ORAL HISTORY TRANSCRIPT

FRED W. HAISE, JR.
INTERVIEWED BY DOUG WARD
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WARD: This is our oral history interview with Fred Haise. March 23rd, 1999. Fred, thanks for coming by. You came to NASA from a background, if I read the biography correctly, that had an aviation touch with the Navy, the Marine Corps, and the Air Force. How did you happen to be involved with all of them?

HAISE: Well, it—I went into the Naval Aviation Cadet Program, is the way I entered the aviation business, as an enlisted person, a cadet. And when you graduate and are commissioned and receive your wings…, you're given an honorable discharge from the Navy. Then I served in the Marine Corps for a tour; and, when I left the Marine Corps, I—in reserves, I went to the Air National Guard. So I had a retirement from the US Marine Corps, an honorable discharge. And then during 1961, I was recalled into the Air Force in the Tactical Air Command from the Air National Guard in Ohio for the Second Berlin Crisis. And after that 1-year assignment, I again received [an honorable discharge] certificate from the Air Force.

WARD: Okay. And of course that grew in part, I'm sure, out of your educational background starting in junior college but then on to the University of Oklahoma in Aeronautical Engineering.

HAISE: Well, the path was kind of devious. I got interested in the newspaper business and worked on the high school paper [as] sports editor, then the first 2 years of college I was in Journalism and worked summers for the local paper in my hometown in Mississippi, the

Biloxi-Gulfport Daily Herald. And the Korean War came along, and I wanted to enlist and serve.

And at the time, the only program I could get into that would lead to a commission, which was my primary goal, was the Naval Aviation Cadet Program. So—and accidentally I ended up in the flying business, which I loved. And that changed my whole career path, because at that—from there I went back to school to get an Engineering degree to become a test pilot. And that put me back at the University of Oklahoma for 3 years.

WARD: Oh okay. So did the—was the exposure to flying kind of coincidental? Or was that some deep-seeded desire that you've had since you were a kid?

HAISE: No. It was purely accidental. I had never—when at the time I signed up for the program, I was 18 years old. I had graduated from high school at 16 and [had] had 2 years of college at 18; and like most 18 year olds, I think you jump into things without thinking ahead very much because I had never been in an airplane—even in a commercial airliner. I had never flown at all. I just wanted to be commissioned, to be a commissioned officer; and I began to get a little worried in the preflight part of the program, where many of the other people in the program talked about their light aircraft, private flying experience and I didn't know the first thing about an airplane. But like I said, I took to it and I really loved the experience.

WARD: Flying is sort of intuitive in a sense, isn't it? It's not one of those things that you're necessarily better adept at doing simply because you've had experience. But some people seem to have the knack for it and the rest of us don't.

HAISE: Well I think there's, there's certainly a hand-eye coordination facet that, you know, is true of anything that requires some dexterity that way—be it sports or flying. I guess there's a physiological part of it that's a little different—that's a different experience from the standpoint of the g's you might feel or the tumbling or rolling or those kind of things that are a little different than most.

WARD: Yeah. What sorts of aircraft were you initially involved with?

HAISE: Well at the time I went into flight training in 1952, I did the basic in the old Navy SNJ, which is—the equivalent Air Force would be the Texan T-6.

WARD: Right.

HAISE: And advanced training in those days was the Hellcat, the Grumman F6F, the one that, you know, won fame in the Pacific War.

WARD: Prop and radial engine.

HAISE: Prop—radial. Both of them—both of them prop aircraft that [I] had qualified…shipboard on two occasions. And then to qualify in jets, it was a very short program of, like, 20 hours' conversion into the Navy TV1/TV2 series, which was an Air Force T-33 Shooting Star trainer version. …Going in the Marine Corps, [my] first squadron, was in Banshees, McDonnell F2Hs. The squadron, before I left, had converted to Grumman F9-F8s, the swept-wing Cougars.

WARD: So your associations with Grumman began a long time ago.

HAISE: Well, if you look at the whole flying, I've flown about 80 types of aircraft. So I've had an association with just about every aviation builder...

WARD: You also had, I think, about 7 years of experience with NASA before you came into the astronaut program as a NASA research pilot. I guess (what?) starting at Lewis?

HAISE: That's correct. I had met a fellow in the Oklahoma Air National Guard (in fact, my squadron commander), Stanley Newman, who had earlier in his life had worked as an engineer at Langley, and he was the one that put the thought in my mind that I should become a NASA research pilot. So even before I finished the University of Oklahoma, I was already scouting around, made visits to Langley and Ames and Edwards, which were then at that time the premier flight test centers of all the NASA centers. But there simply were no openings, and there was a long waiting list.

So I ended up applying and being accepted at Lewis Research Center, which had research programs but more catered to testing of systems using aircraft as the vehicles to test new propulsion systems. We carried aloft…Ram jets hung under airplanes. We had a zero-g aircraft facility. In fact we had the second one in the country behind the Air Force at Wright-Patterson, with an old Navy AJ2, where we did early testing to fix the configuration of propellant tanks in the Centaur rocket, where the screens would be, for instance.

WARD: So you were using it for engineering, but later it became a very valuable tool for astronauts.

HAISE: Oh yes. Absolutely. The one we had, just the bomb bay we used for these experiments. [It] was too small for the, really,—the purposes later I experienced when I became an astronaut with the larger 707, where you had a much bigger area to free float within.

WARD: Right. I was of the impression that we didn't happen on to the use of zero-g aircraft until some time during the Gemini Program. But obviously it was for engineering purposes, at least—it was well before that.

HAISE: I think we inaugurated the AJ2 Program in 1960.

WARD: Well, as a NASA research pilot, I'm sure that you had exposure to and knew a number of the astronauts that were selected in groups before you. Let's see: Neil [A.] Armstrong would have been one of them ahead of you.

HAISE: Yeah. Neil, in fact, followed the same path through NASA that I had. Neil was about 2½, 3 years ahead of me. He started at Lewis Research Center then went to NASA's Flight Research Center (now Dryden Flight Research Center at Edwards), and from there entered the astronaut program. And I just—I followed literally the same route, but about 3 years behind Neil.

WARD: Did you find that made the transition from becoming a research pilot to becoming an astronaut any smoother? Was it—was that a particularly good route to go in your estimation?

HAISE: Well, I think in the development—when you're in the portion of a program that's the development program, which it was—still was—when I entered Apollo and certainly for my early years in Shuttle, I think having a background as an experimental test pilot of any sort (be it a company pilot or with NASA) helps in the sense of your being—having experience to be part of… the design evolution of the vehicle. Because that's a role that you play. In the case of my NASA experience, except for the Lifting Body Program I had some participation in, most of it was for the design (if you will) and implementation of the experiments or use of the aircraft, which often required modification.

WARD: Okay. Well, you were a member of the fifth class. I think you guys dubbed yourselves "The Original 19." There were 19 of you. And—

HAISE: That's correct. Nineteen of us.

WARD: —if I did the math right, eight of you flew in Apollo—nine of you flew in Apollo, eight of you went on to also stay with the Shuttle Program. You, of course, did both. Did you reflect on how you happened to get one of those coveted Apollo assignments out of that class?

HAISE: No. I—it was—to me it was a sort of a guarded secret of, frankly, how the crew selections were made, how the mix was made. I assumed it was predominantly between Deke [Donald K. "Deke" Slayton, Director, Flight Crew Operations] and Al [Alan B. Shepard, Jr., Chief, Astronaut Office] and their sense of who played well in the office environment and that sort of thing. We did, at one time, I know did a self-grading. We were asked to do a grading of our 19, with the exception of yourself. But you know, it was—it's really hard otherwise to define any quantifiable means—it was never exposed if there was—of how the mixes were chosen for the various missions.

I think Deke's philosophy was that any astronaut was qualifiable to fly any mission. And it was probably a truth if you look at the backgrounds of the people in the program was pretty close, as I assume a lot of them chosen today are.

WARD: Yeah, but you certainly—if that were the—in fact the selection rationale, you would have expected that it would be more of a seniority, random sort of thing. But there did seem to be a pattern to the selections.

HAISE: Well, there certainly was elsewhere in NASA. My experience at Flight Research Center, I'd hoped to fly the X-15, rocket ship; and clearly within that office, it was on seniority. And when I left Flight Research Center to join the astronaut program, I was still two people away from getting my turn to have flown the X-15. It so happens, I'm glad I left because I would have never made it by the time that program ended.

WARD: Yeah. The program would have run out before you got through the seniority. I suspect that there was—that all things being equal, seniority was a factor with Deke and with Al, but I think there were clearly other elements that played in it.

HAISE: Well, I could see, just from the mixes that there also was some thought, I think, of the—call it the personalities. Not in a true psychoanalysis sense, but just their feeling of understanding and knowing the people of who would play together well. Although I would say for the drive of the mission and accomplishing the mission and the length of time of those missions, you could've probably mixed any three people and—

WARD: Yeah.

HAISE: —just that drive would've pulled them together as a team.

WARD: How much do you think the technical specialties, technical expertise, that each of the crewmembers brought to it was a factor in how they were placed on the different crews?

HAISE: That, I really can't—I don't know. I know that the only selection I know that was a differentiator was weight. You could not—if I recall, you could not be a lunar module pilot and weigh more than 175 pounds. So that was kind of an upper limit, as I recall, for that just because of the criticality—

WARD: Sure.

HAISE: —of the performance of the vehicle to accomplish the landing.

WARD: Well that's right. They were offering big bonuses to the Grumman employees who could come up with ounces saved off the vehicle. So I guess you don't want to trade back a lot of ounces on the vehicle for a lot of pounds on the crew.

HAISE: Right.

WARD: Do you recall in your group of 19, any of the members of that group who were particular standouts in terms of leadership or played a role in leading the rest of the group?

HAISE: Well it just by kind of the way the structure was set up, Ed Mitchell being the most senior and oldest, really, was the designated leader for our original 19. From there, you know, as you said, there were specialties; and when we got initial assignments, everybody kind of went to the winds a little bit in different areas.

Like… Ken Mattingly was the space suit specialist. So Ken spent a lot of time in that effort. Myself, Jerry Carr, Ed Mitchell, and, by virtue of being the test crew for the LTA thermal test, Jim Irwin and John Bull were pretty much assigned to follow the lunar module in that work at Grumman. And, so you did get very segmented in those kind of specialties during a portion of this early part of Apollo.

I mean, a way of putting it is, quite interestingly, Jack Swigert [John "Jack" Swigert, Jr.], who was a North American test pilot at the time he was chosen, spent most of his time with the command and service module development and continued that in his assignments. When he came into the lunar module, when we were airborne on Apollo 13, after he had shut down the command module, that was the first time in his life he had ever been in a lunar module. So his first experience in that spacecraft was in flight.

WARD: Yeah. Of course, we'll get into that a little bit. Swigert was a very late addition to that crew, and that's one of the areas I want to cover with you when we get into the Apollo 13 part of your background. What was your reaction, the reaction of your fellow classmates, when the next group of science astronauts was brought onboard and then, later, the MOL astronauts, both fairly late in the Apollo sequence when it was clear there were not going to be enough flights to go around? How were they viewed? And how did they get integrated into the astronaut corps?

HAISE: Well certainly as far as a view, I had no opinion one way or the other of the science group coming in at that time. I did not look at it (maybe as you're implying) [as] a threat to positions and ensuing flights. As it turned out, it did have an effect in one case. And the MOL astronauts, to me, were later in the selection process, and frankly, some very good people—some of which like Dick Truly, I was in—I went through Test Pilot School with at Edwards, who I knew—were just unfortunately had had a bad situation and losing—having a program disappear from under them with the Manned Orbiting Laboratory Program, were likely too late to fit into the Apollo Program.

WARD: As it turned out, they (I think) all flew Shuttle. And yeah, I think they were all Shuttle astronauts. Of course one of them, as you allude to, went on to—well, several of them went on to high management positions: Dick Truly becoming NASA Administrator.

HAISE: Right.

WARD: So they did very well for themselves. As you came onboard in ’66, the Gemini Program was in its wrapping-up stages. Did you have any direct involvement with Gemini? Or did you go almost directly—

HAISE: No, no.

WARD: —to Apollo activities?

HAISE: Yeah. When I think, if I recall, when I joined the program, they were about to have Gemini VIII, and I had no involvement. We got to exercise some of the simulators, just as part of—call it that first year of (quote) “Indoctrination, the Docking Trainer. ” Those sorts of things. But [I had] really no direct involvement at all.

WARD: As one of the earlier groups, of course, you were going through all of the full gamut of training, including all of the tropical survival, desert survival, things like that, which were later, with the later groups, tended to get dropped. What did that really contribute to your preparation to fly? Was it really more of a team-building kind of an exercise, do you think?

HAISE: Well, it was—survival training is one of those things that you have for contingencies and, frankly, hope you'll never have to use. So, you know, that's the whole basis of—you don't plan to be in a survival situation; if we—if you plan right, you wouldn't be. Certainly there was team-building, but it's pretty much within our original 19 group because that's—as we went through it, for the most part it was exclusively our group that went through this training. So in a sense of a mission crew assignment basis, it really didn't play a role in that sense.

WARD: You—well, we touched a little bit on the technical skills in your background with test flying. But you did quite early on begin, as I recall, to focus on the lunar module as an area of expertise. How did you end up in that assignment?

HAISE: Oh I ended up as a member of the Apollo 9 team under Jim McDivitt. I was a member of the support crew, which we had in those days. And Jim was, I think, worried more about the—getting the LM ready, so he assigned Ed Mitchell and I to that task, to follow the LM through early testing to get them ready to ship to the Cape and, ensuingly, testing that was done at the Cape. And—so that was my exclusive responsibility, was to make sure LM-2 was ready and then, of course, at a point we decided LM-2 was too far afield with the mods [modifications], so we jumped to LM-3 as the real vehicle that ended up flying Apollo 9.

WARD: At that point, was 8 still envisioned as a lunar module mission?

HAISE: When I—well, you mean, when I was assigned to—

WARD: Yeah.

HAISE: —it? When I was assigned to Apollo 8, yes, it was a high-orbit rendezvous (I think 4,000 mile apogee) with a lunar module. And we—I don't remember how long we were in that training (probably a month) when the decision was made by NASA management to forget the lunar module (it wasn't going to be ready) and turned it into a lunar mission using only the command and service module. This incidentally was the toughest training cycle I went through of the four in Apollo as far as the time squeeze to get ready.

WARD: Getting ready for a lunar mission on 8?

HAISE: On 8. Yes.

WARD: That was an almost audacious decision, looking back on it, in the standpoint of the NASA managers and engineers who had to make that decision. How did you get involved in that? What—at what point were you aware of what they were thinking about doing?

HAISE: The only way I got involved in the decision was providing some of the background material. I worked with Charlie Mars, who was under Ted Sasseen and the test engineering for the lunar module operations at NASA-Kennedy. And at that time, LM-3… had arrived at Florida. …We made up a case, if you will, which Charlie presented at a meeting in the Headquarters building at Kennedy, of all the shortcomings in that vehicle, of the things that weren't flight-worthy that were a number of items… in that vehicle.

So we didn't even have it up to flight [status]… all the components weren't there that you needed to fly. And we were involved in this testing to meet a schedule that was just impossible. And so it was really just a little help [with] that background, the information that was presented, that I think made it clear to NASA management… that they either had to slip the schedule or go to this alternate mission.

WARD: Was there any particular thing that was holding the LM up? Or was it just a matter of a whole bunch of things and getting it—getting all these systems developed and integrated into a flying vehicle?

HAISE: Well, it was a combination of things, …problems with the deliveries of subassembly components, of flight components. There were lots of problems in qual tests [qualification tests]. There were lots of mods [modifications]. There were lots of changes in the vehicle that were driven by, you know, engineering and in conjunction with NASA Change Boards that we literally were trying to test vehicles hot. They were live while people were in the back of the vehicle cutting wires and soldering and making mods [modifications] to wiring and other bundles you weren't using in that test, …

WARD: Testing was going on—

HAISE: —so it was a very bizarre environment at that time.

WARD: Was the problem that they were having with the injectors for the ascent engine a particular factor there? Or did that come along later?

HAISE: No. The ascent engine instability in the injectors and the erosion that was a problem was there. In fact, there was an alternate program started [that] George Low set in place with TRW to try to modify, really I guess, the descent to engine, make it non-throttleable but use it as an ascent engine. So there was [for] some time, … a parallel program that was going on. [Recorder turned off.]

WARD: Okay. Fred, we were talking about Apollo 8. You were a member of the backup crew on that mission. And you mentioned that that was the most difficult training cycle that you went through. I'd like to go into that a little more. What was it that made that such a crunch of a mission as far as the crews were concerned?

HAISE: Well, it the primary reason was the change in mission. We were on a different path than—as I don't recall how long we were on this path of a Earth orbital mission, but I'm guessing probably a month to 6 weeks of the total time. And in those time, flights were cycling at 6 months. So all at once we had the whole new thing to go through. And believe it or not, even though Apollo was ultimately meant to go and land on the Moon, if you want to consider the detailed procedures and techniques, very little had been worked out. You know, the trajectory schemes and those kind of things for missions had been thought of and the work on—and maybe some work on landing site, but actually the checklist level of detail wasn't there.

So we probably spent half the remaining training cycle not training, but figuring out what we were going to do and how we were going to do it. Mission Rules. Emergency procedures. Malfunction procedures. Like for lost comm [communications]. Up to that time, you had a backup in Earth orbit of the VHF ground stations that ring the Earth. Well if you're sitting out at the Moon, the VHF didn't—doesn't—

WARD: Doesn't work.

HAISE: —go that far. So if you had S-band failures, what do you do with total loss of comm [communications], you know, where you're not going to be able to talk to anybody? So there were exceptions to the rules from what we had worked out to that time that just took up, like I said,—ate up probably half the remaining training time. And then we finally got the procedures roughly in place for what we were going to use, then we had to really go double-time to get there.

With the schedule, if I recall, we followed we started out, I'll call it "somewhat leisurely" like 5-day scheduled training. And generally you'd also have meetings on Saturday, normally back here, with, like, Mission Rules and those kinds of things. And then Sunday off. We, within a short time, went to 6 days a week scheduled. And the last 2 months, we were at 7 days a week—

WARD: Scheduled.

HAISE: …Scheduled. And this is like from, you know, 8:30—8 or 8:30 in the morning till the last briefings maybe ending at 9 or 10 at night. In fact, it was interesting on that—on the flight, there was somewhat a surprise of how the crew slept after they got airborne. And the reason is, they were just very—they were very tired. In fact, after this flight, for about 2 weeks after the flight, I was waking up every morning feeling tired.

It was the only time in the whole program I gave up exercise because I didn't have time to run. I ran 3 to 6 miles a day, and [there] wasn't any time of day left to go running. So it was a real, real tough one to get ready for. I really felt, myself, that probably within 2 weeks of launch was the first time I felt (call it) "comfortable" with [a] feeling I could accomplish what I would have to do should I have to fly.

WARD: Of course, that was the first mission—with the—a crew on the Saturn V, it was the first—only the second flight with a crew on the Apollo spacecraft after its redesign following the fire; and a tremendous number of firsts. So it's understandable how you would get into that situation where there was so much development of the flight, in addition just to training for it.

HAISE: That's right. It was a real push.

WARD: I know that even today, it becomes a really insidious problem to control the amount of scheduled time for crews. And they really guard that jealously, because they know that whatever time they schedule, there's going to be a lot of unscheduled activity that's got to get accommodated on top of that. And if, as you say—if they push the crew too hard, they don't get time for the [physical]—to maintain their physical conditioning, which can, as you know be a problem of its own right. Did you find that the lack of physical conditioning was a serious concern?

HAISE: At—not so much from the flights. What I appreciated was the reason you needed to be in (I felt)—in good condition was for more [the] training cycle. Because invariably, all the missions I was on (even though later, like Apollo 16, [with] a very stretched out schedule),—invariably the last 6 weeks to 2 months ended up again being very compressed. A lot of things coming through that sieve to get to the launch point that had to get done that literally drove you to 6- and 7-day weeks. So you're just so much—more mentally alert and active to be able to handle, you know, 14-/16-hour days if you're in good physical shape. In a sense, other than the lunar surface workload on missions, the missions are pretty—physically pretty easy.

WARD: How on 8, how much of a factor was availability of simulators and availability of flight software? Did that stuff come along early enough that you had a chance to train with it before?

HAISE: No, no. That was not as—probably as much of a problem as it was in the early Shuttle mainly because the type of computers we had, those were wire rope computers. So… there had to be a freeze date to get the (quote) get the memory built that gave you a—(call it) "a reasonable maturing time" and time to work with the real software, if you will. In our simulators, incidentally, in those days did not—as the Shuttle is today, does not—did not use the real computers. It was all emulated. But at least they had a baseline to get to early enough that you had ample time to work with (call it) the real—"the real stuff."

WARD: How well prepared did you think the crew was when launch day rolled around for 8? Were they well prepared?

HAISE: I frankly never felt that I would have a problem with the handling what I had to do both in the normal sense, which was [an] easier thing to consider, but also continuously, at least the ones we could think of and train for. So I felt adequate for every mission I prepared for.

WARD: Of course, Mike Collins was originally a member of that Apollo 8 crew and, for a medical problem, was removed. That created a cascading series of things that ultimately ended up affecting your crew assignments, and moved Mike to Apollo 11. I think, if I remember correctly, you were at one point on the 11 crew, were you not?

HAISE: Well, I—Mike had unfortunately gotten well. [smiles] And by virtue of that, I moved to the Apollo 11 backup crew.

WARD: Okay.

HAISE: I was on the Apollo 8 backup crew with Neil and Buzz [Edwin "Buzz" Aldrin, Jr.]. And they moved up to the prime crew. Mike rejoined the crew, if you will, as prime; and I was on the backup then with Jim Lovell [James A. Lovell, Jr.] initially with Bill Anders [William A. Anders]. After a very short time, Bill decided to leave the program; and Ken Mattingly [Thomas K. "Ken" Mattingly II] was put in that place.

WARD: Okay. So that put you guys, then, in line for Apollo 14,—

HAISE: 14.

WARD: —which subsequently became Apollo 13.

HAISE: That's correct.

WARD: And we'll get into that in a bit. One of the assignments that you were particularly notable in, at least in my recollection, was a role in Mission Control as a Capcom [Capsule Communicator]. And I just wondered what, from your point of view, that contributed to your preparation to fly, your trust in the ground when you were in orbit, and that sort of thing?

HAISE: Well, I think the—that, just being a part of a Mission Control team in that role, you're one of the players in the room under the flight director in the preparation—total preparation through many hours of integrated simulations, preparing for a flight. But likewise even as a crewman for the many cycles (I've had two at least in Apollo 8 and 11), working through these integrated simulations with the Mission Control there, the group called "SIM Sup," [Simulation Supervisor] which was a… group of rather devious people that had been assembled to devise the skits for these simulation scenarios to put in specific failures at specific times in the—in their hopes they would make us fail.

But that conditioning, through all those hours, certainly made me confident of the team that was there. And not just Mission Control. Behind them they had the MER team I guess it was called then in building 45. That—

WARD: The Mission Evaluation Room?

HAISE: The mission evaluation that could cascade through the whole contract or force, you know, across the country for brain power if needed. That and then there [were]… "some of the best" brains in the country… on the program because of the challenge of going to the Moon.

WARD: Right. It was certainly accessible to it even if they weren't in the room.

HAISE: Absolutely.

WARD: One of the things that always struck me in my observations of Mission Control was the extent to which it—the simulations in particular were not only a training tool but allowed you to develop the flight planning and the concept for the mission.

HAISE: Right. Each SIM [simulation] we conducted, no matter how short—be it a launch SIM [simulation] which didn't run that long—we would stop and evaluate what had happened, what had been done. And as you said, it often may [have] changed the mission plan, but it—and probably in more cases, it affected our procedures: How we changed the malfunction procedures or our checklist. Those sorts of things. Because we didn't leave anything unanswered. If it couldn't be answered in real time following that mission—that simulation debrief, it would be carried over and worked off line. But eventually if we didn't have a successful outcome in our mind of how we handled things, each of those were eventually brought to a conclusion.

WARD: At the time you were functioning as a member of the backup crew that was in line for Apollo 11, did you guys realize or expect that 11 was the most likely lunar landing mission? First lunar landing mission?

HAISE: Well I don't know if it was the most likely, because of the probabilities of it being successful or not. But we knew it was the first in line to at least make the attempt.

WARD: The attempt.

HAISE: Whether it made it or not was, you know, another question to be proven.

WARD: Yeah. What do you think the smart money would've said at that time? Would you have guessed that 11 would be successful? Or would you have bet that maybe 12 or 13 was the most likely for a successful lunar landing?

HAISE: No, I would've—I had a high degree of confidence in the hardware at that time, and I would've felt, you know, it was a good shot at 11 being the one.

WARD: About a month, if I remember correctly—about a month after Apollo 11, you went through a personal situation that was really quite difficult with the hurricane in your hometown area. I wanted to diverge a little bit from the normal courses and get your recollections of that, because that was, still I think, one of the—Hurricane Camille, in '69—

HAISE: Yes.

WARD: —was one of the worst hurricanes ever to strike the Gulf Coast. And I know you had a lot of direct involvement with that.

HAISE: Well, I went back there afterwards. I still had my mother, one sister, and several aunts that were—

WARD: That's in Biloxi [Mississippi].

HAISE: —resident then, and one of my aunts lost her house. She was about a half a block off the beach, and it just—the hurricane literally cleared almost the first block off the beach. It just took things right off the foundations. And you know, from a even worse standpoint from the beauty of the coast, destroyed many of the beautiful old oak trees. Some had been—were hundreds of years old that had been there.

WARD: Was this in the Biloxi area?

HAISE: This was in Biloxi, Mississippi, right. And my mother actually lost a car, was all. She was not harmed although the water got almost up into the house, which is up on pillars, about 3 feet or so. In fact, Biloxi was very lucky because, as I understand, with the water, if it had risen another something like 5 or 6 feet, it would have crested Biloxi, which is a peninsula, and probably just cleared it off. So they were lucky it, you know,—it didn't get any higher than it had at the time. But I made a visit back then, and again after the mission on a celebration parade. And like I said, I knew of many of the families and had many friends there that had lost homes and possessions.

WARD: Thirty years later, you can still see the effects of that storm if you drive through there. The houses that are gone. The foundations that are just sitting along the beach.

HAISE: Right. There's empty lots with just the foundation with it not—either not chosen to sell the property or rebuild, or no one chose to buy it and think about rebuilding.

WARD: Did that—did the timing of that hurricane have a—work into advantage as far as your training scheduling [was concerned]? Or did it come at a bad time for you?

HAISE: No, it actually had no effect on—

WARD: You were—

HAISE: —what I had to do within the—my involvement in 11 and subsequently into the 13 training.

WARD: It occurred after 11 was really beyond you and then before you'd really picked up the—

HAISE: Right. That's correct.

WARD: —the load on 13. You mentioned that your assignment had originally been to 14. That moved back to 13 when Al Shepard got back into the lineup after resolving his medical problem. And as I remember that story, the managers in Washington were concerned that Shepard would not be ready to fly 13 but Lovell's crew (you and Mattingly along with Jim Lovell) would be. And you were asked if you would take that earlier assignment and let Shepard train for the later one. Is that essentially a correct summation of it?

HAISE: Pretty much, except the—what had changed after the—Apollo 10 backup had lost two members. So really the new assignments were Al, as the commander, and Stu Roosa, [who] had never been through a training cycle, was also assigned to that then Apollo 13 crew (would have been the Apollo 13 crew). So they had all—Ed Mitchell was the only one who had been through a training cycle. So, I—that wasn't discussed with me.

It actually, I guess, was …[discussed with] Jim. I think Jim, just as I and Ken Mattingly felt at the time, the quicker you get to fly the better. So there was absolutely nothing wrong, in our minds, with having made that change. We were happy to get Apollo 13. I'm not superstitious, incidentally, so that part didn't bother me either.

WARD: What did that do to your training cycle? Those flights at that time were going on 6-month centers. Did that leave you adequate time to get ready for 13?

HAISE: Oh yeah. We actually stretched—they started the first stretch on Apollo 12. I'm trying to remember if they had another month (I think a month or 6 weeks more) than the 6-month cycle, and then we bought another few months (2 to 3 months). So it was a stretch in the schedule. And comparatively speaking to both 8 and 11, 13 was leisurely. Although, again, it got compressed… in that last 6 weeks to 2 months' time. And we spent a lot more time—probably [we were] the first crew that spent a lot of time in geology training.

WARD: That was training for Fra Mauro.

HAISE: Training for Fra Mauro. We were the first crew to start the—kind of the scenario of training where we enlisted Lee Silver from CalTech [California Institute of Technology, Pasadena, California], really, through Jack Schmitt [Harrison H. "Jack" Schmitt] who knew Lee very well. And Lee became our tutor on a really an arduous exercise where we spent a week out in the Orocopia Mountains camping out, living on cots, with Lee and the backup crew, John Young [John W. Young] and Charlie Duke [Charles M. Duke, Jr.] and myself and Jim. Mainly to get Charlie—Jim and more up to speed on geology, because they had jumped pretty early into the flying business in Gemini and didn't get the amount of geology… that we got in our first year in the program.

So it was a press effort to get them to (call it)—to become good, reasonable, good field geologists in a very short time. So we [would] go through two exercises, two or three exercises a day, with cameras, using Polaroids in that timeframe to record the events, and get debriefs from Lee, and discuss geology around a campfire till like 10 or 11 at night. So it was a real fast dose and startup of what was kind of the ritual that followed with many of the ensuing field trips. Although it got refined in a higher [fidelity] way with equipment we used and more involvement with the back room people who were going to be there during the mission.

WARD: Apollo 13, coming after two successful lunar landings, really began to mark kind of a watershed in the—at least in the public relations rationale for the missions, where the shift was from accomplishing this national goal to doing useful science. What was going to be the scientific return of that mission and that particular lunar landing site at Fra Mauro?

HAISE: Well it—half of the effort we were going to do at the Moon was very similar to what had been done in both 11 and 12. And that was to lay out a set of scientific experiments involved in the ALSEP [Apollo Lunar Surface Experiments Package] packages.

WARD: That's the lunar surface—

HAISE: Lunar surface—

WARD: experiment package?

HAISE: —right. The second part, which was to be probably more involved in at least a hope of being better field geologists to do a better sampling—was, the EVA [Extra-Vehicular Activity], the second EVA. And, in our case, was to explore the countryside, up a slope toward a feature called Cone Crater in the Fra Mauro region of the Moon. And by strategically sampling up toward the crater, you would be sampling material that at the out—that outside ray of the crater would be the deepest material, where the crater normally forms in the Moon—or on Earth for that matter. If it's due to an impact facet, it inverts—it's an inverted flap; so if you're sampling up a ray, the farther-out stuff is the deepest stuff within the crater. And as you get up near the edge of the crater, you're sampling literally at the surface.

WARD: And it really wasn't known at that point (was it?) whether that crater was caused by impact? Or was it known to be an impact crater? Or was it still thought it might be a volcanic feature?

HAISE: No. It was—I think it was pretty much ascertained that it was an impact crater. The whole area was hypothesized as the—some of the erupted material that had come out of the Imbrium Basin. That's the—if you can envision a face in the Moon, that's the left eye in the Moon. And so when that big meteorite hit impacted there, it caused splash material (molten rock); and part of that splash formed the Fra Mauro hills, which was south of that eye in the Moon.

WARD: And of course the early missions, 11 and 12, both had to land in relatively smooth areas because the targeting was not that precise. By the later missions, you were getting more confident in the landing procedures and willing to go into areas that might have some of the highlands or at least crustal materials in about them as opposed to the basalts.

HAISE: Well, it was driven by confidence in the capability of the LM [Lunar Module] landing capability and steerage. But also if you're going to properly sample the Moon, at least in the committees that formed to look at the site selection, you had to become more diverse in, you know, where you went to get a proper sampling of the Moon.

WARD: Getting back to the crew assignments, the crew positions. Just before flight, of course, you were on a crew where a change was made in the last week when Ken Mattingly was exposed to the measles, pulled off [the primary crew], and replaced by Jack Swigert, who had been a member of the backup crew. And how confident were you and Lovell that

Swigert was going to be able to step in at that late date and do a good job of command module pilot?

HAISE: I certainly had no problem. If you looked at Jack's background, he was chosen for the program as a test pilot at North American Aviation and working on the initial design of the command and service module. So that was his background, even when he became an astronaut. He was the astronaut assigned, because he was the support crew of Apollo 7 ([it] as his first assignment), to work with Mission Control people and Engineering to devise the initial set of malfunction procedures that were to be used for the command and service module should anything fail or go wrong. So Jack was very versed on the technical aspects of a command and service module and flying one. So I had no problem at all with Jack stepping in from a technical (we call it), a "flight safety" standpoint.

Now it did change our practices for those last few days before launch. Normally in that period, you would literally quit training, go off to a beach house, which was an isolated area at Kennedy Space Center with no phones, where we could go off and be isolated and sit around. Generally you might read your checklist, that kind of thing, and go a little fishing on the beach. But otherwise, kind of get rested up, if you will, to for the launch and the subsequent mission. With that change though, we did go back into the simulation mode through most of (I'll call it) "critical phases" of the flight; like launch or lunar orbit insertion or transearth injection, leaving lunar orbit, rendezvous. And more as a test that, even though prime and backup use the same checklist and the same procedures: Was there some verbal difference in how we translated calls back and forth? So it was more an exercise… to make sure that the backup crew hadn't developed something different that way than we had.

I frankly felt—having been a backup on 8 and 11, later 16—that I was—not as capable but maybe even a little more capable of flying the mission than the prime person. Because the prime crew, if you looked at it, they got off on to other tangents. They got taken out of training to do press conferences, invent a patch, worry about who's coming to the launch, a personal preference kit. So all of those times they were out of (call it) "the training mode," as a backup I was in a simulator or continuing training. So I think if you looked at the records, you would see a backup crew generally might get a few more hours' training than the prime crew.

WARD: Yeah. Of course the one element that might be missing when it happens late in the cycle like that is this—and you alluded to it, is this element of teamwork. The ability of building these people together as a tightly knit, almost—subconsciously functioning team.

HAISE: That's absolutely true. But in behind that, there obviously was an emotional effect of (call it) "consideration" for those two people who had to transpose roles, in particular, in a way unfair to both. The way you mentally approach these things as a backup: Within several weeks of launch, I mentally tried to convert my sense away from thinking I might fly to not feeling so bad that I wasn't going to get to fly. I'd done all the work, I was capable of flying a mission, but I wasn't going to get to fly. So [inside I] sort of mentally pulled away in a sense of, "I'm not going to really get to go. The prime crew guy's not going to get hurt, and he's going to get to fly it."

And so that—there's that mental transposition, I'm sure, happened in the case of Jack Swigert. Whereas if you're the prime crew, within that last few weeks you really start getting—"This is real." I mean, "This is really going to happen when we said it was. We're going to launch." And, occasionally, you just sort of feel a few little butterflies here and there, during the day or whenever you start thinking about it you look up at the sky. And so you're more in that "go" side of that emotional train. And I think it was very difficult in that sense for the two parties having to do that shift with 2 days to go.

WARD: I always had the sense that Mattingly and perhaps you and Lovell as well somewhat resented the decision to remove him from the crew, because he really didn't feel that he was going to get the measles. Was that—

HAISE: Well—it wasn't just that. The meeting incidentally—was with Dr. Paine [Thomas O. Paine, NASA Administrator]. It was in crew quarters at Kennedy Space Center. It was Dr. Paine and Deke and Jim Lovell and myself. So that was the meeting. Jim made a request to go ahead and fly, not so much that he didn't—wasn't sure whether or not Ken would get the measles; but on the basis that the timing of the exposure to the incubation of where Ken would have an onset of measles, we would have been well past the lunar activity. And so it was on that basis that Jim said, and his sense was, you know, "If you're sick, well, there ain't—there's no nicer environment to be in than zero gravity. It's a comfortable environment, just heading back home." And—but that was not accepted.

WARD: Yeah. Just do the conservative thing and make the change. Although that had risks of its own entailed with it. Well, during the launch of Apollo 13, there was an anomaly in the—I don't know how apparent it was to you on the flight crew. I'm sure you were very, very aware of it, when the second stage center engine shut down early. Did you think that you were going to make it into a safe orbit when that occurred, or were you—was there some flutter that, you know, this may shut us down and we may not make it into a safe orbit?

HAISE: Yeah, there was a brief episode that from where I was on the right side, at least, certainly you felt the vibrations… for a few seconds, like the feel of maybe a holding a jackhammer kind of an effect. And it went away. Then over on the left side, of course, Jim and Jack could see the center engine light come on that it had shut down and reported it. My main concern then was not, "Could we reach Earth orbit?" But, "Would we have enough fuel left to still commit to the lunar mission?" And that—

WARD: Because—

HAISE: —I thought we'd probably end up in Earth orbit, flying an alternate mission, which we did have in our plan.

WARD: Is that because with that engine shut down, you were going to have to tap into some of the third-stage propellant to make a safe orbit?

HAISE: Correct.

WARD: And that wouldn't leave you enough then to make the translunar —

HAISE: Make the commit to leave Earth orbit for the Moon.

WARD: I guess you did have to get into that propellant a little bit to make orbit.

HAISE: Yes, we did. We had the longest insertion time of the program.

WARD: Yeah. But I think, as I recall, it was (what?) normally about 8 or 9 minutes to—for a Saturn V to put you in Earth orbit—

HAISE: I don't remember the exact numbers, but I know it was the longest.

WARD: Yeah. But it—but the engine did give you a physical sensation before it shut down that something was not right?

HAISE: Well, yes. It—what happened was, there was a[n] instability in the feed to the engine called—an effect called Pogo. And that varies the thrust level considerably; and that variance in thrust, you know, resulted in a chug, if you will… a vertical chug up the stack. That gave us this chatter, and, as I understand it, pegged out the accelerometers on that center engine, which is on a set of crossbeams. Later talking to Marshall people, they were happy it did its shutdown when it did, when it hit a low pressure point. Because much greater excursions in that g-level may have caused structural damage to that crossbeam effect and, of course, even more catastrophic effects.

WARD: Yeah. [Recorder turned off.]

WARD: Fred, we were talking about your launch on Apollo 13 and the shutdown of that center engine on the second stage. So you did, as it turns out, have adequate propellant not only to make a safe orbit but to get you enroute to the Moon. And, as I recall then, the early parts of your flight were really very uneventful from that point up until the oxygen tank exploded when you were about two-thirds of the way to the Moon.

Did you have any inclination when that first happened that you had that kind of a serious problem when the tank exploded? Or was it still—was it obviously a potential showstopper in your minds, or was this just something that, "Hey, what was that?" And go about finding out what kind of a problem you really had?

HAISE: Well, I'll speak from my standpoint. I—at the time of the explosion, I was in the lunar module. I was still buttoning up and putting away equipment from a TV show we had completed, and really we—subsequently we were going to get ready and go to sleep. I knew it was a real happening, and I knew it was not normal and serious at—just at that instant. I did not necessarily know that it was life-threatening. Obviously I didn't know what had caused it.

Within a very short time, though, I had drifted up into the command and service module to my normal position on the right, which encompasses a number of systems (the electrical system, cryogenics, fuel cells, communication, environmental systems). And [then] I was just looking at the array of warning lights (and there were quite a number on, at the time, lit, these red and yellow lights and a caution warning light matrix as well as a computer restart light and a master alarm on). It was confusion in my mind because we had never had a single credible failure that would have caused that number of lights on at one time.

One thing, though, just looking over the instrument panel that became very clear in short order was the fact that the pressure meter, the temperature, and the quantity meter needles for one of the oxygen tanks was down in the bottom of their gauges. These are different sensors, so it was unlikely that this was false. So it effectively told me we had lost one oxygen tank.

My emotions at that time went to just a sick feeling in the pit of my stomach, because I knew by Mission Rules, without reference, that that meant the cancellation of the lunar mission. We were in an abort mode but still not life-threatening, because we had a second oxygen tank, I thought, which looked to be still there. And we'd have stayed fully powered-up and then just took an abort mode to come back home in a—with everything fully powered.

It took some minutes to become obvious that there was, for whatever reason,—that there was a leak that the explosion had caused in the second oxygen tank. Either the tank or one of the lines. And—but a small leak. And when that—when it became obvious it was dwindling or losing oxygen, then the handwriting was on the wall that the command module was going to die and have to be powered-down. Because without fuel cells all that was left was three small batteries, 44 Amp-hours each, that we were going to need to execute an entry when we got back. So it was going to have to get turned off. So that's kind of the emotional cycle I went through in this period.

We probably failed to communicate properly in that early period to the—to Mission Control to tell them about the—not just the sound (the bang) but also about what we saw out the window. Because even then, when I first got back into position in the command and service module, out the window was a sea of debris around the vehicle. And had we reported that, I think Mission Control in a much quicker time would have gotten up to speed in the same way that: this was real and not a false set of readings or instrumentation failure, which I think they wrestled with for a—some 18 minutes if I recall.

WARD: You know if you go back and look at the transcripts, there was obviously a period of time in the control center where, at least in the minds of some of the controllers (if not all of them), there was still a possibility of saving the lunar mission. And yet, I think what you're saying is that from the crew's point of view, that possibility had long since gone away.

HAISE: Oh absolutely. Within probably the first minute to 2 minutes, I knew we had lost the mission.

WARD: As the crew's lunar module expert, once it became apparent that you were going to have to use the lunar module as a lifeboat (a role that it really was not designed for), how confident were you that it could be used for that?

HAISE: Well I was confident it would power-up and provide the resources we needed for a time. What was not clear to me just instantly was that it—we could make it last as long as we had to make it last; namely, roughly 4 days. I did have a point—at—after we had completed the first—the activation and then the first maneuver using the landing engine to get us back on a course that would take us around the Moon—to do some back-of-the-envelope arithmetic on a—on a checklist (which I still have that page at home), that I calculated the consumables on a power-down I assumed. And I figured we would run out of—the critical element (for me at that point was water) that we would run out of about 5 hours before what was then the entry time in the plan that had been conceived.

I felt safe with that because I also had data from LM-5 on Apollo 11, where we left that one in orbit. Before Neil and Buzz left it, they turned off the water valve, deliberately, as an engineering test. And the first major component in any system—one of the guidance and nav [navigation] components failed at 8 hours.

WARD: Well this was because, without water you can't cool it and the temperature goes up and it shuts down.

HAISE: You can't cool it and it never—right, and it would fail. And so, just based on that one data point, at least, I figured we had maybe enough margin to make it even in a case of running out of water 5 hours before entry interface.

WARD: So water ended up being the most critical component or consumable on the spacecraft?

HAISE: No. Actually the most critical consumable I didn't consider. That was the lithium cartridges. It didn't even occur to me that we had these cartridges. LiOH or lithium cartridges were used to scrub carbon dioxide out of the air, and I completely forgot about it. The only spares in the LM were down on the MESA, a thing you would have deployed on the lunar surface. And frankly, there wasn't enough spares, as I recall, to have sufficed anyway for 4 days. So that was the commodity we had the shortest (quote) "supply of." And the ground—the people on the ground subsequently worked out the way of implementing the use of the square, a different shape cartridge, from the command module, which there were an abundance of, to deploy in in the lunar module.

WARD: Did you ever reach the point where the buildup of carbon dioxide was becoming noticeable in the atmosphere in the lunar module?

HAISE: As I recall, we did break the red line and got a master alarm on. But I never felt physically any effects… at that level.

WARD: One of the things that I recall there was quite a bit of debate about (I don't remember how long it went on) was whether or not to use all the available propulsion, turn the spacecraft around, and head it back to Earth as quickly as possible, or go on around the Moon, use the Moon's gravity to send the spacecraft back. A little bit longer, but it didn't require using the service module engine. Did you have any hope that that service module engine would've worked if it had been needed?

HAISE: Well we were not involved in that set of arguments, again, and the choice made. I frankly would only say now in a historical sense, I'm glad they didn't make that choice. What we saw when we separated the service module, just before entry and took a lot of pictures [of] but also observed, it looked like the high-gain antenna that protruded out near the rear of the service module had been bent over and actually had impacted the engine bell on that SPS (service propulsion system) engine. And if—obviously, if it [had] either cracked it or dented it even slightly, we would have probably had an instability in effecting the use of that engine and it may have even exploded. So it was a good decision.

WARD: Yeah. I think when people saw the pictures that you brought back, they would have agreed with that. So as it turned out, you ended up completing an orbit around the Moon using the Moon's gravity to head you back to Earth. And, what was your recollection of the high points and the low points in that transition back to Earth?

HAISE: Well again, it's—there wasn't too many high points. Probably the best, at least to have that opportunity, was to view the Moon as we went by, which is quite a different variety body than the Earth (it's rather lifeless), and to get to see the backside, which is quite different from the front. Mountainous, very hilly, only a very few small mares or seas, the so-called smooth areas. And that was exciting. Jack Swigert and I both had cameras out and shot quite a number of pictures while we passed by briefly.

The lows probably came as the ensuing days, when the cold—the vehicle had gotten very cold. There was no temperature meter in the lunar module, but I would suspect it's 40—35 to 40 degrees [Fahrenheit], somewhere in that range, because it froze the water tanks in the command and service module. So I suspect with the little equipment we were running, we were a little warmer than freezing but not a lot. And that kind of wore on you after a while.

We did not have adequate clothing to handle that situation. We did put on all our—all—every pair of underwear we had in the vehicle. Jim Lovell and I wore our lunar boots, the boots we would normally put over our spacesuit boots on the lunar surface.

But the material in the clothing we wore, the two-piece suits (the pants and the shirts) because of the earlier loss of the crew in the fire had been changed along with a lot of other materials in the vehicle to a beta-cloth material, which tended to fray so it was coated with Teflon to prevent fraying. And that Teflon just almost assumed the temperature of the environment, so it was kind of like wearing a cold coat or a cold pair of pants. With—without a—some—probably some degree of insulation value, but not what you'd normally have even if it had been plain cotton material.

WARD: How quickly after you got into the lunar module and began to power things down did it start to get cold?

HAISE: From our power-down it probably took almost a day to get, you know, all the way down. Because there was lag, thermal lag, and—from where the vehicle set at (call it) "normal" temperatures to lose that much heat transfer without the compensating heat from all the equipment being on that no longer was on.

WARD: But you were in a passive thermal control mode, as I recall, rotating the vehicle so it got constant exposure on all sides to the Sun. Did that help much?

HAISE: We were, (I'll call it) in a "pseudo" passive control mode. We had great difficulty manually setting it up as you would have done through the computer in the command and service module. So it was continually rolling, but not in a perfect alignment with the normal X axis of the one through the center. So it was kind of cavorting in various directions. So I'm not sure it was really getting an even heating all—in all sides.

WARD: How did the ground and the flight crew work together during this period of time to handle this great concern that I know everybody had about having to throw out 6 months' worth of procedures and checklists and start from scratch? And was that a big concern from the crew's point of view?

HAISE: There was a big concern from my standpoint in with one respect, and that was just knowing that for the situation we had—with the loss of the mother ship, of the command and service module, and even though using the LM as a lifeboat had been conceived—I knew there was no hard procedure and no hard (say, hard) alternate flight plan that someone could go grab off a shelf and say, "This is what we're going to use." So I knew there had to be a lot of brain-power brought to bear to invent this alternate plan in real time. And that some of that real time started immediately.

For instance, the lunar module power-up: We used an activation checklist, but that was quite lengthy, to be used in lunar orbit to prepare the vehicle for landing. And we were time critical, so that was done totally ad hoc with the live communication through the Capcom to those in—the flight director and those in Mission Control to ascertain what we would leave out of the power-up. What we would cut out. …As I went through the pages, I had a Pentel pen [and] I would just "X" through segments of that activation procedure. We just rapidly moved through it.

It was interesting that when Jim Lovell and I, after the flight, went just out of curiosity—went back into a lunar module simulator, we could not replicate the time of that activation in… the nice, calm conditions of a ground simulator that we had done in flight.

WARD: You couldn't do it as quickly?

HAISE: Couldn't do it as quickly. So I'm guessing, adrenaline does help.

WARD: Well of course one of the concerns is that, with a complex vehicle that's already crippled as this one was, that if something is done out of sequence or a process isn't followed in precisely the right order, that some additional damage may be done. And I recall that the flight directors at the time seemed to be most concerned that, even though they had the situation under control, that if a mistake were made that this narrow margin would suddenly evaporate.

HAISE: That's absolutely correct. I have to give my hats off to the crispness of response, as I said, in this (call it) "ad hoc" mode. To me the two biggest challenges and the times I felt the most pressure during the flight was, number one, the lunar module activation and the haste at which we had to do that. The second one was the power-up of the command and service module, the mother ship, which Jack Swigert and I executed. Because it was an—again, a very—well, a new, had to be invented, procedure by people on the ground that we had never done before.

And anything of that nature, had we known we were going to do it before flight, we'd have practiced it dozens of times in a simulator. And here we could only read through it a few times, which we did, and sort of walk through the switches and circuit breakers as to the play of that power-up. But then [we] had to do it, again, in a fairly short timeline.

WARD: Now was this when you were getting ready to come back from the lunar module to the command module to reenter —

HAISE: Come back to it to prepare it for entry. Right.

WARD: Right.

HAISE: And that was the second time I felt a great deal of pressure. Because it—we were going to have one shot at it and it had to be right.

WARD: Of course it was a real tribute to that vehicle, that it withstood being powered down, frozen, inactive for all that period of time and then came back to life and did its mission, to get you back through the atmosphere.

HAISE: Absolutely. I was—you could say the case for both vehicles, the lunar module to the degree we took the power-down and the temperatures that… violated every redline specification on literally every system in that vehicle. And similarly so in the command and service module, which obviously had never planned to be shut down.

WARD: Were you aware at the time of the intense worldwide interest that had developed over your plight in getting back?

HAISE: No. We were not. That was never discussed on the airways, you know, what (quote) "the reception" might be by people in the U.S. or around the world. In the back of my mind I had a concern that it might be taken negatively. That, you know, here we had failed. It was planned to be the third landing mission and we weren't going to accomplish it, and I could envision the headlines of, you know: "NASA Wastes $100M" or something on this mission that failed.

And it was the kind of thing that bothered me not from the standpoint of I felt I was the cause of the failure, but being a part of the team as a whole, you just didn't want to be a part of, you know, a mission that failed. And then frankly I worried that it may affect the program in some way, or even halt the program, and I certainly wouldn't want that on my record, that I was involved in something that, you know, caused that.

WARD: And of course the mission was a failure, but it was not perceived that way. It's viewed today as one of NASA's shining moments. Do you—?

HAISE: Well, I think in—that for whatever reason, I guess it was because we were human beings and people saw us as in trouble and saw the work that had been done, and had admiration and—the salvage operations, if you will, that enabled us to get home. It reflected more on that human interest side of it rather than the other side of, you know, what monetary side of it and what wasn't accomplished in the original intent of the mission, which I'm very grateful for.

I think it—you know, clearly it offers a graphic example and a very dramatic example, which is why it was chosen for a movie versus other missions, which were more successful obviously. …It does make it very clear, you know, what can happen if you do have… the right people, the right skill mix, that are trained and they're assembled in this team and they work together under the right leadership. You know, what a miracle can happen. And that's what was the case of Apollo 13.

WARD: Were you surprised at the time by the outpouring of public sentiment worldwide after you had gotten back?

HAISE: Yeah. Particularly worldwide. I—you know, I figured that when I saw that, that was the thought people had, I certainly felt [that in] the United States that would be the case because, you know, it was predominately a United States program at that point. But I was really surprised by that worldwide effect. And as I saw that personally in visits—we made State Department trips to various countries—and I saw that effect as we went overseas.

WARD: You alluded to the fact that, even though you didn't get to conduct the lunar landing, you did get a view that very few people have had, and that was a nice close-up view of the Moon. Did you have much of a chance to see the Moon as you were approaching it? Or was that time when you went behind the Moon and started the free-return trajectory back to Earth the only real close-up view you got of it?

HAISE: No. That was the time we—as we passed around the backside and came out was the only time we had to really observe [it]. And as I said, we—Jack Swigert and I at least got cameras out and took a lot of pictures. We had a maneuver, another use of the LM landing engine, scheduled a couple of hours after we passed the Moon the low point around the backside. And Jim kind of cut short our touristing looking at the view to make sure we got ready to execute that maneuver, which was a very critical part of the plan because that cut our time short by, I think, 10 or 11 hours, which really made our consumables then pretty healthy.

WARD: Of course Lovell had been there once before. So he—

HAISE: Jim had been there. And I think he was, again, having been there now twice, he was, I think, bothered more at that point, maybe, by the fact he had lost a chance to land. And of course he being the commander, I guess in that respect he'd clearly feel more accountability for the total happenings than if you're the rookies like Jack and I, that for all we knew we might—I might even get back.

WARD: One of the things that was, of course, a concern was using the lunar module engine to do something that it really—and the lunar module to do something it hadn't been designed to do, and that's to propel the whole spacecraft stack, docked with the command module.

Would you have been confident doing that if we hadn't had the tests of that system in that mode on Apollo 9?

HAISE: Well, it—yeah. I was going to—I was going to correct you that it had been thought of as being used for really for the purpose of the failure of the service propulsion system engine on the command and service module as you entered lunar orbit. If it failed at certain times, you would use the LM descent engine to do that. No, clearly it added a lot of validity to that being an acceptable—not the—not from the standpoint of the engine running but from the standpoint of control of the stack—the guidance, nav [navigation], and control—to have had that done on Jim McDivitt's Apollo 9 mission. And that was the purpose, [it] was to prove out that use of that engine for—in LM to handle that abort mode.

WARD: You had one other technical problem as I recall, and that was the ability to align the platform for that important engine burn. You had to have an accurately aligned guidance platform. Now what was involved in getting that done?

HAISE: Well it—there were two alignments that we had to deal with. The first one, frankly, was done by—right after the LM powered up (if we're backing up to then) by taking the noun 20 or the gimbal angles' readouts from the command and service module, which had a good alignment, and manually we had to convert those to the LM axes and account for the misalignment in the tunnel.

We had marks in the tunnel. When you docked, you didn't always get zero-zero, so we had a yaw misalignment to deal with, which we mathematically manually cranked in and keystroked those into the LM computer, and that torqued the platform to that alignment. So that was the way we devised the initial alignment of the lunar module platform, which was normal—which was done in normal activation.

WARD: And that—at that point, the command module was still a functioning vehicle?

HAISE: Still a functioning vehicle. And that frankly was also the time criticality of power-up, was to get that alignment done. Because we knew we'd be in deep trouble getting a good alignment if we had not executed that in time before the command module died because of that sea of debris around us. We—you couldn't see stars. I mean, a little ways away from the spacecraft, those charred pieces of the thermal blanket, shiny material, or the frozen oxygen, they looked like stars.

WARD: Of course they just stayed right on—right with you.

HAISE: Stayed with us. So the second alignment was done to do two manual burns. And that was done fairly simplistic. And what was—the way that was done was there was a sight in the commander's window called a COAS [Crewman Optical Alignment Sight] (sort of like a gun sight) and with that Jim Lovell aligned roll on the—using the points of the cusp of the Earth. It was a half-Earth. And with that alignment, he would pitch the vehicle until I could pick up the Sun looking out the periscope, which was an AOT [Alignment Optical Telescope] in the LM; at the upper point of that view was up about 60 degrees. So when the Sun first peered in that, I'd tell Jim to "Freeze" and he'd stop the maneuver and then I keystroked in a small, low-power backup computer (a body axis freeze), which would give you crossed needles on your eight ball.

And if you kept those centered, that would freeze at that attitude we were at. So from that—with that for use for attitude control, we executed two manual [maneuvers]. …One manual stop-start of the descent engine, a very short burn (19 or 21 seconds, something of that sort), and then a second maneuver later using that same alignment protocol, using 4-jet, 100-pound rockets on the LM for again another velocity change to effect our entry path.

WARD: This was to set you up on that very entry—very narrow entry corridor that you had to have to safely—

HAISE: Right. That was to get aligned for the entry corridor.

WARD: But the guidance platform had been, as you pointed out, aligned early on. Was the concern that it would have, in that amount of time, drifted off? You needed to assure that it was still accurate before doing that course correction enroute back to Earth?

HAISE: That's correct. Yeah that—well, if you look at it, obviously every one of the maneuvers were important and had to be reasonably accurate. Probably the two most paramount would have been the one that first got us on the right path to go around the Moon; and the second one, which reshaped the trajectory to get the 10 hours' relief on the return. The others were coarser burns which, obviously, if they'd tracked a while and saw that it didn't turn out right, we could have repeated those. They were very small maneuvers; tweaks, I guess is the terminology used. We could have executed several of those.

WARD: Of course one of the things that was significantly different about your entry into the Earth's atmosphere from previous Apollo missions is that you still had the lunar module attached as you approached Earth and [you] had to get rid of it. Was there any concern that the lunar module and command module might collide as you were coming back into the atmosphere?

HAISE: No. I didn't worry because that was again part of the plan that Mission Control had worked out. We set up an attitude and pressurized the tunnel—between the two vehicles. So when we separated the lunar module (and it was quite a jolt), it actually projected [the lunar module] away from us out to the side.

So it dramatically changed its path, so as, again, to lessen that likelihood that we would have this collision.

WARD: But that is something that had to be taken into account. But you just felt it was properly planned for?

HAISE: Oh yeah. That was—it was just part of that final set of steps that had to get done. Before that even, the attitude at which we separated the service module in a similar way to make sure it—we wouldn't drift back into it when we separated and shot the pictures to try to collect the—that piece of data to support the accident investigation.

WARD: I would imagine after you had gotten back in the command module [and] had its full power more or less available to you that this cold situation took care of itself. Things warmed up pretty rapidly at that point, didn't they?

HAISE: Yes, it did. And it—we powered up some of the things on the LM earlier, too, so that—the combine of the two when we knew we had adequate power left in the lunar module, you know, it felt great. Because it did get pretty much [get] back to the normal temperature by the time we hit entry interface.

WARD: Probably a very nice sight to look out the window and see those parachutes above you.

HAISE: That's the time in Apollo where you really knew you had it made, when you could see the final deployment of the main chutes—at least two of the three. You knew then that there was probably nothing else could go wrong till you splashed down.

WARD: Well you mentioned that, in your mind and probably in Jack Swigert's, there might be other chances; and of course you were on backup crews for other lunar missions. Were you pretty confident then that you would get another chance to go back to the Moon?

HAISE: Well yes, I was. I knew that the program had been altered in the flow of the schedules because they had injected Skylab in between what was then to be the ending missions, which would be Apollo 18 and 19. Having cycled to Apollo 16 as the commander behind John Young, with an initial crew assignment of Bill Pogue [William R. Pogue] as the command module pilot and Jerry Carr [Gerald P. Carr] as the lunar module pilot, I did hope and expected that I would get a chance to cycle through that backup assignment and be—we would be the crew for Apollo 19, which at that time was advertised as the last mission of the program.

WARD: Yeah. So it was a very good prospect that you would have made an Apollo flight and had that opportunity to walk on the Moon, until those last two flights got canceled.

HAISE: Yeah. I don't recall how many—how long we were in that training cycle. Probably a couple of months (2 or 3 months) where that eventuality did happen. 18 and 19 were canceled. Bill Pogue and Jerry Carr were cycled then into the Skylab Program to give them an opportunity to fly. And I inherited Stu Roosa [Stuart A. Roosa] and Ed Mitchell [Edgar D. Mitchell] off of 14 to complete that deadhead backup assignment.

WARD: In a sense, ironically, the loss of Apollo 13 and the near-loss of the crew on that mission was probably a factor in the decision to cut short the remainder of the program.

HAISE: I can't—I cannot really attest to—not having been involved in that decision-making, what was the cause. I frankly surmised it was more one of budgeting. And the hiatus of the—of trying to cycle through Skylab and then get back in the (quote) "lunar mode" over a fair number of years, it would [drag] that out. And the thought of the Agency of getting on with the next program, whatever that may be. I guess in those days there was probably still a buy-in between Space Station or Shuttle (let's call it (quote) "the next step"). And so I think it was that concern of not having sufficient budget to both continue as well as have sufficient budget to get the next program under way.

WARD: And of course there wasn't much beyond that, that the Shuttle became a very serious consideration; and the costs associated with—

HAISE: Right.

WARD: —getting the Shuttle off the ground were a big factor.

HAISE: Yeah. And there was probably a—certainly a feeling of risk versus gain. We were flying vehicles that were, at best, redundant and two string. And, you know, rather precarious sitting out at the Moon. So it probably was, you know, from the landings that had been made or were already committed to be made, there was probably in NASA's management's view a risk versus gain of, you know, "Should we take this hiatus from the program and then come back at it again and have that—face the risk of eventually losing a crew?"

WARD: Of course in hindsight, you know many of the people in the country today weren't around when Apollo flew, but it's perceived as being the highpoint of NASA's career as a space agency. And yet, in reality, in addition to the crew that we lost in the Apollo fire, there were a number of really close calls in the Apollo Program.

HAISE: Well, I think that the reason it's looked at that way are several. One is the mission. I mean, there's no question the thought of going to the Moon in those days, you know, was paramount obviously, and obviously something people could envision and there's no question it was [an] exceptional challenge. So that—just that picture of what you were having accomplished in Apollo [made] it obviously… a major engineering challenge. Probably in the 20^{th} century, only—the only tougher one or equal… was the Manhattan Project, driven in a similar way on a time domain, too, that evolved the atomic weapons.

So clearly it stood out in that regard. Shuttle in its own right [was a challenge], though, it's unfortunate because the mission did not have the same hype as going to the Moon. But there are facets of the Shuttle and the Shuttle design that if you stick with the engineering side were very tough problems. In fact, for instance, guidance, nav [navigation], and control, particularly the control system evolution in Shuttle [was] more difficult. It's a more difficult problem than the Apollo vehicles. The tile (the design of the tile), which was key to having a reusable vehicle, was a big, difficult engineering problem.

So there are facets of Shuttle that also, if you look at it from NASA as a developer in new technology and pushing the frontier, it had its own frontiers that it's—it pushed. And frankly [has] done exceptionally well.

WARD: Well of course, at the end of Apollo you moved into a Shuttle management and flight test position. And, is that the sequence that really precluded your flying in Skylab, the fact that you were on one of the late crew assignments and then moved into Shuttle?

HAISE: No. The only choice I had in that time period was to be a—I was asked by Chris if I would consider being a member of the Apollo-Soyuz crew. And I—in my discussion with Chris (I don't remember the exact words), but basically what I felt I could do the Agency better because of my past experience and Edwards experience with… some degree with winged reentry vehicles, that I could serve better by skipping that and going on to Shuttle. And in fact, …to support the Shuttle management. And so I actually… left the Astronaut Office for about 3½ years to work under Aaron Cohen in the Orbiter Project Office, to work through that whole evolvement of early design of Shuttle.

WARD: And of course, in a lot of respects the Shuttle was much more of a test pilot's vehicle than any of our previous spacecraft had been.

HAISE: Certainly from—yeah. Certainly from a stick and rudder, as we'd say, piloting role of view, clearly it's a winged vehicle. Certainly entry at least, entry through landing. Going uphill it's much the same vernacular as previous, except the stack configuration's different.

And the wings and the tail feathers of the fin [are] really an encumbrance on ascent. You'd just as soon not have them. They're kind in the way. You got to worry about them not being overstressed. But certainly for entry, landing, it's a piloting machine.

WARD: And of course the Shuttle introduced us, from an astronaut's point of view, into a totally new regime of having to come back through the atmosphere at hypersonic velocities and then to begin to fly it at supersonic and land at subsonic with a lot of new computer technology involved.

HAISE: Well that I didn't mention it, but the—you mentioned it just now. Referring to computers. That was the other technology jump, I would say, in Shuttle was to get the sync [synchronized] set or redundant set of four computers to work together and actually by data comparison to do voting of both the sensors on the ends as well as the computational aspects of what was going on within the computers. But clearly the control system was the most complex that had been devised to that date because it almost was—it was several control systems.

There was one control system for very early entry, where the air was still very thin and you're at a very high angle of attack, and in some axes, more use of the rocket engines than aerodynamic surfaces. Then a blending, in an intermediate range, of a combination of aerodynamic surfaces and rocket engines were needed. And finally to a pure aerodynamic stage, which probably didn't truly happen to be [like] a normal airplane, including the rudder even in the mix, to below Mach 5. So from there on, it was reasonably conventional as we would think of an airplane control system.

WARD: Of course you mentioned that you were out of the Astronaut Office for 3 years as a manager. This was the period of time, as I recall, when the approach and landing tests were beginning to take shape under Deke Slayton. And from your vantage point in management, I wonder what your perception was of Deke as a manager, [who] previously had been your boss in the astronaut corps, now he's a colleague, manager over an important part of the Shuttle Program.

HAISE: Well I frankly was very happy with Deke to volunteer for that role, which is what he did, because of his background. I mean, we had no one, in my mind, that was at Johnson Space Center at the time that was better suited to take on that role. And I think it was reflected in the way the program went. We missed the first free-flight release from the 747 only 2 weeks from a schedule that had been made several years before.

We completed the program (I forget), it was like 4 or 5 months earlier than we'd planned—which is almost unheard of in a test program, certainly something as complex as the Orbiter (even that vintage Orbiter) was. And I think that was Deke's leadership in pulling together both the contingent of NASA, which involved a lot of integration of Kennedy Space Center people and Dryden NASA people, as well as the contractor Rockwell in that phase.

WARD: You know, certainly, it would not—to the outside viewer—have been the norm of the Shuttle Program, which was experiencing very highly—widely publicized delays and schedule problems and budget problems. And yet as you point out, the approach and landing test phase came through very nicely in both those respects.

HAISE: Now it was—to me it was just remarkable. I mean, I'd been involved in the test business before, and one example is: We did have a problem on Joe Engle [Joe H. Engle] and Dick Truly's [Richard H. Truly] second flight—second free flight, where they had a leak in a hydrazine tank on the APU [Auxiliary Power Unit] system, which did damage some wire bundles. And they turned that around, if I recall, in 9 days'… including weekends, which caused Gordo [Charles. G. Fullerton] and I, we really, even for the simple kind of flight plan we had to fly, we were pushed to be ready with the training to make that next flight. Turn[ed] it around in 9 days flat.

WARD: You flew (what?) two of the captive flight tests and three of the free flights?

HAISE: Yeah. I flew a total of five of the total eight flight program. …Again we cut the captive short. We only did three; originally I think we had five of those planned, but we got what we needed in three. And then we flew five free flights. Gordo [Charles G.] Fullerton and I flew three of the five.

WARD: Right. And Fullerton was your second in command on all of those?

HAISE: That's correct.

WARD: Did that require you getting back into the Astronaut Office?

HAISE: Oh yes. No, I'd cycled back into the Astronaut Office probably about a year before that first free flight. And in that role, we went back to the more traditional role, even before flight, of being a participant in the testing of the real hardware at Palmdale [California] (in that case), involvement with the software development and the discrepancies that were showing up in the loads, both through our simulation, which could accurately work that because we had real IBM-101 computers that were being used in the simulation of Shuttle.

So when the new software load came, the problems we saw in the simulator were identical to what you would see in the real vehicle or in SAIL [Shuttle Avionics Integration Laboratory], which is [an] avionics test facility here at Johnson Space Center. So we had all those kind of involvements working with Mission Control people again and in that same timeframe, defining the flight plans, procedures; and with the Test people at the NASA and the contractors, where the vehicles were being put together.

WARD: While it's not unusual in an aircraft program, in a space—in the space program, it was a bit of an anomaly to fly a vehicle manned for the first time. We'd always done unmanned test flights. Was this any particular concern or consideration from your point of view?

HAISE: No. Certainly not for the approach and landing test. It would have been very difficult to have devised a scheme, in my view, to have flown that program unmanned. I guess you could've used an RF link and really had a pilot on a stick on the ground like they have flown some other programs. But to totally mechanically program it to do that, and inherent within the vehicle, would have been very difficult for that part of the program.

There was on the orbital program initially a planned unmanned flight. Again it was of great complexity, and handling the myriad of potential system problems you—would occur to automate that. One of—one of the (call it) "vehicle shortcomings" that showed up in approach and landing tests, things we missed, was in redundancy management. So there was a lot of lessons learned… that were put into improvements, if you will, into the orbital version. But even with that, with a crew aboard, even though they might not be aboard on the day of launch to fly the vehicle, to be there in a systems diagnostic and be able to handle the multitude of things that you could work around, just inherently made the success potential of a flight a lot greater.

WARD: Was the astronaut corps, and particularly Young [John W. Young] and Crippen [Robert L. Crippen] who were scheduled to fly the first orbital mission, were they among the strong proponents for doing it with a crew onboard at first flight?

HAISE: Absolutely. And the Program Office were all—Charlie Duke [Charles M. Duke, Jr.], at that time, was working (I think) for Mr. Cheatham [Donald C. Cheatham]. And

Charlie set off on and did a study—on that manned versus unmanned with the pros and cons. That was reviewed, you know, at least through Bob Thompson [Robert F. Thompson] here at Johnson and I'm sure followed up in Headquarters reviews. That kind of sold that as the baseline.

WARD: You had a chance to observe—I don't know how close you were—to the—or how much knowledge you have of the Russian system, but on the surface at least, the Russian Space Shuttle, the *Buran*, looks almost like a carbon copy of NASA's Orbiter.

HAISE: Well I'm sure—again I don't know that much personally. In fact, I've never been to Russia. But you're right; it's clear it's a carbon copy from the—pretty much the mold line aspects. Which has great advantages. It's obviously a vehicle configuration, aerodynamically, you know would work. It eases a lot of their cost and time for wind tunnel testing, to some degree, in considering variations and things that you do in simulations (closed-loop simulations). So it short-cut to a great degree of (call it) homework they might have had to do from just the aerodynamics and control—guidance and control aspects.

Now as far as the systems onboard [go], I have no idea how much they replicated the guts of computing systems or environmental systems. Probably have very little similarity to Shuttle for all I knew.

WARD: Yeah. And of course on the other hand, too, the similarities in the mission or the role you have for an intended vehicle will have a lot to do with shaping what it looks like.

HAISE: Yes. We were driven on Shuttle by—within the design phase—what were called design reference missions. If I recall, there was five of them, and one of them had an A and B variation. They had some resemblance to what you might consider real missions, but the—but at the same time, some aspects of design reference missions I'll say [were] falsified to the degree you'd probably never fly the mission that way. But were meant to challenge the design, to make the design margins encompass virtually—a mission set you might fly. And different designs pushed different aspects of the design. And so by having this set of them, you kind of covered the spectrum of what you might ultimately have to face in flying the vehicle through (what I call) the "real" missions.

WARD: Describe for us the way the free-flight test off the back of the 747 worked and what the vehicle was like to fly for the first time. How did it compare with the simulators and so on?

HAISE: The real flights on the back of 747 were unusual in a couple of respects, one a real surprise. When we first rode on top, you couldn't see the 747, no matter how, you know, you'd lean over and try to look out the side window or—it just—you couldn't view any part of it.

WARD: Not even a wingtip?

HAISE: Not even a wingtip. So it was kind of like a magic carpet ride, you know. You're just moving along the ground and then you take off. And something below you, you knew it was there, but you couldn't see what was taking you aloft. It was also deceptive sitting up that high. Things always looked like it was going slower than it was, for your taxiing and particularly the first takeoff I really thought Fitz had rotated too early. It didn't look like we were going fast enough.

WARD: Fitz—Fitz—

HAISE: Fitz Fulton, who was flying—

WARD: —who was flying the 747.

HAISE: Yeah, he was the 747 pilot at that time. And when he rotated, I said [to myself], "We're not going fast enough to make it off the ground." In other aspects, airborne there was not too much unusual. The unusual thing we faced, though, that we—I don't think we thought of, frankly, late in the program, approaching flight, was to have to do a taxi test backwards from the way you would normally do it in an airplane.

In an airplane, you have a jet engine or a reciprocating engine, and you normally approach flight test by first of all doing some taxi tests around the ramp and then some runs down the runway, progressively getting faster and faster. And finally you reach the day in the test program you take off and start doing the flight test portion. Well we had no way of doing taxi tests, because the Orbiter—our Orbiter, *Enterprise*, had no engines.

And so we were going to have to face doing taxi tests from the upper end of the speed spectrum backwards. In other words after we landed at 190 knots or so, somewhere down that rollout we were going to do taxi tests. And we did it by each flight—first flight starting it at a very low speed. Didn't touch anything till we got down slow. The lakebed allowed that [with] a very wide expanse on the Rogers dry lake at Edwards Air Force Base. And then each flight, step it backwards up the speed spectrum to check out braking and nosewheel steering at progressively higher speeds. So that's the way, a very unusual way, taxi tests were done on *Enterprise*.

The only other concern that I had, and it was because we did it differently in terms of aircraft preparation, [was] flight tests. Normally you do full loads on control surfaces in a flight aerodynamic load sense to integrate the whole control system before you fly by using weights and things [on the ground]. And here we're going to we didn't have that luxury. But we did have the advantage of being on top of the 747, so through very small control motion on top of the 747 we were getting real air loads, although not through—we couldn't do it through full control sweeps. Structurally, the stanchions couldn't have stood that with the Orbiter on top. So we did that testing—part of the testing a little bit different than the normal protocol in an aircraft program.

WARD: Was that a cost factor?

HAISE: No. I think it was just the ability to productively do that within the facilities that we had at hand. But as far as the handling, that question you asked: To me it handled, even at the first flight, it was very clear it handled better in a piloting sense, a piloting rating sense, than we had seen in any simulation—either our mission simulators or the Shuttle training aircraft. The term I use is: it was tighter. Crisper, in terms of control inputs and selecting a new attitude in any axis, and being able to hold that attitude, it was just a better-handling vehicle than we had seen in the simulations, although they were close.

The landing also was a pleasant surprise from the standpoint of ground effect. Ground effect is a phenomenon you run into… when you get within one wingspan height of the ground, you start running into air-cushioning effects, which can, depending on the vehicle's shape or configuration, it can be very different. In fact our variations we had to consider in the Orbiter, looking at the worst-case aerodynamic variations: on one side we called it the "vacuum sweep," where if you got down low it would actually tend to suck you into the ground. And if you were at too high a sync rate when that happened, you'd end up with a hard landing.

The other extreme was one that would "balloon" you. You'd come down and get this cushioning, and it would actually balloon you back up into the air, which of course was a different kind of problem. Now you were sitting back up in the air with speed bleeding off, no engine to compensate, and you're likely to run out of airspeed from a stall standpoint or sync rate standpoint before you could effect a second attempt at a landing.

It turned out the Shuttle, in my view, was a perfect vehicle. …If you get set up with the right sync rate, coasting along, you can literally almost go hands-off, and it'll settle on and land itself very nicely. In fact the landing gear people were somewhat chagrined through most of that test program because we were not landing hard enough to get them good data for the instrumentation they had on the landing gear struts. Although I solved their problem on the fifth flight (the fifth landing flight) where I landed on the runway and bounced the vehicle, and my second landing was about 5 or 6 foot a second. So that gave them the data, and they were very happy with that—although I wasn't.

WARD: Would you say it performed more like a heavy bomber-type aircraft or more like a high-performance fighter in its reaction to the controls?

HAISE: Well, to me the handling characteristics were—they were certainly not as crisp as a fighter. Just [because of] the inertias involved in the size of the vehicle. They're frankly better than a lot of transports, though the only bomber I've flown was a B-57. But they were better than the (call it)—the "average" 707-type of transport or certainly earlier versions I've flown like a DC-3. So it's kind of in between in that respect.

It had very large control surfaces, mainly driven by the requirements for control uphill at high Mach—higher Mach. And in fact, if you sized the surfaces only to do the landing part of the mission, the elevons would've been much smaller. But—so they were very effective in that speed regime because of their sizing.

WARD: Its one negative feature might be that when the nosegear comes down and you touch down, the wings are at what's called a negative angle of attack. Tip downward. I presume that's because they couldn't make the nosegear longer for weight or whatever reason. Is that correct?

HAISE: It was—it actually was for weight. And it's kind of funny the first time you de-rotate or try to put the nose down. For a little bit you almost think you don't have a nosegear because it goes down so far. It does present a problem more today—in today's flight operation where the vehicle's heavier with actually [having to follow] a ritual on de-rotating to get the nosegear on. I've never been on an airplane that you actually had to worry about a sequence to do that effectively.

Because if you do de-rotate too fast, too early while you're still at high speed, the effect of the negative lift—putting pressure down on the tires—can conceivably blow the tires. So you have to go to a point in pitch to hold and wait till you get below a certain speed to then continue the de-rotation to effectively get the nosegear on the ground. And at the same time, you can't hold it off too long, while it's still too high, or else you'll lose the ability to arrest the fall [through]. And if it—if you kept it up too long, it would fall through and damage the nosegear from the standpoint of hitting down too hard. So you've kind of got to work in between [with] a scheme of getting the nosegear on the runway.

WARD: Of course, you didn't have a feature that has since been added to the Orbiter; that being a drag parachute.

HAISE: That's correct. Yeah, we had it—we had that on the original vehicle's original design in proposals received. And that fell out early when we got into what we considered were serious weight problems, and we went through (I recall) at least several weight scrubs.

And the drag chute was one of the things that gone thrown out early in the development program.

WARD: Before Skylab reentered Earth's atmosphere prematurely, you were scheduled to command a Shuttle mission (as I recall) that would have rescued Skylab. Now, what happened with all of that?

HAISE: Yes. I was scheduled at that point to fly the third orbital flight. (I was going to command it.) Jack Lousma [Jack R. Lousma] was my crewmate at the time and, quite appropriately, Jack [was] there because he had flown a Skylab mission. And what happened obviously was the—there was a miscalculation, I guess, on the solar effect on our atmosphere, which was raised, causing more drag. So… the Skylab… [predicted time] for reentering was moving to the left in schedule, and our flight schedule (including the first flight) was going to the right. So at a point…, they crossed and that mission went away. And from there it became really a rescue team established [in] a control center to effectively try to handle the demise of Skylab in as safe a way as possible. To put it in[to] unoccupied ocean.

Jack and I were together, I don't know how many months in that training cycle. And really when that mission went away, which I was very enamored with, and just seeing, you know, the younger team that had come in of younger astronauts in 1978 that joined the force, considering where I was in age and life, having that experience in the Orbiter Office and an interest in getting into aerospace management, an opportunity came along to join Grumman [Grumman Aerospace Corporation] that I just felt it was the right time to start my next career. And so I left the program in '79 for that purpose.

WARD: Well you continued to have a close association with NASA and the space program then with Grumman and the International Space Station, although it was called Space Station *Freedom* at that time.

HAISE: Yes. I had several contracts I worked with NASA on (as a contractor from Grumman) initially with the Shuttle Processing Contract. I… headed the team, part of the Lockheed initial team, to handle the ground turnaround of Shuttles back in '83, [when] we started on that contract. I then moved in '90—I'm sorry. '80—about '87… I moved to Reston, Virginia… to head the integration contract that Grumman had won on the Space Station *Freedom* at that time with the NASA contingent that was stationed at Reston.

The only—the other major program that I was involved with is under the service company I headed for Grumman, later Northrup-Grumman. We had a contract here at Johnson Space Center for the institutional computing systems, personal computers purchased with a COT software [and] for a while the mainframes, although most of them departed to Marshall at a point. Most of the networking around the Center. And the telephone system. So that contract umbrella'd the institutional site computing services.

WARD: Is the Space Station—[Recorder turned off.]

WARD: Fred, I'd like to conclude by getting some of your thoughts on the International Space Station. You were closely involved with that program, as well as with the programs that led up to it. Do you think we're more or less on track with that now after some really serious birth pangs?

HAISE: Well I guess the you know, I only follow it these days from what I read in the—in newspapers or hear in the news. I guess the the critical thing still, as it has been all along, is to execute the assembly process. It has, as you said, had several turns in the way of the configuration and the design of it, the basic vehicle, the fairly late addition of the Russian components in the configuration, which is always added turmoil—in, "How do you encompass that and integrate it into the whole vehicle?"

But it mainly it—in the process of the assembly, each time you're dependent on a—on a very success-oriented set of things that have to happen where you're bound by the limits of the Shuttle lifetime on orbit. And I'm primarily, I guess, talking about the mechanical aspects.

You certainly would like to not get hung up in the middle of mechanically assembling the various components that go up on each flight, and have to have it only partially completed or—particularly in the early assembly segments, where it's not a completed vehicle, not an operational vehicle and the Shuttle has to leave it and come home in the middle of some sort of problem like that. So I'm hoping there's a lot of contingency planning for how to, you know, handle those kind of hiccups, which you hope won't happen but are possible to happen.

Now as it grows on up and you start having (call it) the "internal" problems, which be it—may be in software [where] things quite aren't right, those I think you can cope with better. At least if you have an operational vehicle and you have a crew there that can be there reasonably full time, you can kind of work those problems on an ongoing basis. But the real critical facet of those early flights [is] to get it to the point it is self-sustaining to some degree, where you've got the time and the crew there that [can] continue there, working with the ground to continue to work problems that may be there.

WARD: Of course once it—once it's been successfully completed on orbit, then do you see a path through the Space Station, perhaps, to get us back to the sort of exploration that we did on Apollo?

HAISE: Well, I think, you know, the follow-up to Station is frankly with any program of that scope and scale, is highly dependent on national policy or (we follow it in virtue of Space Station) international policy. What's the drivers that are going to make the United States, the Congress, the Administration, want to foster the funding? Because clearly funding is behind doing any of these things. Or on an international basis, that that coalition of countries that are again going to partner in some way to provide the funding to make those next steps.

I'm afraid I'm not a very good tea leaf reader to right now, at least, see any clear-cut thing evolving that's going to say, beyond hopes, that, "Here's the funding, and we're going to Mars" or "We're going to Mars to set up a permanent station." I just don't see that in full.

WARD: Do you think a successful Space Station Program might engender public enthusiasm for further exploration?

HAISE: I think it the hopes of that being accomplished would be from the outcome of the various types of experiments that are done. There are (call it) "breakthroughs"—be it in medicine or other things that are going to be done—type experiments on the—on Space Station that can be really almost (I'll say) headline-type of findings that are very clear to the public at large that this has been very worthwhile in that sense. That's the kind of thing I think that would, you know, warrant the consideration in the investment.

WARD: Would you like to see the country set a next role of going on to Mars, or perhaps going back to the Moon first?

HAISE: Well that, I certainly would like to see a continuation of the things that will provide us the capability to move outward in technologies, if nothing else in the interim, which also is at a fairly low ebb today.

You know, somewhat philosophically over the years, I've come to think of the space program as really the means that (very, very long term; it may be thousands of years, maybe a million years), it is the mechanism to establish the human race elsewhere. We think we live on a big object called the Earth, but it's really a very small object. It's a single spacecraft. There is no—we don't have a backup for Earth that we all live on.

I couple that with a thought… you know—we uniquely were given the capability of all the creatures I know, the Creator uniquely gave us the capability to do this. And it just seemed almost divinely ordained that we should use this capability to ultimately preserve the race. That's one of the things the Creator gave us [the talent]—for that consideration. And it's up to us to use—to somehow focus and to use our talents in that vein, rather than a lot of talent and resources we use in other veins that consume a lot of resources.

WARD: Well I think on that philosophical note, we'll end it. And I thank you very much for coming by.

HAISE: Thank you.

[End of Interview]