ORAL HISTORY 2 TRANSCRIPT

ROBERT F. THOMPSON
INTERVIEWED BY KEVIN M. RUSNAK
HOUSTON, TEXAS – 11 SEPTEMBER 2000

RUSNAK: Today is September 11, 2000. This interview with Bob Thompson is being conducted in the offices of the SIGNAL Corporation in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Sandra Johnson.

I'd like to thank you for coming back again to visit with us.

THOMPSON: Kevin, you're welcome. I look forward to reminiscing a little bit more here today.

RUSNAK: I look forward to hearing what you have to say. Before we started rolling, we were finishing up on landing and recovery, and I guess we're going to make the transition to Apollo Applications. But in between that time, you had a brief stint at NASA Headquarters, is that correct?

THOMPSON: Well, yes, I guess you can—you bring up a part of my history I tend to forget a little bit. Yes, toward the tag end of my time at recovery, I was approached by George [E.] Mueller about coming to Washington [DC] and being set up in Washington in Operations Office as one of three mission directors he was talking about putting up there.

It would, of course, have been a promotion. It would have been a change of career path and so forth. On the other hand, I was not personally that convinced that we needed that kind of an office in Washington or that kind of a function, so I expressed kind of some doubts to George and told him that I would be willing come up there for a period of time, forty-five to sixty days, to look at what he was proposing to do, and if I thought that clearly was something I would want to do, then I would stay. Otherwise, I would come back to the Johnson Space Center [Houston, TX].

So I went to Washington, transferred to Washington, stayed about forty-five days, I guess. I still wasn't completely convinced for the need to have that kind of a function operated out of Washington, knowing how the missions were run and knowing how the operation of control center went. It looked to me like more of a superficial staffing function rather than something that had to be an in-line mission director function.

So I wrote George a letter and told him I preferred to stay at the Johnson Space Center. He was very gracious about it, and that was the end of my career in Washington.

They subsequently set up the office, set up some mission directors, and used that activity for a fairly short period of time, a few missions. Then events overcame that, and that was dropped as a function and not picked up again later on. So it was tried and, I guess, did some good things and some things that maybe weren't so good, but, in any event, it was not something that stayed in a permanent part of the program.

RUSNAK: You talked about going back to Houston. One of the things we didn't mention before was moving the Space Task Group from Langley [Research Center, Hampton,

Virginia] to Houston. I was wondering what you thought of that move, as someone who had grown up in Virginia and had most of your life to that point there.

THOMPSON: Well, I was like a lot of the people that were in that situation at that time. We were all in our mid-thirties, had young children, spent a lot of time at Langley Research Center. Our entire careers had been there up to then. So you naturally are not anxious to move, but I think I understood once I joined the Space Task Group that the possibility of a move was there. So when the move came about, you know, I accepted it as just part of the job and moved the family here. We were very pleased, after it was all over with, with the move. But it's probably not something you would seek out. It's just something that you get caught up in the flow of events. It certainly made sense to me that, particularly with the lunar landing function now assigned to the Space Task Group, that we could not longer live as a first cousin at the Langley Research Center. We had to move off and take on an identity of our own.

Not that we didn't have an identity of our own there. The Langley Research Center was very supportive of the Space Task Group, but facilities, people, it's hard to mix those two functions, and for the Space Task Group to grow and take on the responsibilities that they had, it had to move and go somewhere else. Of the places that were discussed to move, it boiled down mainly to a kind of debate to going to Florida or coming to Texas. I guess the politicians at the time were stronger from the Texas vantage point, so here we are in Texas forty years later, I guess.

RUSNAK: At the Johnson Space Center.

THOMPSON: At the Johnson Space Center.

RUSNAK: Gives you some indication, I guess, of the politics.

THOMPSON: Of the politics of the time. That's correct.

RUSNAK: Some of the other functions going on here weren't just the lunar landing, but they came up with this idea of Apollo Applications [Program, AAP], which you became involved with. Tell me how you made the move here from Headquarters, I guess, into AAP.

THOMPSON: Well, I actually came from Headquarters back to the landing and recovery job and then moved from the landing and recovery job to the AAP job in 1966. I don't recall the exact date of when I went up to Washington for the forty-five days. It must have been in '64, '65, somewhere in that time period. In any event, to answer that question, I think I have to give you a little feel of the way bureaucracies work and their gyrations within the federal government.

Annually an agency is required to give a five-year budget projection, at least they were at that time. So when you take the time in 1966, the agency was being asked what money it needs for the next five years. So that would take you from '66 to '71, for example. Well, the lunar landing was schedule for '69. So to project the agency's budget needs, particularly the manned space flight out beyond '69, you had to have some justification for what you were doing. The funding had already been identified to carry out the basic Apollo

Program. So, like any good agency, you then come up with some new thoughts on what you'd like to do that would extend your lifetime beyond lunar landing.

None of us were particularly interested in landing on the Moon and then going off and looking for another career. We thought there was a future for manned space flight. So the natural thing then was to think about taking some of the Apollo-designed hardware and using it for other applications, hence the name Apollo Applications.

Then I need to also explain a little bit how an agency works in the very early conceptual phase of identifying some new work. The burden for making these five-year budget projections predominately falls on Headquarters. So the people running manned space flight have to project out what money they need for the next five years and make that part of the overall NASA budget. In an office like Manned Space Flight, they had a small group of people thinking about the future. At a center like Johnson or Marshall [Space Flight Center, Huntsville, Alabama] or Kennedy [Space Center, Cape Canaveral, Florida], usually somewhere within the organization there's a small group of people charged with thinking about the future, future activities. At the Johnson Space Center, we always had that small group in our Engineering Directorate. It was always called Advanced Planning. Those were the people trying to guess where you might want to go.

So along about 1965, '66, the Office of Manned Space Flight, and George Mueller was the Associate Administrator for Manned Space Flight at time, he had to put into his five-year budget projection some money for new activities over and beyond Apollo, so he began to put in an Apollo Applications budget. Then these small groups at these different places, advanced planning people, would try to figure out what to do that made up that program. You had command modules out of the Apollo Program. You had lunar modules out of the

Apollo Program. You had Saturn V vehicles. You had Saturn IC vehicles. So Apollo Applications, in those people's minds, were just a group of individual flights using that hardware to do various things.

Also, by 1966 George Mueller was beginning to lean on the Center to set up Apollo Application Program Office, because you get that money in the budget and the people who oversee your budget begin to ask details of exactly what you're going to do, that becomes to be a lot of activity in that area, and people want a point of contact at the Johnson Space Center to work everything called Apollo Applications or everything called new program kind of things that have progressed to that point.

So in 1966, George Mueller was asking Bob [Robert R.] Gilruth to set up an Apollo Applications Program Office at the Johnson Space Center. Bob realized it was time to do that because of the increased activity of what you're going to do with that projected budget five years hence. So he asked me to leave Recovery and come over and set up the Apollo Application Program Office, which I did in April of 1966, utilizing some personnel that were formerly in the Gemini Program Office, because Gemini was phasing down at that time.

Chuck [Charles W.] Mathews, who had headed the Gemini, had agreed to take a job in Washington. So in April '66, I went over and became the Apollo Applications Program Manager at the Johnson Space Center and began to try to sort out what the Apollo Application Program was and what the Johnson Space Center should do to support that program. Well, the thing, in looking back from my perspectives, and I was the Program Manager for that program from 1966 to 1970, in that four years it was mainly an activity of debate on what the program should be. Originally, as conceived, as I said, it was a lot of

individual flights using Apollo hardware and Earth orbit, even some discussion of follow-on lunar kind of things, but mainly centered on Earth orbit.

A large extent was a fishing expedition on the part of Manned Space Flight to see what other people in the agency or in the country might want to do using this hardware. What kind of experiments would the Earth sciences people want to fly, or the lunar physics people want to fly, or the human resources people, or the medical people and so forth?

So it was a matter of trying to really collect a set of what we would like to do instead of, "We've got this hardware. How can we make it do it?" So we had a whole hodgepodge, if you would, of different kinds of missions that were being discussed. All the while, each six months you had to submit the budget, some dollars and some specifics, to fulfill the national budget requirement.

So that environment naturally led to a lot of debate. Some people wanted to do this, some people wanted to do that. Some people thought this was a good thing to do, some people thought that was a good thing to do. So there was a lot of meetings and discussions and pros and cons of what really should be done.

Also at that time period, a lot of people were very busy with Apollo, particularly at the Johnson Space Center and, to some extent, at the Marshall Space Flight Center. So we went through, oh, two or three or four different cycles.

One thing that was proposed, maybe in the first eighteen months of the program, was an experiment using the third stage of the Saturn V vehicle, the S-IVB stage. This was a propulsion stage having a large tank for liquid hydrogen, a somewhat smaller tank for liquid oxygen, as the third stage of Saturn V. It was the stage that you put in Earth orbit and then restart to the send the lunar hardware toward the lunar trajectory. Some people, particularly a

lot of people at Marshall, the German team over there, [Wernher] von Braun had always had some thoughts of how use spent propulsion stages in Earth orbit. You expend the energy to put these stages in orbit, you ought to use them for something.

So someone came up with the idea of building an airlock so that the command module could turn around and dock with this airlock. Then you'd go through this airlock down into this empty hydrogen tank from this leftover stage that helped put you in orbit. The original thought was just to go down in there in an extravehicular activity [EVA] suit and float around in this big tank, just to see what it was like. So that got to be one of the flights in Apollo Applications.

In the meantime, we were looking at flying the Apollo Telescope Mount [ATM], which was an experiment that was being supported on the unmanned side of the house, but Manned Space Flight was able to entice them to bring those experiments over and let us fly there in the empty bay of the service module. The Apollo vehicle had an empty bay in the service module, and the thought was to put some of these solar telescopes in that empty bay and fly the Apollo command and service module in Earth orbit and shine these experiments or telescopes toward the Moon and take that data. So you had AAP doing solar physics. You had AAP having people float around in big empty hydrogen tanks. You had flying missions where you had a lot of cameras looking down at the Earth in different frequency ranges.

As the program evolved, people began to say, "Well, gee, if we're going up there with an airlock,"—and by that time we'd contracted with McDonnell-Douglas out of the Houston group because we had the Gemini contract with McDonnell [Aircraft Corp.], and the airlock was conceived to use some of the Gemini components, particularly the door. So

McDonnell-Douglas, they would have won that contract, I think, for $10 million bid to build us an airlock.

So the program was growing kind of in that kind of a hodgepodge fashion, and the medical people at that time were beginning to say, "Gee, we're going to have fourteen days' worth of experience of man in zero gravity or low gravity. We would be willing to go out on the LM [lunar module] and commit a man to flying twenty-eight days. We'd be willing to double it. It's no more scientific than that. We can do it for fourteen days, we'll try twenty-eight." The doctors were very adamant you couldn't do twenty-nine, but you could do twenty-eight, or you couldn't do thirty. So we went a twenty-eight-day mission, and then we doubled it again, go to fifty-six days. Then they said, "Well, if you've got that, you can go three months." So we went twenty-eight, fifty-six, and so on. So the medical community came in and very much supported long-duration Earth orbital missions of twenty-eight, fifty-six, and ninety days.

So now we've got a lot of people wanting to do solar physics, people wanting to have manned Earth orbit for longer periods of time. We've got this Apollo hardware with the airlock contract going. We're trying to put this together in a program. Lots of meetings, lots of debates, lot of budget projections.

Meantime, the country's going on with the Apollo Program. We got through the Apollo fire and got the program back on track. As we at the Johnson Space Center began to look at some of the things that people were talking about doing, for example, not too long after the airlock and the spent stage was approved as flight, people were saying, "Well, look, we got an empty airlock and we're going to be up there that long, we've got to at least have a bathroom. So why don't we figure some kind of potty we can put in the thing."

Then, "Gee, you know, we're going to be up there for twenty-eight days, and we need a reasonable place for food, so why don't we put a kitchen and a refrigerator?" And the next thing you know, we've got the building of an embryonic space station down in this empty propellant tank. It's sort of like when you're getting ready to go camping with a tent, in a pup tent, and then after you think about it a little bit, you want a bigger tent, and then after you think about it a little bit more, you want a mobile home, and why not just build yourself a summer cottage out on the lake? Well, we were going through that. It was all serious. We were trying to put a program together.

Well, by the time we got into maybe the 1968-'69 time period, there was a fairly serious study chaired by the Vice President, [Spiro T.] Agnew at that time, and he was the Chairman of the Space Council. As far as I know, we still have that Space Council and the Vice President's still the Chairman of the Space Council. We did a so-called post-Apollo study, where they got together a large body of knowledgeable people and tried to figure out where the country should go in manned space flight after Apollo.

That study looked at four things. It looked at going out of business. You know, you could just shut off the funding and quit flying men in space, shut it down. You could do things in low Earth orbit, and low Earth orbit is, say, up to 500 or 600 miles altitude above the Earth. You could colonize the Moon, in other words, continue the lunar program. Or you could mount a major expedition to Mars. Those were the four options they settled out and studied.

Finally they came in with a recommendation of they didn't want to quit, get out of the business. So that was fine, and everyone was happy about that. The low Earth orbital infrastructure was the only one that they could get any real strong support for, and that was

the recommendation that the country focus on a low Earth orbital infrastructure, that to continue to fly to and colonize the Moon was too expensive and not that productive, and a manned expedition to Mars was super-expensive and wasn't that productive. So those two were set aside.

So this group recommended low Earth orbital infrastructure which gave, again, some impetus to move back to low Earth orbit and extend the flight time and so forth. Apollo Applications became fairly stable at that time, around taking this airlock and this spent stage and trying to do the twenty-eight-, fifty-six-, and ninety-day mission. The solar telescope part of the program was still pretty solid, because solar physicists really wanted that data, and the size of their instruments and what they wanted to do really required a fairly big vehicle. It wouldn't be good science to try to do it just in the bay of the service module or do it with the unmanned vehicles that they had available to them at that time. So they were a strong faction. The long-duration Earth orbital thing was a strong faction.

So Apollo Applications began to be relatively serious of putting some kind of an embryonic space station in low Earth orbit and doing solar physics and doing the medical things, and then also fly the auxiliary experiments that people wanted. So this idea of taking this empty stage and making it a seaside cottage with a potty and a kitchen and so forth, got a lot of support, and that program began to grow like Topsy, because you had to build the refrigerator in such a way you could store it in here and have liquid oxygen in it. Then it would become a refrigerator. Or you had to store it outside and bring it in and plug it into something to make a refrigerator.

So this thing became, and I use a term, we called it the "wet workshop." People didn't want to call this thing a space station, because they didn't want to kill the thrust of

going on to a future better space station. It was called a workshop. But as we looked more and more to the wet workshop, particularly those of us here at the Johnson Space Center looking at it, the more and more it looked like we were getting in over our head. You know, we were taking what was to be a fairly inexpensive simple floating around in a tank, and now we're trying to build a half-way reasonable space station out of it. It looked it was too heavy.

Also at that time the people at Headquarters wanted to use the S-IB, S-IC, I guess it was called, the interim vehicle that was developed in Apollo, because the funding projections and all of the conversation between the Congress and the agency was that all the Saturn Vs that were being funded were required for the lunar program. They'd been justified in the lunar programs, and they were required for the lunar programs. So the Saturn V was unavailable to AAP at that time.

So we were trying to do all this stuff with the S-IC. Well, this workshop, this wet workshop, became a Tower of Babel, in my judgement, and it just overwhelmed the S-IC, plus it also overwhelmed, in my opinion, good judgment of what you ought to—if you're going to spend this much money to go camping for two weeks, you ought to take a reasonable camp site along with you and not a tent and a whole bunch of pegs and spend your whole two weeks there trying to put a camp together.

So we at the Johnson Space Center began to become hard to live with, because we kept arguing with the people in Washington and the people at Marshall, who really supported the wet workshop. They believed in it quite a bit more than we did, and they wanted it more than we did. They weren't able to see all the warts, kind of like trying to convince a mother her baby's ugly. You should never try to do that, you know. The warts on a baby never look bad to the mother.

So we had the problem of trying to go up and tell them that they had an ugly child, and we really didn't want to do that. If we wanted to use the S-IC, we argued, you should take the SLA [spacecraft lunar module adapter, pronounced "slaw"] area on the S-IC and fit it out on the ground and, like a trailer, and go into orbit with that. Or you take a Saturn V and fit out the third stage before you launch it dry. So you can either go to the dry workshop on a Saturn V, or go to the SLA lab on the S-IC, but third in that choice was a wet workshop, and we shouldn't do it.

Well, that was a relatively unpopular position, because the people at Manned Space Flight had made commitments to OMB [Office of Management and Budget] and made budget projections. You know, people who say, "This is a good thing to do," don't like to go back and tell the people six months later that it didn't turn out to be a good thing, and they wanted to do something different.

The Air Force at that time also was using the Gemini vehicle in a program called MOL [Manned Orbiting Laboratory], where they were doing something quite a bit like the S-IC SLA Workshop that we were proposing. The people in Washington were worried that if we got these programs looking too much alike, the Congress would ask the obvious question, "Look, the Air Force is doing that, and that's a lot like what you're doing. Why don't we just take the money out of your budget and let the Air Force do it?" That's just a logical question.

So we spent, I don't know, quite a number of months arguing back and forth over whether or not the wet workshop is something the country should do, and we were very much against it. A lot of the people at Headquarters were very much for it. The people at Marshall were basically for it. So we kind of had a Mexican standoff for quite a bit.

Fortunately, people were mature enough to handle that kind of pro and con, back and forth argument to where no one got seriously hurt in the debates. Toward the, I don't remember, late '68 maybe, George Mueller called a meeting one day down at the Cape and announced at the meeting that he had finally found a way to free up some Saturn Vs and that we would go to the dry workshop. That made everyone very happy.

We proposed, we at the Johnson Space Center, proposed that we shift the airlock contract to Marshall so that they could combine that airlock with the S-IVB stage and make a very good program out of it. McDonnell-Douglas, in response to that, moved the airlock project to Huntington Beach [California] and their organization and put it all under one group out there. I think from that time on, once we went to the Saturn V launch dry workshop, Skylab got to be a very productive program.

I actually stayed with Skylab until 1980—no, excuse me, 1970, at which time I left Skylab and went to the Shuttle Program. But the four years that I had Skylab here at the Johnson Space Center were primarily years where we were debating what the program should be, went through the evolution into long-duration manned, solar physics, and some other kinds of things as the basic requirements. When we got over the hurdle of using the S-V, Saturn V, for the basic launch, use the S-IC to put the command and the service modules into orbit to fly with it, it got to be a good program once that occurred and, I thought, ended up being a very productive program.

RUSNAK: How did the centers go about defining the areas of responsibility for this? Because previously in Apollo and earlier programs, there had been very sharply defined interfaces. You know, the spacecraft goes to the Manned Spacecraft Center, and then you can draw a

line, and the booster's Marshall's, where here this spacecraft is part of the booster, with the workshop being in—

THOMPSON: Well, that was part of the growing pains of Skylab. What I call the growing pains of Skylab were a combination of not knowing exactly what you wanted to do, not knowing exactly then if you could decide what to do, who was going to do what with what, which, and to whom, because it was bringing Marshall into spacecraft kind of things, which was new and different for them. So you had those kind of issues in the back of your mind while you're trying to debate whether you should have a wet workshop launched on an S-IC or a dry workshop launched on a Saturn V, or a SLA lab in the workshop launched on an S-IC.

So you had a big mixture of issues that kept boiling for maybe eighteen months to two years. You had different personalities. You had the people in Washington who were under the gun to interface with the Office of Management and Budget and the White House staff that was overlooking them and they would go over there and say, "Flying this S-IC wet workshop is the greatest things since sliced bread." Then they'd come back and we'd come into a meeting and say, "That's the dumbest thing we've ever heard of." I mean, these people were in a hot spot there.

Then they would go down to Marshall, and Marshall would say, "Sure, we can make the wet workshop work." They'd come to Houston, and we'd say, "No, the wet workshop isn't a good thing to do. It's too heavy. It's too much EVA. It's too expensive. It's too this, it's too that. If it's a dumb thing to do. If we're going to spend that kind of money, we should do this."

That puts people into kind of an interesting high-frequency mode. My experience of the first four years in Skylab was mainly in that kind of environment. Fortunately, we got through it. I think the Skylab Program, as it finally evolved, where the solar physics, the Apollo Telescope Mount was put on, the Saturn V now could launch the wet workshop, the long-duration things and the solar physics things in a much better environment and put the country into where it could do those three missions in a very effective manner.

Skylab was deliberately conceived as not a long-duration space station. There were never any provisions the way Skylab finally evolved on the dry workshop. There were never any plans to resupply the propellants, to carry it beyond the three missions that were planned. The way Skylab was left on orbit and then decayed and burned up was exactly the plan. Late in Shuttle, all the conversation that came out in this discussion in the newspapers of taking the Shuttle up and extending the lifetime of Skylab was pure unadulterated rhetoric. No one ever seriously considered that, not that there was any way to do it. Skylab wasn't configured in a way—it was a one-shot adventure, and that's the way it had to be.

The modifications that we ultimately had to do to the command and service module to support Skylab were relatively modest, and we did not use any of the lunar module hardware or the LM or its hardware, although there were a lot of debates that used the LM hardware early in the program. But as it finally evolved, I think Skylab was a very productive use of residual hardware out of the Apollo Program, and the spending that brought new hardware in, like the Apollo Telescope Mount and the bathrooms and the kitchen and the sleeping rooms and the exercise equipment for Skylab, was all money well spent.

It also then freed the country up to come back to the post-Apollo studies which says "Let's build a long-duration space station in Earth orbit and a build a logistics vehicle that

can fly people and equipment and hardware to and from the space station." That got us back on the path to the Space Shuttle, which was the first part of that long-duration manned Earth orbital thing, and we're on that second study path to this day.

One of the things that has been somewhat of a disappointment to me is that I don't think we have articulated that second study path as effectively as we should have in this country. I think we haven't laid out as effectively as we could what you might do over a twenty- or thirty-year period in low Earth orbit using things like the Shuttle, things like Space Station, things like solar power generation, those kinds of things. We tend to—and I know a lot of my colleagues will disagree with me—we tend to get off on this kick of, you know, a hero astronaut to Mars, and that's maybe a good thing to do at some point well in the future, but when you focus on that, you deter people thinking about the low Earth orbital infrastructure, and I think you put a lot of confusion in where we should be going over the next ten years.

It's one thing to be a visionary and throw out lunar landing and flying through the cosmos, you know, with the wave of a hand. It's something else to figure out what you're going to do in the next five years or ten years or fifteen years or twenty years. And the country can only afford so many visionaries running around and saying what's going to happen in the next 2,000 years. That's only so effective because you have to live in the next five years. You have to figure out a funding profile for the next five years. You have to convince people that you'd like to do something in the next five years. These programs now are such, it takes ten years from the time you start talking about a space shuttle till you've gotten one. It takes ten to fifteen years' time to start talking about a space station until you've got one.

I'm not a person that wants to run out every day and say we ought to go to Mars tomorrow. I don't think that's necessarily very productive. We went through enough debate the first three years of trying to understand just taking some Apollo hardware and applying it to what became known as Skylab. I think it ultimately came out very effective, but there were lots of long meetings and lots of heated debates and lots of activities that had to take place before we emerge in something that was practical there.

The four years I spent in Apollo Applications or Skylab did give me a good understanding of how to work with other centers, how to work with Headquarters, how to deal with issues where people don't all agree. How do you get a consensus out of people disagreeing? That was a good stepping stone to get into Shuttle because at the time I joined the Shuttle, they were an awful lot of loose ends still on the Shuttle at that time. So there was a lot of debate, a lot of loose ends, a lot of management issues that had to be sorted out the first couple of years of Shuttle, and they weren't that dissimilar from the same sort of things we had gone through on Skylab. So that's kind of summary on Skylab.

I think Kenny [Kenneth S.] Kleinknecht moved in as the Program Manager after I left at the Johnson Space Center. He worked really effectively, I think, with the Marshall people. Marshall had the predominant job of building the new hardware associated with Skylab. The modifications, as I said, in Glenn's service module were important, but they weren't that significant.

Of course, the operational aspects of Skylab brought some operational factors from Marshall that had to be integrated with the operational activities here at the Johnson Space Center. You had to also reach out and bring the scientists into the picture. So it was a good program as far as a precursor to a space station kind of an operation, where you have to work

with people from multiple centers, people from inside the agency, as well as people from outside the agency. They will have that in spades now on the Space Station as they work with the Russians, they work with the scientists that are involved in the program, work with all the different people they have to work with on the Space Station.

RUSNAK: Since you mentioned the scientists, what direct role did they have in this definition period? You've mentioned generally including the Apollo Telescope Mount and these types of experiments in terms of helping to shape the workshop and the requirements and such.

THOMPSON: Let me talk about the solar physicists. As it boiled down, the solar physics experiments ended up with five different major experiments. In other words, there were five different groups around the country, most of them in either academic environments or research environments in government labs or something somewhere. Now, those people were people just interested in getting their instruments in space, having it take reliable data, give them the data, and then they would analyze it and report it in their technical channels. So they were less interested in the vehicle than they were in the science they were looking for. So they were very willing to come forward and say what science they would like to have. They were not very visible in trying to argue whether it ought to be in a wet workshop or a dry workshop or this way or that way. If you had to fit it into a compartment in the service module that didn't give them enough physical size to do what they wanted, or you couldn't handle the data rates that they wanted, then they were very unhappy and they said, "We don't want to fly in that environment, but we'd like to fly over here where we can get the length we want for our gathering instrumentation, the stability we want for our pointing,

the ability to record or transmit data at certain rates." So they had an influence on what you did, but they didn't weren't in the meetings where you argued. They generally stated their requirements. Then you took those requirements and tried to meld them into some approach on how to go about doing it. If you stiff-armed them too much, they would say, "We just don't want to fly with you. We'll go somewhere else. We'll take our money and our experimenting and go do it some other way."

RUSNAK: What about their influence on Congress, for instance, in whether or not they see something like a Skylab as a useful scientific platform?

THOMPSON: Well, of course, they're a very valuable aid to you when you're in a hearing in the Congress and you say you want to build a dry workshop that has an Apollo Telescope Mount that is this big physically and it does this kind of pointing accuracy, and then they stand up behind you and say, "That's a great thing. We'd love to have that. It give us exactly what you want." Then the congressman overseeing your program says, "Hey, the scientists like it, the engineers like it, the politicians like it." You've got a program.

But you're trying to fit them into something they're unhappy with and you go up and try to say, "We don't care what they say. We're only going to give them so much data. We can only give them so much stability of pointing, so much physical length," and they say, "That's not enough," then you don't have a program. You think you have a program, but you don't have a program. Or you might hope you have a program, but until you can get enough of a consensus, you really don't. Skylab was going through that kind of iteration.

RUSNAK: What interaction did you have at this sort of upper-level policy and budgetary discussion?

THOMPSON: Well, at the level I worked the program, generally speaking, not that much. My interface was principally with Bob Gilruth at the Center and with George Mueller in his office in Washington. Then it was up to George Mueller and his office, the AA for Manned Space Flight, to interface with the Congress and interface at the senior level with the scientists and so forth. So what I saw personally were mainly internal meetings within the Office of Manned Space Flight debating whether to do the wet workshop, a dry workshop, a SLA lab or nothing and what the merits of this approach versus that approach was in the way of cost or probability of success and things of that nature.

Our influence on the program was mainly causing the engineering design to evolve in such a direction that we ended up on the dry workshop. We were very happy once we went to the dry workshop. We would have been happy with either, if we could get a Saturn V with a dry workshop or if we had to stay with the S-IC and go to a ground-outfitted SLA lab. We did not think the wet workshop on the S-IC was a very—it was our judgment that it'd be a high-risk program from the weight standpoint, from the long, complex, on-orbital build-out and assembly that began to detract significantly from the medical work we wanted to do and from the habitability things you wanted to do, because if you go camping and you spend the whole time camping setting up your camp, you haven't had a very good camping. That was part of our argument. So we spent a good deal of our time trying to have constructive dialogue with George Mueller in his office and with Marshall, predominantly, and evolving into what was finally flown as the program.

I've always been curious about how other people felt about the program. I'm sure if you talked to some other people, they'd give you a very different perspective of how Skylab emerged than I would, because I saw it from my vantage point, they saw it from their vantage point. That's part of what you historians have to sort out.

RUSNAK: That's right.

THOMPSON: And I'm giving you the perspective as I saw it from the vantage point of trying to represent the interest of the taxpayers, the interest of people involved in manned space flight as to what would be a good thing to do with your money and your abilities and capabilities over a period of time. As I said, I'm very happy with the way it finally worked out.

RUSNAK: What level of support did you get for these efforts from Bob Gilruth?

THOMPSON: Quite a bit. Bob was a very straightforward kind of a guy to deal with. Bob was an extremely wise person on how to interface. You know, it's not an easy job to go up and tell your boss that what he wants you to do doesn't make sense. It's not easy for me to go tell Bob that what his boss wants to do doesn't make sense. So you can't just in and frivolously say, "That doesn't make any sense." You got to go in and say, "Here's what they want to do, and it would probably work, but here's an alternate you could do that might be a whole lot better."

So you have to then work in such a way that people may not like what you're saying. Most people like to hear what they want to hear. People don't like to hear what they don't want to hear. But if you tell people what they don't to hear with logic and reason, most engineers deal with the physical laws. You know, weight is weight. Weight projections have a certain statistical value and experience value to them. A judgment that says we shouldn't spend our time doing this, we should spend our time doing that, reasonable people will generally iterate to a common understanding.

But while you're doing that, you've got to do it in such a way that you don't either get fired or put your boss in such a position that he gets fired or put your boss' boss in such a position that he gets in trouble with the Congress. So it's a ticklish situation, but we all face that when we're trying to evolve into how you should spend several billion dollars of the taxpayers' money. Unfortunately, when you look back at a program, it looks pretty simple, but until you have grown into trying to decide what to do and how to do it, it doesn't always just come into focus immediately.

Bob Gilruth was very good in that environment. Bob could work with the people in Washington in a way where he could tell them that in his judgment what they were trying to do needed to be changed a little bit. He wouldn't say, "You're wrong." He'd say, "You know, you ought to change that a little bit," and he would do it in such a way that you could all survive. I call that wisdom. It's wisdom coupled with a lot of intelligence, a lot of experience.

RUSNAK: Yes, several of the other people we've talked to about him have expressed a similar affection for that ability of his to present these types of problems in a way that's very approachable, to see the logic behind what's going wrong and what needs to be fixed.

THOMPSON: Right. He also was a person who would allow you to do a lot of your work. He didn't try to do all your work for you. He would let you come in with all of this stuff. He'd listen to whatever you brought in. If you could convince him that there was a good logic to what you had to say, he would take that and go forward with it, or he would take that and give it some adjustment, whatever was needed before you'd go forward. He could handle himself in meetings with George Mueller and other people, Wernher and [H. Kurt] Debus and the other people that he had to interface with.

Apollo was a relatively straightforward program from the standpoint of interfaces between the centers, as you've already pointed out. AAP got us into a much involved set of interfaces, and then Shuttle got into much more significant set of interfaces. Bob was very good in that kind of an environment, but he'd worked in government bureaucracy all of his working life, in essence. You know, there's nothing better than a good bureaucracy. People criticize bureaucracies. You can't do big programs without bureaucracies. We need to spend maybe a lot of time thinking how good good bureaucracies are compared to how bad bad bureaucracies are. But when you can have a good bureaucracy that everyone's pushing in one direction and working effectively, you can get a lot of things done. You can't get some big programs without an effective bureaucracy. It's just that simple.

RUSNAK: How much support and interest did you get from the rest of the Manned Spacecraft Center and within NASA?

THOMPSON: Well, one of the challenges any program manager has is how to use the institutional capability that is there supporting him. You know, a program manager is nothing more than just a quarterback or a coach or something that has to ultimately decide what play to run or what to do, but he can't do it without all of the information coming up to him. So you have to work in an environment where people are willing to tell you what they think. Then you have to be willing to listen to all the people telling you what to think and be able to evaluate the things that you want to keep and the things you maybe don't want to keep and make some judgment calls and go forward with them. So you use the institution very much every day from day one, because that's where the knowledge, the broad spectrum of knowledge can filtered down and brought to you from which you get your job done. Plus, it's also the way in which the job gets implemented, because you go back down through that institution to get the job implemented.

So a center like the Manned Space Flight Center, if you're running a program like Skylab, or if you're running a program like Shuttle, the institution is key to you. That brings you information, and that implements what you're trying to get done. So it has to work up and down very effectively.

RUSNAK: During this early period, a lot of the institutional capability is being directed elsewhere, towards Apollo. What effect did what was going on in Apollo, both the failures,

like the Apollo 1 fire, and the successes, like the lunar landing, have on what was going on in Apollo Applications?

THOMPSON: Well, again, what you have to do is you're in Apollo Applications, you have to be sensitive to the priorities. You have to recognize, number one, that the number-one priority is the Apollo Program. You know, ninety percent of the Center is working full-time on the Apollo Program. If you find the fringes of capability and you find the ten percent you need to get your job done, so the structures people are working on Apollo problems while you're also asking them to do some things for you on Apollo Applications. So you're willing to take second priority and be sensitive to their needs on Apollo. You can't just go over there and demand your work at everyone else's expense.

So the Center was very heavily engaged in Apollo at the time we were trying to settle on what Apollo Application was. But the Center, you know, had 5,000 people. Not only that, but you had then access to contractors. We had a number of contracts. So there was plenty of manpower to work the Skylab issues at the same time we were working Apollo.

You know, if you needed some input from the Flight Operations Directorate, they had an individual over there on the staff who had the Apollo Applications or Skylab responsibility. That was his full-time job. He got paid a hundred percent of his time for that. So he came to your meetings and you asked him to do something, he'd go back into that group and get it done and come back. So you're able to run multiple programs out of the institution very effectively, if the people will be sensitive to each other's needs. I never felt that we were short of either human resources or other kinds of resources to do what needed to be done at that time.

RUSNAK: Since you mentioned the contractors, what role did they have in this whole process?

THOMPSON: Well, the contractors typically operate with the government, and the way that at least I'm used to them operating most of the time I was at NASA, NASA always acted as its own prime contractor, prime meaning overall contractor. We never really asked a contractor to come in and tell us what to do, like Apollo Applications. There was no way a contractor could have worked Apollo Applications and had it converge onto the dry workshop the way that it did. They couldn't interface with the scientists. They couldn't interface with the Congress. They couldn't interface with the people at NASA who wanted to use empty tanks versus the people at NASA who didn't want to use empty tanks. A contractor can't do that job.

Now, a contractor can, if you'll give him a set of "desirements" or requirements, saying, "If I wanted to put a dry workshop in that S-IVB tank that had these kind of capabilities, it had a bathroom, it had a kitchen, it had a sleeping compartment, it had a place for exercises, it had a place to throw our trash, could you design it for me?" Yes, he could sit down and he could make you some drawings. He can show you where to put your electrical system, where to put your potty, and where to put your kitchen, where to put this. You can interface with him and he can conceive that design for you, and you look at that design. He can tell you roughly how much it's going to weigh because he'll have a weights team that'll go through and tell you how much it weighs, or he'll have an electrical team that can tell you how to put the solar panels on and run the wires through it and so forth. So you can get that

kind of information from him. So you can say, “Gee, it’s going to weigh about this much and look about like this if we want to make it dry. It’s going to weigh this much and look about like this if we’re going to make it wet.”

For example, all the while we were debating these kinds of things, we had some contracts for people like McDonnell-Douglas who was building the airlock, McDonnell-Douglas who was building the S-IVB stage in Huntington Beach. You would just put a little rider on their contract to give you information ASAP [as soon as possible]. So you take them questions of what would a—for example, we put a floor in the S-IVB stage, even when it was wet, we put a floor in there to be a floor for the workshop once we used the tank, but it had to allow the propellant to flow through. So they designed that floor and that’s the same floor we kept when we went to the dry workshop. So you use your team of contractors.

NASA’s strength wasn’t in detailed design of hardware. NASA’s strength at that time was in deciding ultimately what you wanted to do and trying to make some judgment to call on whether you want to do it this way or that way or some other way. Probably even in today’s world, too much is made of the "prime contractor." To say that Boeing is a prime contractor on Shuttle today is a little bit of a misnomer in that NASA still has to sit on top of that program and decide what you’re going to do, when you’re going to do it, how you’re going to do it, how much money are you going to spend, and so forth. Then, yes, Boeing can then take that information and go work with the other contractors and cause something to happen. They’re doing more of an integration at that level than was done previously because when I was at Shuttle, the government did that integrating among the contractors rather than have one contractor integrate among the contractors. But we’re getting down into semantics as to what is prime and what does prime really mean.

RUSNAK: One of the related questions in terms of groups input, what role did the astronauts themselves have in this, these guys who are going to be going up and flying this?

THOMPSON: Well, typically the astronauts, from the time they were first brought into the program, were always invited into and were a part of the team involved in these discussions of what should be done or what shouldn't be done. So typically, for example, in Mercury, the seven astronauts, they were given prime assignments in certain areas. For example, Al [Alan B.] Shepard [Jr.] was given a prime assignment in recovery. He was to monitor recovery from the Astronaut Office point of view. John [H.] Glenn [Jr.] was given the cockpit layout, I think, for example. I don't remember what all the other designs were. Now, what that meant is that if there was a significant meeting of some sort, Al would come to the meeting, and if I wanted to talk to Al about something, he was more than willing to participate or go to a meeting or out in the water and evaluate something or have another astronaut go if he was tied up.

So, starting back in Mercury, they were brought into the program so that you could get their inputs early. As we had progressed on to Skylab, for example, once the Apollo Application Program was set up as a program, one of the astronauts was given the assignment to monitor that program. That was his staff assignment in addition to his flight assignment. So he would come to the staff meetings. He would listen to what was going on. He'd get correspondence in the program. He would read it, and if he wanted an input from the flight crew, you would invite him to the meeting and say, "We're talking about having

this kind of a potty or that kind of food or this kind of something else or this kind of a display for the Apollo Telescope Mount. What's your input?"

He'd make his input, just like a structures man would or an electrical power engineer would, and so forth, and his input of the design was utilized like everyone else's. So, yes, they were very active in helping evolve the thoughts and helping evolve the design as it progressed. They changed from time to time because if they would get a prime flight assignment that took all of their time, then someone else would pick up their program duties. So you had different faces that came from time to time.

RUSNAK: As you have mentioned before, you were with the program from 1966 until 1970. What was the state of Skylab when you were getting ready to leave the program?

THOMPSON: The state of Skylab when I left the program was, sometime earlier we had settled on the Saturn V launch dry workshop. We had moved the airlock contract from Johnson Space Center to Marshall so that the workshop could be all integrated and put together and designed by one center. As I said, McDonnell-Douglas had moved that project from St. Louis. They had acquired Douglas by that time so they moved it to Douglas on the West Coast, or what was formerly Douglas, so the program was pretty well firmed up, to use a term, on the path that it ultimately was carried out starting in '73, but it was still three years away from flight. We had just finished the lunar landing and we were doing some of the follow-on lunar missions.

By that time Shuttle was beginning to emerge, and the talking stage with the advanced planning groups in Washington, Marshall, and Houston, and Bob Gilruth called me

one day and said, "Gee, looks like Skylab's pretty well settled down now. I'd like you to go over here." So I went over and started looking into what Shuttle was all about at that time.

RUSNAK: To once again use your expertise at this sort of early stage to formulate—

THOMPSON: Well, as I said earlier, for some reason, I don't know whether it was by plan or good luck or bad luck, I never took over a job from anyone. The recovery thing was a start-up job, one person starting to see what recovery boiled out to be. Apollo Applications was the same way, and Shuttle was the same way for me. So, frankly, I think it's good to go and start something new like that. You don't have to go in and replace someone else or try to get up to speed with what's going on. You get the chance to go in and generally pull together a team of people that you had confidence in, and you get to work things essentially from day one.

On the other hand, you quite often start with sort of a can of worms or spaghetti, and you're trying to make something out of it. So it takes a little while to get it all sorted out. That was true both in Skylab and in Shuttle.

I don't know whether anyone has talked to you about phased program planning. Has anyone brought that term up?

RUSNAK: Only in the most general terms, so why don't you go ahead and describe that for us.

THOMPSON: Well, as far as I know, this thought came out of some of the military programs of how you do configuration management. But in any event, NASA had picked up on this and by the time we got to Shuttle in particular, we were doing what we call phased program planning. Phased program planning has four phases: A, B, C, and D. "A" is the very early conceptual phase where you're just kind of throwing ideas around in general. They aren't firm by any stretch of the imagination. You're just trying to decide whether the country ought to do something or not. At that time, lots of different wild ideas can be thrown around because you're not spending a lot of money, and at that time usually you're using your advanced planning groups, all advanced programs in that area of responsibility. As I said, we had a small group within the Engineering and Development Directorate at the Johnson Space Center that was our advanced planning group.

Usually by the time you got ready to go into Phase B, which is the preliminary design phase, by then you set up a program manager, set up a full-time program office to worry those specifics, because you're now getting serious about going and doing something.

Phase A is so-called conceptual or preliminary design. Phase B is design. Phases C and D are detailed design and implementation and development. So by the time you get to Phase B, you're fairly serious, or you should be fairly serious about what you're going to do.

I joined Shuttle at the start of Phase B. Phase B was when we started detailed work with the contractors. Up until that time, Shuttle had been run out of an Advanced Planning Office at the Johnson Space Center, out of a staff group in the Office of Manned Space Flight in Washington, and a similar group at Marshall. They had been pretty well throwing around the ideas of what the Space Shuttle should be.

When Gilruth asked me to come over and set up the Shuttle Program Office and get serious about Phase B, we were—"we," the agency—were just getting ready to go out and contract with contractors for what we called a Phase B study.

In view of time, maybe we want to break here and go into Shuttle, because we won't do it in thirty minutes, and you want to be through at three. Or we can do thirty minutes and pick up again, whatever you'd like to do.

RUSNAK: We can go for a little bit if we want to. Maybe we can break it up by phase.

THOMPSON: Well, let me do that, yes. Let me at least go through the introductory part of it.

At the time, as I say, I felt that Skylab had pretty well firmed up and stabilized. All of the debates, arguments, pros and cons were behind us. The contracts were in place. The changes to the command and service module were contracted for at McDonnell-Douglas, and Gilruth said, "Look, Shuttle is beginning to get serious. I'd like you to leave Skylab and go become the Shuttle Program Manager. They're getting ready to start Phase B."

So, again, I agreed to do that and went over and set up a Shuttle Program Office. I really stayed in the same office. I just handed off Skylab to Kenny and his office and brought Shuttle into my office. In fact, I stayed in the same office from 1966 till I retired. So I just ran two programs out of the same office.

But in any event, we started Shuttle in 1970 at the start of Phase B, or I did. At the time I got into Shuttle, the man in Washington who was essentially the key staff manager for the Office of Manned Space Flight—by then George Mueller had retired. He was there during part of Phase A, and then he retired, and a fellow named Dale [D.] Myers took over as

the Associate Administrator for Manned Space Flight. Charlie [Charles J.] Donlan, who had worked at the Langley Research Center, he was a section head there in the same group I went to work with in 1947. Charlie had been there since, oh, maybe, ’39 or ’40, had worked up to be the key technical engineer on the Center Director’s staff at Langley, and then had joined the Space Task Group after we had been under way a while. Then when we moved to Texas, he didn’t move. He went to Washington and was working in the Office of Manned Space Flight in Washington and was heading up the Shuttle activity as we entered Phase B.

Marshall had a Shuttle Program Office, and a fellow named Roy Godfrey, if I remember his name right, was the Shuttle Program Manager at Marshall. So the concept at that time—and the people in Washington had a big influence on this, and, I don’t know, the people in Max Faget’s organization had been working on it—the concept was to have a two-stage fully reusable Space Shuttle, and that’s what we entered Phase B with.

That vehicle came out of the preliminary design kind of debates and studies that had been going on for eighteen months maybe. That’s the configuration that was being put out for bid when I joined the program. The concept was to bring two contractors on board, have these contractors work for a period of time, I don’t remember, a year maybe, something like that, to do preliminary design on this two-stage fully reusable vehicle.

One contract would be managed out of my office in Houston, and another contract would be managed out of Roy Godfrey’s office at Marshall, and each contractor would study the entire vehicle. So you had two different contractors' study. So my job was to manage the contractor that was selected out of this process, one of the contractors, and Roy Godfrey was to manage another one. An RFP [Request for Proposal] was already in the process of being written for this two-stage fully reusable configuration.

Well, we went through that bidding process, and McDonnell-Douglas won one of the contracts and Rockwell won one of the contracts. The natural wisdom was to have the Rockwell contract managed by the Johnson Space Center since we had a lot of history working with Rockwell, and to have Marshall manage the McDonnell-Douglas contract because they had a lot of history working with McDonnell-Douglas. So we started out with that kind of arrangement overseen by the group in Washington, Charlie Donlan and his staff in Washington.

So we began to look at what it would take to build a two-stage fully reusable Shuttle. Now, when you think about it, the configuration at that time was a pretty convenient configuration, convenient in several aspects. One, it's split very nicely between the flyback booster, which Marshall would build, and the flyback orbiter which the Johnson Space Center would build, so politically it split up much like the Apollo Program. So, you know, that was real nice.

Two, everything was reusable, and people just were willing to equate reusability and low cost as the right thing to have. If it's reusable, it's low cost. I spent a lot of my time challenging that, because I don't believe that, you know. I can have something that reusable and be a hell of a higher cost than something that's not reusable, both doing the same function. Otherwise, why do we have Dixie cups? Why do we throw away Dixie cups? Why don't we have a glass there with a sterilization system and someone overlooking it and locking it up in a cabinet every day, if it's the best and cheapest way? So just because something's reusable doesn't necessarily mean that it's the best or the cheapest or the way in which things should be done.

But, in any event, some wisdom had come down that says it shall be two-stage fully reusable, and that's what was being pushed. Well, as the studies got under way, and as here in Houston I began to look at that configuration, I began to have quite a few doubts on it. There were a lot of things about it that didn't make any sense to me. The booster, for example, the flyback booster at that time, was extremely large and was extremely complex. It worked out engineering-wise to have a very high staging velocity. You had to go to about 12,000 feet per second before you even lit off the engines on the Orbiter in order to make it reasonable on the weight analysis of staging. It was manned. It had a whole bunch of turbojet engines in it in additional to a large number of rocket engines, and all it did is help get you on your way.

But it would have been a tremendously lot of fun for the Marshall Space Center to build. They would have had their own astronauts. They would have had their great big flyback booster, and it would have been cheaper, so to speak. But it just didn't look, feel, sound, or look right. Also, to have everything reusable on the Orbiter was making it big. The Orbiter was very large, because you had to find room in the wings or places like that a hell of a lot of hydrogen. Hydrogen's very cold, very hard to handle. Had to have a lot of LOX [liquid oxygen]. So the Orbiter was a big, complex vehicle. But here we're designing this two-stage fully reusable vehicle.

So I began to question the wisdom of that. So I began to look for ways to make it—it's one thing to be in an advanced design group and throw wild ideas out. It's something else if you give them a job to go get something done. You know, you get realistic in a hurry. So we began to think, what could we do to simplify this vehicle? Even though the message from on high was coming down, "It shall be fully reusable," we said, "Well, let's just look at

what it would take, what it would do to the Orbiter if we took the hydrogen out of the Orbiter."

So we had some contractors who had not won Phase B contracts, but we had agreed, we, the government, had said, "We will use you in some offline studies to keep you competitive, so when we get to C, D, you can compete." So we had Lockheed out there and we had Grumman out there, that we were looking for something, a few bones to throw them, to look at things, so that they could still compete for the contracts. We didn't want Rockwell to have a lock on it or McDonnell-Douglas to have a lock on it, although they had a big advantage by having won the Phase B contract.

So we called Grumman in and said, "How about looking at the Orbiter in a kind of preliminary way, what it would look like if we took the hydrogen out of the Orbiter and put it in the tanks that we'll throw away." So they went away and studied, and we look at it internal with our engineering capability here. Lo and behold, the Orbiter starts getting smaller. You know, if you look at the Orbiter today, it's big, but if you would take all that hydrogen and oxygen and stuff it in tanks in the Orbiter, it gets big. Then the booster was twice as big as the Orbiter, to give you a feel of what we were studying at that time.

At the same time, I was trying to see what it would take to simplify the vehicle and saw taking the hydrogen out made it look good, and I said, "Well, let's take the LOX out, too." I mean, if a little bit's good, a whole lot's better. So we went back and studied taking the LOX out. I say, "I," but there were people at the Johnson Space Center trying to do the same thing, and they would come in and, "Why don't you this? Why don't you do that?" and you'd listen to all this and then you'd say, "Let's go do that."

So while we were studying this configuration that we'd given the contractors here, we had some other contractors looking at maybe other things we ought to do. So, lo and behold, we took the LOX out. The Orbiter looks even better.

So, in the meantime, I'm going to Washington, and a fellow named Jim [James C.] Fletcher is the NASA Administrator at that time. We would go up there for our monthly meetings and we'd explain what the program looked like it was going to cost and what the funding curve looked like, would the two-stage be fully reusable, and the funding curve on any of these programs, you want to start and ramp up to some peak, and we were running, you know, we would need two or three million dollars back in the 1971-2 dollar kind of things to carry the program on a reasonable schedule.

Fletcher kept saying, "You guys haven't got the word." He says, "We're being told by the White House," and [President Richard M.] Nixon was in the White House at that time, "that we can build anything we want to, but we're going to be held to one billion dollars, peak annual funding." And he says, "I've told you this a dozen times." He'd come in here showing us these funding curves that'd go to two billion dollars. "That's not for real. We're not going to get it. I'm not going to ask for it, and get out of here."

So after about the third time of that, we began to say, "Hey, this guy's serious. He's not interested in programs that are going to bump the agency's funding much more than a billion dollars out on these years because he's been told by the OMB and the White House that the agency budget not going to be bumped up out there then to cover this development."

Now, personally, I wasn't that uncomfortable with that because I didn't like the vehicle that was bumping it up anyway, and I wished that there was some way to drive the

vehicle down to something that made more sense. So this fell right along the line of that. I was pretty happy to agree with it.

So we began to say, "Well, look, maybe we don't need a flyback booster." Now, that's heresy. You know, you're taking a flyback booster away from Marshall, right? So you've got to be careful how you talk about that. So we began to look at some other ways of getting the Orbiter not only smaller, but get it in orbit without building this great big monster flyback booster.

Well, you had to be careful about how you did that, because, as I say, you were going right to the lifeblood of the Marshall Space Flight Center. There were a lot of people committed to that two-stage fully reusable, thought it was the right thing to do, it was great, the country ought to do it.

But, anyway, we began to look at throw-away boosters. Maybe we just ought to build a booster to take us up to some velocity and then light the Orbiter engines and go on to orbit. So we'll use just a booster, not a fly-back booster. So we began to look at some liquids, and then someone says, "Well, why don't we just put a big JATO [jet-assisted take off] bottle on it?" A solid propellant on it.

So we began to look at that and, lo and behold, when you put those kind of things on it and you lit off the Orbiter engines while it was still on the pad—because the Orbiter engines are the most efficient engines, their propulsion efficiency is very high compared to other things—you begin to get tradeoffs that brought the staging velocity down to about 3,000 feet per second rather than 12,000. You use the Orbiter engines all the way from liftoff to the pad and all you'd need was a great big JATO bottle, two big boosters out here, particularly if you took all the propellant out of the water and put it in a central tank. Then

all of a sudden you're looking at programs that you could live within the one-billion-dollar peak annual funding over an eight- or ten-year period.

So, lo and behold, you know, we've got a solution that solves the funding limitation thing. You look at an Orbiter that's not a hell of a lot bigger than, say, a 737, and so, you know, you aren't shaken up by building that. So I'm throwing an aluminum tank away, but I'm still using the engines, and not only that, but all I've got to do is build a couple of solid rocket boosters like they have in the Titan Program, even though they're twice as big, and I've got a program.

So, man, we'd found a solution, but it wasn't a very popular solution. The Marshall folks hadn't studied it. They weren't interested in that. They were building a fly-back booster. Not only that, but the booster was simple enough that you didn't to have to start spending money on it right away. You could go ahead and start spending money on the Orbiter, and then you could later on spend money on the tank. Then you could later on spend money on the booster, and you could flatten out the spending curve, because the new technology's in the Orbiter. Building the simple tank and building the solid rocket boosters wasn't that much of a challenge, so you could time-phase the start of the funding curve so you could flatten out the funding curve.

Well, hell, I was happy as a bug in a rug, right? Got the solution. Now you're kind of back at the dry workshop/wet workshop stage, right? How do you sell this thing? Well, the thing that sold it was just the practicality of it. The funding, you weren't going to get the funding for the two or three billions dollars or whatever you're going to do. I say you weren't going to. The administration didn't want to go and fight for it. The OMB didn't

want to give it to you, and the White House didn't want it. How in the hell were you going to get it?

So, you know, you weren't to get a two- or three-billion-dollar peak annual funding program. The argument to build a great big fly-back booster to go up to 12,000 feet a second and then turn around back and land with a bunch of rocket engines and a bunch of turbojet engines, and it's huge—it made a 747 look small—when you really got down to it, it just wasn't very smart to even think about doing that in the first place.

So the program, by the time we got to the end of Phase B, it had started with a two-stage fully reusable, went through this evolution and came out the end over here as an Orbiter with an external tank and some throw-away booster rockets. I would say over the last three months the program very quickly saw the practicality of that and went to that. Fletcher and [George M.] Low went out to the West Coast and had a meeting with Nixon out there, had a model of it, showed him to it, and said, "This is what we want to spend. Here's the funding curve," and so forth, and away we go.

So now it comes time to decide how you're going to do that program. Fortunately, we had some people in Washington who understood how programs were run, people like Dale Myers and people like Charlie Donlan. Dale and Charlie got their heads together and said, "Hell, we'll run that by setting up Bob Thompson as the Program Manager and run all the other projects, give him the responsibility of running the Orbiter project, the tank project, the engine project, the booster projects, have him work out of the Johnson Space Center using the resource in that center for his management team. We'll go to this so-called lead center concept with the Program Manager located at Houston. We'll run the program that way."

Well, we had a meeting, or Dale had a meeting at Williamsburg [Virginia] explaining to everyone. By that time, Wernher had left Marshall and Eberhard [F. M.] Rees was at Marshall. The Marshall folks weren't that happy, but, you know, they wanted the program. They had the engine, the tank, and the booster rockets. JSC [Johnson Space Center] had the Orbiter. I don't know whether he liked me being the Project Manager or not. He didn't really say one way or the other, because they told him that's the way it's going to be, and they sent out a directive saying that's the way it was going to be, so that's the way we started Phase C/D.

We went out and had a competition for the Orbiter contract, and then in that Orbiter contract we put an integration support function, because we wanted the contractor to come and do some things for the government to help integrate the program. So we had the Orbiter integration contract. I chaired the Source Selection Board. We selected Rockwell from among four bidders. Rockwell, McDonnell-Douglas, Grumman, and Lockheed bid. We selected Rockwell for a number of reasons—obviously we thought why they should have it compared to someone else—and started that contract.

Even prior to that, we had started the engine contract out of a project office in Marshall with Rocketdyne. Rocketdyne won that in a competition with Pratt & Whitney. We didn't start a tank or an SRB [solid rocket booster] contract till sometime later. We maybe started a tank contract out of a project office in Marshall maybe eight months later and then started a booster program out at Marshall with the preliminary design work done in-house at Marshall maybe a year later, to hold the funding down while we were getting started. Ten years later, we had a vehicle ready to go to the launch pad, or eight years later, from '72 to '81, nine years later.

RUSNAK: If I could stop you there so we can change out our tape.

THOMPSON: Sure.

[End of recording]