't cover the field.

BERGEN: What did you think about ASTP from a political perspective?

RAINES: I really didn't have any thoughts on it. The Soviet Union, to me, has been an enigma all the time, and while I appreciate the fact that the astronauts were great individuals ..., the political backing and what was going on in Moscow was something else. I think everybody in the Space Program, at least on the working-level in the Space Program, tried to put that out of their minds.

BERGEN: Then we go into Space Shuttle development. That was a really long process throughout the development, before we actually launched a shuttle. What did you do during that time development? Did your job change more because it was more of a development stage than through operational programs?

RAINES: No, because safety, reliability, and quality assurance starts at the cradle and ends at the grave. During the design phase, we look very carefully at the design for reliability, for safety considerations, analysis of that. As far as quality assurance, are there techniques, better techniques for fabrication? Where are the inspection points? Where are the best places to look for problems? It's essentially the same thing. You have to start with the design, actually with the design requirements. We were a party to all the design requirements all the way through. So we were busy, right up to here and beyond.

BERGEN: I wonder if you could explain the Space Shuttle Reliability Engineering Policy to me and your role in its development.

RAINES: Policy. Reliability is a number of things, and mainly what we did was make sure that items were built in accordance with specification, that the specifications were correct,

that they met the test requirements, and basically that when you turned the switch on to do something, that it happened.

The policy, I guess you would have to say, is to make the most reliable item absolutely possible. Sometimes this is not the cheapest way. There is one other thing, and it's a matter of redundancy, which is, the policy was being at least fail-safe, which means that one failure will not cause a catastrophic event, that you have to have another way of doing the same thing, either the same part or another path, numerous secondary paths, so that there's not one wiring bus, there's a number of components to do the same thing.

RAINES: So we looked to make sure that everything is at least fail-safe, and in some components, the requirement is to be fail-operational fail-safe, so you have to have a double redundancy.

BERGEN: I guess that now brings us to the *Challenger* accident, which safety reliability/quality assurance people don't like to use the term "accidents," do they? From my experience, people don't like that word.

RAINES: What word do they use?

BERGEN: I'm not sure.

RAINES: It's generally referred to in the press and elsewhere as the *Challenger* accident, and that doesn't give me any problem.

BERGEN: What was the impact of that on you and your division?

RAINES: Well, I was, and I'm sure everyone in the division was, in a state of shock immediately. It was just unbelievable. But there it was in front of me. I had to believe it. I knew exactly what had happened, not why it had happened, but what had happened.

For a couple of hours around there, I think you could have heard a pin drop in the hall. My immediate action was, "What can I do?" I called my counterpart down at the Cape immediately to see if there was anything that I could offer that could be done. Sadly, there wasn't, and I guess I knew when I called that there would be not anything to be done.

I, however, immediately started to impound any kind of records which had to do with the *Challenger* when it was under our control, any kind of *Challenger* components, any open failure items which might have had something to do with that, impounding those not for myself, but for the investigation boards that I was sure was coming. And sure enough, those records were very carefully scrutinized by experts in the field.

Then, oh, after a week or so, we got into the phase of looking at all of our procedures to make sure that whatever we were doing was not something that was going to overlook something, to make sure that whatever it was that had caused this, that we could learn from it to make sure it didn't happen again.

I think we found a few things, which we changed in the course of a year, to tighten up on things which we had been doing. But at least we found, I'm sure from the investigating boards and everyone else, that the problem was not anything that our SR&QA had an control over, knowledge of, or anything else. The problem was not at our center. So we felt somewhat relieved, but nevertheless, remember that the crews come from here. It's our family from here. We know, or at least many of our people know and work with the astronauts and the crews that are on board. So you feel a deep sense of loss.

On the other hand, that deep sense of loss has not got to change your perspective. You've still got to go on, and what you want to do is to go on and make things better. So shock, number one; trying to get better, number two.

BERGEN: Shortly thereafter, you decided to retire. Was the *Challenger* incident part of the impetus for your retirement or did you just have other things that—

RAINES: Well, I stayed for about a year after the accident to make sure that we were doing the right things, that anybody that felt that myself or any of my staff had done anything that we shouldn't have done, we were there to answer questions and to be available.

It was perfectly obvious the first of '87 that it was going to be a while before we flew again. I was getting to be seventy years old that year. It was going to be another year before we flew. I had two very excellent people that certainly had the capability—at least two. Two in my mind, but at least two that were very capable of taking over, and I just thought it was time to quit. There was nothing more or less to it than that.

BERGEN: Looking back over your career, what do you feel most proud of that you've accomplished, because you played such a big role in the Space Program.

RAINES: Well, I guess I was certainly proud of the work that was done out at White Sands. All of our engines worked in flight perfectly. I think we had one RCS [Reaction Control System] problem on Gemini. I'm not sure that those RCS units were tested at our place. I hadn't thought about that. But that was on Dave Scott's flight, when one of the thrusters stuck. So I'm proud of that activity.

I was particularly proud of the activity at the Army Ballistic Missile Agency, where we took the Redstone missile, which was strictly and R&D [Research & Development] missile, from von Braun's group and standardized it, got all the equipment together, got the manuals written and everything to put it in the active Army, and to see it in the active Army was very fulfilling.

I'm not displeased with much of anything that I did.

BERGEN: Good. Just one general question. Since you were in the military prior to being part of NASA, what impact do you think the Space Program had on the Cold War?

RAINES: I hadn't thought too much about what the Space Program had in the way of an impact. I'm sure it did, to drain the coffers of the Soviets a little bit and helped to bring down the Communist threat. I'm sure that they found it very embarrassing that they had to give up their moon project.

But I think the big bulk of the things which caused the Soviets to go down was the rearmament program which we had, and they just couldn't keep up. While people may say we spent too much money on armaments, the nice thing is, we didn't have to use them, and it did bring down the Soviets. So I think the combination of the Space Program and the rearmament program of the Department of Defense had a lot to do with bringing them down.

BERGEN: Looking into the future, what would you like to see happen with the Space Program?

RAINES: Well, when you say the Space Program, that's a pretty big thing to cover. My background is entirely in the manned space part of the program, so I wouldn't want to touch any of the other subjects.

I think, with the budget limitations and so on, that we're just about right in what we're doing with the Space Station. I know many of my acquaintances and friends have often talked about, "Gee, we've got to go to Mars," but they forget that we don't have all the technology answers to go to Mars today. I would like to see us go to Mars, but I think before we go, we need some big breakthroughs in propulsion systems. We need some big

breakthroughs in how we handle expendable items and so on. After all, people somehow don't seem to realize that just to fly around Mars is at least fifteen months. If you're going to try and make a landing there and develop any kind of a base or anything else, it's significantly longer than that, and you have to take everything with you. I'm not sure it's feasible right now. I would not suggest that we jump into something like this, but I do think that you need to study the technology and work on the technology in the laboratory before you make a step like that.

So I'm perfectly satisfied. I think the Space Program is in the right direction. I can't see anything significantly different than I would do, although I'd be a little bit careful about the Russians and what they're going to do in their part of the Space Station.

BERGEN: Well, we thank you very much for allowing us this time with you and for sharing your history with us. We've enjoyed it.

RAINES: Well, I've enjoyed it, too. Come back, particularly if I've made any big mistakes.

BERGEN: I'm sure you haven't.

[End of Interview]