NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY 3 TRANSCRIPT

JOHN D. "DENNY" HOLT
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is February 2nd, 2005. This oral history interview with Denny Holt is being conducted in Houston, Texas, for the NASA Johnson Space Center Oral History Project. The interviewer is Rebecca Wright, assisted by Sandra Johnson and Jennifer Ross-Nazzal. This interview is the third session with Mr. Holt.

As we concluded our last session, you began sharing information with us about STSOC, the Space Transportation System Operations Consolidation contract. Would you start today by telling us about this contract, and how you were selected to lead that negotiation team and then later serve as the COTR [Contract Officer's Technical Representative] for it?

HOLT: Okay. Just some background on—the agency at that time was trying to find enough money to go do Space Station, so the way that that was decided was that they'd contract out Shuttle Operations, try to give that to bigger—big chunks to industry, and then take the wedge that should have been reserved for the Shuttle Program and use that then to fund Space Station. So that was the strategy, and at that time [James M.] Jim Beggs was the Administrator; a lot of experience in industry, and then back even earlier in NASA and back in Apollo days, and he brought in Air Force, which tends to be the way things go around here. Anytime you get a contracting initiative, it always starts with something the Air Force did.

So [General James A.] Jim Abrahamson came in, who later went to Star Wars right after he left us. But he had been a Program Manager on, I think it was, F-18—F-16 or F-18,

whichever one it was—and that was a joint venture across a lot of different—with Europeans, primarily. But he'd been a lot—heavy-duty contracting activity. The military always does jobs; they give out a big job, and they give it out in what's called completion form, so as you hand the job to the contractor, and you give him what you want him to do, and then the contractor then is responsible for the day-to-day development management and to a broad set of priorities and goals that you've set. So the government maintains an oversight-type role.

The military has gotten to that standard, and every time we bring in military—and we're on another round, now, of managers into that—they're always surprised at how deeply involved the civil servants are into the system. But it's always been one of those things that says the civil servants were the integrators when we developed it back when, at the start of all this stuff. Many of the facilities were built with contractors and civil service going hand in hand, and there was an awful lot of badgeless society back in the early days of NASA. Just everybody pitched in and did the job. The only time you could really tell that there was a big contract presence was if you're buying a full vehicle or you're buying a flight system or buying a launcher or something like that.

Even there, the teams were highly integrated, because you're in a development environment. Anybody that had the intelligence and knew how to do the job, then that expertise was applied to the program, whether it was the government, or whether it was the contractor, or whether you had to go buy somebody like Draper Laboratories out at MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts] to be able to do it. So you always had that flavor of "built here," and there was a big "not invented here" that went with all that. Each of the centers had their own "not invented here." The cultures at the centers are pretty firmly set and have been for years.

The Johnson Space Center culture, since JSC was opened up new, it started with basically the guys that Dr. [Robert R.] Gilruth brought with him from [NASA] Langley [Research Center, Hampton, Virginia], but a big, heavy influx of Air Force, people from contracts who had been out in industry to a great degree. A lot of flight test experience; guys from the Air Force. And then in our world, in the Operations world, we had a big contingent of Philco-Ford [Corporation] tech reps [technical representatives], who had done installations around the world, and so they had very, very broad experience. So when you take that whole backdrop, then you've got an organization then that has worked and just rubbed elbows, and you never really worried about— until it got around to promotion time—who's going to get the job.

That environment all started changing when things like the SPC [Shuttle Processing Contract] down in Florida was the first. They took all of Launch Operations, which had been— [NASA] Kennedy [Space Center, Cape Canaveral, Florida] had cut the job up into pieces and had a contractor for each piece, and so they bundled it all and put out the Shuttle Processing Contract. The incumbent team was Rockwell [International Corporation] was the program manager, and they lost to Lockheed [Martin Corporation]. The big incentive on the contract was cost.

So the next chip to fall was STSOC, was here, and it was 3,600 jobs, roughly; that's equivalent personnel. That's when we first all learned that it was equivalent personnel instead of man-years, because some of those equivalent persons weren't men anymore. Things had really started changing. There were twenty-two contracts, and sixteen contractors, all in the local area; Ford [Aerospace], McDonnell Douglas [Corporation], IBM [International Business Machine Corporation], Barrios [Technology, Inc.]. You can just tick them all off. Lockheed, everybody,

and then Singer-Link [Corporation] and so on. Everybody was affected by this contract.

Everybody had a piece of the pie in Operations.

So the Rockwell team that won, Rockwell had no presence, really, here. They had

provided the Orbiter, and they had some staff here. Tom Short and Lamar Bowles over the years

had had a Rockwell field office here. But that was really about the only thing they did was they

did technical support for the program and for the Orbiter. So when they had 35 total permanent

people in town, so 3,600 people on this contract, so you knew there was going to be a lot of

badge-swapping.

We went through all the proposals. There were four teams that bid the job. The

incumbent team, which—Ford, McDonnell Douglas, IBM—and then the team that won, the

Rockwell team, had Bendix [Corporation] to do the facilities, big mission maintenance

operations organization, and big heavy presence up at [NASA] Goddard [Space Flight Center,

Greenbelt, Maryland] and running the network for years. Then software was Unisys

[Corporation], and there were an awful lot of people that were just literally in shock that all of a

sudden anybody thought they could do software at JSC without IBM or do the [Mission] Control

Center without Ford.

So it was really cathartic. It was a cataclysmic event for an awful lot of folks in the

contracting ranks around here. A lot of them were affected pretty dramatically in their retirement

plans and all, so that culture was a beginning of a cultural shift as well. So from that point on,

you never quite had the same relationship with the contractors that you had before. So in this

case, you gave the job up—on paper, at least—to the Rockwell Space Operations Company,

which was an organization that had been set up to bid the contract by Rockwell International.

They had a good team, a good management team, very well qualified. Picked up a lot of the very well qualified guys here. A couple of areas that they didn't do well in, McDonnell Douglas and IBM were effective in holding onto their staff. So we had big training programs that we knew we were going to have to go through. McDonnell was kind of a surprise. They managed to find jobs for a lot of the flight design people.

So the backdrop of that long-winded explanation was that we knew things were going to change, and we knew that business as usual with JSC was no longer business as usual. So the Center had reorganized at that time. The guys who had normally run the facilities had—classically, we had split the flight control team and the guys that did training and who were the staff for the flight controllers and the trainers and so forth—had always worked for the Operations, for [Eugene F.] Gene Kranz and that part of the organization. And then the facilities had been developed by another organization, and they had run the contracts. So for STSOC, when it was consolidated, it was all given to Gene.

That was the first time Gene had ever had responsibility for the facilities, and it left the follow-on facilities, for like Space Station and any big improvements and so forth, in an operations engineering organization. It stayed separate as another Directorate. That was then to go do future programs. Again, that was the, "Here's Shuttle. Here's going to be the Advanced Programs world."

Then the flight crew was split off under George [W. S.] Abbey, and [Clifford E.] Cliff Charlesworth was the Director of Space Operations. So we had [Gerald D.] Gerry Griffin as the Center Director; this is after [Christopher C.] Kraft [Jr.] left. So Cliff was an old-time Flight Director, and had a lot of years, and was ornery enough to deal with George and Gene and Jerry [C.] Bostick. In fact, he was ornery enough to deal with damn near anybody.

So we had that cultural shift going that said all of a sudden it was going to be a job that Kranz was responsible for the whole operation; flight controllers, Control Center, trainer. So you not only had the people that were supposed to do the job, you had the facilities and all the resources to go fly Shuttle.

So I was minding my own business, running Payload Operations for John [W.] O'Neill at that time, and I had a very nice setup. I had Earl [W.] Thompson for a deputy, and Earl then was the director of [Institutional] Data Systems when he retired, only recently. Earl was great. We had five sections, and we had fifty civil servants and fifty level-of-effort contractors, so life was really good. We had a going and blowing operation. And Kranz called and says, "How would you like to go run this contract?" I had no clue what that meant, other than the fact that I had just been invited to go do something, and that usually you didn't turn down those kind of invitations.

I went and talked to Carl [B.] Shelley, who was the Deputy Director of Mission Ops [Operations] at that time, and Carl said, "Well, yeah, it's going to be you or Ted [A.] Guillory or somebody, one or two of you guys that are branch chiefs right now are going to have to go do this."

I asked him, "Why me?"

He said, "It's just one of those things."

Carl had been pretty much my mentor all those years, so I was pretty well convinced that he had been the reason I ended up with the job, and Gene told me that later.

So we took the job on, and we had to transition the NASA organization into the thing to where Kranz all of a sudden became responsible for the facilities. That left us—so we had to reorganize. [Donald R.] Don Puddy got half the organization. He got all the facilities and the

flight controllers, and John O'Neill got the operations piece. And then I had the contract; I also had the production schedules.

If you think about it, every time you fly an Orbiter, you take everything out, and then you load it back up, and you go off and do a new mission, so it's very—we were in the process that—and it was in the formative stages of trying to figure out, do we know enough to make a process with a template so that you'd do the same types of things every time, and then you'd just pick up the mission specific. So we were very much in the formative stages of that when we were trying to do this contract. It wasn't mature. It was not something that you would boilerplate. It was advertised that way, but it wasn't.

I also had the Budget Office. It was interesting, in that prior to this contract, I couldn't buy paper clips. The average—if you're not a supply clerk, you can't spend money for the government. So the first purchase order I ever signed was for $749 million dollars, for five years. It was kind of a surprise. They walked out of there with that piece of paper, and I said, "Where are you going?"

And the guy said, "Well, I'm going to take this back."

And I said, "Well, I want a copy of that, because it's the first time I've ever signed a purchase order. Last year I couldn't buy a paper clip." So it's kind of interesting.

But it was typical of the kinds of thing that says if you understand the business—and there are people who understand how the business gets done. My job was to make sure that we got the right job done. So I went off, spent a year developing the statement of work. [Charles S.] Charlie Harlan was actually the Board Chairman for the procurement, and Charlie had been a branch chief for Gene, also.

I remember some of the comments that were made by people that said, "Well," they said, "it's really going to be a shock to Kranz' system," and there were a lot of people out there that were really looking forward to Gene having to go to this kind of work, because he'd never had to do it before. Charlie and I talked about that one day, and I told him, I said, "You know, Charlie, I don't know how much Gene's going to like this or not, but I know one thing. He'll do it brute force if he has to, but he'll get it done."

And Charlie said, "I don't have any doubt." And there were some parts of it we really had to brute force.

So we turned on the contract. Some of the problems we had were there were people who had decided to take their savings along the way before we had set the contract into place. So we had the unusual event of turning on a contract, and then on the same day having to negotiate a $45 million change to keep from having an interruption of service, because we didn't have the contract. When they had taken their savings out of the contract, they had assumed that the contractor would respond in a way that they would get the savings.

Well, that didn't happen, so it was like when you fund the contract, you had to pony up, so we had to pony up about another $45 million as part of the contract. It's a long, involved story, and there's only two or three of us who really probably know how to tell it, and it's too long for this discussion then. [Laughs]

WRIGHT: Okay.

HOLT: And you really wouldn't want to hear it anyhow. So John [H.] Beall, who ran the budget contract, who's now the Center Financial Officer, John and I ended up at [NASA] Headquarters

[Washington, D.C.] delivering the bad news, along with [William P.] Bill Bays, who was the

Procurement Officer. They weren't real happy with us, but they didn't have much choice, and

we didn't, either. We didn't have a way to go lay off a hundred people out of this thing.

So we started into transition. The contract was set up along the lines of you'll have cost

incentives, and so we had a cost-plus-incentive-fee contract. The incentive fee was based on

flight rate, so if we flew and met the flight rate, then the contractor could get full fee. We were

one month into transition when the *Challenger* accident happened. Now, when the flight rate

goes to zero, all of a sudden your fee evaporates in that arrangement. So in the situation we were

in, all of a sudden Rockwell finds themself in a position to where they can get their costs

covered, but they can't make any money on this contract. That's usually not a very tenable

position for a new Program Manager to be in, and [Robert] Bob Miner was no exception.

So that was pretty tough, and the first call we get from Headquarters was, "Why don't

y'all lay everybody off, because the Shuttle flights only cost *x*, and so you need to—." Same

type of thing that's going on over here right now. It's been going on for two years. So we went

through the wars over prioritizing and figuring out what to do next, and we knew that we were

going to have to give—you know, "How much money do you need?"

"Well, I'm not real sure. We've got a brand-new contract. It's not like the old ones.

We've got all our cost basises on thirty years of operations prior to this."

So it was a pretty rough period of time to go through, and for a guy that had just been

struggling with his checkbook, and all of a sudden you had a few million here and a few million

there, and you were talking swings of every other day you've got somebody in Headquarters

asking you a question about why don't you take some more out here and take some more out

there. So we're trying to figure out just how much money we're going to have to have just to

renegotiate, and we hadn't quite figured out—because we hadn't transitioned from the old

contractors—just how much money it was going to take, and we didn't know exactly what kind

of shape we were in.

So Rockwell's still out trying to hire. A lot of people don't want to go now, because

they're not sure when the Shuttle is going to fly again. People took off and went back to college.

People moved on and got into other industries. The McDonnell Douglas flight designers went to

Iridium Global Satellites; kept them going for ten years. And the IBMers just didn't show up.

IBM got—we get exactly zero out of IBM.

So from that perspective, it was kind of traumatic in those times. Jon [C.] Harpold had to

build a training program for new hire flight designers that Rockwell was going out and hiring

right out of college. And today some of those kids are Flight Directors. So, we got our money's

worth out of them. A lot of them are now civil servants, but they're all in the USA [United

Space Alliance] world today. So you found yourself all of a sudden trying to adapt to a new way

of doing business in an environment of chaos.

The other part of it is we were using quite a bit of DoD [Department of Defense] money,

because we were getting ready to go fly some Shuttles for the DoD. They had just built a launch

facility out on the West Coast at Vandenberg [Air Force Base, California], but when they—as

part of the Rogers Commission, which was the big analysis board back in those days—when they

finished, the Shuttle no longer was the preferred mode of getting to orbit.

The commercial business had pretty much evaporated, and the DoD had walked, so we

were down to where all of a sudden you didn't have near the money you used to have, so you

had to find a way to go—and that was about a third of the funding that we were getting out of the

Shuttle Program for missions, not for the whole activity. But we saw a chunk of that change in

the contracts that we were turning on. So that had to be made up.

So it was a pretty nasty time in there, and a lot of long hours. I can remember budget

numbers still running through—they'd just run through your head. And just about the time

you'd think you got it squared away, remember, we had one period of time there where the

cardinal number was $7.9 million. We had three or four things that were $7.9 million, and we

had a couple of others that were like 8.1. Every time you'd go run a set of numbers and they

wouldn't be right by 7.9, you could say, "Wait. Just go figure out which one you missed."

Either you double-counted one or you didn't count, but you could always count on it, it was

going to be off by $7.9 million. It would just drive you crazy.

So I took that for about fourteen months. That environment, we had put in a place—

literally had to go through and build the template and build the products that would let you go do

a flight, and hand it off. The kinds of things we were dealing with, I told you, you had the mix of

contractors and civil servants. Well, in the old system a lot of the flight design was a couple of

guys sat in the same office; been sitting in the same office together for twenty-five years. And a

guy says, "I just need this converted to such-and-such."

And he says, "I've got a little program running on my HP-35 over here." Of course, it

used to be a slide rule. And he'd flip that out, and give it to him.

Well, nobody had any traceability on the fact that those two guys had to have a

conversation every flight in order to get that little thing done. So we had what we were calling

phantom tools, things that weren't identified to the contractor, and we knew that we were in a

world of hurt for going off and pulling all that together. So there was a big activity [Lawrence

S.] Larry Bourgeois ran, for about almost two years, to go hammer out through every single

process and every single product so that we could develop what it took to go from the start on a

Shuttle flight all the way through to build a product so that the lights came on in the right places,

and the commands got to where they were supposed to go, and all of those kinds of things got

done right.

So the numbers of people all has to do with the fact that you've got great big facilities.

The Control Center, it's just got software running out its ears. You've got wire all over

everywhere. We had wire in the Control Center that they couldn't figure out where—some of

that wire in there had just been—they'd just tied it off rather than—run another wire instead of

trying to figure out what was there. So Rockwell had some of that to go—Bendix had to go

contend with some of that. We just had to go learn from scratch how to take it apart and put it

back together again. So it was kind of like reverse engineering a car, probably an Italian car.

[Laughs]

So we had a really rough year, and every time we turned around we had another meeting

in the Center Director's office, or we had another rondure going on with Headquarters over how

much money we were going to get or not going to get or whatever. It was a tough transition.

They didn't have a lot of choice, and Gene was pretty hard.

Gene knew that he wasn't going to—that at the time there wasn't anybody who was

going to challenge the Director of Mission Operations. If he told them he had to have something

to operate, then he was going to get it, probably, as long as we knew what we were going to do

with it. So from that standpoint, we had a lot—we were dealing from strength, from that

standpoint. It made it hard on a day-to-day basis, because you had to go just keep banging on it

until it finally toppled.

The thing we did in that time, though, I took it for about a year, about fourteen months, and on the way—and I'd just pretty much decided that I just couldn't do that for a living. My deal with Gene was I'd go do it for a while, and his idea of "a while" had changed the minute *Challenger* happened, and my idea of "a while" was starting to run out, and I was getting awful tired of playing budget numbers and contracts, so I was looking for an opportunity to get back into the business end of the business.

So on the way out the door, I did some work for him and told him I didn't think he could stand to be operating in a completion form environment and needed to change his contracts. People had gotten a couple things mixed up. When you consolidate, you got all your cost savings out of consolidation. It didn't have a thing to do with the kind of contract you were in, and the reason the military always liked completion form contracts was because they had three-year money, so if they ran a little long one year, they could make up for it the following year. Or if they were short one year, they could spend the money the next year.

NASA's on a one-year budget cycle, so you could roll money from year to year, but you couldn't spend next year's money this year. So any dollar you got had to be a dollar that was committed from this year, or it had to come out of reserves from somewhere. So that, and there was always the fallacy of everybody that's walked in out of the military is not recognizing that the contracting environment is not what they're used to; that they don't have the flexibility that they're used to. So those have always been the traps, is every time we get a procurement initiative, it's always something that just worked great on the F-whatever. Of course, they've got their overruns, and we have ours, and they're all tough like that.

So STSOC—Bob Miner's team was good. Ben Boykin was the Facilities Manager they brought in, and he and Don Puddy hit it off very well, and they were both very professional.

Doug Johnson and John O'Neill were very professional. Keith McClung and I worked together. Keith taught me more than I'll ever be able to repay him for, because he knew more about what I was supposed to be doing than I did. He had a lot of experience.

So they had a really good professional management team that came with the contract, and that was the nucleus of the USA effort, and so when you think of USA, it's really the consolidation of the Shuttle processing contract in Florida and STSOC here, and also then they started pulling in all the other pieces, like the tank and the elements out at [NASA] Marshall [Space Flight Center, Huntsville, Alabama] and the main engine and so forth. And then NASA then maintains the engineering of the upgrades and any new processes. So the idea was NASA will put its emphasis on the new and will contract out the operation and the maintenance.

It's never been quite that pure, because the Shuttle never really was an operational vehicle. It's always had that kind of developmental nature. It was declared operational, just out of convenience as much as anything, after four flights. But literally I suspect that the money we took to go fund Station, when we were going to go do all the contracts, was actually money we would have needed in order to plug back in just to keep the system running.

So a couple of years go by, and you've not flown, and you're getting back to go fly again, and in the meantime people are thinking they want to go do Space Station, and they've announced the initiative, and they've moved out. They've finally got the President to give them the green light, which is a couple of years after—President [Ronald W.] Reagan finally had to be convinced, and the way he got convinced was they managed to get the contracts all broken up in pieces to where you could get—almost every state in the union had a piece of it. So it's nothing new; I mean, NASA's always been political.

The hard part of that was that the money that would have been the wedge, since you lost the DoD, you lost the commercial funding, and you had to use the money that you would have like to have had as a wedge to go recover the Shuttle. The Shuttle cost just as much the years it wasn't flying as it did the years [it was]—so you didn't save any money back. So what should have been the elegant strategy evaporated. So at this point in time, I made an astute career move and ended up working in the Space Station world, so, no money and big contracts. So all the stuff that I wasn't going to ever do again, I was right back in the middle of it. Timing is everything in this world.

So I was about to leave MOD [Mission Operations Directorate], and I wanted out of this job, and they put me on a transition task team at Headquarters. Supposed to be six weeks to look at Operations across the agency, and this was the third-order fallout of the Rogers Commission. It was down after Sam Phillips was about the second-order fallout, and we were about the third, so we were into a "go look at reorganizing for Operations." That six weeks took six months of back and forth to Washington [D.C.] and never went anywhere, because every recommendation we could come up with, nobody could stomach. It was pretty close to the way it ended up operating.

At the time, Space Station was a separate organization in Headquarters, separate from the Space Shuttle. Since it wasn't approved, you didn't need to go mix it in. Well, for operating, it was all going to use the same Control Center, trainers, the bulk of the same people, and the only thing different was going to be the development contracts. But it was never put together that way. The program was dispersed.

Then once the *Challenger* accident happened—Space Station was going to be run out of JSC, and you'd have the two programs running together, and roughly what you got today.

Where you have [William H.] Bill Gerstenmaier and [William W.] Bill Parsons, well, at that time you had [Arnold D.] Arnie Aldrich, and [Richard H.] Dick Kohrs was here, and you had Neil [B.] Hutchinson and John [W.] Aaron doing the Space Station.

When the accident came along, then they decided all program management needed to be in Washington, so they moved the Station program to D.C, only they didn't move it to downtown D.C. It ended up in Reston [Virginia], which is out close to Dulles [International] Airport. I don't care what kind of field center you have, if you're not at the place, and you're away, and you are a field center, and you don't think like the people do that are in the downtown area, and that's probably not all bad, because the downtown area tends to be an interesting place.

So we had a field center to deal with in the Space Station, and most of the people that had been working on the Space Station, here and over in Huntsville [Marshall Space Flight Center, Alabama], [NASA] Lewis Research Center [now Glenn Research Center, Cleveland, Ohio], and Goddard, didn't really have jobs anymore. If they'd been in management, they were persona non grata anymore, and they'd just need to go find new jobs somewhere. So very, very few—there was almost no transition there of people who were in the Space Station that went to Reston.

So you had a learning curve, and you typically had people who, if there was a GS-15 [General Schedule] job up there to be filled, it was filled by somebody who'd just gotten a [GS-]14 somewhere. So everybody was taking a bump to go to Washington to start the new field center, and it did right well for a lot of people. There were an awful lot of young folks that made out in their careers very well.

I had signed up to go to work for John [T.] Cox. John had been a Flight Director down here, and had moved. He'd gone to the Station office to run Operations and Utilizations, and I'd signed up to do Operations with John. Then in the intervening time, I had my six months back

and forth. I saw enough of what was going on up there to realize that I just didn't think I wanted to do that for a living anymore.

So I stayed at the Center, and Gene put me on staff to go do special projects and anything that was—I got to where I worked on Shuttle C, and then the Crew Return Vehicle with the—a lot like what's going on today with the Orbital Space Plane [Crew] Return Vehicle; the same studies that we did back in 1988, which were updates of the studies that were done in nineteen-seventy-whatever. So there's nothing really new in this business over the years.

So from a personal perspective, I just pretty much—I tried to get out of there. Had a job lined up to go work in the Shuttle, and the Center didn't want to let me go. So I ended up, Gene let me stay where I was and gave me housing, as long as I was willing to go wherever to go do whatever, and I didn't have much choice. But I was out of the contracting business for a while. That was good. So I got that part of my advantage done. It wasn't a very astute career move, but it worked.

So STSOC really was a change, a cultural change, because for the first time you had big chunks of the organization who were actually being managed by the contractor, and not just bodies provided to NASA to manage. That transition was a difficult transition. It would have been hard without the *Challenger* accident. There are people that I've heard make statements, that say, "Well, they would never have been successful if the *Challenger* accident hadn't occurred." I think that's not true. There was enough professionalism in the business to where the skills were there, and the skills transitioned to Rockwell; at the time, Rockwell Space Operations.

If worse had come to worst, we would have had to go do some additional contracts to incumbents, maybe with IBM or somewhere, and we knew that going in, that those were always

the potentials. That's the one thing we didn't have to do, with the accident. You had enough time to where you could then go back, and so it made for a stronger contractor coming out the other side than it would have.

But the completion form part of it died, and it went back to a very, very large task orders, the difference being you just set how much effort you're going to expend on it, and break it down at the task level, rather than handing it to the contractor and asking him to break it down. So there's always a—it's never pure, anyhow. Everybody that thinks that you throw contracts over the wall and walk away from them and come back in a month and get your product, I don't know what kind of world they live in, but it's not the one we lived in. Things changed on a day-to-day basis, and everybody had to pitch in or you didn't get there.

WRIGHT: How did the contract, if it did, affect the return to flight work?

HOLT: [It didn't.] I think the return to flight probably affected the contract more than the contract affected the return to flight. Coming out at the end of all of the work, the one thing that the accident allowed you to do was concentrate on nothing but the processes that you had to have implemented within the contract. So you were able to then just break it down without having to produce products for multiple flights at the same time.

So it allowed you to, in effect, just QC [quality control] one set of products for the upcoming flight, and the other stuff you knew was behind you, but it was really behind you. It didn't have to get worked as hard as that first step. So it wasn't much—and it looked a lot like STS-1, from that standpoint. You worked so hard on STS-1, and then all of a sudden STS-2 showed up, and it was like, god, you've got to do this again. So I think that's probably the

perspective that I'd have on that, that it was a benefit, probably, to not have the distraction of additional flights.

But at the same time, you had such a cloud hanging over you for, "What are you going to be doing? When are you going to fly?" You did have to recrank for every month. Every time you'd go across a seasonal boundary, for example, all your trajectory work had to be redone, so you had to go recrank. Well, it's hard to say whether that was a problem or whether it's an opportunity when you've got new people in the system, to the extent that we had them in the system; and you had new managers in the system.

So from that standpoint, I think the *Columbia* [accident] is not as traumatic, from the having to do the work and transition the way you did the work. In the *Columbia* recovery, I think it's more along the lines of people just wondering if they're going to have a job when this is all over with. And there was an aspect of that, but most of those folks cut and ran, and the rest—so there was more of a "It's time to put your nose to the grindstone and get this thing back to work." The first time an accident occurs, that's the approach. The second time, I think people are much more circumspect, and they're somewhat more concerned about, "Is this really a career path that's going to pay to put my kids through school." So there's some of that.

WRIGHT: You were working those special projects for Gene Kranz.

HOLT: Yes, right.

WRIGHT: How long were you—

HOLT: About six months.

WRIGHT: And then where did you venture off to next?

HOLT: Well, I got roped into—I was trying to get into the Shuttle Program Office, and that didn't work. I wanted to go work for Dick Kohrs. Dick Kohrs is one of the really top program managers NASA's had in years, and I really enjoy—I like Dick. I was looking for the opportunity, and had pretty much gotten agreement out of him and Arnie Aldrich that they had the job for me. Every time I'd—but I'd come back to Houston, and [Aaron] Cohen had asked me to go talk to the guys in Space Station, and I'd go down and talk to Clarke Covington, and Clarke would ask me why I was there.

I told him I had been sent, and he'd say, "I don't know why."

And I'd say, "I don't know, either." So I'd turn around and leave.

And I'd get a call from the ninth floor, and they'd say, "Well, how'd it go?"

And I said, "He didn't know why I'm there, and I don't know why I'm there."

So finally after about a month or so of that, Cliff Charlesworth called me and says, "Well, you're going to Space Station, to the project office down here." At that time, Carl [B.] Shelley was over there working as a deputy, and I knew what was going on. Carl had already told me he was trying to get me over there, and I really wasn't all that excited about going, but I was told that, "Well, you go down there for a year, and we'll get you out if you don't like it." Of course, Charlesworth retired and died in a year, so I'm not too sure how I'd ever have gotten out of there.

So I rode the Space Station Freedom Program into the ground, and when it died, I had to go scramble and find another job. And it was probably one of the most chaotic, miserable experiences of anybody's life. I gave you that little bit of backdrop about how they started it under a cloud, just because it didn't have enough money.

They also started with a design that didn't work. The whole structures community fell into two camps, those that thought that you could do some really neat thing, that had the elegant solution. Do you remember the trusses that had the sticks and balls and all, the tinker-toy-type arrangement? Well, if you're structures people, then that has the elegant simplicity of being lightweight and high strength, so you can get a very large station for very light weight. So if you're in their world, then that says, "Well, all you've got to do is get all this mass to orbit, so if there's less mass, I can get more Station for the same mass than if I just were to build up chunks of it and stick them together."

The complexity factor of that got lost in the noise. NASA had done a flight experiment back in the—let's see, [19] '85. Jerry [L.] Ross and [Sherwood C.] Woody Spring did a beam builder experiment on [STS 61-B], two flights before *Challenger*. They had built a beam in the Shuttle bay, but it took quite a while, and nobody factored in the amount of time that it took them, because everybody had fallen in love with the design. Because when you're trying to think about the Space Station, everybody wanted a big Space Station. There had never been a day that—and JSC and the agency was in love with the idea of, "We want a big, new start. We want a great big Space Station."

So they went out and got all these international partners, and said, "We'll build a great big truss, and you guys build modules and the Canadians will build us an arm, and then we need a robot; Goddard will build a robot." So you get all the trappings of the program. Well, the next

thing you knew, the thing had huge arrays, and it even had a solar dynamic—same kind of thing

you use on a submarine for electrical power. It had a dual keel. Had a big barn out there so you

could keep stuff outside. It had modules all over everywhere. It was the kind of thing to where

if you had five or six Shuttles that you could dedicate to it, you could almost get it to fly.

The only problem you had was you could never put it together, because you were

constrained by the fact that the Shuttle cargo bay was only so big, and you have to get enough on

orbit to sustain itself. So figuring out where to start and where the break points are got to be kind

of complicated.

By the time I got on the Space Station, they'd already trashed the dual keel and had gone

to a single-beam arrangement, roughly the kind of thing they've got today. But you still couldn't

figure out how to package it so that you could get enough on orbit at any one point in time that it

would be self-sustaining when you came back to it. And that got pointed out to us in spades

when we went through our preliminary design review.

McDonnell Douglas, who was the prime contractor for JSC—we had a Byzantine

arrangement. We had a program office in Reston; program director was downtown; they had

450 people in Reston, about half of them from [Northrop] Grumman [Corporation], contractors.

And we had a project office. Every center that got to play had their own project office, and they

had their own contractor. Then on top of that, we had all the facilities here at JSC and the crew.

So it was an inverted pyramid, in effect. It was unbelievable.

So we had the McDonnell Douglas contract. When they brought in their design, and the

design was NASA's, and they were supposed to build their piece, and NASA was going to do the

inter-system integration. So the whole thing was never contracted out; it was always the pieces

were contracted out. So McDonnell Douglas came back in, and they were capable to where you

had your first ability to sustain people on board. It was called the man-tended configuration. So you could go up and live there, but you're going to be back and forth until you can finally get it outfitted. But you don't have to keep the logistics burden going; that's the problem the [International Space] Station has got today. Next was permanently manned, which was the full-up configuration. That's before you start hanging on the European and Japanese labs.

So at our CDR [Critical Design Review], McDonnell Douglas came in and said, "Here's the way it works. Here's how it's all put together." But when they showed their performance chart, we were 100,000 pounds overweight at the permanently manned configuration, and about 60,000 pounds overweight at the man-tended configuration. So on flight five, you needed about another 60,000 pounds of Space Station in the first five flights, just to have something that would function.

So the project initial response was, "Well, gosh, we need a weight scrub." And there's nobody that scrubs weight like engineers. Boy, they love to get in and scrub weight.

"Does that weigh five ounces?"

"Sure. Let's take ten out of it." You know, that type of thing. So, they were going through, brutally going through line item by line item, scrubbing weight.

We had a small team, and I was doing SE&I [Systems Engineering and Integration] by then, and I had a couple of guys, Keith Reiley, for one, and we were sitting around and just asking the questions about just how did we get into the mess, because we were watching them take twenty pounds out here and thirty pounds out there, and it didn't look like we were making much ground.

So I asked a few of those guys to go look to just see how much the overall effect of the Station, the fact that it was as big as it was, how that was going to impact the weight design—

taking weight out. And what they came back with was that we would have had to take, since due to the fact that it was so big, the weight of wire running out to all these places and the weight of tubing running out to all these places and the weight of structure that had to be deployed was affecting the overall weight of the configuration to the point where we were going to probably have to get about 55 percent of the weight out of the systems that we were flying. So that's fewer gyros and fewer—and there wasn't any way. So there was really no way to get there from here with that design. I can remember we closed the door on the second floor of Building 1 in Room—whatever that room is; 210, something like that. We had one set of viewgraphs, and we had the project management and John Aaron—and [Robert E.] Bob Bobola was the Chief Engineer—down, and we says, "We just want to have a little chat."

We flipped a few charts, and it was like, "Oh, this is not going to be pleasant, is it?" And it wasn't. So that afternoon John told the Program Office in Reston, told [Robert W.] Bob Moorehead, says, "Hey, we're not going to get there. We're going to have to go make a fundamental change in order to get there." So packaged a briefing for Moorehead, and Bobola took it up and sat down with Bob and went through all of that.

So we knew we had a redesign, and the design had been a political animal back in the mid-eighties, because there were an awful lot of people that didn't like the design. It was the favorite son of what came out of the Langley structures crowd, and they're aristocrats of structure. So it had all the political clout behind this one design, and it had been the design that everybody was supposed to bid against. The Work Package 2 contract had unfortunately delivered almost all of it, so the burden of change was all on JSC and McDonnell Douglas.

So that put us in a position that says, "Okay, well, we better start looking at alternatives." Well, we couldn't look at alternatives without looking at all the alternatives, so the next thing

you knew, you had people that had cans. You know, it was all, "Let's look at something that looks like Skylab," or, "Let's look at something that looks like this."

So at the same time, the only thing that allowed us to actually get through all those alternatives is, it was in the fall of the year. We were doing this between Thanksgiving and Christmas. If you ever want to get anything done in NASA, you always want to do it between Thanksgiving and Christmas, because the rest of the world doesn't pay any attention to you.

At the same time, the program was doing a program-level Critical Design Review on the concept that we'd just concluded wasn't going to work. So Reston had two good big buildings, and so most everybody was over in the one big building, arguing over the program that wasn't going to work during the Critical Design Review, while there was a nucleus of us who—and I got fortunate enough to live there for a while, so I got back to Reston, all while they were working at Marshall and here and out in McDonnell Douglas, Rocketdyne, all those places, coming up with what the alternatives were.

So the banging through the alternatives, and finally it was fairly obvious to everybody that a pre-integrated truss was—hang everything on it, put it where you wanted it, weigh it, tailor it to fit in the cargo bay, and then carry it to orbit and screw it together. And it's still, to this day, there are people who would sit there and ask the question that says, "Well, I don't understand why the difference, or why that would be that much more efficient."

But if you think about it, it is nothing any more complicated than if you want to go build a place on a lake in deep East Texas, and you want it done in a hurry, and you want to be able to occupy it, then you're better off taking two double-wides and go up there and put it all together, and you can have it in two months. Or, you can find a custom builder in deep East Texas, and you'll be lucky to have it in six years. And that analogy is not far off.

So we lived through some fairly interesting times right then, and the only way we pulled it off was the fact that the program cashed in the NASA robot that was being developed by Goddard, the Flight Telerobotic Servicer, because the Canadians had a robot. And that's another story in itself. So that was a billion dollars that they had to run their project on that became the reserve for the program, and so about right here is when you had the real catharsis in the Freedom Program.

Everybody had to change something. Actually the guys over at Huntsville changed it the least, because they were building modules. So Marshall and Boeing got the least amount of change. McDonnell Douglas, it was a horrendous change. Some at Rocketdyne, just because we had to package things differently.

And quite a bit of change difference with the Canadians, because all of a sudden—I don't know if you remember when we flew the Space Station arm, it was folded up so it would fit on top of a pallet. We couldn't find a way to stretch out the arm. We always had the arm to where we did two pieces at the elbow, and you just lay it down. We couldn't find a way to do that anymore, so, literally, the guys, and I think they'd been out—well, let's just say they were eating pizza at a local establishment, and I think they had liquid refreshments.

They came back with an idea that said, "Well, maybe if we just broke these beams in half and stuck it down inside the truss, and then we'll come up with all this stuff, and then we'll just bolt it all together when it's through."

And it was like, "And what are you guys drinking?" But it turned out that that's actually what is on orbit today.

WRIGHT: Was there ever a discussion of possibly just scrapping the whole Space Station

Program in the midst of that?

HOLT: Oh, yes. Oh, gosh. Yes, they'd been through that so many times, it's not even funny.

Because you had hearings again, and you always had the big argument going on about how much

it took to maintain the Space Station. We had a couple of teams. We had one congressional

investigation, [William F.] Bill Fisher and Charlie [Charles R.] Price. Charlie was out at JSC

Engineering; he was a robotics guy. Bill Fisher was Astronaut Office.

They did an assessment—called the Fisher-Price Team—of just what the maintenance

demand was going to be. Of course, what you find out then is that the reason the maintenance

demand was so high was because they just had let the Reliability and Maintenance guys just go

run the numbers, based on specification numbers, and nobody had ever really paid much

attention to what they were. It just looked like they were pretty high, and everybody says, "It

can't be that high."

And it wasn't, but at the same time, the numbers were in public record, and there were a

lot of people starting to pick them up and saying, "Well, wait a minute. If this is the case, you

won't ever do anything but do EVAs [Extravehicular Activities] to fix your Space Station or

maintain; you'll be doing maintenance all the time. You're never going to do any utilization.

You'll never have any science return."

So that's why you had to have an activity to go off and grind through probabilistic risk

assessments and all kinds of new stuff. Guys like Barry [E.] Boswell learned an awful lot in

those days and times. No, it was ugly. Yes, the congressional folks were all over us. We were

overrunning. We were taking—the Work Package 2, which is the JSC project, we required all the reserve in the program two years running, just to be able to fund McDonnell Douglas.

And McDonnell Douglas wasn't all that well organized. The guy that had been Chief Engineer for McDonnell Douglas, a guy named Jim [D.] Barrett, was—the guys at McDAC [McDonnell Douglas Aerospace Corporation] adored Jim. He walked on water. The guy could get an unbelievable amount of work out of people in a short period of time. So when we took the old design and cranked it into a new design, he got that done, and we were able to run a delta CDR in something like six months. Unbelievable change, and it was a good CDR.

The only problem was that Jim was there the day we kicked it off. He went to the doctor that afternoon and found out he had lung cancer, and he never came back. And McDAC never really had another Chief Engineer. They tried splitting it a little bit, and they never really had a Deputy Program Manager. So they just really were kind of awash a bit, and we were—well, we were 2,000 miles in the other direction. It just didn't have good management focus.

We never trusted their numbers, and as it turned out, for good reason. The "should cost" at the time the contract was negotiated, and Bob Bobola did the negotiations—and he's around here by the way; if you haven't talked to Bob, Bob would be good—but was about $5 billion. And negotiated value was three and a half, and JSC assumed, "Well, okay, that's reserve."

McDonnell Douglas knew it was there. The contractors always know exactly what's in the NASA budget. They know probably to the line item better than we do, sometimes. But so all of a sudden, we were in a world of hurt. We had gone and exhausted all of our—we didn't have any reserve, and we were now all of a sudden in a situation where McDonnell Douglas had made enough changes, and that they had very, very big liabilities with their subcontractors, and at the time that our numbers showed, in John Aaron's opinion, we were about maybe $100

million out of bid with the McDonnell Douglas estimate. Actually, McDonnell Douglas was

closer to $750 million out of bed with their subcontractors and their liabilities.

So that's the kind of—when you get that kind of spread, that was at the time when—and

we were treated to the privilege of watching John get fired by Representative [Robert] Krueger

[Democrat-Texas] on CNN [Cable News Network]. It was a pretty ugly time in my career.

There was never really a good relationship between JSC and Reston.

The personal relationship between John Aaron, who was our Project Manager, and Bob

Moorehead, who was the Program Manager, was abysmal, and it was historical. Moorehead had

never, ever liked John, and literally, they just didn't talk to each other. So we were treated to a

situation where Moorehead would talk to Aaron Cohen, the Center Director, and chew on Aaron

[Cohen], and John would talk to Kohrs, who was the Program Director down in Houston, but so

you had this going on all the time, and it was really—it was about as ugly a situation as you

could get.

So we were hammering out—I was doing system integration, and there were twenty-two

interface control documents among all the program elements. Eighteen of them were McDonnell

Douglas Work Package 2 products, so with the Europeans and the Canadians and the Japanese,

everything hung on the truss. All the systems were ours. So for the most part, we were the

integrating element for the Station, and that was a source of irritation for the program for Reston,

because they wanted to do that.

But they didn't want to build the products; they just wanted to do the work. They just

wanted to be responsible for it. So it was like, okay, so what are you going to add to the party?

So we didn't—and that's part of the problem of having young, inexperienced people go into a

program. Now they've got the job. The piece of the job they've done before, they know, but

they don't understand the program in big enough detail. They don't want to give up what they know, and so it's the same old—fun times.

WRIGHT: How long were you in that circle of confusion?

HOLT: I went through that for—well, I died in that program. I got in in '88, and in December of '93, that was when they gave the whole program to Boeing. Well, we knew the game was up in the spring. By that time, [Daniel S.] Goldin was in as the Administrator, and the deal had already been done with the Russians. The Russians wanted to keep their space program, and they didn't have enough money to fund it.

So I can remember people saying, "Well, yeah, we said we would have permanently manned presence about 1995." And now what President Reagan had in mind was we'd build a Space Station, and we'd put people in it. The implementation was, "Well, [Norman E.] Norm Thagard's living on the *Mir* [Space Station]. Isn't that the same thing?" [Laughs] The spin-doctors can really get out of control in this business.

Yes, it was a tough, tough run, and the day-to-day—the Space Station that was put together is not that far off of what's up there today. You had to put another piece of truss in to make it work with the Russians. But during the time that we were getting ready to finish up on our process—we had been told that they're going to put it all into one prime contract; Reston's going away. And the guys in Reston were scrambling, trying to find jobs anywhere. They didn't have jobs for them downtown. A lot of them couldn't find jobs at Centers, so they were just starting to look for jobs in other government agencies in the D.C. area. It was not a real good time, and everybody hated each other.

Of course, things never really just die. It's kind of like something on life support. You can't imagine it stays alive. So we were going through red teams and blue teams, and Goldin had turned on—I can't remember who he chartered; I think it was [Joseph F.] Joe Shea, who had been the Apollo Program Manager—for the fire. Well, he brought Joe Shea back in to go look at the Station Program, which was fitting. So he had a team to go do a search and destroy on this. The program, then, see, was told to go put a team together, and then you have to respond. I got drafted to go do that. I got all the neat jobs.

So I ended up back in Reston, going back and forth, back and forth, as we were going through the—I got put on to one team there, and we were asked to go look at the management. Well, the management structure was so complicated and inverted that literally you had more people managing the program than you had doing the work. And it didn't just seem that way, it was that way. So we went through, and that was the finding that was coming back from the Joe Shea team, anyhow, and they were right. Take a look at it on paper, it was easy to figure that out. It was the first time I'd ever seen, though, what was going on.

We were at Reston, and a guy from Booz-Allen [Hamilton]— they got us off in a room and said, "Flip your charts." So this guy starts going through charts, and all of a sudden you see the Space Station with the *Mir* hung on it, and it's like, "Well, that's interesting. How are you going to do that?"

And they said, "Well, you guys need to go figure that out."

And we said, "I don't think so. I don't see how we got enough time in a day to go do that." Because it was clear that it was what they'd been working on with the Russians, and that was the first time that any of us had ever really seen that, and it was like, "Wow, this party's

over. If they're going to do that, this party's over. We're not even going to be part of it anymore."

And that's pretty much what happened. The Center knew that if you're going to do prime contracts, you don't need project offices anymore, so every Center that had a project office was not going to have a project office. All the contracts that we had, like McDonnell Douglas—the argument was whether it was going to be Boeing or McDonnell Douglas who would be the prime.

Well, McDonnell Douglas was already hammered for the fact that they had the public overrun. In point of fact, Boeing was costing twenty-five—all of McDAC problems were an 18 percent increase over what—Boeing was running a 25 percent increase. But they were much more skillful in keeping it quiet. [Laughs] And theirs was all over rates. They had just told the government they wanted more money to do the job, and got it.

But McDAC was pretty well disorganized. Never really had it pulled together very well. It cost us a quarter of a billion dollars just to—Elric McHenry was brought in to go fix the avionics and the software, and that was a quarter of a billion dollars one year, and it was going to be another hundred and fifty or so the following year. So we were half a billion dollars out.

Then when they did the new program to add—to do the Russian participation, that all got cooked in Crystal City [Virginia], right there on the Potomac next to the [Ronald Reagan] Washington National [Airport]. A lot of people from here, a lot of guys who then found jobs in the Station Program. For the most part, all of us who had had management responsibilities in the Freedom Program were persona non grata in the new program, and so that's how I ended up in the Shuttle Program, 'cause I knew I was going to have to go find another job, and they had already told us that the office was going to be abolished.

It's probably the biggest shock I think I ever got in my career was when they got us all together in a conference room in Building 1, the whole project, all the civil servants, and they put up the list of everybody who was eligible for an early out. My name was on the list, and I was forty-eight years old, and I'm thinking, "God, how could that be?" [Laughs] But I had twenty-five years in. So they would have given me the twenty-five-year version of a retirement at that time, and I could have left.

I said, "Well, I just don't think I want to go out there and mess around with this stuff." So, but started working in earnest on getting the guys that worked for me new jobs around the Center, and then I went and talked to Tommy [W.] Holloway, who was down at the Shuttle [Program] at the time, working for Brewster [H. Shaw, Jr.].

I told him, I said, "Well, I need a job." And ended up talking to the Customer Integration Office, [Cheever H.] Hal Lambert [Jr.] and [Ronald D.] Ron Dittemore. Ron had worked for me years back, so I knew—and I told Ron, I said, "You know, I'm not sure I'd want to work for everybody that ever worked for me, but you're an exception. I can handle that." So that's how I ended up at the end of the Freedom Program.

The Freedom Program had an awful lot of people that are at JSC who still carry those scars, who were in the program and got dispersed out into the system. It's kind of like whenever you go through some process, and you look around the room, and you realize, "Okay." You know, it's kind of like the secret handshake type thing. You knew who'd died and gone to heaven and who had just died, and end of deal.

But it was—when they started putting together the new program, and they changed the design of the avionics and trashed all the IBM—took IBM out of the program altogether and changed the whole design, based on the way the guys in Huntsville thought it could be done, it

was like, "Hey, guys, we just spent half a billion dollars trying to get this squared away, so you're automatically three years down." So we knew they were in a world of hurt. It was interesting.

WRIGHT: So how was your transition to working for Ron Dittemore?

HOLT: Oh, it was good. I didn't have a problem. And the transition there was more—I just happened to be at the right place at the right time.

WRIGHT: Good.

HOLT: Or in the wrong place at the right time. But Hubble [Space Telescope] had just come along, and they'd just finished doing it. The Shuttle Program at JSC was still smarting over the fact that Randy [H.] Brinkley had showed up as the Mission Director on that program. Randy worked for—what was that head of Code M; a Marine General they brought in—Jed Pearson. So Pearson was the Associate Administrator, Code M, and Randy Brinkley had actually been in his operations officer, a Colonel over in Desert Storm in Kuwait and stuff, so he brought Randy in to be his Mission Director to go look at the Hubble repair.

Well, Hubble, at that time that was the bad optics; we had to have the optics correction. You'd gotten yourself into a situation to where the latest round of threats to the Station Program came from folks that says, "Too much EVA, too much robotics, too much this, too much that." So NASA had a solution to go fix Hubble, but it was a very intensive six-EVA flights, and that

became a moratorium on Space Station, almost by—it was never declared that way, but it was

sure looked at that way.

That was surely the way the administration and Congress viewed it, that says, "If you

can't go fix the Hubble Space Telescope with EVA, then don't come tell us that you can do this

other program." So that jacked the gain up very high, and Randy then was, in effect, a

Headquarters Mission Director assigned to go look over the preparations.

The Shuttle Program took that very poorly. So did JSC. It was not very well received.

Mission Operations hated it. So nobody really wanted to see somebody from the outside come

in, and especially from Headquarters, and especially from outside, looking down our throat.

So the flight was over, and the flight was successful, and so when I went to talk to

Tommy and Brewster, they told me at the time, "Well, we have just gone through this experience

with the Mission Director, and we think we need to change the structure of the Shuttle Program."

Because all the stuff to return to flight, they'd got all that bloat it took to, in effect, to go recertify

the program.

Well, they still had all the vestiges of everything that was part of that and the

development program. Mind you, the Shuttle lost a lot of its manifest in the process, but it was

like you take the Shuttle Program and the Orbiter project and all of its contractors, you were

talking 450 people. And quite frankly, they thought they were at a point that says, "We now

think that what we're seeing is we're actually stomping on top of each other, and so rather than

adding value to the system, we think it's actually slowing it down." Got too many checkers

checking the checkers.

So they were interested in setting up what is called an Integrated Product Team, just to

deal with the flight-specific preparations. They didn't want to call it a Mission Director, because

they didn't want to run the risk that somebody at Headquarters would decree that that was their guy and worked for them. So they called it a Flight Manager. We already had a Flight Director. And most places, anybody that showed up with a payload of whatever they wanted to fly, always brought their own Mission Manager. They didn't want to use Mission Director, so Mission Manager, Flight Director, Mission Director, so that left Flight Manager out of the four. That was the trade-off.

So went through and worked with Ron Dittemore, and Hal Lambert was—Hal was close to retirement. He retired in April of '94, and Ron took—but that was right at the start of a lot of consolidation in the Shuttle Program Office. But we set up a team and you just met—when you were close to a flight, you'd meet on a weekly basis. When you were back baselining a flight, then you'd meet maybe every couple of weeks to once a month. But what it gave you is it gave you one day-to-day point of contact on the flight.

So we had the authority then to approve the mission-specific changes, so I've always told people, I say I had gone through all those years of contract this and that with STSOC, and budget cut this and that with Space Station, and having to lay people off and go find jobs for them, and all of a sudden I showed up in the Shuttle Program Office, and I got a job with no direct reports, no budget, and they gave me the mission requirements to manage on a flight-to-flight basis. I thought I'd gone to heaven. And it was really a great job.

WRIGHT: Before we explore too much about that, we're going to take a second and change the tape.

[pause]

You were going to share with us about what those duties were and how it was to work in that job for a while.

HOLT: Well, the flights I've described a couple of times, talking about the template. Boy, by the time you'd flown—say, when I got back into the Shuttle, they were up to about flight fifty-nine or sixty. So when I had gotten out of Shuttle, it was right after *Challenger*. So I had been out for a while, but I had been working with them from the Station perspective, and had actually had a payload that we put together that we flew in the cargo bay on STS-39 or something.

I'm going to take just one second, because that experience gave me an awful lot of feel for how the job needed to be done from a perspective of—I was a customer of the Shuttle Program, and it was a miserable experience.

The guys in the Shuttle Program, I knew them and had worked with them for years. We didn't really want to fly this payload. We came out of the Space Station redesign, and they came up with an idea that says—we had already decided that it was sticks and balls, and we needed to have a flight demonstration of how sticks and balls were going to work. Well, we just went through this arrangement that says, "Get rid of that sticks and balls nonsense."

So we had our flight experiment that we'd finally gotten approved so we could go do this sticks and balls demonstration, and then we go off and throw that all out. So we came back and says, "Hey, that's $10 million we're not going to spend."

And we get a call from Headquarters that says, "Oh, yeah, you're going to do your flight experiment."

And I said, "We don't want to do that flight experiment. That's $10 million that we don't have. You ought to know what kind of shape we're in."

And the answer was, "Well, but we're going to do the Intelsat repair flight, and if your payload is not in the bay, the bay is going to be empty, and that doesn't look good." [Laughs] And I told you, perception is stronger than fact. So, as it turned out, Intelsat was the flight that took three EVAs, and the third EVA crewman—you had two people standing on the sill, and the third EVA crewman was on a foot restraint on the ASEM [Assembly of Station by EVA Methods] payload, which was our payload. So, if nothing else, we flew a $10 million footstool that let them go do the Intelsat flight.

But we were pretty limited in the number of people we could put on that flight experiment, and I had Bobby Kyle just bird-dog the flight, and he handled all the documentation and everything. The Shuttle has a lot of documentation. So after having lived through that experience, it was pretty obvious that the Shuttle Program didn't go to much trouble to try to help the customer through the process. And always, even when I was over in Payloads, we'd get a lot of grousing from the customers during the Flight Operations Reviews and all, about the Shuttle Program being unfriendly. And I always took it as an affront that says, "I think I'll go flog my Payload Officers again for not being customer friendly."

I found out that wasn't the part of the program that was unfriendly. It was the engineering to get you there and the integration and all the documentation and the safety and all that stuff. So when I went to work for Hal Lambert, who owned that process, and Ron Dittemore, who was the Deputy, they said, "We want this Integrated Product Team to go deal with the mission-specific, and we want to try to peel it out—we want to make it more efficient, and we want to localize the changes on a flight-specific basis to the people that are implementing it, so that everybody knows what's really going on. You don't have to go educate every manager in the system to say yes or no."

It was localized control, and we then—I was staff to Ron and Hal. It was viewed by the average manager in the Shuttle Program Office as probably the equivalent of hell. It just really was not a popular idea. They had big organizations. [They were] pretty comfortable. They had a lot of contractors to do their work. So the last thing they wanted was to have somebody show up who was going to make all the decisions, and to where that they'd got used to doing evaluations and turning them into a board and then debating them.

So we had the board authority for flight-specific changes, and the way it worked, is the Lead Flight Director, the Shuttle Crew Commander, the Launch Processing Director for the Orbiter processing, and the Payload Processing Manager at KSC [Kennedy Space Center, Cape Canaveral, Florida] all had—and whoever the individual was assigned to that flight had the responsibility then to participate in this team. And we had cargo integration.

So we set the design of the mission. And the Shuttle Program was very, very rigorous about things, and says, "We're not going to let you get outside the flying box. You've got to make sure the CG [center of gravity] stays there. We're going to have it fly. At launch, we want to make sure that we've got enough performance, so you can't get us in a situation where we can't get off the ground or can't get to orbit."

So it was always you had the constraints well-defined that you were banging up against. But you lived within the constraints, and you were able then to take—and the customer sat on our team as well. So instead of the customer being this person who is obtuse and far away, the customers, all the customers, were there. Typically, you end up with one big customer, and on some flights like Hubble, where you have the program, and you don't really have a lot of secondary payload.

So that was quite a dramatic change, to where the business of a flight got done there, and if crews had something on their mind that they didn't like and they didn't think things were going very well, they asked questions. If there were some things that the Lead Flight Director was coming up with that says, "I'm not going to be able to implement these requirements the way you want, and here's what I think we need to be doing," you can have it right there and have the discussion. And if you needed to have it again next week, you'd have it again next week.

So we were able to put pretty much a fairly standard agenda in place, limit the meetings to about two hours, and hammer through the cycle that says that today we're at the start of this thing. We're trying to figure out just how much we can put on this flight and whether we can put any secondary payloads and we can hang some gas cans on the back. And what can we do, and then how much time have we got, and then now we're going to basically take you to the Shuttle Program control board and get it baselined. Then the next milestone we've got is the launch site flow review. Then the next is the launch site requirements review, and the next—so you've got to have your engines defined. You've got to have your yada yada yada.

So the process said these decisions need to be confirmed by the program at these points in time. But for the rest of that, you had an awful lot of license to make the changes. And the Shuttle Program talked to itself a lot. It's probably been accused of that for years.

The Program Manager had the whole program report on Monday morning, early, seven a.m. Then we started out meetings with the Program Integration Manager around eight-fifteen, and we'd go through the Flight Managers, and for the most part, there were—for the first couple of years, [S.] Nat Hardee and I did it almost all the flights, and it was really great. But we just flipped through, and here's the issues on the flights, and we talked through them. That was just pretty much—we gave the Program Integration Manager—Dittemore first, then Bill

Gerstenmaier, and then Linda Ham—or [Richard N.] Dick Richards; that was before Linda, before Bill—and going through there. So we just went through and ticked them off, so we had a system then that let the organization know what was going on.

In the meantime what the organization was going through is Brewster Shaw was Program Manager when I first went to work there, and the organization was huge. So about six months after I'd been there—and there were a lot of people thinking that one of these days this Flight Manager stuff will all go away and we won't have it anymore. Well, what really was happening was that the Flight Managers were always moving closer and closer to the Program Manager every time it reorganized, because that was what we were there for was to implement the day-to-day direction coming out of the program. So as the program organizations collapsed, then we got a better and better and better job out of this deal.

When Brewster called the whole Shuttle Program into the auditorium and sat and went through the new org [organizational] chart, and I don't think there were more than maybe four or five people in the management chain that knew what that org chart was going to be, because there was an awful lot of people on pins and needles going in there. Brewster sat down. He went through the whole org chart, and called every name on the org chart. Called every person—had their last names on there; called every person by their first name and their nickname, and told why he put people in the organizations. When he moved them, he told them why they were in that organization, and he did that for about an hour and a half without a break.

One of the most impressive displays I've ever seen of a guy that says, "I am in control, and this is what we're going to go do." So we all walked out of there with a pretty good idea that says, "Yeah, you can go argue if you want to, but I just don't think it's worth your time." [Laughs]

WRIGHT: How were you affected by that org chart?

HOLT: Well, what happened to us was we just kind of moved closer to the Program Manager.
We were part of the ability for the program to shrink, because it just took people within the
organization, and it gave them more responsibility instead of having a bunch of line managers.
Program Offices function best when they don't end up with a lot of line-like organization. You
really need to—and that's what happens, is when you look at historical perspective on JSC and
NASA, the days when the programs are flush, then the line institutions tend to collapse, and they
tend to be roads and commodes. So they're just there—Division Chiefs don't feel like they've
got any power, and they're just body shopping.

Then on the days when the programs get their comeuppance, and they get hammered
down and are lean and mean, then they have to go rebuild those fences and mend those fences
and go back to the organization and make sure that they're getting the support that they need. So
matrix organizations have this built-in expansion and contraction arrangement, and it goes on
between Headquarters and Centers as well. So you can take it at any level, and that's how matrix
organizations function.

So when you have strong personalities in programs that dominate the institution, then all
the decision-making power starts to flow into the program. When it's the other way around, then
the programs are weaker, and you have more give and take. In either case, in one case you can
have pieces of the institution that are inflexible that you have to continually work around, that's
not good. Then you can also have programs that to where they get a mindset and they won't
listen, and that's not good.

So there are always the extremes, and there are always the problem areas, so there's never going to be a perfect situation, and you can pretty much guarantee yourself that anybody that walked in as the new boss is not going to like something about the way it's run, and he's going to change it. What my experience says is if you don't do that within about the first three months, then you've kind of run out of your grace window to be able to make fundamental change in the way things operate.

Those of us who came up in Mission Operations never had that problem, because Kranz is going to reorganize you once a year, come hell or high water, just to keep you loose.

WRIGHT: Tradition, huh?

HOLT: Yes. And at the same time, you could see it coming. He'd take anything that was—Gene would also worry about things that were running too smooth. I don't know that he actually really thought about it in those terms, but a lot of times you'd get places to where you'd say, "That's running—." You just didn't hear anything about it.

The next thing you know, he'd pluck something out of a section in one division and put it in another division at the section level, and you'd hear a lot about it then, because you'd get two section heads with different views about how it ought to be done, and they were running through the division chains. It went all the way to the top, and the debate raged for a little while, and then they'd get all squared away, and it would kind of quiet down.

Then, in some cases, maybe two reorgs [reorganizations] later, he'd put it back the way it was two years earlier. [Laughs] So it was the kind of thing that says—well, it's not capricious, but it's certainly designed to keep you on your toes.

WRIGHT: Tell us about some of the missions that you were responsible for.

HOLT: Oh, the missions were great. Well, the first one, you're never going to forget the first one, because we had this brand-new toy, Integrated Product Teams, and the jury was out. I mean, nobody knew whether this was going to work or not. We had just gone through and put the memos in place from Brewster that says, "I'm going to start this up."

I wrote the memos for Ron and Hal and Brewster, and the only comment we got back on all that was—we were talking about handling the day-to-day business of the program. The only comment we got was from [Brock] Randy Stone [Director, Mission Operations], and he wrote one word in there. He says, "Mission." He didn't want any day-to-day inside of his organization. It was all had to be mission, work. And that was the way we had intended it to be, but he clarified it; and that was the only comment we got. We didn't get any comments from Florida. We didn't get any comments from the rest of the organization.

So we kicked it off on STS-64. Dick Richards was the Commander. Dick had a tight relationship with Brewster. He'd been the copilot for Brewster, PLT [Pilot], on Brewster's flight. So he was pretty tight with Brewster. We went through; had a big Marshall payload on there. Well, it was a typical payload. You had the JSC Mission Manager with the Marshall pallet and Langley camera. It was a LIDAR [Light Detection and Ranging]. It's an optical system that measures precisely; it's a radar-type arrangement. Flew it over a typhoon out in the Pacific [Ocean], and you could see right over the eye, and it went bang, all the way to the floor, and bang, right back up. Unbelievable resolution on this thing. So it was an interesting project.

We had some technical problems on that flight, payload-type problems. Arguments between the Mission Manager and the guys in Huntsville, and the guys at Langley were all arguing with each other. So it was kind of like you had a little minefield that you had to work your way through.

We got into the flight. The JSC payload on the flight was an arrangement they'd flown to where they could measure the effects of reaction jets, how far away the plume actually had an effect, because you never were quite able to model what the effects of the plume were going to be, and you worry about it if you're getting ready to do a lot of dockings, like the *Mir* and the Space Station, that all that plume is out there, and you don't know exactly what's going to happen. You don't want to blow whatever it is out there around. You'd kind of like to make sure it stays where you want it to be, so you need to make sure you characterized it well.

That arrangement was built by JSC Engineering. We took an RMS [Remote Manipulator System] arm boom, the spare, and flew it on the other side, away from the arm, and then the Shuttle arm reached over and picked this thing up. So it gave you another forty-foot-long arrangement, so you had something like ninety foot of arm, and you had a pressure pad at the end. That pressure pad had to fold up, so it flipped out, and then so out at different stations, they'd fire combinations of jets just so they can measure the pressures.

The reason I bring that up is because that turned out to be the problem child on the flight. So we had a situation to where we got worried that once we ever got it out, that we weren't going to be able to fold it back up and put it back and bring it home. Everybody said, "Well, we'll just leave it on orbit."

I said, "Yeah, right. Yeah, we're just going to leave the backup RMS arm on orbit."

So we had people saying, "Well, but that's what the PIP [Payload Integration Plan] says. We wrote the PIP with those requirements in there."

I said, "That's fine." I said, "I'm just not going to be the one to tell Brewster that we'd thought we'd leave this thing on orbit. I don't really think that would go down well."

So Granvil [A.] Pennington was the Flight Director, and right before he—so we're going through this discussion about how this thing worked, and we couldn't try to figure out whether we really wanted to attempt it, because we weren't sure what the situation was. We corralled a couple of guys from Engineering, the guys at Lockheed that had built it and the guys out at Structures Division that had been the guys that put it together, and we went off in a conference room and says, "Look, you guys have got to give us a test of this system that says you know what's going on with it, and we know we're going to be able to fold it back up."

So they talked it around the table for about five minutes, and one of the guys from Lockheed came back and says, "Well, I know the test that we can do, and it's the kind of thing that will give you confidence." So the guys from MOD and the guy from Lockheed took off, and they wrote the procedure and put it into a chit form so we could run it back through the system for evaluation and make sure everybody agreed.

I called Brewster. It was on a Saturday. They had called me, and I was working out, back in the days when I used to work out. So I had come in, so I called Brewster and told him what was going on. He was in his office. I says, "Now, you want me to call you before we start this if we do anything?"

He says, "No." He said, "It's going to work, isn't it?"

And I said, "Yeah."

And he said, "Okay."

So at that point in time, I said, "Well, okay. This is the test. Now, either—if this screws up, there won't be a Flight Manager after this flight." [Laughs] "And if this works, then there's a fifty-fifty chance that you'll have a Flight Manager." And it worked fine.

So the debriefing for the flight—Commanders always come in and debrief the Program Managers. So I sat in. Dick Richards came back and was talking to Brewster, and the last question Brewster asked Dick was, he says, "What do you think of the Flight Manager idea on this?"

And Dick says, "Well, actually, I liked it."

And I'm sitting there thinking, "You know, if he had said the other one, I'd have just had to go find another job." [Laughs]

But Dick told Brewster, he says, "Actually, worked pretty good." He said, "I had the opportunity," he says, "to talk to the program on a routine basis with a minimum amount of overhead, and I didn't have to trust a whole bunch of other people to go tell my story." He says, "It was okay."

And nobody else completely panned it, so that was the—and the whole idea was to make sure that the Mission Director job that Randy Brinkley had started, that you just kind of—pretty much I was told to go reel that in and make sure that that function—"We think the function's necessary, but we want it inside the program." So that's what we did.

So I did that flight, and the next one was STS-63, which was the first—[James D.] Jim Wetherbee and Eileen [M.] Collins—the first approach to the *Mir*. Tommy Holloway by then was running the Phase One Office, and Phase One wasn't run like Space Station. Phase One used Shuttle Integration resources as their engineering arm.

Some of those guys, guys like George [W.] Sanders, would be somebody you ought to talk to, because George had to serve two masters. He had to be the Shuttle Program, but he also negotiated with the Russians for Tommy, as well. And quite a few of those guys, [William D.] Bill Reeves did the same thing in the flight control world as a Flight Director. Bill had a very good relationship with [Viktor D.] Blagov, who was the Flight Director from the Russians. So you started to see the—I worked with the guys who worked with the Russians, and I don't know, they'll probably tell you I was as hard to deal with as the Russians were.

So STS-63, we had a whole bunch of other commercial payloads on that flight, and Wetherbee and [Philip L.] Phil Engelauf, who was the Lead Flight Director, wanted to go do the docking—they wanted to go do the *Mir* thing last, so that they could build the suspense around the flight. We kept saying, "You know, it's probably not going to be to the best."

We got down very close, and so I talked to Tommy, and I also talked to [Joseph H.] Joe Engle, who was also working, doing the external review, for [Thomas P.] Tom Stafford. I asked Joe finally, I said, "Joe, just tell me. If you do the rendezvous and the approach last on this mission, what would you think of that?"

He says, "What's the first priority on the mission?"

I says, "Doing this."

And he says, "Then you got it in the wrong place."

And I said, "Yes, I was hoping that wasn't going to be the answer, but yeah, I understand what you're saying."

So we went back and got Mission Ops [Operations] and Ron Dittemore and [Alan L.] Lee Briscoe and several others, and we had a little bit of a discussion with the Flight Directors and the crew and aired it all out, and got down and says, "That don't pass the sanity check. You've

got to go the other way. You've got to go do the *Mir* Program, and then whatever you're going

to do with the rest of this flight, get it out of the way."

So that was kind of one of those defining moments. The real challenge was to set the

priorities for the flight and then make sure that people followed through, because you can get

yourself trapped—you set the priorities up funny, and you get Byzantine answers. Or people

will go off and invent reasons why that's not—that they met your requirements by doing it

slightly different than you might have imagined in your wildest dreams. After that, then we were

heavy duty into the *Mir* Program. STS-71 was the first docking flight, and it was a Spacelab.

We changed the whole approach for Shuttle flights at this point. Up to that point in time,

the Shuttle had always baselined the primary mission and held back reserve, and then as you got

closer to flight, it gave up cargo reserve and assumed that there would be more and more cargo

that they could add. Well, what was happening was people that couldn't get manifested on a

flight couldn't get any money either, so there weren't any payloads available that were ready to

go fly at the time the Shuttle wanted to release the reserve to payloads. So I'd look around, and

there wasn't anybody, so it was like, "Well, what are you going to do with this margin?"

Well, so they came up with a thing that says "how about—we'll do some tests." So each

of the subsystem managers went off and started coming up with tests for Shuttle systems, and

then that got expanded a bit to where it got a little more—and, in effect, you were building some

cheapie experiments, instead of getting peer-reviewed stuff that had been done by the agency,

that was filling up the manifest.

So what we did was—and this came largely from having watched in the Station days, and

I'd been working logistics over there some and knew what was coming—so we set the flights up

full. Said, "You're going to fly this complement. You're going to fly everything you can fly.

You're going to fly full. So it's just a question of when you fill it up, but you want to go do all of your analyses based on a full flight, not on half-flight and then add it."

And that just was, "The sky is falling. That's a square wave. We can't do that." And then after about two or three flights, it was just old hat. The real kicker was you had to finally convince somebody in program management that you could put payloads on, and if you ran out of performance, you had the guts to go take them off. That was the way it was going to have to be. And that worked, finally.

For the *Mir* series, we did STS-71, which was traumatic, but obviously it had to work; you didn't have much choice. STS-74 was much more interesting, because you had this docking module we flew, and stuffed it on top [of the airlock], and then that's how you're going to go back and forth. Bill Reeves and I worked an awful lot of these flights together, and on that one, on the front end we had kind of concluded that chasing options was going to be a problem for us, that it was better if we made sure that we had time to check these things out and set the system up.

So rather than do—the quickest that you can do something on orbit is probably day three. It takes two days just to get there; forty-one hours to rendezvous, to dock. Now, the next day you could have taken the docking module out, checked it out and done your business and docked. You're always in a situation with orbital mechanics to where you're either going to rendezvous on the third day or rendezvous on the fourth day, so it's a question of how many days does it take to get docked.

Well, if you don't want to—and you don't know where the *Mir* is going to be, because the Russian vector can change from your planning, and so you may not know until a couple of weeks before. So we said from the get-go, since we had performance on the flight, that we were

going to just set the whole flight up to do this on day four, and then we're not going to care what the actual—whether we could have done it a day earlier or not. Bill says, "I'm going to build a timeline that will let me do it a day early, but we're going to advertise one time." And we followed through on that.

Tommy didn't particularly like it. Tommy had been a Flight Activities Officer, and he used to build timelines for Apollo and Gemini, and so he didn't particularly like it, but he went along with it. That worked. That got us through. So that was another place where we were able to say, "Okay. That's the best for this mission," and we were able to set it up for that mission. And it was. It got us one set of analyses, and it got us one good way of everybody out there getting on the same page, which is the most important part of this particular function. And it got the Russians on the same page, which was hard, for everybody just to get synced up. At the start of the program, that was pretty important.

Then we started flying the logistics flights, and we depended on Spacehab for that. So we flew Spacehabs for—well, probably all the way out through STS-[91]. I know I did a bunch of them, and Nat did a couple of them, and I think Michele Brekke did one as a Flight Manager. The real change there was—the Spacehabs looked the same on every flight. They had two modules, and they'd move them around. They really only flew with one. So they'd get it back, take the back end off of it and dump it out and reload it over at their facility offsite, and roll it back over and stick it in the Shuttle and go.

We were having this discussion, at lunch, actually, and the cargo organization was having all kinds of trouble with Rockwell over how are we going to do this, because we've got all these drawings that we've got to change, and our whole configuration management system is different, and you do all these things on a flight basis, and we've got new Orbiters and everything. And

we were sitting at lunch, and George Sanders was listening—had just been down this litany of

discussions, and we were all sitting there, and finally, somewhere along the line, somebody says,

"Well, why are you doing that?"

George says, "Well, what do you mean, why am I doing that? We've always done it that

way." And so the question was, since they're all going to look the same, why don't you just do it

once, and tell Rockwell to get on board? And George says, "I think I can do that." [Laughs]

And so he walked out of there, and so we had one Cargo Integration Review for all of those *Mir*

flights instead of having one for every flight, and the only thing we had to discuss were the

changes for like what gas cans we were flying in the back and any of those kinds of

modifications to the basic. But we had one set of engineering to fly that whole series of flights,

and we cranked them out like clockwork.

So when Tommy was just dead convinced that he wanted to fly—if you set a date, you

fly on that date, and that's the Ops influence. You won't get operational in this business unless

you can fly when you say you're going to fly. We were very, very successful with it, but a lot of

it had to do with the fact that the Spacehab team—the jury was out on those guys. They were

largely a commercial venture, and they had good people, but they were untested, and they rose to

the occasion, and they held up their end very well. So that it's the kind of thing to where that

that's typically what you find, and the rest of the team cut them some slack after they finally

proved themselves. The Ops team was very, very reluctant to give them responsibilities to do

their own timelines and do this and do that. It didn't take long. It took about one flight, and then

they were up and cranking.

And the system held together good. There's one thing that you notice, especially in the

Orbiter, is that if you turn your flights around, and you don't spend a lot of time on the ground,

then you don't have as many people down there dropping wrenches and screwing around with your systems. You don't have the daily traffic in and out of the Orbiter, and you just tend to have a tighter system. It's like old cars sitting around, and they're hard to start. Well, I think Orbiters have a little bit of that in them, too. So that was one of the things that we always observed, is that if we were able to crank an Orbiter and get the payload in without a lot of trouble, then we were able to crank them in a hurry.

WRIGHT: As part of your Flight Manager work, you became involved with the Hubble Telescope.

HOLT: Yes. Dick Richards, after he flew, Dick came back to work for Brewster. After he'd decided not to fly anymore, he came in and took the program integration job—or he became the Hubble Mission Director. He hired on just to do the job, and that was right after Randy had been for STS-82; it was a second servicing mission. So it was Dick's job to make sure that he implemented all of the things that they said they were going to do from the last flight; that they'd implemented it twice. It's okay to implement it once, but to implement it twice is sometimes hard. So Dick had the chore of ensuring that everything that had happened on SM-1 [Servicing Mission] as wishing you will do it this way—got done that way on the next one.

Then when Ron Dittemore moved to the Orbiter Office, then Dick became the Program Integration Manager. So when the next Hubble flight came along, SM-3, then I was available. Dick had gone, and I got tagged as the Mission Director for Hubble. You had your Flight Manager job, but you also had some additional responsibilities to work with the Goddard guys, and they were a joy. John [H.] Campbell was the Program Manager for Hubble, and he was after

[Joseph H.] Rothenberg. And by this time Joe was the AA; he was the Associate Administrator. He knew Hubble pretty well, since he'd been Program Manager during the servicing mission.

So SM-3 was going to be a pretty aggressive flight. They wanted six EVAs, and then the Hubble guys were pretty aggressive, anyhow. I had worked with [Frank] Cepollina [Hubble Space Telescope Servicing Project Manager] back on the Solar Max [Solar Maximum satellite] back in [19] '82, so I knew that they were pretty aggressive. Things got off to a pretty interesting start. We were going to have a discussion about how to get the EVAs—because the Shuttle Program really didn't want to sign up to go do six EVAs. That's about as much as you really can do on a flight. You can probably squeeze out seven, but we wanted to schedule five. The EVA Office was run by [Gregory J.] Harbaugh at this time, and Greg really didn't want to do six EVAs. He'd done three EVAs on a flight, and it wore him out.

So we had some reviews and were getting—first we had to figure out what Orbiter to fly it on, so we'd gone through a bunch of discussion there, and had a few reviews. About that time, the Hubble Telescope gyro started crapping out, and I can remember that conversation with [John] Campbell, and John says, "I am really worried that I'm going to be out of gyros, and I'm just going to be sitting there waiting for a Shuttle flight to come replace them." He says, "And it's going to happen." And he says, "Right now if we wait on the time that I'm supposed to fly, then I know I'll be out of gyros," because they had a wear-out component.

So we'd been having this ongoing conversation about it, so the next week John called me and says, "The other gyro's gone." He said, "I've lost one. The other one's on its last legs. I'm going to be out of business in a week, maybe two."

And I said, "Well, okay, then I'm going to start looking at options." We'd always carried a contingency—a launch on need capability for Hubble. Turned out we probably couldn't use it, but the thought process had been—we'd gone through the thought process.

So we're right at the start of Station assembly. We had the node, the power system, and the laboratory were all right there, or the systems that power it right after the node. There was the 3-A, 4-A, and 5-A flights were all just right together, because you wanted to get them all done just as fast as you could and try not to expose yourself to too much risk. You wanted to get people on board. So that was sitting there right about the point in time of where we would have had to fly to go do the Hubble fix. So that was not exactly a popular notion, that we ought to go interrupt or do Hubble at the same time that we were doing that.

At the same time, most of us who were working—I was working on the 4-A flight and the 6-A flight and a couple of other Station flights, so we all were pretty well convinced that they wasn't going to happen on time, anyhow. So John and I—John Campbell from Hubble—went off and worked on a few options. We had USA go back and look at what we could do to minimize—what was the quickest flight we could crank, and we convinced ourself that if we took just what we'd flown back on the last servicing flight, that the configurations were close enough to where that if we could match up, then we could probably fly in seven months. That's off of a normal thirteen-month template. But it says—pretty much, and it was based on what we'd just done with *Mir*, where we knew if we had a high amount of reuse, then all we really had to worry about was turning around the Orbiter and not having to mess with the payload that much.

So we worked that out and had decided that we had to have the 103, and we had to have roughly the same configuration, and so we laid all those constraints out and gave them to Hubble and says, "Can you live with that?"

Well, they didn't have much choice. So they cranked their process and came back and says, "Here's what we've got." And they had one pallet that was different, but it didn't have any electrons running through it, it was just structure.

Our structures guy said, "Well, we're not worried about that one. We can handle that." But we had one small problem, and that was that this was in the year 2000, okay? And Y2K, [Year 2000] as it turned out, where the build that we were using for the Control Center and for the Orbiter, both those had all been done on systems that were being redone for compliance to Y2K and had to be put in place. So we were looking at—we said, "Okay. Well, we'll do our flying in September or October. That's a couple months, so it's worth going ahead and taking a shot at," because by this time the Station flights were starting to move, and it was obvious they were going to be in the next year.

So we went through and we had a discussion with Mr. Abbey and [Alphonso V.] Al Diaz, who was the Goddard Center Director, and Mr. Abbey very much said, "Okay," grudgingly. Not really happy about this thing, but he went along with it.

So we took it to Headquarters and had a conversation, and John and I briefed Headquarters, and they came back and said, "Okay. Well, it's worth a shot to get the Hubble back in working order." Worried that just leaving it up there rolling around the heavens too long, and you expose yourself to other risks.

So in the middle of all this, they launched Chandra [X-Ray Observatory] on whichever vehicle it was; had a great big power short, almost enough to where it could have knocked out an

engine. It was attributed to all the wire scuffing and everything in the payload bay, so they realized then that they had kapton wiring and that shielding—that a lot of this was they needed to check the shielding, because the area that had been done probably was from just being trampled on and just the amount of work that had been done in the payload bay, so just the routine abuse over time. So every vehicle then was suspect. Every vehicle had wiring mods [modifications] that had to be made. Every vehicle had to be stripped down, and [STS-] 103 was no exception. So we had the *Discovery*—so now all of a sudden trying to get back to flying, and we're getting closer and closer to the end of the year.

Our first attempt at launch, we had what looked like a hurricane, just terrible weather. They put the crew in with not much hope of getting it going. Sat there for about a—we had a nice long—and after about an hour, [David A.] Dave King was the Launch Director, and he says, "Folks, I've just looked out the window, and it's not getting any better." Says, "I'm sending my team home. We'll try this tomorrow night."

So we came back the next night, and the next night was better, and we thought we were going to get off. We didn't. So on Sunday morning we all got together for an MMT [Mission Management Team] with [Joe] Rothenberg and [Dr. Ed] Weiler and the Shuttle Program and the whole mission management team. So we were having a conversation about the length of the flight was going to be determined by when we had to land, because we didn't want to do anything in 2000. We had to get it all done in [19]'99. So we had this horrendous argument. It finally turned out, yes, we trimmed one EVA off the flight. That was kind of something John and I had cooked up, because now we were going to be having to do two flights. To do their SM-3 objectives, we were going to have to split the flight up and do one emergency flight and then do—the next flight would be what turned out to be the [STS-] 109 flight. This was 103.

So we got off, argued with everybody over Y2K conservatism, because nobody wanted to work Christmas, and so on Christmas Day we were sitting in the Control Center watching the crew change out gyros or flight guidance systems or something. The flight was really successful, and got it all back up and running.

It was a really neat experience, because there really aren't that many opportunities, especially today, to do something other than Space Station, and those other flights, and *Columbia*—the *Columbia* disaster just changed the whole dynamic, because that flight was the flight that was going to put commercial capability back in the Shuttle Program. What will always be lost in that whole discussion is that [OV-102], *Columbia*, on that flight had no Orbiter anomalies through the whole flight. There wasn't a single system problem written up. Nothing happened through the whole flight. But we had a chunk of wing missing from the launch, and it had been doomed from the get-go.

So, when that happened, then that's put a tremendous kink in the whole system, because when you're down to three Orbiters functioning, you really can't do much more than get back and forth to the Space Station. That's put an awful lot of strain on the system. It's been two years yesterday. After about six months in the Flight Manager job, I went in for a mid-term evaluation with Ron and I told him—and we were talking, and I was enjoying the job. And he knew I was enjoying the job. And I told him, I said, "Well, Ron, I'm going to retire in this job." I said, "The job is a bird's nest on the ground. They don't come any better than this, and I've done all that other stuff, and I'm not going to do it anymore."

And Ron told me, says, "Oh, no." Says, "Hey, I'll probably move out of this job. You can have my job."

And I told him, I says, "No, I don't want your job. I don't ever want to have to worry about main engines and SRBs [Solid Rocket Boosters] and tanks and all that launch stuff again, and have to work that much with Marshall. I just want to do the missions."

I really wanted to do Space Station assembly, and I knew from what I'd been through on Space Station how hard it was going to be to go assemble that thing and how much trouble every flight was going to encounter. I thought I was in a position to help, and it was something I wanted to do, so—and I really just wasn't interested in more responsibility in a different job. I'd done all that. So I spent seven years and retired from that job and was more than happy to have retired in that job.

WRIGHT: How did you know that was the time to retire, when you did?

HOLT: Oh, that was easy. Well, there's two things. First off, I was in the old Civil Service retirement] system, and when I hit fifty-five, I got my little statement from them in the mail that says—and I knew at that time that I could make two-thirds of what I was making, sitting home watching *Oprah [Winfrey Show]*. So I'm thinking to myself, "I'm getting paid for a forty-hour week. I'm getting a third of my salary that I'm working for forty hours a week, on the weeks that I get to work a forty-hour week," which most of them weren't forty. So that was the clue. I says, "It's probably time to go let somebody else do this."

But I knew I didn't have enough money to quit working, so I had pretty much decided that after the Space Station arm [Space Station Remote Manipulator System (SSRMS)] got on orbit, then that would be the last flight I'd do, and then I'd go do some stuff on the outside. I didn't know what it was going to be at the time.

I wanted the Station arm, as much as anything because I'd worked so much with the Canadians in the Freedom Program, and I had a good rapport with them. I loved working with the Canadians, because they were absolutely the most matter-of-fact, pragmatic bunch of people in the world. If it was something that was right to do, then that was what you did. They tried to stay off the philosophical high ground and pretty much viewed everybody south of the Canadian border as marginally insane, anyhow.

So I had a really good relationships with the guy—Tom Darlington, who was the head SE&I for the Canadian Space Agency. A lot of the stuff we did in the redesign worked, and then after finishing up the truss redesign, we didn't have the mobile transporter for the Canadian arm. It hadn't gone through the same amount of redesign, and it was obvious it needed it, so Tom and I ran a review for that to come back to reshape the design for that, and that's held together pretty well. They made a few modifications in the new program, but for the most part it stayed together pretty well. So I had that relationship with the Canadians, and I wanted to stick with it through that flight.

And it was a lot of fun. The crews—the best part about it, the last seven years, was I hadn't had a chance to work with the crews for twenty years. I'd been through training with them some, and I'd worked with them back in the Skylab, but that had been the first time I'd just gotten back to where I could work missions with the crew and working missions with the flight team.

You come out of that totally optimistic. That's the one thing about it. Because it doesn't matter what you poured into the mission; it got done. And it didn't matter too much how hard it was; it got done. So you couldn't help but leave on the note that says that you're optimistic,

because you'd seen people that weren't alive when Neil [A.] Armstrong walked on the Moon, who were able to crank through all this stuff and do it as well as we all did when we were kids.

So, when you think about it, I was twenty-two years old when I went to work for the Johnson Space Center, and I was fifty-six when I left. So I spent my whole adult life at the Johnson Space Center doing kids' games. The place was Disneyland compared to other jobs that you could do, and I'm not alone. There are so many other people that came up when I came in who literally couldn't imagine going and doing anything else, or couldn't imagine wanting to do anything else.

There's probably things I could have done to make more money. There are probably things I could have done to make less.

WRIGHT: Although you retired, you still worked in the space industry.

HOLT: Yes, I've stayed active. I didn't have enough money to really quit working, so—and the cars were old, and the house wasn't paid off. But I've been able to—the real question was whether I was going to do part-time work or consult, and I've been able to make a go of it consulting. There's some things I really like about being self-employed, and there's not much I don't like about being self-employed. All those years of being institutionalized.

But I've helped a couple of small companies with some jobs done, and helped one of them locally open up an office, and then recently been working with Texas A&M [University, College Station, Texas]. They just got a piece of a contract out here with JSC. Then I've done independent review team work, mostly for Hubble, so I was doing the—about a year after I

retired, the chairman of the external review team for Hubble had moved on, so I took that responsibility on, and it's been interesting.

Then last summer, after [Sean] O'Keefe decided that NASA wasn't going to use Shuttle to service Hubble, I went off and had a team of people, and we looked at the robotic servicing of Hubble, with the Space Station SPDM [Special Purpose Dexterous Manipulator] robot. There again, you talk about people you haven't seen in a long time, well, a couple of guys on the team that I got are doing other things, but we were at the SPDM review back in [19]'91 at a PDR [Preliminary Design Review], first SPDM back into Canada in Toronto, back in '91. So you just keep—the people you run into, you can run into them again and again.

I don't know whether to do that mission or not. It's very, very risky. It's an extremely aggressive mission. Hubble was made to be serviced EVA, and you've got to make an awful lot of tools and do a lot of stuff that you don't have to do if you're just doing it EVA, in order to use a robot, and the robot is the Station robot, so it's not one you'd designed to go do the job with; it's what you got, and you're going to go try to do the job with it. So it's a pretty aggressive program.

WRIGHT: Looking back over those thirty-four years as you were at the Center, what do you consider to be the most challenging aspect of that time for you?

HOLT: Oh, Lord. I'm not sure there's any one. I think probably the—it was great to work in the space stuff, and I enjoyed the mission work more than anything.

I think the thing that I feel was the contribution was the ability to hire, because for a long period of time NASA hadn't been able, wasn't able to hire, and so many of us grew up as the

youngest guy in the organization, even though we were in our thirties. So having the chance to

hire and then having the chance to promote and to find people who weren't necessarily the

logical standing-in-line choice, and be able to put them in the jobs and then later in their career,

see where they got to. And just feel like that, well, okay, I didn't screw them up. So that, I

think, is the most satisfying part of looking back on the career, and that's the opportunity that

thirty-four years gives you, is the opportunity to then just see the fruits of your labors in that

thing.

The technical accomplishments, I never patented anything. Every job I pretty much went

into was a job that I probably was underqualified for and just got in and swam through it and

somehow came on out on the other side. So I think from that standpoint, I was blessed with

people that were dumb enough to give me the opportunities and hope I wasn't going to screw

them up. I had the opportunity to work for people that really didn't expect you to fail, and you

didn't want to disappoint them.

The hardest job I had probably was the STSOC stuff. It was a new office. It was a total

change in the way we've done business in the past. It took some people that we had to go pluck

out of some organizations and places and put them in. We had to take some people that were

pretty ornery and put them in some places. Anne [L.] Accola, I hired Anne. Anne and I had

been in the training world together, and Anne moved to Washington; finished out her career up

there.

But I put Anne in to run the production system, and this was before STSOC actually

came online, and we'd already picked up the job. We had [STS-] 41B shut down on the pad, so

the Shuttle Program decided they wanted to remanifest. So they took two flights and plugged

them together, and took the payloads off [STS-] 41C, 41B, and made up another flight. And it

was like—okay; and they wanted an immediate turnaround on an assessment. So put Anne in charge and says, "Okay, go get an assessment."

I can remember to the day, Anne walking around the office and then she closed the door, and she says, "The Shuttle Program's already called now with five things that are different than what they wanted to do."

I said, "You mean the signed list that we got from the Shuttle Program, they're already making end runs on every one of them?"

"Yes, they've called everybody out there." Those are the people they used to work with.

I said, "Well, we're not going to do that. Just go tell everybody to work on what they gave us." Anne walked back into her office and told them that. I was sitting next door, and I heard the laughter come out of that office. I said, "This is really not going to be pleasant."

But when we went over to brief it to the Shuttle Program, to [Glynn S.] Lunney—Glynn was Shuttle Program Manager—and on the way over, Anne slipped in the rain; had a long skirt on that pulled the seam out all the way up the back. Had to go in the bathroom with a stapler and put herself back together.

So we get through there, and she stood in front of Lunney, and Anne was real soft-spoken. I told her, I said, "When you start talking, you walk right up in the middle of all of those tables, and you tell him what your deal is." So she did, and we walked out of there, and Glynn says, "Okay. That's good. Thanks." Gene had slid in the back and was sitting in the back listening. We were on our own to go do it, and he was down there checking to see how it went, but it was our story to tell, and you went and told it to whoever you were telling it to.

So there was always the opportunity there that says, "We'll give you the responsibility if you can handle it. And if you can't handle it, then you need to be someplace else." I've given

that advice to people in organizations that I had, people that didn't get sections when they

thought they should have, and I made it easy for them to move, and I told them why. In a lot of

cases, some of them did very well out in other organizations, and in most cases, they'd come

back and say, "Well, thanks for getting me out. I wish I'd have gotten that job, but I'm glad I got

out."

So on balance, it was a trip. I worked with people that I respected and admired. I worked

with people that I couldn't stand. And I think in some cases—we used to make the joke that says

that we've been working against each other for a common cause for so many years around here,

you know. So the job had to get done, and it was just a thing that says the closer it got to where

you could remove the obstacles, the closer you got to it. But you had to stay focused on the fact

that the job had to get done, and you couldn't let people that worked for you forget that the job

had to get done.

WRIGHT: That's a great piece of advice.

HOLT: It was a lot of fun.

WRIGHT: Before we close for the day, I was going to ask Jennifer or Sandra if they had any

questions or any other topics you wanted to bring up, or do you? Is there anything else that you

can think of that we might not have talked about, that we might have missed?

HOLT: Yes, most of the things that affected JSC I think are—I've tried to couch them in at least

the terms as I understood them. You've got quite a bit on the *Mir* Program, probably, just from

looking at who you've interviewed and all. So I have one or two little things there on the *Mir*, but that's from just the perspective of making them run faster. That was pretty much just to keep Tommy moving. But I don't think I ever had a day that I didn't think we'd get it done.

I had some times I—had an APU [Auxiliary Propulsion Unit] leak on a flight. It was launched in the evening, and I'd stayed in the Control Center overnight, because we needed to have a meeting at four a.m. the next morning, and I just said, "I'll just sit it out here and make sure nothing else happens and be ready in case we need to do something." And it was the kind of thing that says you might have to call that one off.

Another example, though. I can give you one example of people you run into. When we did the SPARTAN [satellite] flight [STS-87], SPARTAN got away from us, and that was, well, it was KC [Kalpana Chawla], took the arm, and the only way to deploy it—if SPARTAN doesn't do its little wiggle, it's not going anywhere. They had made a change to the way SPARTAN run, and we changed the plummet time and didn't change the timeline, so we ended up, it just timed out, and they didn't—Goddard didn't realize it was going to happen. So she went back to get it with the arm, and she went too fast, and so the pin got—there are snares in there, actually coiled wires, and she got on the wrong side of one and missed it, and that pulled it and tipped it. So it picked up rates and it went off in the tules, so we had to do an EVA.

We did an EVA with Takao Doi and—oh, Lord, I'm going to forget a name here; it's a career astronaut. Winston [E.] Scott. So this was an unplanned EVA. Now, SPARTAN's a ten-foot-long telescope tube, and they had to grab it and put it down into the pallet by themselves. The Japanese paparazzi is as bad as the Italian paparazzi. So the Japanese had agreed that they'd do this. We were a little worried, because these guys weren't trained for it. So we'd had crew

often look at it in the water and look at it in the Virtual Reality Lab. You ever been in the

Virtual Reality Lab?

WRIGHT: Yes.

HOLT: The Virtual Reality Lab. So they'd come back and say, "Well, it's doable. It's not that

big a deal." You would always worry when two guys like Jerry [L.] Ross and [James S.] Jim

Voss come back and say that this is not a big deal, or [James H.] Jim Newman, because

nothing's a big deal to them. It may be a big deal to the guys that have never done it.

But the Japanese said, "We've got our Program Manager coming in, and if you're going

to be around, we for sure want you to talk to him."

So I'm sitting in the Customer Support Room, and the door opens, and it's [Yasushi]

Horikawa [phonetic], who I'd met back when we'd do operations in the Freedom Program a

long, long time ago, and he was back for another stint in the Station later on. He walked in, and

he saw me, and you could just see the sigh of relief that says, "I know you." So he and I went

over in the Virtual Reality Lab; got the helmets and the gloves on; and walked out of there and I

says, "Are you okay now?"

He says, "I know exactly what I'm going to tell them." But it was just—yes, okay. So it

was the kind of thing that says, "Okay. Well, whatever we've got to do to get you half-

comfortable, we'll do it." And they said, "We know. We've already said it's okay to for Takao

to do it, but we sure would like some help in trying to explain it to the Japanese press." So you

get to those things that says—all of a sudden, out of—a little serendipity here and there always

makes life a little easier.

WRIGHT: It certainly was an interesting journey from your early recovery days to working with all the international partners and seeing the Station go up.

HOLT: Yes. Yes, I can't complain at all. NASA changed so much over the years, though. NASA went from a bunch of cowboys to a bureaucratic operation. You never will see another Moon shot like we saw, because nobody's ever going to give you an open checkbook and say, "Go develop it from scratch." In all the conversations that you hear about today, people compare the NASA budget to the Apollo budget, and they do it in what the average cost is over a number of years.

What that ignores is the fact that so much of that Apollo capability didn't come on until way out here [gestures], so you've gotten through a lot of years. You look at what the funding profile was for Apollo. The peak years were incredible. This wasn't an average funding profile at all. So we talk about the average NASA budget; so much of the NASA budget today is not discretionary funds, it's just keeping the doors open on the facility and paying the light bill. So those are self-serving arguments. I heard one on C-SPAN [cable network] the other day, and a guy made that exact analogy. Same numbers; same numbers per year, and I said, "It's not the same kind of dollars." They weren't development dollars for today.

NASA is a zero-sum game. The minute you're in the discretionary budget, then the discretionary budget gets scrubbed every year. You get a different set of numbers every year. You want to do the President's vision and go do exploration, you've got to kill off a bunch of programs in order to get it done. Because when you look at what the deal was, the deal was if you can go reduce $11 billion worth of content in five years and reprogram it, we'll give you a

billion dollars. A billion dollars is termination liability on the kind of contracts we're talking about. So it's pretty much—NASA's got a zero-sum game budget.

It's going to be slow and steady progress. JSC has always not been a slow-and-steady-type operation. JSC wants flash and big bang, and so does Kennedy. The only guys that have had the long, methodical view have been over in Huntsville. I told John Aaron one time after a very frustrating day he had with the guys out of Huntsville, I told him, I said, "Well, now, you've got to remember, the guys in Alabama have been dealing with carpetbaggers for a lot longer than you have." And they're good at it. Anybody from out of town with money is a smart man, and we ought to relieve him of as much of that money as we can before he realizes how smart he is.

WRIGHT: That's right.

HOLT: So it's a real difference in the way—the center cultures pose some interesting challenges in getting jobs done.

WRIGHT: I'm sure they will continue to do that.

HOLT: Oh yes. I think JSC is one of the best integration and operations organization probably that's ever been put together. We're not as good a development organization. We're not as strong as—and it's cultural, because we've not allowed the engineering organization to stay as strong as it was during Apollo, because we've had to go favor operations over engineering, and over in Huntsville, fire and thunder rules Huntsville. If you're ever a Chief Engineer over there, you're like Flight Directors around here.

So when you look at cross-culture, we can [talk tough on] engineering but they have the culture that says—their whole Center's is culture is on that model, and we're on another model. We'll never be able to compete on a development basis with them, and I don't think it's healthy to do so. I think the Centers need to realign to the point where you got some very strong roles, and quit mixing it up so much.

Because that was the infighting; the infighting killed [the Freedom] program. Everybody wanted to do operations; everybody wanted to do logistics; everybody wanted to do this and everybody wanted to do that. And you had Reston on top of it, and they wanted to do it all. So there wasn't enough money to go around. You literally starved the development contracts because of the bickering that went on between the Centers.

WRIGHT: It should continue to be interesting for you as you move through your self-employment days, but yet still being able to do so much with the different Centers.

HOLT: Yes, it's been interesting. I don't mind doing it until I can get my Social Security quarters in, and then I— [Laughter]

WRIGHT: Well, we thank you for all the time that you've given us.

HOLT: I've enjoyed this. It's been cathartic. [Laughs]

WRIGHT: Well, good. We're glad to have that, so thanks again.

HOLT: All right. Thank you.

[End of interview]