STS RECORDATION ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

JOHN TRIBE
INTERVIEWED BY SANDRA JOHNSON
KENNEDY SPACE CENTER, FLORIDA – JULY 13, 2011

JOHNSON: Today is July 13th, 2011. This interview is being conducted with John Tribe at Kennedy Space Center [KSC], Florida as part of the NASA STS Recordation Oral History Project. The interviewer is Sandra Johnson. I want to thank you again for joining me today and participating in this project.

I want to start out by talking about the beginning of your involvement with the [Space] Shuttle Program. In 1972 North American Rockwell was chosen as a prime contractor for the Space Shuttle, and you were temporarily assigned to the Shuttle program in '73 during the KSC facility concept design phase. If you want to talk about that, and how you first got involved, and what you did during that period.

TRIBE: I'd worked the Apollo Program from 1965 to 1972 until the Apollo 17 lunar landing, the last flight. Then in December 1972 after that last flight, they asked me if I would switch over and start working in the little Shuttle office we'd just formed down here. At that time it was headed up by Charlie [Charles W.] Murphy, and there was Ted [Alfred] Carey, Ray Reedy, Bruce [R.] Haight and myself. We were the neophyte Shuttle team down here at KSC, those five of us. We called it Happy Valley because we had a job. We were coming to the end of the Apollo Program, and layoffs were imminent for many many people, but the five of us had a future. We were already working the new program.

I started Shuttle really the same year that we got the contract. This is like 39 years now, almost, that I worked on the Shuttle. So we started in the new group and of course the first thing that we had to work was the operational phase of a vehicle that was still in preliminary design. I often tell some of the people today that when I started on Shuttle the Orbiter had pods on the wingtips, and on the vertical stabilizer. It had forward RCS [reaction control system] doors that opened outwards. It had abort motors above the wings next to the aft fuselage. It had jet engines in the payload bay that were deployed if you had to do a flyaround or you had to adjust your cross range for landing. It was a very different vehicle back then.

It also weighed a whole lot more than the eventual Orbiter did. The first thing that came along was a weight reduction. We had to cut the weight back down to 160,000 pounds, and a lot of the features of the Orbiter changed. Of course a lot of the design features affected the operational aspects. When you're in a weight criticality issue like we were back in those early days, the first casualties are all those features we wanted down here to make life easy to turn the vehicle around. So we were in a continual struggle in those early '70s trying to get things we wanted on the vehicle. The disconnects, the instrumentation that allowed us to see what's going on in the vehicle, how to access the various systems. It was like pulling teeth because weight was the driver.

We worked down here and we were feeding design changes back to Downey [California] and at the same time we were acting as the interface with the NASA design engineering group here at KSC that was responsible for the facilities. We've got this vehicle coming down and they've got to know what it looks like. We've got to provide that information to them, and then we've got to continually update them as the modifications came through.

We'd argue back then what the facilities would look like or how many access platforms we would need. Things like when the Space Shuttle rolled out from the VAB [Vehicle Assembly Building] and went to the pad, should we have tails north, tails south, tails east, tails west. What configuration launch site should we have? The Rockwell approach was tails north with a file drawer-type access structure. The DE [design engineering] approach was the rotating service structure that you still see today – tails south. So we argued all through those sort of aspects.

That was our role back then in the early days of Shuttle. It was just basically to try and get our people in California, the Rockwell people, to design a vehicle that would allow us to turn it around in short order and easily. At the same time we had to feed all this design information into NASA down here through interface control documents and just verbally. We attended lots of meeting. As the '70s wore on this got to be tougher and tougher and more and more demanding on us.

Then in 1975 I got interrupted on my Shuttle work by being called back to work Apollo again for Apollo-Soyuz Test Project [ASTP]. At one time my old propulsion group that I managed back on Apollo was almost forty strong, and [after Apollo] we were down to less than ten. They didn't have enough strength in the RCS, reaction control system world, so they called me back to work that system.

As it turned out it was probably one of the more fun flows I've ever had on Apollo. We were down to where we only worked one shift, so there was no handoff to second or third, and trying to catch up the next day. You just worked that one shift. Sometimes when we were in critical operations it was a twelve-hour shift. Working closely with the technicians and the

quality guys we got to know everybody by first name. The procedures were all in good shape. It was a great flow.

We worked with Deke [Donald K. Slayton] and Vance [D.] Brand and Tom [Thomas P.] Stafford—all those guys—and got to know them well. In fact I still see Tom Stafford now and talk about those days. Anyway, that lasted about nine months, and then I came back on Shuttle and it was more of the same.

By this time we were starting to approach the phase out in California called approach and landing tests, ALT. Instead of being the only guy working all the airborne fluid systems, we were starting to build up a little bit and I was starting to specialize more in the hyper [hypergolic fuel] world again, which was my specialty. I was leaning towards OMS and RCS, orbital maneuvering [systems], reaction control systems. Whereas some other guys were coming on board that were working main propulsion, APUs [auxiliary propulsion units], hydraulics, ECLSS [environmental control and life support system], fuel cells, PRSD [power reactant storage and distribution]—all those other fluid systems.

So I concentrated on hypers. Then as the ’70s wore on into the delivery of *Columbia*, I became the supervisor of what we call the D^2 [D squared] group. D^2 is design designee. The design designees were the system specialists down here that Downey looked to as being their counterparts. We were the guys that the operational people would go to for system specialties. I had this group and I had some great guys working for me.

Before that came up I had begun to work the operational side also. Here we were faced with a whole new world of launch processing. The launch processing system [LPS] was the way we controlled the vehicle. We had to write the software for those programs. We had to design and build the skeletons that gave us all our CRT [cathode-ray tube] displays. A lot of us were for

the first time really getting knee-deep into the computer world, which was very interesting. I built my first program, which was how to load all the helium tanks on the Orbiter. How you do this is not just a matter of opening the valve and pressurizing the tank to flight pressures. You've got all sorts of limitations and constraints, pressure and temperature and rates. It was a complex program and I thoroughly enjoyed writing it.

At that time I started to date a young lady down here who was in the software group. She helped me a lot with that program, and eventually we got married in 1982, a little bit farther on. Of course we're still married today. That was by the by. Anyway, once I was in the design designee group, I tended to get away from the hands-on type activities and we were more in a management consultation role.

Of course *Columbia* arrived in what I would say was a sad shape. Basically the Orbiter was not finished when it came down here. The tile installation was not working. I don't know how many times we put tiles on and took them off again during the period before first launch from '78 until April '81. Those were really tough years. A lot of the Downey and Palmdale people moved down here for that period so we could finish the vehicle off and get it ready for its first flight. We were very active during that whole period.

JOHNSON: What were the hours during that time period? Were you working pretty much around the clock trying to get it finished?

TRIBE: It was always twenty-four hours a day seven days a week during that whole period. Not for all of us. Back on Shuttle, I don't think I worked more than a six-day week nominally. Apollo, it was seven days. Apollo was just a full speed ahead. We had a goal we had to achieve.

Shuttle, we had schedules and we had goals, but they weren't as critical as landing on the Moon in a decade. Of course that was the goal we were set by President [John F.] Kennedy.

It was still long hours. Of course when you're working with a company that's based in California you've always got that three-hour difference. If they have a 3:00 [p.m.] telecon [telephone conference], it's 6:00 at the Cape [Canaveral, Florida]. Then the telecon lasts till 5:00 their time, it's 8:00 our time, so you're getting home really late at night. The same thing happened on Apollo, and it does really interfere with family life. My first marriage folded up primarily because of that activity. My second marriage, is a whole lot better. I had somebody that was in the business and understood it and also had long hours. It survived a whole lot better.

JOHNSON: Makes a difference.

TRIBE: Yes. We had one incident in 1981 that was very traumatic. I think it was March of '81. We were doing a simulated countdown on *Columbia*. We were in a configuration on the pad where the crew module is pressurized and the crew were on board, but the rest of the internal volume of the vehicle was purged with nitrogen, gaseous nitrogen, GN2. This is a safety aspect. Obviously we've got cryogenics on board—the fuel cell propellants—what they call the PRSD, propellant reactant storage and distribution. That's what we used to power the fuel cells.

Because of those hazardous conditions this nitrogen purge is flowing down through the vehicle and out the aft. There was a cross-communication in the firing room between safety and the operations people, and we got an okay to go back into the vehicle, but they had not switched back to air. So we still had a vehicle full of GN2 and we had technicians enter the aft, and we lost two technicians. They were the first *Columbia* victims, the way I described it. I was put on

the investigation committee for that along with a couple of other guys. Charlie Murphy, the guy I first worked with on Shuttle, headed up that team. That's a little known story. It was big at the time, but you've never heard about it hardly since. That was just a month before the first *Columbia* launch.

JOHNSON: What kinds of changes were put in place because of that accident?

TRIBE: It was a communication issue between safety, operations, and stand talkers. It was a compound thing. The procedures were all cleaned up to preclude that from ever happening again.

But anyway, 1981 of course we had a successful launch. That was very exciting. It had been a long drawn-out period getting to that first launch. Even after launch the hours were still long because we were still trying to turn around fast.

Later that year prior to STS-2, I think it was September or October, I got a call, I think it was 1:00 in the morning, "Hey, they've had an oxidizer spill during hyper load out on the pad." I came charging out, and the tile was sliding off the vehicle. They had a major nitrogen tetroxide spill up on the forward RCS. It melted the RTV [room temperature vulcanizing] that bonds the tile to the vehicle. The tiles were just sliding off. They were trying to mop the spill up and collect the tile. It was a serious—slipped the launch, caused a major impact to the flow. But that basically changed my life at that point.

They asked me to go back in and take over as manager of that OMS RCS group. Get back into the operational side. They took my design designee group and spread them out amongst the various systems, so the design designees actually reported to the operations guy

now. That put me back into hands-on management. That's where I was happiest. That stayed in effect until the fall of 1983 when NASA put out bids for the Shuttle Processing Contract, SPC. We had what we called the great partnership. It was Rockwell, Martin [Marietta Corporation], Thiokol [Morton Thiokol Incorporated], the three element manufacturers, and we got together and said, "We'll produce an operational team that will conduct all the Shuttle operations for NASA."

In the meantime Lockheed [Aircraft Corporation] came in as another bidder with no background at all on the vehicle and won the contract. To me I think that was probably one of the biggest mistakes NASA made was to give that contract to a neophyte Shuttle contractor. As big and as experienced as Lockheed was, they hadn't worked the vehicle like we had; they hadn't built the vehicle like we had.

That was immediately obvious once they took over the contract in 1984. Rockwell went from I think 2,500 down to about 300 people and I was lucky to survive that. I came out of it as director of engineering; I actually got a promotion out of it.

JOHNSON: Did they bring their people in and not hire any of the people that already had the experience?

TRIBE: They tried to hire everybody, but a great proportion, especially the skilled and management people, Rockwell kept. They had contracts going all over the country, and they found jobs for just about all the people who wanted to stay with the company. All the management structure, pretty much to a man, was Lockheed. It was immediately obvious that they were on a long learning curve and were stumbling along in those early days.

They relied heavily on those of us that were still here. I was back into my design designee role again because now we had the system specialists that Lockheed needed to call upon to support them during their operational work. They relied on us, and they relied on NASA to really get them through this phase.

When we got to 1986 and [Space Shuttle] *Challenger* [STS 51-L accident] that to me again was symptomatic of the Lockheed problem at that time. If Rockwell had still been managing the program, we would not have had a *Challenger* incident. I'm convinced of that.

What was particularly bad was the series of events leading up to *Challenger*, which finished up on the day before it actually flew. They had a hatch handle stuck. They had a cross-thread on a bolt in the hatch handle, and they couldn't get this bolt out, so they needed to drill. There was no drill in the White Room [environmentally controlled chamber]. The drill finally arrived, the battery was flat. They asked for more batteries. They got a dozen new batteries come out there, they all had very little power left in them. They finally got an okay to use a powered drill. They were concerned and they didn't want to use a power drill because again, we've got a potential for hydrogen vapors that might be explosive. But they finally convinced everybody there was enough airflow around that area that it was safe to use a commercial drill.

A combination of that and just hacksawing the handle off worked. Even the vice president of Lockheed at the time decided to go up into the White Room. He didn't have to, he chose to, which was again a violation of who should be there and who shouldn't be there at that stage of the game. He went to "help" the technicians. That's all you need is your boss to come and look over your shoulder while you're doing something.

But this whole exercise took so long that the weather had now turned bad. By the time they finally finished there was too much wind for a return to landing site [RTLS] abort. The

launch attempt was canceled for that day, which moved us into the coldest day of the year. People say, "Oh, that's circumstances." But you'd never have got into that position in the Rockwell days.

To start with I think we'd have been a whole lot better organized. Secondly if Rocco [A.] Petrone had been managing us down here like he had done in the past, we wouldn't have flown on that cold morning either. That's probably not the thing to throw out. I don't know whether it's even appropriate for this sort of discussion right now, but it's very uppermost in my mind. Going to Lockheed in 1984 was a major mistake.

After *Challenger*, everybody got beaten into shape. There was a zillion corrections introduced. The Lockheed team settled down. They brought in new management, and we chugged on through the '80s and into the '90s. Then of course we came to the USA [United Space Alliance] implementation, which was when Lockheed and Rockwell said, "Let's quit this fighting back and forth over the contract. Let's merge into a single entity." It was headed up by Kent Black of Rockwell and it worked pretty well. USA of course has been in the driver's seat now ever since. Rockwell and USA have a whole lot better relationship than Lockheed and Rockwell did back in those early days.

I'm convinced that if Rockwell had maintained that contract in 1984, we'd still be flying Shuttles. It would have gone commercial ten years ago. I think NASA would have realized that the right thing to do was to bail out, let a commercial operator handle all low Earth orbit activities and push on with research and development. Just what they're doing now basically, except I think it would have been ten or fifteen years ago we could have gone into that mode. It would have been better for the program and better for everybody concerned.

JOHNSON: Let's go back to *Columbia* and when you were getting ready for that first launch. You mentioned the tiles as being a problem when they were doing the testing, and when it came back and lost the tiles. Were there any other concerns that you had at that time building up to STS-1? Any other concerns as far as your systems?

TRIBE: No, I think when you're here at the launch site your focus is primarily on trying to get your ground systems to work with your flight systems. We had a whole new facility here. Like I said all the software that we'd written, all the procedures that had to be written. The infrastructure that is necessary to launch a vehicle of that complexity is horrendous. I don't think the politicians and a lot of people in the country realize that it's not just go design a new launch vehicle. It's all the support facilities that have to be built down here, you have to hire all the right people, and you have to train them. They have to either be trained and they have to learn their systems.

That was what we were struggling with all the time. At the same time the vehicle is being finished, and you have all these modifications trickling down from the design groups. All the testing is ongoing out on the west coast and elsewhere to verify vehicle configurations and design limits. In some cases they'd have to come back and make changes to the vehicle. This is even before it flies. So we have all these EOs, engineering orders, coming in with all these changes, and it can be overwhelming at times.

We never really had any doubts about whether the vehicle would fly or not, but we were just overwhelmed with trying to get it ready to launch. Just to try and get it finished. We had people problems down here. We had a large crew from Palmdale down here. There was a little bit of friction with some of them and the local people. It was tough. Everybody was stressed.

Everybody was working long hours, frustrated in fact by things that you couldn't get done, or you thought you'd got done, and now you have to undo them again because of another change that's coming down.

The biggest technical concern I had about that first flight—as just about everybody else did—was the engines. I didn't work the engines in detail. I used to be an engine guy back in the early days, not too much on Shuttle. The SSME's [Space Shuttle Main Engines] were complicated. They were state-of-the-art. The most advanced design piece of hardware on the vehicle, and in the world. They were fantastic. Having lived through the early days to the Atlas programs and Titan programs way back in the early '60s, and seeing so many fail because of engine problems. Just about every other launch would blow up.

We thought wow, these are really way-out engines. We're going to burn them for eight and a half minutes to get into orbit. I'm serious, we would have nightmares. Our nightmares were always the engines. The engines would blow either on the pad or during ascent. Here we are 135 flights later and those engines have been magnificent. Back then those of us that had been in the early days of rocketry, we were really pushing our luck we thought. The engines were the biggie, plus just trying to get the whole package put together.

JOHNSON: The hypergolics and the area that you were starting to focus on, can you talk about that development as far as choosing that as the way to go with the OMS and the RCS?

TRIBE: I felt like it was pretty straightforward. We had used hypergolics on Apollo. The OMS system was not that different from the service propulsion system on the service module of the Apollo. The reaction control systems on Orbiter were just a bigger version of what we had on

Apollo. What we did do on the Orbiter was we married the RCS and the OMS into a single pod on each side of the vertical stabilizer, and we had a separate forward RCS system.

The RCS tanks were spherical tanks with a screen retention system whereas on Apollo they were sausage-shaped bladder tanks. Of course the big problem with any storable propellant in zero g is how do you get it out of the tank, because it wants to float around all over the place. So you have to build a complex system inside the tanks called zero g screens, basically a propellant retention system that only allows propellant to come out of that tank, and not a mixture of propellant and pressurant. If you had the two coming out mixed then of course you're going to have engines blowing up on you if you don't have a solid stream of propellant. We were fighting through all those problems.

At the same time on the ground side we were saying, "Okay, we've got to dispose of the fumes and the excess propellant when we have any release." By then we'd learned just how toxic and carcinogenic the propellants were. On Apollo we were a little more cavalier in the way we disposed of them. We just used big fans and blew the gases up into the air and diluted them with air and they just drifted off. This program we couldn't do that. We had to decontaminate; we had to basically neutralize the vapors. So we had equipment called scrubbers that Martin was building in Denver [Colorado]. Those were an interesting challenge. We had to put those on every site we had hypers.

But basically the vehicle design was a very simple design. A storable propellant system is just a pressurant pushing hypergolic propellants down into an engine where it mixes together, and the two spontaneously ignite. Again, putting all that together with different tanks and different systems and different manufacturers, that's always a challenge of course. But I didn't feel like it was a big technical issue. I felt pretty comfortable it would work.

JOHNSON: Of course STS-1 it did work.

TRIBE: It's worked ever since.

JOHNSON: It's worked ever since. Talk about if you will for a few minutes once STS-1 landed and then all of this work that you'd been doing preparing to process the vehicle to get it back and ready to fly again. That first flow and how well it worked and any lessons learned from that.

TRIBE: We'd planned what we were going to do on turnaround. Of course that was implemented after STS-1. In my world, in the hyper world, I'll cover that even though initially after STS-1 landed I was still doing design designee work. But shortly thereafter I was back in the hyper world. What we would do then is remove the forward RCS from the vehicle, remove the two aft pods, and take them all down to a facility we had down in the industrial area called the Hypergolic Maintenance Facility [HMF]. There it was set away from work areas in the industrial area. We could work down there to our hearts' content without worrying about gassing office workers or anything, because we were still working with these hazardous propellants. We would drain if necessary and do all our checkout down there, all the pneumatic checkout. Get the pods ready to put them back on the vehicle for the second flight.

That was a fairly long business. As the program progressed we did less and less of that. Eventually we'd leave the pods and forward RCS on the vehicle. We'd leave them pressurized. We'd do minimal checkout between flows. Back in those early days we wanted to go back to

square one every time and check them out thoroughly. It was demanding work, but the schedule was laid out, and we pretty much met that schedule. Didn't have any major problems.

JOHNSON: The Hypergolic Maintenance Facility, had that been built before the first flight?

TRIBE: That was built for Apollo. In fact that was one of the places I activated when I first started working Apollo. During the '70s when I was in this consultant role with NASA DE we redesigned HMF to accommodate the Shuttle hardware. The Apollo stuff was all removed, we put in new access platforms, new flooring, and laid it out so that we could hoist the pod into the vertical or horizontal and forward RCS the same way, so we had three cells down there that we'd use for three Orbiter modules. Each one was tailored to fit that particular module.

Again that was part of the '70s, getting all that facility installed and built and activated. That worked out real well. We had LPS, we had our own little control room down there that worked with each of the cells. All that software had to be written. Skeletons had to be written. Again all that infrastructure that was needed. You don't just turn a vehicle around, wheel it in, hose it down, and get it ready to fly again. There's a lot of work to do.

JOHNSON: Definitely a lot of work. You mentioned the spill that happened before STS-2. What exactly caused that spill? I know it happened out at the pad.

TRIBE: It was a disconnect. A disconnect is what we use to basically connect the ground system to the airborne system. They're very complicated pieces of hardware, and the technicians need a lot of training on how to use them, how to connect them.

In this particular case we had a seal in that disconnect, in the nose area, that hung up and allowed propellant to flow by it. We had what we called scuppers around it to collect spills, but they were to collect little drips and minor spills. They're not designed to contain a mass flow that was coming out. It just came out so—the tank was actually pushing the propellant back out past the seal, and it filled the scupper up and just overflowed. The oxidizer was literally running down the side of the vehicle. They finally realized what was happening, got the flow turned off. By that time of course a lot of the damage had been done. It was a failure of a seal in a disconnect, and a lot of corrective action came out of that too afterwards, so that didn't happen again.

JOHNSON: That's what I was going to ask you, if that happened ever again. I noticed on your resume you mention because of a series of hardware-damaging incidents in the systems you were reassigned. Are there any that you can recall during that time?

TRIBE: The OMS RCS group I think was having some personnel problems also. There were other incidents also prior to that time. I can't remember exactly what they were now, but it was enough I guess for the senior management to say we need to put somebody else in that slot. That's what elevated me to the manager's position.

JOHNSON: You took on some other areas too as far as the ECLSS.

TRIBE: It was shortly thereafter they gave me the environmental control system and the fuel cell and reactant distribution systems. So that was about a seventy-man group after that. I enjoyed

those days. They were challenging but we were flying, the guys were settling down. I think we were starting to really get into a smooth operation when SPC came along. We flew ten times, then SPC flew after that. By the time we got to that tenth flight it was really starting to jell. As I said, I think NASA screwed up by just upsetting the applecart at that point.

JOHNSON: On average as far as turning around the vehicle, at that point in the early part of the program, how long was average turnaround time? You said it got smoother.

TRIBE: It got progressively better. When I started on Shuttle—let me switch back to 1972, '73. We were looking at a 160-hour turnaround, 40 flights a year. So that says you're flying every ten days literally, or twelve days. We never even got close to that. I think the most we ever did in one year was nine. But the turnaround time after that first flight. We flew in April, and we flew the second time in November, so that turnaround time was a good six months. I think the best we ever did was fifty days, down to where it was less than two months. Of course now the last few years it's been a lot longer than that.

Normally if I had to say the average for a Shuttle flight, it was like three months in the OPF [Orbiter Processing Facility], a week in the VAB, and a month on the pad. That was typical. So you're looking at a little over four months under normal conditions. You could throw a lot of people at it and a lot of money and you could do it a whole lot faster, but we didn't do that very often unless there was a real demand.

JOHNSON: You mentioned how you removed the OMS and RCS at the beginning, but then you were working with the environmental control and life support systems and the power reactant and distribution system. How did that turn around work?

TRIBE: I can't really remember any significant issues back in those days. The biggest problem we had was just getting the procedures written. They'd already been written, but each time we ran through them in those early days there was a lot of changes that had to be folded in. We had to streamline our operations, we had to improve what we were doing. There was no big crisis. We had a big issue during those early days with the waste management system on the vehicle in flight, which involved a lot of work for us on the ground.

We had the fecal matter problem on the vehicle. Back in those early days we used to have a slinger in the can that would sling the fecal matter round to the outside of the can. Then we'd basically vacuum-dry it by opening up to space. What happened is when it was used it would tend to become dust in there because it was so dry, and it would get out past the slide valve. So then you'd have this fecal dust in the cockpit which would get in the crew nasal passages, and when it gets moist it would reconstitute, you see. This gave us a lot of problems, so there was a lot of design rework going on in that area. That was all under ECLSS.

Fuel cells were pretty straightforward. Fuel cells were not really a whole lot different from the Apollo fuel cells, so it was just a matter of building a new system to get the reactants to them. Again I don't remember any big issues at that time with either of those systems.

JOHNSON: I know they had the preflight checkouts. A lot of that didn't just involve KSC. That involved between KSC, JSC [NASA Johnson Space Center, Houston, Texas], Rockwell. How did that work? How was that coordinated? Or how well did it work?

TRIBE: It worked pretty well. By this time you'd got to know your Downey counterparts and your JSC counterparts pretty well. All through the phase leading up to the first flight and after the first flight, the subsystem managers in these various systems had been down here lots of times. They'd got to know us, we'd got to know them. The same with the Downey people.

In fact a lot of the design guys spent months down here, weeks or months down here working with us. So the working relationship was really settling down. I always found it excellent. You always have a few guys floating around that you could probably enjoy being somewhere else, but on the whole the guys I worked with and the ladies were super. It was really a good crew. I don't remember any real issues with any of them.

Everything we did, if it was already operationally approved, part of what we called the OMRSD, the operations and maintenance requirements [and specifications] document. That's the way the design people governed what we did down here, and as long as we pursued that there wasn't any real issues. If we had to do something out of scope, we didn't do it unilaterally. We'd call up JSC, the subsystem manager. We'd call up Downey and say hey we want to do this and this is how we're going to do it. We'd beat it around. We'd have a bunch of telecons. We'd iron out the paperwork. They may even send people down to work with us on it, but it worked out well. I thought it was a pretty good arrangement. It was a real good check and balance.

Of course down here we also had not only the Rockwell people, but we had a whole KSC NASA group down here, almost one for one with us. So we had a coordination with NASA first down here, and then with JSC or Downey or both. It worked out pretty well on the whole.

JOHNSON: Just a lot of paperwork, right?

TRIBE: Always a lot of paperwork. It never got less. It just seemed like it got worse and worse as the programs went on. Every time you have any sort of problem or accident, you have all this corrective action. The corrective action invariably involved more paper, more signatures, more approvals, and it took longer.

JOHNSON: There wasn't really a problem I guess unless you had to turn the vehicle around, but STS-3 landed at White Sands [New Mexico]. Did that affect any of the systems that you were responsible for?

TRIBE: Yes. The landing at White Sands itself was a bit of a challenge because we had to get all that ground support equipment there by railroad. But what happened at White Sands was they had a huge storm. The white sand is not sand, it's gypsum dust. The white gypsum dust has the texture of talcum powder. When that storm blew, that powder would come right into your car door. With the windows up tight, it would still blow around and get in the car. It would get through every little surface that was open. So you can imagine that poor old Orbiter sitting out there on the floor of White Sands just had powder driven in everywhere. It was in the payload bay. It was in every thruster. It didn't matter how we plugged the thrusters, we had powder

driven into them. We had to pull every thruster when we came back down to KSC eventually, which was a huge job.

I was totally involved in the RCS side of things, but I'm sure all the other systems had similar nightmares trying to get STS-4 ready to fly after that. We all said never again would we go to White Sands. It was a big impact. It was not a good flow.

JOHNSON: I can imagine. We've talked to other people. They talked about how some of the astronauts would fly later, and they'd still see—

TRIBE: They'd still see powder.

JOHNSON: —powder in there from it. The hypergolic systems that you worked with, as you mentioned they're dangerous. I know they had safety systems in place, part of which was that you had the facility to work in. What other safety requirements were in place as far as to protect the actual technicians that were working with this while these systems were being processed?

TRIBE: If you're going to work hands-on, you're going to be working disconnects, or you're going to be working where you're going to have the opportunity to have propellant spilled or vapors released, you would wear a SCAPE suit, which means self-contained atmosphere protective ensemble. These were rubberized suits with a Plexiglas faceplate and an air pack inside on your back.

I lived in one of those a lot during the Apollo program. The ones we used on the Shuttle program I never got to wear one, but they were a little more improved than they were on the

Apollo program. I can tell you what it was like back on Apollo. You had these yellow long johns like a yellow underwear set that you'd put on. You'd tape your wrists, tape your legs, and you'd put these suits on and you'd wear them for an hour.

Then you'd have an hour back in the little trailer, which was the maintenance trailer for them. Then you'd go back up again for another hour. They were very uncomfortable. They were either hot or cold. One guy had a line break on his air pack. It sprayed liquid air down his back and burned him. They were not the nicest things to wear. But they did give you complete protection from a hyper spill and that's why you had to wear them. So that's the way we protected back during Apollo and all through Shuttle. They still today wear a newer version of that same suit.

JOHNSON: Just an improved version.

TRIBE: Yes, more comfortable. I don't think they wear them as long as we used to.

JOHNSON: Eventually the *Challenger* came along, the vehicle, and flew the sixth mission. How did that impact the systems that you were in charge of as far as processing, and how did you coordinate having two different Orbiters?

TRIBE: We had *Columbia* and *Challenger*; we had two different vehicles as early as STS-[6]. Then after *Challenger* of course we had *Discovery* here. Then *Atlantis* came along.

JOHNSON: Yes, and as those vehicles were added, I know it had some impact on the processing flow and how they were moved through. So if you want to just talk about that for a minute.

TRIBE: I don't really know. There was more to do.

JOHNSON: Did it increase hours? Or were the hours pretty much the same and just different locations as far as the teams working on the vehicles?

TRIBE: We did not double the staff. We did take on more people. We were working more areas. If we've got two vehicles in flow then we've got to support people on the pad and people at HMF. Again back by the time you're at *Challenger*, then we're in the SPC mode. So I was not again working hands-on, and it was less of an impact to us in the design designee world than it was to the hands-on people. One of the actions that came out of the Rogers Commission [Presidential commission formed to investigate the accident] was more design involvement after *Challenger*.

That affected me directly. It just about doubled my headcount. I hired a whole bunch of talent, a lot of people from the design areas, and a lot of people that had been relocated with the SPC [contract] were brought back to act as design designees. So *Challenger* just about doubled our headcount.

JOHNSON: Let's talk about *Challenger* for a minute and the accident itself. Were you here for the launch?

TRIBE: Yes, I was on station. We were in what we call the engineering support area. The launch crew normally was in Firing Room 1 or Firing Room 3. The engineering support area was in Firing Room 2. That's where most of the management and the design people would sit, like a back room. Just like at the Mission Control Center in Houston there's always a back room governing what they're doing in their room. We were the same.

So we were there for launch. The night before we'd come in for tanking and it was bitterly cold. It was one of the coldest nights I remember. It was like down to 18 degrees in the night there. The wind chill was horrendous.

They'd left the showers running in an effort not to freeze the water in the lines leading to the safety showers. They cracked them all so they would flow. What that did was it overflowed the shower pans and you had this ice everywhere; great sheets of ice on the decks and icicles hanging down all the railings.

We would be in the firing room and look at all these pictures on TV. I described it to Downey as a scene from Dr. Zhivago [1965 movie], the icehouse. That night I came out and walked across the parking lot and I passed some guys coming the other way. I said, "There's no way we're going to fly tonight. There's no way we can fly safely with the conditions out there."

I'm talking purely from FOD [foreign object debris]. I'm talking from what happens to all that ice when we lift off and it's flying around, it's going to damage tile, who knows what it's going to do? It's an unknown. We'd never analyzed or never addressed what to do under those conditions. It was just dumb to think about flying.

As much as we wanted to fly, this isn't the time to make a jump like that. I didn't know that right next to my office over there over in Complex C, Marshall [Space Flight Center, Huntsville, Alabama] was having all these telecons all night over the O-rings. Right next door to

me. They were a different world; this was the solid rocket booster [SRB]. All of us in Rockwell had no knowledge at all. Of course a lot of the NASA people in the integration world had no knowledge of these O-ring issues either.

When we had the management team meeting to discuss whether we were going to fly or not, my boss, who was a vice president down here, said, "We're no go." He got overridden by the KSC Center Director. Two vice presidents we had from the west coast were also here at the time. The guy we should have had down here was Rocco Petrone, who was the president. Unfortunately he had got so frustrated the day before by this exercise up on the hatch that he stormed back to Downey and was back in the Mission Support Room on the west coast. He was not here.

We didn't get a crisp decision down here whether we were go or no go. We kind of implied like we weren't really happy about all this ice, "but." It was just left. If you want to go ahead and take the risk, you can, NASA. The O-ring never came up. This of course all came out in the Rogers Commission. We went ahead and launched.

We didn't launch until 11:30, so there had been time once the sun came up for some of that ice to dissipate and melt. I was feeling a little bit better about it by the time we finally launched, but I never expected to see what I saw, when the vehicle exploded. We're sitting there transfixed by the sight of a wing just floating down like a leaf. The stuff was hitting the water. We saw this with long-distance television cameras, but it was just horrific. We were stunned. We came out of the firing room and walked back across the parking lot, and you could still see the smoke trails in the sky. Then of course we started hauling in the debris.

We have a building just down the road from here called the Logistics Building. It has a big area in there that we could put all the hardware we recovered from the ocean. I can smell

that area now because it just stank. In the time it was underwater, it already had barnacles and shellfish and little crabs in it. You couldn't get it all out. They were stuck in all sorts of places, so it smelt of rotting seafood over there like it does when you get barnacles and stuff getting old. It was very very traumatic, and really brought you back down to Earth. That was *Challenger*. I haven't forgiven the guys that overrode the O-ring decision.

Again I think there was launch fever that morning. The fact that the local Rockwell people were really no go, but we didn't have the impetus to really hold anybody's feet to the fire. We were basically making an input to our leaders from the west coast and they didn't make a real hard stand so we flew. Like I said earlier, I think if the SPC had not happened, I don't think we would have had a *Challenger* accident.

JOHNSON: Right after the accident in the downtime, what were you doing during that time before STS-26 flew?

TRIBE: Hiring, training, educating. We implemented an awful lot of modifications to the vehicle that had been pending. All were warranted at that time. This was a down period. It was a good time to go in and let's try and bring the vehicle up to scratch while we're at it. Before then we were trying to launch so fast we couldn't get a lot of these mods done. So it became a modification period for the Orbiter.

We didn't have the issues that the SRB had. They had to go back and redesign and retest the joint seals. We had the opportunity to go try and make the Orbiter a safer vehicle. Plus we implemented the slide pole, stuff like that on the Orbiter. We did all sorts of work around the

hatch in that respect. Most of that didn't affect me. I was working across a whole bunch of other smaller systems.

JOHNSON: Were there any modifications in your systems that you recall?

TRIBE: Yes, there were modifications all across the board. But I'd got to the point now where I wasn't really involved with the details. I had a lot of the guys working for me that were a whole lot smarter than I was working those. I was just managing a large group of people.

JOHNSON: What about return to flight? What are you memories of STS-26 return to flight?

TRIBE: Not much. Rick [Frederick H.] Hauck I think was the commander of that. In fact I was with him a couple weeks ago on a tour. I took him around. We talked about those days, but it was basically a routine Shuttle flight. It was obviously a lot more focus on it because it had been two years since we'd had *Challenger*. Just a feeling of relief that it went off well and we're back flying again.

JOHNSON: Did you have much interaction with the astronauts during those early years or during any of the time?

TRIBE: During *Challenger* a lot of the astronauts were assigned specific tasks as part of the investigation and recovery. They'd come down and spend a lot of time with us. Brewster [H.] Shaw was one that spent a lot of time in my office, and we got to know each other well. We'd

meet them and every now and again they'd come through the offices and stop and talk, or we'd have [Silver] Snoopy awards [NASA Space Flight Awareness award] and that sort of stuff, and they'd come by and spend some time with us. Or maybe it'd be arranged for them to come down and brief us.

There wasn't a lot of interpersonal relationship. We had these astronauts assigned to KSC called the Cape Crusaders. They would assign several astronauts to be permanently down here and we got to know them a whole lot better, because they'd be one of the workers here. Then they'd cycle back into a flight role and we'd see them every now and again.

We had a few astronauts that came from KSC. Joan [E.] Higginbotham, Kay [Kathryn P.] Hire, Frank [Fernando] Caldeiro, they all worked here. Frank worked for me and then he went into NASA and then he became an astronaut. Kay Hire sat next to my wife as a test project engineer for a long time and she's still an active astronaut. But most of the time we didn't know them real well. Plus by the middle of the Shuttle program we were up to 150 astronauts or more. It wasn't like the seven original. They were people that if you saw them in the restaurant, wow, there's John [H.] Glenn, or there's Alan [B.] Shepard. A lot of the time you didn't even recognize some of the astronauts.

JOHNSON: Definitely too many of them for that. In the early '90s, your tasks expanded again to include the ground support equipment sustaining engineering and the Orbiter project engineering functions. Do you have any specific memories about adding those?

TRIBE: That was just more work, more responsibility. More talented people coming on board. I had the vehicle project managers and the project office, which handled all the modifications and

the changes and the configurations. It was work I'd been involved with all the years, so it wasn't really a big headache to me to pick up these people as well.

JOHNSON: What was the other area that you added, the Shuttle Logistics Depot?

TRIBE: Back in the middle '80s Rockwell saw a need for a facility to be established somewhere that would provide logistics support in terms of a lot of the manufacturers of the components on the Orbiter were going either out of business or losing interest in supporting it. We knew that we were going to have to pick up this task ourselves. So Rockwell bought a building down in Cocoa Beach [Florida]. It was called the Rockwell Service Center, RSC. We started to build a group down there that were capable of handling a lot of the logistics support; repairing components, reservicing components, taking over the design of some of the parts in fact.

This attracted NASA's attention, and they became very interested and wanted part of this. The building became the NASA Shuttle Logistics Depot, NSLD. It grew, and it's still down there. It's still the NSLD. It's right opposite the Ramada [hotel] down there in Cocoa Beach.

We built an engineering staff down there to support it. That came under me, so I had a director down there under me that handled all the logistics engineering down in that facility. Eventually in 1997, I guess it was, when USA took over, one of the agreements was that they would take over that facility rather than it would be basically driven by the Rockwell people. That's still the way it is today. In fact now they're talking about it reverting back to a non-NASA type depot that would handle contracts with the Air Force and with other contractors, commercial people. It's a neat facility. It's got a great machine shop and avionics sections, cryogenics world down there. A lot of talent, and it'd be foolish for this nation to hand over that

facility to somebody else, turn it into a shopping center or something. So hopefully it'll keep going.

JOHNSON: About how many people work in there?

TRIBE: I haven't a clue right now. I'd guess 300 or something like that. I'm not sure. Maybe more than that. It's been a while since I've been down there.

JOHNSON: It's an interesting facility. When I was reading about it it seemed really interesting. Of course you were talking about USA, the consolidated contract, and taking over all that processing. During that time period when they were letting out that contract did you have any input?

TRIBE: Definitely. This was a combined Rockwell-Lockheed effort, so they really used inputs from us down here as to how that should be structured. I spent quite a bit of time out in Houston working that with the USA people. Some of those guys are still here. I saw Howard DeCastro this weekend down here. He was one of the original USA guys they brought in.

JOHNSON: That first time back in '84 they didn't get that same sort of input for the processing contract?

TRIBE: There was a whole lot more friction in '84. We were hurt.

JOHNSON: In ’97, when you decided to retire, what led to that decision?

TRIBE: I was sixty-one. I’d been in the business since ’54, so that was forty odd years. I figured it was time to start enjoying life a little more. But I had a problem. I’d been doing this now for so long, I just couldn’t imagine not having a badge and not working out here. So I talked to Jay [F.] Honeycutt, the Center Director, and I said, “When NASA guys retire they get a retiree badge that allows them to come back. What do us contractors get?” Nothing. We can’t get back on the base even, once we hand our badge in. They literally slam the door on us. He said, “Go work with Hugh Harris in guest relations, in the Public Affairs Office. We need volunteers like you over there.”

So I went over there and they basically changed my badge over to a NASA badge, and I just kept going. They call me up now for VIP tours. I usually escort the crew families for launch and landings. In fact that’s what I was doing all last week. Saturday I had a call. Would I escort eight busloads of former astronauts and flight directors coming down here? Would I take a bus? I said, “Happy to.” I had Gloria Estefan on my bus, which was neat.

I’ve done tours for Jim [James A.] Lovell and Tom Stafford. Especially if we get any European VIPs, they always like me to do it, even though I don’t speak any of the languages other than English. I’ve been doing that since 1997, and it’s usually at least one or two a month. So I’ve stayed active. I’m still badged as you see. I’ve got more numbers on my badge now than I had when I worked out here. I can go into every operational area, so I’m still involved.

JOHNSON: Is it every area of the Center that you’re able to take VIPs to?

TRIBE: Historical tours on the Cape side, because I worked over there for four years before I ever came over to KSC. I do tours of every facility out here. What I don't do is Delta IV and Atlas V, because they're new, and I never worked with them, so I don't know the background. I handle the lighthouse over on the Cape. I've taken people over to Launch Complex 3 where the first V-2 [rocket] was launched from and showed them the flame pattern on the concrete. I take them over to Complex 12, show them the pieces of Atlas that are embedded in the road over there, when we blew up 9C in 1959. Where the lighthouse used to be before it was moved, and where it was before that. There's three different sites where the lighthouse has been. Where the Vanguard blew up, that iconic picture of the Vanguard toppling into the flame bucket and the nose cone falling off.

I had a Canadian guy one time that came down that wrote a book on the Cape. He and I spent all day out there just roaming around the sights. It's neat. Complex 14 where John Glenn launched from, the guy that pushed the button that launched him was Tom [Thomas J.] O'Malley, who was my boss all through Apollo and into Shuttle. When Tom died he wanted his ashes put on Complex 14. There's not a recognized way of doing this, so we just did it. His ashes are out there underneath the Mercury Monument right out in front of Complex 14. Funny afterthought of that was when he launched John Glenn, there's a button he pushes at t minus 18 seconds on an engine panel in front of him. If you ever listened to the countdown, that last half minute before, it's always, "T minus 18 seconds, all recorders to fast, engine start." He punches that button, and that starts the 18-second sequence that launches the Atlas.

He wanted that button as a souvenir, you see, so he told the blockhouse monitor. He said, "Pull that button out of that panel." The panel wasn't a Convair panel to start with, it was a Rocketdyne panel. The guy pulled it anyway and mounted the button in a plaque for Tom. They

presented it to him. The Rocketdyne people meanwhile sent a technician over to get that button. He gets over there and the button is gone. Where's the button? Nobody knows where the button is. When O'Malley died, his wife asked me. She said, "I want this button to go to the Smithsonian [Institution, Washington, DC]. This is the button that launched John Glenn."

I said, "No you don't want it to go to the Smithsonian. It'll get up there and get lost. It's not significant enough for them. It is to us down here. Let's keep it local and put it in the Astronaut Hall of Fame in the John Glenn exhibit. I'll get a letter of authentication put together so we can justify and back up what it is." So I actually got the original blockhouse monitor who is in his 80s now to sign that authentication. I got the NASA test conductor from that launch. They're both up there in years. I got them to sign it. I signed it, and printed it all up. We presented it to the NASA, and that's where it is now, down at the Astronaut Hall of Fame.

JOHNSON: I'll have to go see that.

TRIBE: I'm digressing here a little bit. But there's a lot of history that I've been involved with that I can talk about when I take people over there. Back in January we had [M.] Scott Carpenter, and I took him over to 14. We went into the blockhouse there. I said, "This is where you remember you were sitting when you said to John Glenn, 'Godspeed, John Glenn.'" That was like ten seconds before his launch.

JOHNSON: I'm going to ask you a few more questions if you don't mind. Getting back to Shuttle, the Shuttle landed in the early years more in California than at Kennedy. Was there a

big difference in anything that you were involved in as far as—I know with White Sands obviously that caused some issues—but between California and here.

TRIBE: The problem was we had to be ready for it. When we were the operational guys before SPC, we had to have people out there on a contingency basis, so you've got to worry about getting your people out there. Then when you're out there you've got to work twenty-four hours, three shifts, or two twelve-hour shifts. Of course it impacted the turnaround down here, because you lost that couple weeks involved in getting the vehicle safed and ready to put on the 747 [Shuttle Carrier Aircraft] and fly it back. I went out there a couple times on recoveries. I can remember one time we had a leaking forward RCS thruster in flight, and we had to drain the manifolds before we put it on the 747. I'd hooked up to the vehicle, and I was not in a SCAPE suit, I was in street clothes, draining oxidizer out into a barrel of decontaminant out there on the desert floor. I didn't have enough decontaminant to handle the amount of oxidizer that was coming out, so it was starting to boil and get really hot. The barrel was too hot to touch. I'm standing there and this great red cloud of oxidizer is going downwind.

The safety guy back there in the control room was saying, "Is this normal? Is this normal?"

I'm saying, "Yeah, this is the way it's supposed to be, Ken, don't worry about it, it's almost finished." I couldn't imagine why so much oxidizer was coming out. We'd figured out how much was in the manifold. About the time I was getting ready to drop everything and run, it finally quit. A lot of the operations you did out there were literally off the cuff because we didn't have the procedures. It was scrambling, writing stuff up quickly. We didn't always have the

right people out there. We had to make do. It was an impact, but it was not something we couldn't handle.

JOHNSON: As the program went on though, did you get the right people and everything out there and everything went smoother?

TRIBE: This was STS-4 I was talking about. It was the early days. We landed out there fifty-odd times. So yes, it became pretty smooth. The procedures were established. We were very critical of what we thought was safe and unsafe back in those early days. We got a little more flexible as the program matured.

JOHNSON: You mentioned earlier about writing the computer programs and learning that also. Of course going back to your time when you first worked here, '61 time period until now, until current times, the technology has changed so much. It's not just computers but everything has changed so much. Do you want to talk about that and maybe how it affected any of the processing or anything that you were involved in directly?

TRIBE: Just the technology. Back when I started it was all slide rules. I think I've got six slide rules at home still now. It wasn't that long before slide rules I was still working with log tables even before I got a slide rule. So slide rules all through Apollo into—halfway through the Apollo program we started using a Friden calculator. You probably don't know what that is, but it's about the size of a typewriter. It's just a clunky analog noisy mechanical machine that does calculations. We'd sit there in what we called the old ACE [Acceptance Checkout Equipment]

station over in the O&C [Operations and Checkout] Building with this Friden calculator doing loads on Apollo. I was sitting there going kachunk kachunk kachunk kachunk kachunk kachunk kachunk. Just literally bouncing. Then it would give us this number, which was our load.

At that time towards the end of Apollo we started to use software programs to load gases, to load pneumatics. We started to write up the first ADAP [Adaptive Intercommunications Routine] programs for Apollo. We still didn't have calculators back then of course. We got to where we were getting pretty good at loading pneumatics on Apollo when the program ended, and then we moved into Shuttle.

About '76 timeframe is when the first of the handheld calculators started coming out. Rockwell had a calculator. They built calculators back in those days, and they came out with this great big calculator that the price dropped from $300 to $200 to $100 to $69. I think by the time I bought it it was $69. It was a basic plus, minus, multiplication, divide calculator. It wasn't a scientific calculator. I've still got it. It still works. That was a giant step forward.

Of course when we got into Shuttle with this new software, it was an adaptation. We just moved up from the old ADAP programs with this new technology. Of course the size of the onboard computers as we moved into the Orbiter and moved on down through the program, everything kept getting smaller with more capacity. We went to the glass cockpit in the Orbiter. People say the Orbiter is a 1960s, '70s design. Basically structurally it is, but the guts of the vehicle have really made a lot of changes, the cockpit especially. The avionics is a whole lot more modernized. We could fly the Shuttle for another ten years quite happily. We should be flying the Shuttle for another ten years.

JOHNSON: I know after you had retired and then the *Columbia* accident [STS-107] happened, and you were called back as a consultant after that. You want to talk about that for a moment?

TRIBE: In fact it started off I was supposed to bring a crew family out for landing on that mission. They called me up the day before and said, "We've only got a few coming out. We can handle it in the office. Don't bother." Thank God, I never had to do that. That would have been a nightmare.

My wife and I, it was a Saturday morning. We were just getting up. I said, "Oh, get the TV on. The Orbiter is coming in." We kept waiting. You get the sonic boom where we live in Merritt Island [Florida]. We kept waiting for the boom and nothing happened. We had just one ear open on the TV.

I heard them say, "Hello, *Columbia*, hello, *Columbia*." I forget the words they used now. This doesn't sound good. As soon as the landing time came and went, we knew they were in big trouble. The following week they asked me if I'd come back. I arranged to get the design director for the structural systems on the Orbiter, who had a condo in Cocoa Beach, and retired some years back. I got him back as well, a guy called Sam [Samuel] Kreidel.

He knew more about the tile and the structure on that vehicle than anybody else in the country. We came back and all the recovered hardware was trickling in from Texas and Louisiana. We set up the hangar next to the runway, the X-33 hangar. We started laying all the hardware out over there. Sam said, "What we need to do is build a three-dimensional frame for the leading edge on the left-hand side." By this time we knew where the failure, nominally where it had occurred, because you could trace by the instrumentation the failure pattern.

We knew we had to get into that left-hand leading edge. We built this three-dimensional framework and put what hardware was recovered back in that area. Sam was brilliant at doing three-dimensional drawings of that stuff. Drawing all this out and starting to—he could see the flow pattern into that structure. He almost nailed exactly what leading edge with the RCC [reinforced carbon carbon] on that leading edge, which panel—I think it was left-hand number eight—which one had failed. The path of the ionized gases going backwards, like a blowtorch going back through the wing, until the wing failed and we lost the vehicle. It was about three months of all that that I worked along with lots of other people down here at that time. The *Columbia* loss was another instance of bad management. We should never have got into that position. If we'd just taken one look at that damaged wing using the capability we had at the time, even though it was classified, we could have seen the hole that was there.

When we did the post-accident verification test, when we blew the foam into the leading edge, that leading edge that looked so hard and so strong just shattered into an eight-inch hole. I think that could have been another of NASA's finest hours, like Apollo 13. We could have done something to bring those guys back. Saturday I had Dave [David M.] Brown's brother and mother on the bus on the tour. I had this same shirt on [STS-107 memorial patch]. They said, "Oh, that's so nice that you wore that."

I said, "I thought you might be on the bus."

JOHNSON: That is nice. Do you have any other memories or maybe some things that you share with people when you're doing those tours, or any memorable missions working on the Orbiter that you want to mention?

TRIBE: I tend to dwell more back on Apollo than I do on Shuttle, and back in the early days of the Atlas program. Some of the stories, because they're so antiquated now, people are amused when I talk about the un-air-conditioned office areas over there on the pad in the early days. We'd get the critters, the snakes and armadillos, coming into the office areas. We'd get armadillos stuck under the lockers. You'd have to tilt the whole locker to get them out, because they'd just push down and jam themselves. So if we had that we always hit them with a can of green spray paint, stick a decal on each side of them, and make them look like a hard hat. See all these hard hats running off across the boondocks. I tell stories like that and the rattlesnakes we had back in those days.

Shuttle, it's a little different. I remember so vividly those early days in the '70s when we'd look at concepts for the facilities. You'd have an artist's concept of this Orbiter sitting in the Orbiter Processing Facility with guys in white coats running around with little push stands, like aircraft access steps. Have you ever been over in the OPF? You can't even see an Orbiter. We were so far out with some of those early concepts as to what it really finished up like.

I'll walk people through the OPF. We'll talk about tile at length. A lot of times I'll take them in there. We'll stand underneath the Orbiter and they're still looking for it. I'll say, "That is it." [pointing upward]

"Oh. Wow." Then we'll talk about the tile and the ET [external tank] doors and forward RCS. Anything I can cover on that ground floor.

As far as thinking back on specific missions, I don't know. I remember Glenn's second mission well. I was an escort that time. Steven Tyler [*Aerosmith* musician] was one of the guys there and I got a picture of him literally draped over me. I sent that to my kids back in England along with pictures of Glenn, because I took Annie Glenn out to the launch. My kids just

couldn't care less about John Glenn. "Wow, you got to meet Steve Tyler." Yeah, I'd say, "That's not what it's all about, guys."

JOHNSON: One of the things I thought about when we were talking just a minute ago about *Columbia*. Of course part of what came back with the CAIB [Columbia Accident Investigation Board] was that it was almost a complacency that led to the disaster. You were working with the Shuttle, these processes to turn these Orbiters around, how did you as a manager keep the people working for you from becoming complacent? After you do something over and over and over again sometimes things can get skipped or things get done quicker than they should be done.

TRIBE: The hands-on guys, that does tend to happen. If you've got flow after flow after flow and it's the same hardware and the same procedures. The group I had, we tend to work the off-nominal stuff. We would come into play when we're working material review action, which is where you accept something that's out of configuration. We'd work the unexplained anomalies where you've got something that you don't understand and you've got to rationalize why you can either accept it or why you've got to go look some more. Doing testing that's out of limits.

So it was a little less routine in the world we were in, because we were doing all the off-nominal stuff. We'd have to approve everything they did. So we only worked the interesting stuff. The boring stuff we didn't do if it was just routine. As soon as something went wrong, then we'd get involved. That probably answers your question.

JOHNSON: Is there anything else you can think of that you want to add? Or anything you want to talk about?

TRIBE: I don't know whether what I've said is applicable for what you're looking for.

JOHNSON: It sure is. I appreciate you agreeing to do this today.

TRIBE: I hope I don't get into trouble for anything I've said. They can't fire me anymore.

JOHNSON: No, that's right.

[End of interview]