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THOMAS P. STAFFORD
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is April 23, 2015. This interview with General Tom Stafford is being conducted in Houston, Texas, for the NASA Headquarters Oral History Project. The interviewer is Jennifer Ross-Nazzal, assisted by Rebecca Wright. Thanks again for taking some time to meet with us.

STAFFORD: My pleasure.

ROSS-NAZZAL: We know your schedule is very hectic. I wanted to start by asking if you would talk about the Astronaut Office. If you would describe it for us when you first came here, the camaraderie, maybe the jokes and pranks, the competition between all of you guys, the 16 of you that were here.

STAFFORD: It was very small when I arrived. Of course, this goes back when I was a little boy, when I was five or six years old. I grew up in the dust bowl of western Oklahoma, a little town called Weatherford. The main street was old Route 66, now Interstate 40. As a little kid, when I was five or six years old, this was 1936, '37, I noticed every day during the day two or three giant—what I thought were silver—airplanes would go over. Those were [Douglas] DC-3s, and the first transcontinental air route, American Airlines and TWA [Trans World Airlines]. I'd look

up and I'd watch that, I'd say, "I want to do that." I wanted to fly since I was five or six years old, seeing those airplanes.

I had my first ride in an airplane. A lady instructor, a Taylorcraft [airplane], when I was 15 or 16, at the local airport, which was a grass strip, just a few planes.

ROSS-NAZZAL: Did you pay for that flight?

STAFFORD: Oh, no. No. She just took me up for a few minutes. I just loved it. At the [United States] Naval Academy we had aircraft indoctrination. They'd fly a biplane with floats on like a Stearman, it was a real dog. Climb to 60, cruise at 70 and dive at 80. We'd fly around in [de Havilland Australia DHA-3] Drovers and [Consolidated] PBYs [Catalina], and one summer at the Naval Academy we went to [Naval Air Station] Pensacola [Florida], they put us in the backseat of a [North American] T-6 [Texan]. I loved it.

I volunteered for the Air Force from there. I graduated before they had the Air Force Academy. The Korean War was going on. The Air Force had the first swept-wing airplane called the [North American] F-86 [Sabre]. All the Navy had these straight-wing Panthers, a dog of an airplane. I wanted to go to Korea and shoot down [Russian Aircraft Corporation] MiGs and kill commies. Kind of a cold warrior, I guess.

By the time I got my wings, the Korean War had ended before I got my wings, it was Air Defense in the United States, flying fighter squadron in Rapid City, South Dakota. Then to another fighter squadron. I'd read about the latest airplanes, really airplanes were really getting more powerful, bigger, and I wanted to fly the higher and faster and latest ones. To do that,

you've got to be a test pilot, so I applied to Test Pilot School, was accepted and student one in my class. I stayed as an instructor at the Test Pilot School and as a test pilot.

Meanwhile, after about three years or so, assignment would be up and I'd have to go somewhere else. I always said the Air Force had great technology, and what they were lacking was management. Also, the astronaut group had started. I was ineligible to be in the first seven. I was still in the Test Pilot School as a student.

The Air Force had two or three slots a year at Harvard Business School on how to manage things, so I applied and got one of those slots. Meanwhile, then [President John F.] Kennedy made the commitment to go to the Moon, and NASA started, and I wanted to fly higher and faster. That was going to be the name of the book, and my coauthor said really it concentrates more on the Russians.

I went through, came down to Houston, and NASA was spread out all over Southeast Houston in these rental buildings. We had interviews. I was staying at my mother's house and my wife's parents' house with my wife and two little daughters. I was supposed to go on to Harvard. I had to report in. I called Deke [Donald K. Slayton], he said, "Well, selection has been delayed, you'd better go on to Harvard." Okay.

I got there, I told the landlord, "Look, I'm in the astronaut group selection. I'm going to take it if I get it, but I'll pay you some extra of course." He said okay. He was all for the space program.

I'd been there, and just started Harvard, three days later the telephone rang, and it was Deke Slayton. He says, "Hey, you want to come on the program?"

I said, "Yes, sir." So real fast, I told the landlord, "I'm leaving, I'm out of here."

Then we arrived, and the astronaut group, we were in a building with Dr. [Robert R.] Gilruth and the [NASA] Headquarters management on the bayou called the Farnsworth and Chambers Building. It was the original seven group. John [H.] Glenn wasn't there much. Scott Carpenter wasn't either in my group. Then we moved from there, as they were starting to build the [Manned Spacecraft] Center, we moved out to Ellington Air Force Base. They'd rehabbed some barracks and an office building. It was an adequate office building.

Then of course, everybody had the same systems engineering training on Gemini, and then also got familiarization with Apollo, and started the instruments. It came time for the selection of the first Gemini crew, it was Al [Alan B.] Shepard and myself. We couldn't say anything, there was no announcement. The backup was [Virgil I. "Gus"] Grissom and [Frank] Borman. Then one night we were having a dinner at the Rice Hotel and Shepard came up to me, he said, "Hey, has Deke talked to you about my problem?"

I said, "No, what's that?"

He said, "Well, I've got some inner ear problem, I get dizzy, and I'm grounded. I'm going to be taken off the flight." He says, "I think Wally [Walter M. Schirra] wants to talk to you too."

I went to see Schirra, he said, "Look, here's the deal. Al is out because of his Meniere's disease. But I want to do the first rendezvous Gemini VI." That time would be the first spacewalk, very simple, nothing big like Ed [Edward H.] White did. Just stand up in the hatch with a double length hose and move around.

He said, "We'll be backup for the first Gemini flight, then we'll do Gemini VI, the first run." We started out. Gus and John [W. Young] were the primes for Gemini III, a three-orbit mission, then Wally and I were the backups. We lived with that spacecraft that we had put

together in Saint Louis [Missouri, McDonnell Aircraft Corporation]. We'd leave every Sunday night or Monday morning to Saint Louis, come back on Friday. Sometimes we would spend a couple of days a week here, but it was practically Saint Louis, Saint Louis.

ROSS-NAZZAL: It's got to be tough on your family.

STAFFORD: It was.

ROSS-NAZZAL: How much time had you spent with Al Shepard?

STAFFORD: We spent a lot of time in the spacecraft doing tests, and making inputs to it changing things, so we were deeply involved with the design. Gus, before we ever got there, he went up, they called it the Gusmobile. He spent, it was nearly full-time. It was a lot like a fighter plane.

ROSS-NAZZAL: Can you explain that? What do you mean that it was a lot like a fighter plane?

STAFFORD: It was small, like a [Lockheed F-]104 [Starfighter], but all the switches and things, it was just like a regular airplane. The Soviets, after we got working with them, we could fly the whole thing from the ground. They had backups where they could do manual and all this, but the ground couldn't do anything in Gemini. All they could do is update the computer for navigation, that's all. Same way in Apollo. We flew the Apollo. The computer, the ground could update the computer for navigation, that's it.

ROSS-NAZZAL: Was that because of the way Gus wanted the spacecraft to be designed? He wanted to fly it?

STAFFORD: It would be like an airplane. We were all test pilots. Without the crew there, it couldn't fly.

ROSS-NAZZAL: What was your involvement? I understand you were working on range safety and communications and instrumentation. What was your focus?

STAFFORD: Every one of my group, and it carried on through other ones, Deke Slayton would assign us to certain things, like John Young had pressure suits. [James A.] McDivitt had guidance and control. I had range safety, instrumentation, communications. I interfaced a lot with the Cape [Canaveral, Florida], and the communications, how that would work, and the various instrumentation modes, telemetry.

ROSS-NAZZAL: Did you find that that was helpful when you eventually flew on Gemini?

STAFFORD: Oh, sure.

ROSS-NAZZAL: Did it pay off in any way, do you think?

STAFFORD: I don't think I had any emergency where I had to use it, but it was a good background, because it interfaced with all the other systems too.

ROSS-NAZZAL: I understand from your book that the commanders got to pick their crewmates.

STAFFORD: Pretty much so.

ROSS-NAZZAL: You were pretty close with Alan Shepard, since you were picked for that first mission?

STAFFORD: Real close. Yes.

ROSS-NAZZAL: Would you talk about your relationship with him and how much time you had spent with him before you were selected?

STAFFORD: I didn't spend a lot of time with him, because we were busy going through systems training and all this. Our personalities, we hit it off good together. Both Naval Academy grads. Our personalities were very compatible.

ROSS-NAZZAL: What about Wally Schirra, when you went to work with him? How was that similar or different for you?

STAFFORD: Wally was a real joker. I take myself too serious, Wally was really fun. Everything that Wally—he can think up jokes like that [snapping fingers]. So it was a good balance.

ROSS-NAZZAL: You mentioned that you spent a lot of time in Saint Louis, not much time here in Houston.

STAFFORD: That was up until we shipped the Gemini III spacecraft to the Cape. After that, the only real rendezvous simulator was a mock-up, a hybrid that they had in the basement of McDonnell Aircraft. We'd work that till two and three o'clock in the morning. See, you had a radar, you had a guidance, and you had the computer. If everything worked fine, you could just follow the maneuvers it would tell you. The ground would call up maneuvers too. But what happens if you lose your radar? What happens if you lose your platform? What happens if you lose the computer? We worked up all these procedures, and that's where I really got deeply into it.

ROSS-NAZZAL: I found that interesting in the book, because today, astronauts have trainers and they have people who write up checklists and cue cards, but it sounded as if you were writing the procedures.

STAFFORD: We were writing the checklist as we went. See, things have gotten rather sophisticated now, the computers. Our computer, the only one that had a full readout was on the right side. Like the orbital velocity, you'd hit it, it would come up like a slot machine, pa-ting, pa-ting, pa-ting, pa-ting, pa-ting. It wasn't a big readout like now. The commander had three-digit things for X, Y, and Z for velocity change. He had to maneuver. But I wanted to have a chance to be able to fly it too, with a center stick. So I got them to put in a maneuver controller on the right side. Did you hear about the Stafford bump?

ROSS-NAZZAL: I did, but tell us about it.

STAFFORD: We had the Gemini spacecraft, the mock-up. It was on two big rollers, and it rolled to the vertical position. When they did that again, I had this problem with my back, scoliosis. I was a little over six feet tall. Oh, my back would really hurt, and I couldn't figure it out; McDivitt had the same problem. I don't know why people hadn't thought of this before, they got a plywood mock-up of the ejection seat, and they measured us like this, and measured us like that [gesturing]. From this position, everybody's different. From my buttocks to the top of my head, when I went from here to here, I shrunk about one and a half to one and three quarters of an inch. McDivitt was two and a quarter. He had a longer trunk. You're okay when you're like this under one G [force of gravity], you go like this, it was like zero G. We said, "Gee, ought to be some way we could do something." You couldn't change the outer mold line because of the heat influx.

But the hatches were real thick, less insulated. So they were able to put a little bump, and it was to take out some of it, not that much. Just a little bump. They did that for all the rest of the spacecraft, on both sides, give you a little more room. But Gemini was cramped, you couldn't put your feet together in the footwell. On launch, your feet were back in the stirrups on the ejection seat. Then in flight Gemini they were down like this. I had to ride with one foot on top of the other. You could have never hacked it in one G, but in zero G. Then the same with the window, it was right here in front of your face. You could have a big window like that, far away, or you have a small—of course, Gemini was so small, we were limited in what the Titan II

could do. Weighed about 8,000 pounds, the total. That was the total weight. That was the service module and the retro module and the reentry module.

It was also the first spacecraft to ever use fuel cells. Those were General Electric fuel cells, they weren't working too good, take pure hydrogen, pure oxygen, give you water and electricity. They weren't ready early, so Gemini III was three orbits, had batteries, Gemini IV was four days, batteries. Gemini V was eight days, so it had fuel cells. All of the membranes get poisoned in the type we had, and they slowly degrade. The Gemini VI was a one-day mission, we had batteries. From Gemini VII on, it was two weeks, VII, VIII, IX, X, XI, and XII were all fuel cells. By the time they got to Gemini XII, they were finding little improvements to make. Apollo was a completely different type of fuel cell.

ROSS-NAZZAL: I'm sure they improved on those.

STAFFORD: Oh, yes. Today we'd use solar panels. You see, solar panels weren't that effective then.

ROSS-NAZZAL: Would you talk to us about the training that you participated in with Wally Schirra, for your mission?

STAFFORD: Of course, we had one or two practices in the water tank for water survival. Then they had us—because we had ejection seats. Then we got towed behind a pickup truck with a parasail inflated up to about three or four hundred feet, then let it go bang, and the rope was stretched. This was about half of the opening shock of a parachute, then you'd come down and

drop the lanyard, get ready to do the parachute landing fall. Then it had us over in Galveston Bay on a big, powerful Chris-Craft racing boat. That could tow you up to about 700 feet, you could look down, you could see the buildings in Houston, then boom, they'd cut you loose and real fast you had release this and pull your life preserver under arm, deploy your life raft and all of that. Then you come down and get in the water, and then you'd get into the life raft. I did that twice. Most of the time was spent in the simulator. For the rendezvous, we spent so much time in the really high-fidelity [simulator]. But it was made out of cardboard and plywood, up at McDonnell.

ROSS-NAZZAL: I've read that, and to me that's fascinating.

STAFFORD: Yes, it was kind of funny, too, Mr. Mac [James Smith McDonnell] was a great guy. He loved the astronauts, he'd do anything for us. But there was an analog digital setup he had to support it. Every afternoon at three or four o'clock—his brother was president of the Boatmen's Bank, one of the biggest banks in Saint Louis. They'd shut the computer complex down and they'd rent it out to Boatmen's Bank. We just weren't getting there. So he would have us over to his house for dinner occasionally. We went over, he always stuttered, he had a little black book. We said, "Mr. Mac, we can't guarantee we can do this rendezvous unless, we've got to have this computer complex really full-time to work these things out. We just can't stop at 3:00 or 4:00."

The next day, David [S.] Lewis—later became chairman of General Dynamics—came over, said, "Mr. Mac wanted to let you know you got the computer as long as you want." The whole thing. We'd take shifts and we'd work till two and three o'clock in the morning, working

it out. We'd just do run after run after run, working out these charts and nomographs. What we worked out were—here we're in a normal kind of a basket of velocity vectors and position, you could do real well, it depends what mode you're in. When the real rendezvous occurred, I got the lock on, I went through my charts and things and figured it out. I had the solution before the computer. Then the ground called up, and I told them they were right.

ROSS-NAZZAL: All that training had paid off?

STAFFORD: Yes.

ROSS-NAZZAL: Did you finally migrate into something beyond the cardboard and plywood that you had?

STAFFORD: Well, yes. We finally got it going better and better and better. It wasn't a real star field, it was just symbolic stars. But it got better and better and better.

ROSS-NAZZAL: Did you have to convince Deke Slayton or Bob Gilruth that you needed something more high-fidelity than what you had? Did they come over and watch you in these simulations?

STAFFORD: Well, we'd talk to Deke, and of course simulators were under Flight Crew Operations. Those people, we'd tell them. Riley [D.] McCafferty was the Chief Training Officer, and we'd tell him, and they were working on it, they knew the shortfall.

ROSS-NAZZAL: Would you talk about launch for Gemini VI, that first attempt?

STAFFORD: I had two attempts, we made it on the third time. First attempt, we heard the countdown, it was going to launch off of Pad 14, where the Mercury astronauts were. We could hear it roar off the pad, and 90 minutes later, when it came across the Cape, we were going to go. We heard it roar off, but it never showed up over Ascension Island. What happened, the Air Force really goofed this one. The Atlas worked fine. When they fired the Agena, for some reason—well, in a liquid rocket engine, you always lead in with fuel and then follow it with oxidizer. You always shut the oxidizer down first. You don't want an oxidizer-rich shutdown, you'd have an explosion. [Wernher] Von Braun learned this back in Deutschland in the V-2 [rocket]. But for some reason, the Air Force put a quarter or an eighth of a second oxidizer, which is N2O4 bleed-in, and it blew. Now what do we do?

We had a few drinks, we were stuck up there. In fact, it was Walter [F.] Burke came up with the idea, he said, "Look, we've got Gemini VII scheduled for 14 days. If we can take VI off the pad and put a transponder on VII, we can't dock, but we can demonstrate the rendezvous." You got to remember, the whole thing, we're building this big building at the Cape, with the giant Saturn V, the Lunar Module, Command Module, all based on doing a rendezvous around the Moon. Nobody had ever done one. That was critical. Everything was based on rendezvous.

It proved to be very difficult, and all this, it could really be a bear. It turns out, what we originally—you know what a Hohmann transfer [orbit] is?

WRIGHT: If you could explain it for us?

STAFFORD: That's the most efficient thing to raise your altitude. You're down here, your horizontal posigrade, 180 degrees later you'll raise your altitude, if you do one foot per second around the Earth, it will go up about half a mile. But there can be big variations. One of the people in Flight Dynamics, Ed [Edgar C.] Lineberry, had seen this open article by a Russian, and he showed it to us. It had diagrams, it was called "The Concentric Method of Rendezvous." It had all this Russian—I couldn't read a thing. I could see the diagrams and look at that. We all said, "It sounds interesting," so we got it translated. That's what we used and still use today. Now, we modified the very final portion, where we went and made it easy, when you got to a certain point. You start in lower, and you keep raising your altitude and then be sure you don't get out of plane, because that could chew you—of course, you're doing 25,700 feet per second.

If you get out of plane, that vector, to get it back is tough. You use a lot of fuel. You do this at nodal crossings, in planes. So anyway, got that. When you got to about 27 degrees, and you're tracking the target, you're lowering all of the angular rates faster, so you track it. We worked out this was a little bit different from what he had. You thrust at the target, so you'd come like this. What we had from here on up was inertial, and do it just before sunrise or sunrise, so you still see stars in the background. With that, it was like flying an instrument landing system [ILS]. You know what an ILS is?

ROSS-NAZZAL: No.

STAFFORD: You have an instrument here with crosshairs, if this moves to the right, you bank to the right, or if this moves up, you pull up. Simple. So it was like an ILS, instrument landing

system. As you're coming in like this, inertia, in other words, you're fixed with respect to the stars. Right before sunrise, that means the bright stars would still be there, and you'd see the target. If the target moved left, you moved left. If it moved up, you moved up. It was really simple. Really, you'd come in, if you didn't do anything, you're thrusting like this. You give it an up vector plus plus. So if you didn't do anything, you would do that.

ROSS-NAZZAL: How did you practice that on the ground with your simulators that you had?

STAFFORD: We practiced it on the simulator, it's in the equations in the simulator. Now one thing we did on the middle of a back road out there somewhere, one of those back roads all built up now, we had a plywood Agena. We would come at it this way, 90 degrees to it, and try to judge. You were always about the last couple of hundred feet, the radar wouldn't be too good. We were always off by about a factor of two for distance, at the very last.

ROSS-NAZZAL: Did you train to do it so you weren't relying on the computers themselves?

STAFFORD: Oh, yes. That's all those charts we had. The charts, and we didn't have the computer. We had the range and the inertial platform. The toughest thing was—or if we had to—was losing a platform, that was a bear. If we lost the radar, and we could angle-track, we could do it. The easiest thing is just losing the computer, because we had radar and we had the angles. The next one down is if we lost the radar. Losing the computer was the easiest, because we still had the radar to tell you how far you were out, and the rate you were going, and then you could angle. When you got within about 70 miles, you could see it, because you always—except

if you go in the complete nighttime. They had a flashing strobe on it too, you could see that from about 20 miles out. The worst thing is if you lose that platform, because then your reference, exactly what degree do you make the angle of thrust. We worked all these out in the charts.

ROSS-NAZZAL: It's amazing.

STAFFORD: It's what they still use today, exactly, except they didn't do it now for the [International] Space Station. They do a phantom rendezvous, come up and do a phantom rendezvous, like, here's your Space Station, with your solar panels. Say it's going this way. They come up and you do a rendezvous about three miles behind to a phantom point, and stop. Here's the Space Station. Then, you just push a down vector so many feet, a few feet per second. If you didn't do anything relative, you'd do this type of thing. You come ride her from below. All you got to do is thrust down, at very low brake, see. We started braking 25 feet, see, as the target is going like this, you're braking in a posigrade manner. The vector is going this way, so you're braking. You're still inertially aligned with the stars.

WRIGHT: You make it sound easy.

STAFFORD: We did a lot of work on it.

WRIGHT: It sounds like it.

STAFFORD: Everybody still uses the same thing, I hear. Then only they just use, it's called a phantom rendezvous, and it would go around.

ROSS-NAZZAL: It's amazing. You had mentioned something in the books that I thought was interesting, is there was always an astronaut at liftoff for Gemini in the blockhouse called Stony.

STAFFORD: Oh, yes, yes, yes, yes, yes.

ROSS-NAZZAL: You had to say, "Liftoff."

STAFFORD: He's the only one who could call, "Liftoff."

ROSS-NAZZAL: Why is that? Why was that important?

STAFFORD: We had a TV camera aimed at the base of the booster, and only he was the one who could call, "Liftoff," when he saw first motion. Agena vehicle blew up, we put the transponder on VII, launched that. We were to go nine days later. Wally and I were all set to go. Also, he said if the clock starts, boom, the clock starts and the computer goes, it means that disconnect plug on the base is pulled out, and you have lifted off, you got to eject. We got T minus three seconds, started to shake, rattle, three, two, one, zip, it shut out and zero. The clock started, computer started.

It was Wally's responsibility to pull the ejection seat, my responsibility to back him up. We didn't do a thing. We had lots of simulations of hold kills, but none exactly like that. But

we knew in the seat of our pants that we hadn't lifted off. We also didn't know about 100 percent oxygen, we were about 16 psi [pounds per square inch]. We had been soaking like that for two hours. Shoot, if we'd fired that, bang, pyrotechnics, open the hatches and snub them, fire the rockets, boy, you'd see two Roman candles going up. But three, two, one, and Al [Alan L.] Bean was our CapCom. There wasn't a word said, and that's exactly the right thing to do is don't say a thing. Bean didn't say a thing.

ROSS-NAZZAL: I'm not sure, though, why it was important to have someone there to say that you had lifted off the pad. Was it just so then you would know you had to eject? Was that the whole purpose behind that person? I know you served in that role yourself.

STAFFORD: No, it was just another positive indication that you had lifted off. They said you're supposed to have 50 pounds' pull, some wire you break like that. The high speed camera showed, and it started going, and this plug just fell out. That, in a way, helped save our lives too. And here's the thrust chamber pressure building up. Then when that plug fell out, just to stop things before it shot out, and here, there's two engines on Gemini. Here's one, and here's the second one. They noticed the second one did that. Why didn't this one do that? Then they found in the gas generator, every engine has—pump your fuel and oxidizer and you start with a pyro charge, then it takes fuel and oxidizer into it, burns that.

Well, they all had it covered with dust caps, the hose, everything, keep everything clean. In installing it, in the gas generator on the engine, you're supposed to hook up the fuel and the oxygen, take those things off. Some technician—you're supposed to have a buddy system. I forgot what happened to him, whether they filed charges against him or what, but here was a cap.

He just screwed the fuel line right in on top of it. The pyro spun on this engine. It built up, and then there was no fuel flowing into it. Down it came. We went out, found the problem, worked on it, fixed it. Three days later, we lifted off, finally.

ROSS-NAZZAL: Yes. What did you guys do for those three days at the Cape?

STAFFORD: We'd go to the simulator.

ROSS-NAZZAL: Just more work?

STAFFORD: Have a drink, work out. I designed the gym. The astronaut gym at the Cape, I designed that.

ROSS-NAZZAL: Oh, did you? I didn't know that.

STAFFORD: Yes, in the O&C [Operations and Checkout] Building, when it was built, in the astronaut quarters, I liked this health club that this person let us—we were kind of rock stars around here then. He invited us down to work out at his gym free downtown. It was a posh gym. So I designed a little gym up there around his.

ROSS-NAZZAL: What are your memories of the actual launch of Gemini VI-A?

STAFFORD: Counted three, two, one, zero, and Al Bean called, "Liftoff," and we felt a slight pressure on our back. You can hardly feel liftoff, well, the whole thing was vibrating the pad, and then the bolts blow, become a free body. The vibration goes down some, it always goes down a little bit, and off you go, and into liftoff. Then the Gemini was a real sporty ride, you're in orbit in 5 minutes and 35 seconds.

ROSS-NAZZAL: That's quick.

STAFFORD: The big Saturn I flew to the Moon with is 11 minutes to orbit, three stages, and they only use a little of the fuel on first stage. The small Saturn for Apollo-Soyuz [Test Project] was about 10 minutes. But this was built for a Mark VI warhead that had a nine-megaton weapon, you get up out of the silo and go. What was really unique was when we'd go up to nearly six Gs when we staged. To be sure that this thing is staging, and put a weapon, if you look at a picture of Gemini you'll see some holes, rectangular holes on the side. When you give the signal to the engine of the second stage, about an instant, milliseconds before they blow the thing, well, it doesn't matter whether those bolts blow or not. They had a camera on board, so they were seeing the camera film, then they parachuted out, boy, you see all those pieces fly. So the fire went down this dome on the second stage, out through these holes, enveloped the whole spacecraft, it flew through.

Then the second stage was real quiet. Practically no vibration. You knew something was going on back there, but then just like a nearly invisible force, just kept going up, up, up, up, up, up. Finally, right near the end, you went from eight Gs, nearly eight Gs to zero G in a tenth of a

second. Then you could feel, right to the last, you could feel it like that, to match the vector. It was a hell of a ride.

ROSS-NAZZAL: Tell us about that rendezvous, that was such a historic accomplishment for that mission.

STAFFORD: Oh, yes. You've seen the pictures from Gemini VI that we shot of VII?

Again, this was just laid out planning, where I was to do the first spacewalk. We were taking double length hose and you had to stand up, and around a little bit. Nothing fancy, no chest pack or anything. [Russian Cosmonaut Alexey] Leonov, he goes out on the [March] 18th [1965], and we launched [Gemini III] on the 23rd of March. We didn't know, because it was way down in the boondocks. They had wolves out there yelling, clawing at the spacecraft, and we didn't know anything about that. It was the next day they finally got skiers, and a helicopter came in and dropped skis to him so he could ski out.

We were sitting around the crew quarters, I forget, we saw it was only a couple of times, they got back, it was the 19th, maybe the 20th, it was only just a couple of days, one or two days before the launch. Here it's on TV shows Alexey floating around. He said, "See, I pushed off." It looked like no problem. Well, I didn't know he nearly got killed out there. His suit ballooned, and he had a heck of a time getting in. They had a feature in their suit that was better than what we had, we never put it in. Maybe some of the later ones, I don't know. But he could let pressure out of his suit, which was—you've got to watch what you're doing. He let some of the pressure out of his suit. He was built like an ox too, he barely made it back in. He told me that

one night at a Georgian restaurant, training during Apollo-Soyuz. First anybody's ever heard what happened to him.

There was two Voskhod missions. They were basically the Vostok vehicle, but they had those three people in at one time. They didn't have ejection seats. Yuri Gagarin, [Gherman] Titov, Valentin [Lebedev], [Andriyan] Nikolayev, all those people. They had an ejection seat pointed up, somewhat like Gemini. You could eject on the pad, going up. I asked him, I said, "Hey, you and the first crew had three people in it, and then when you and [Pavel] Belyayev went," I said, "you didn't have ejection seats." I said, "What did you do?"

He said, "Yes, I talked to Sergei Korolev about that." He said, "Yes, for about the first 20 seconds, we couldn't have made it. I was talking about that. He said, 'Alexey, don't worry, they'll give you the Hero of the Soviet Union.'" That's the only time that I know that the Russians flew those two missions, where they didn't have a way out.

But you look at our [Space] Shuttle, we had no way out. I was always very critical of that. A lot of us were convinced, at least the [Space Shuttle] *Challenger* crew [STS-51L], if it had something like as simple as the YANKEE [Extraction] System like we had in the [Douglas] A-1E [Skyraider] in Vietnam, the ejection seat or the Yankee system we could have gotten them out and glide back in. But the [Space Shuttle] *Columbia* [STS-107], forget it. It came apart at a high Mach number in heat. Then we started writing, Joe [H.] Engle, myself, I forgot who called us about it, "Why don't you read the specs for crew safety?" I said, "From the time you close that hatch on until you get into orbit, you need a safety number like we had on Apollo." It was designed for four nines, 0.9999. I don't know how meaningful it is actually at past three nines.

WRIGHT: Did you feel pretty confident when you launched in the Gemini VI that you were going to fulfill your mission and be safe doing that?

STAFFORD: Yes, see, it was an SR-71, the Blackbird, ejection seat model. But we didn't want to eject, because we knew your back would get a heck of a jolt. Do you know what a dead man's curve is?

ROSS-NAZZAL: No.

STAFFORD: It came from flying helicopters. If you get down to a certain height in a low speed and the engine quits, you can't autorotate. You might ding the skids, or you might kill yourself. It was something that you were going to do some damage to the helicopter or yourself. That area is called a dead man's curve. We had that on Gemini, and they'd have everybody calibrate, I think it was myself, maybe [Charles] Pete Conrad had the fastest reaction. In other words, you'd see the light, the thrust chamber light, "Boom." It's about from the time you see something and react and pull. Mine was 0.38 seconds, a little over a third of a second. Then of course the whole thing is starting to fall. Here you are, about 300,000 pounds of hypergolic propellant, boom. We knew we had a dead man's curve of probably—because see, you pull that, and the pilot would have to fire, open the hatches, fire the ejection seats. Probably about three quarters of a second. It's not too much, but that's the most critical time.

Also, they said you could eject up to 70,000 feet, but all of us said, "Hey, no way." After we went supersonic, when we got to about 35,000 feet, 40,000, we just let go of the D-rings, put them down. We had the D-ring here, and we figured what would happen, we could shut the

engines down, the commander could pull inboard, like that. That would shut the engines down. Do like that, bang—that would separate the service module and fire the retros. We would fire the retros [rockets] and jettison the retro section. Then just let it fall down. Then throw out the drogue chute. If the drogue didn't work—then of course, the main [chute] has come out at 10,000, that didn't work, then boom, you'd blow yourself out. There were ways to get out of it. In Apollo, it was the big launch escape rocket on top, which gave you about a 10.5-G ride for about two and a half seconds. That would throw you over a mile in altitude and downrange.

But in Apollo, we were safe. I felt safe, all the way out.

ROSS-NAZZAL: Did you feel safe in Gemini with the ejection seats, or you weren't so sure because of that pure oxygen?

STAFFORD: Well, I felt, except for that first second or so, there was something we could do.

ROSS-NAZZAL: I did want to ask you, there were a lot of tragic events that happened during the Gemini Program in terms of crew members who were flying [Northrop] T-38s [Talon], like Theodore [C.] Freeman.

STAFFORD: Ted Freeman, who was a real good friend of mine. I was looking back, he was a student of mine at the Test Pilot School. I knew Ted real well, he was also a Naval Academy grad. He could easily have been one of the ones that Deke Slayton came to me for Gemini IX, said, "Who do you want?" I would have probably took Ted Freeman, because I knew him, and

knew how he worked and everything. I knew Charlie [Charles A.] Bassett real well. He was a student of mine.

ROSS-NAZZAL: You seem to have a lot of relationships with folks who were in the Astronaut Office, in some way, having either been with them in Test Pilot School, or been their instructor.

STAFFORD: John Young and I go back to 1949, to the battleship *Missouri*, after your first year in Naval Academy, a midshipman cruise to Europe, and ROTC [Reserve Officers' Training Corp] people. John Young was in ROTC at Georgia Tech [Georgia Institute of Technology, Atlanta], we were both two decks down below the main deck, and had about 30 midshipmen, we had lots of midshipmen. Also, John and I were on the same gun crew, for five-inch 38 twin guns. I'd met John, and we got along real good together. The next time I saw him was I was back at Pax River [Naval Air Station Patuxent River, Maryland] and he was a test pilot, I was an instructor at the school. I talked to him, and then the next time I saw him was when we were selected as astronauts. Everybody had to take a fake name, I used the name Max Peck.

WRIGHT: Max Peck?

STAFFORD: Yes, that was the name of the manager at the Rice Hotel. I walked in, I had security with me. I had gone to Harvard, and I stopped off in Wright-Patterson [Air Force Base, Ohio], saw Ed White, who had been a student. He was at [United States Military Academy at] West Point the same year I graduated the Naval Academy. Saw him at Wright-Pat and then went to Boston for a while. Three days, turned around and stopped at Wright-Patterson, saw him again

on the way back. No, wait a minute, did I see him? Yes, I did too, because I flew down to Houston and back, and then of course it was announced, and I saw him on the way back.

ROSS-NAZZAL: How did that influence the Astronaut Office, having been friends, or an instructor-student relationship with some of those guys, when you got down here?

STAFFORD: I had Charlie Bassett, Ted Freeman were students of mine. Jim [James A.] Lovell was a classmate of mine from the Naval Academy. Pete Conrad was a good friend, I met him because he was head of the Performance Section of the Navy Test Pilot School. I was head of the Performance Section of the Air Force Test Pilot School. I used to go back there and I'd fly Navy planes, and he'd come out to Edwards [Air Force Base, California] and we'd talk back and forth about the manuals we'd write, and all of this. I knew Conrad before. I knew Jim Lovell real well, John Young had been with me on the battleship *Missouri*. Pete Conrad. Neil [A.] Armstrong I'd met, but didn't really know him. Let's see, McDivitt was a student of mine, and Borman was a student of mine even though he's a couple of years older. So one, two, three, four, five—we had nine people. Elliot [M.] See I didn't know. Who did I miss out of my group?

WRIGHT: Did you count yourself?

STAFFORD: Oh, no. That makes nine.

WRIGHT: Did you know him very well?

STAFFORD: Yes.

WRIGHT: Deke called you about all of those guys then, I take it, and asked you what you thought of those guys? No? He didn't call you for recommendations?

STAFFORD: For a reference?

ROSS-NAZZAL: Yes.

STAFFORD: No. When we saw each other, we knew we were in the finals, because we had a big group. I don't remember who else were in the finals, but they had more than nine in the finals that met down in Houston. We weren't all together at the same time, we'd get different batches to come.

ROSS-NAZZAL: It made it pretty easy when you got here to Houston, you all had some sort of—not all, but most of you had some sort of relationship before then, so it was pretty easy to work together?

STAFFORD: Yes, I knew McDivitt, I knew Borman as students. I knew John Young from the battleship *Missouri*, I had seen him before. Pete Conrad, Jim Lovell. See I didn't know. Neil I had met, but didn't know him well.

ROSS-NAZZAL: There was a lot of camaraderie there, before you even got here.

STAFFORD: Yes.

ROSS-NAZZAL: Was there a lot of competition between all of you for flights?

STAFFORD: Of course.

ROSS-NAZZAL: Would you talk about that?

STAFFORD: No. We didn't talk among ourselves, just everybody worked hard. Deke and Al made a decision.

ROSS-NAZZAL: Would you talk about Deke's leadership in the office, and how he helped to shape that office?

STAFFORD: Oh, yes, Deke was tremendous. Had great integrity.

ROSS-NAZZAL: Did you guys ever play any pranks on Deke Slayton?

STAFFORD: I don't think so. We played—well, first, we played pranks on each other—I don't think we were—the occasion didn't come up. I can't think of any. Maybe we did. I know the original seven played around a lot. Shepard and Schirra and Gordo [Gordon Cooper] were always pulling something off. Our group didn't mess around.

ROSS-NAZZAL: You were a more serious bunch?

STAFFORD: The original seven, they were very friendly to us. Gordo Cooper, particularly since we were both from Oklahoma.

[pause in recording]

On that EVA [Extravehicular Activity], as soon as Leonov did that, we had to react. It was really amazing the way our program drove their program. Do you know, I could talk a lot, and while I was to do the first EVA, we had to respond, so real fast, they kludged up this umbilical, a squirt gun, and this chest pack for Ed White. Ed nearly got killed coming back in. His heart rate went to 220. His suit ballooned, but see, it ballooned this way, besides this way. He couldn't get the hatch closed. He finally got it closed. I think Ed was out 22 minutes, Alexey was out 12 minutes.

The next one coming up was going to be Gemini VIII, but they had a roll thruster, that was a close one. Have you talked to [David R.] Scott?

WRIGHT: No.

STAFFORD: Did you ever talk to Neil [Armstrong]?

WRIGHT: Yes. We did get to talk to him.

STAFFORD: Good, because that was a close one. We had two close calls in Gemini. That shutdown on Gemini VI, and then the spin-up on Gemini VIII. Scott was fairly tall too. They came up with an invention after Gemini IV, very simple. It was an aluminum I-beam about this long you would hook to the hatch, then here you had a steel cable you hooked over here. The commander could take it and do this over the center, so it was a crunch. That's what got [Eugene A.] Cernan in. The hatch was about that far, he couldn't get the hatch closed, where he could ratchet it on. Thank God we came up with that device. Then it was after Gemini IX, we started thinking, well, how can we be better simulate walking and working in space.

ROSS-NAZZAL: That was a pretty bad spacewalk that you had on your mission.

STAFFORD: Have you read Cernan's book?

WRIGHT: Yes. I did read about Cernan. It still makes my toes tingle.

STAFFORD: You've talked to him?

WRIGHT: Yes, we have.

STAFFORD: Good.

ROSS-NAZZAL: That conversation you recorded with Deke in your book about what was going to happen if something happened to Gene on orbit, were you thinking about that when he was out there struggling so much?

STAFFORD: What it is, you focus on the job at hand.

WRIGHT: It was good to be home after that one, wasn't it?

STAFFORD: Oh, will either one forget that spacewalk? It was—Jesus. We were so naive, we didn't even think about putting defog on the visor, like you do when you go snorkeling or scuba diving. He had his old chest pack, I could tell he was—Gemini was a real—it weighed about 25 pounds a suit. When it was inflated, it was rigid, you have to put it out like this, boom. You had to expend a lot of work. Where Apollo weighed 55 pounds, you move your arm and it stayed there.

That was a real tragedy when we lost Elliot. I think Elliot was—he had never flown in weather a lot. I guess I'd never flown with him much, I flew with Conrad—great pilot. But I flew with Wally a lot. Young and I—see, backup [crew] couldn't fly with the prime [crew]. I flew with Ed White a few times. But See was kind of—I think of all the pilots, Deke rated him—he had been at Edwards for years. He hadn't been in a cloud [weather]. He was 60 knots too fast on the final approach. That's why he missed the runway. Then he tried to stay underneath it. Now, Charlie Bassett was an outstanding pilot. He was the second one in his group to be chosen to fly. I think psychologically, he didn't want to tell his commander, "Hey, get the speed down and knock it off, and try to stay in the clouds and bend it around like that."

ROSS-NAZZAL: What impact did the loss of those crewmen have on the astronaut corps? Or were you all just accustomed to seeing people lose their lives?

STAFFORD: Oh, as a test pilot and a fighter pilot, I had a lot of friends killed. But we lost a lot in a short period of time. Ted Freeman was ’64. Then in early ’66, we lost See and Bassett. Then we lost C.C. [Clifton C.] Williams, Beth Williams that owns the building, her husband. It was a brand-new airplane, it had about 27 hours on it. I’m sure somebody left a bucking bar or a screwdriver or something in there, and it jammed the aileron. He bailed out. Then the next was Bassett and See. The next one after that was Gus, Ed, and Roger [B. Chaffee].

At the same time, I had the sister spacecraft, commander was John Young and Gene Cernan, in LA [Los Angeles, California]. We were doing the same test, but we didn’t have oxygen in the cabin. We had air, we may have had oxygen in the suit, but I can’t remember. But everything was bad. There was electrical shorts, the cooling loops were leaking, and all of that. I called off a test, and scrubbed it. We got out, that’s when I found out they had the fire.

ROSS-NAZZAL: What a terrible loss.

STAFFORD: Yes. John and I particularly had talked about having an outward-opening hatch like Gemini, and Joe [Joseph F.] Shea later had a nervous breakdown over it. He said, “No,” he said, “more weight, and all this.” My gosh, all it takes is a pound per square inch, and you really couldn’t open those inside. I saw their suits, and they weren’t burned that bad. They had a few

burns on them. CO killed them, carbon monoxide. They couldn't get the hatch open. When you open the hatch though, all it took was about one, two, three strokes, open.

Then we changed the atmosphere to 60 nitrogen, 40 oxygen. We got into orbit, we were five pounds per square inch. We were at a third of an atmosphere. What makes you function is partial pressure of oxygen in your lungs. Unless you get very low total pressure on your body, so 63,000 feet is when your blood starts to boil. But you can fly at 45,000 feet. That's two pounds per square inch. Sea level, where we are here, it's 2.97 pounds per square inch of O2 goes to your lungs. Once we got into orbit, then we'd blend down to five. Then we opened the valve and started letting air out of the cabin, pure oxygen came in, so within one day we were 99 percent O2.

WRIGHT: Do you want to stop for now?

STAFFORD: Yes.

ROSS-NAZZAL: Okay.

[End of interview]