NASA HEADQUARTERS ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

CHARLES F. BOLDEN
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is March 31, 2014. This interview is being conducted with NASA Administrator Charlie Bolden in Washington, DC, for the NASA Headquarters Oral History Project. Interviewer is Rebecca Wright, assisted by Sandra Johnson. Also in attendance today is [Dr.] Joanne Hill-Kittle from [NASA] Goddard Space Flight Center.

Thank you, Charlie, for finding time in your schedule. We'd like to spend some time to talk to you today about your experiences related to the agency's Commercial Crew Program. Several years before you became Administrator, NASA had begun a new initiative to help commercial companies develop the capability to transport cargo and crew to low-Earth orbit. The Commercial Crew and Cargo Program Office—as people call it, C3PO—opened in late 2005, had a fixed budget, limited staff, and then seven years later, two cargo transportation systems began operating successfully by two commercial companies. In August 2009, C3PO issued an announcement, as people referred to it, CCDev [Commercial Crew Development], for potential industry partners to develop vehicles and technologies needed for commercial crew transportation. At that time, you were just in the first few months of your new role, so share with us your thoughts on this program that was underway to pursue industry partnerships for NASA to get to low-Earth orbit.

BOLDEN: When I became the NASA Administrator—my interview was in May of 2009, and then nothing happened for a while. Then I got word that the President [Barack Obama] had

decided that he wanted to nominate me to become the NASA Administrator. I went through my congressional hearings and I gained Senate confirmation. My hearing was July 16th; we (Deputy Administrator nominee Lori Garver and I) were voted out of committee that afternoon, and Senate confirmation by unanimous vote took place that evening. I was sworn in on Friday, July 17th, and I came into this office to begin my work as NASA Administrator. It didn't look like this, then. At the time that I became the NASA Administrator, there really was no Commercial Crew Program. It was something that was supposed to come with the [Space Shuttle] *Columbia* Accident Investigation Board and their recommendations. The recommendations made back in 2004 were that Shuttle should be phased out by 2010, and that NASA should take maximum advantage of commercial capabilities to carry crew and cargo to space. That was as far as they went.

The Senate confirmation process and The Augustine Committee [Review of the U.S. Spaceflight Plans Committee, chaired by Norman R. Augustine], met simultaneous. The Committee actually started prior to my even being nominated to be the NASA Administrator. It was interesting timing because the Augustine Committee would play a large role in defining what we were supposed to do after I became the NASA Administrator. I got credit for it, as the NASA Administrator, but I had nothing to do with the establishment of the Augustine Committee, nor with addressing the Augustine Committee as the NASA Administrator because I wasn't at the time.

Augustine did not talk about phasing out Constellation [Program]. Augustine talked more about how NASA should go and explore—if, in fact, that's what they were going to do. Their big thing was, if you're going to do this thing that the Agency has decided to do, and if the Obama Administration has indicated they really want to do, you probably need to stand up a

Commercial Crew and Cargo Program. You need to really do it, and in order to get the best product, you're going to need competition, and you're probably going to need about $6 billion to get the program started, Commercial Crew.

It's always been asked, how did they come up with that number? There is no definitive answer on how they came up with that number, except that I think NASA probably provided it to them. Their due diligence was not as good as everybody gave them credit for. That's not a knock on Norm Augustine or anything; it's just that nobody knew. Nobody knew how much it was going to cost. I did the same thing. When I became the NASA Administrator, I just went to my friends in industry and I said, "Hey, if you were going to do this, if you were really going to do it, what's it going to cost?" Almost everybody told me—Boeing, Lockheed, all the people said—it's probably going to cost about $2.5 billion per provider to stand up a Commercial Crew Program. That's for the development of the program, and then once the program gets stood up, then NASA's off the hook. All you're going to have to do is pay for services because you'll pay a per-seat cost.

It's not going to be anything at all like Shuttle because at the time I came in, we were paying $3 billion a year just to maintain Shuttle, and that was mainly for its infrastructure, the thousands of people working on the program. I think we had something like 10,000 contractors. It was massive. I was neither a fan nor an opponent of Commercial Crew. You probably know this from being at JSC [NASA Johnson Space Center, Houston, Texas], but when I first came in—because Lori [B.] Garver was my deputy, who was considered to be a champion, if not the author, of the commercial concept—then she was painted as the champion of Commercial Crew and Cargo, and I was painted as the good soldier who would just do whatever somebody told me and I was really opposed to Commercial Crew and Cargo because I wanted to preserve Shuttle.

Both of those were absolutely wrong: I had no opinion about Commercial Crew and Cargo because I didn't know what the plan was going to be, and I try not to speak ill of something if I have no clue about it. Yet, I won't endorse something if I have no clue about it.

It didn't take anything at all for me to go along with phasing Shuttle out because I thought we should have done it a long time ago. I'm a huge fan of Shuttle, but I'm an explorer, and I knew we couldn't continue to operate Shuttle and go beyond low-Earth orbit, so I was a huge fan. Not from a safety perspective—I think people still get it wrong. Shuttle was as safe as we're going to get, given the way it was configured. You could do it better, but given technical stuff, we were about as good as we could get, and contrary to what people think, I will challenge any other program that we come up with to be as safe as Shuttle, to be quite honest. So safety was never a factor for me, but cost was, and the ability to get off the planet and get to deep space.

Leading up to the rollout of the 2011 budget request from the President, we started that preparation; it was already underway when I came into office. They were well down the road to putting together the President's budget request for 2011. It was sort of like going after an asteroid—I jumped on it and I was along for the ride. I was not going to change anything. That was well down the road, and what I didn't realize at the time was how much down the road it was. I didn't know what Augustine was doing, but I didn't have any idea that the Augustine Report eventually would come out and it would support exploration, and unwittingly, whether they liked it or not, their report would be used to seal the fate for Constellation, to be quite honest. Days before the budget came out, I got an opportunity to see our budget for the first time.

The way that the process works is an agency sends their proposal over to OMB [Office of Management and Budget], and then OMB does something that we call "pass-back." You get

your first look at what you think the President is going to put in your budget. Normally, there are tweaks from what the agency submitted. When we got pass-back, it was dramatically different from what we had submitted. We didn't have anything at all about terminating Constellation in it. In fact, I opposed terminating Constellation because that's a bad word to use, that's a horrible word in the contracting world because it means you're going to incur—I didn't know what it was at the time, but I knew we were going to incur all kinds of penalties. It turns out it was another one of these monsters that ate New York. We ran into something called termination liability. It was something that I knew was out there; I just didn't know that it had a technical name. My strong recommendation, going back and forth between here and OMB and everybody, was, "Okay, I got it. If you want to get us out of Constellation, there is a way to do it. We still have to explore. You can't go back to square one." What OMB wanted us to do was drop all efforts at exploration through government means and rely on commercial space to do that, to provide the vehicles for it. I said, "But we don't have any vehicles. There is no commercial space."

They said, "It'll come."

This was a battle of ideologies, and there were ideologues around the President and ideologues over here. You had an incredible ideological battle going on just between the White House [personnel in the Executive Office of the President] and here. A lot of people like to say it was just the White House—it wasn't. There were proponents here and proponents there, opponents there and opponents here. When we rolled the budget out, I don't need to remind anybody, it terminated Constellation and it said that NASA would undertake the development of a LOX/RP [Liquid Oxygen Rocket Propellant] engine, a heavy-lift engine, for no vehicle. We would do this for the nation, and that was going to become NASA's task, and that NASA would

become more of a research and development agency. We were going to transform the agency, which was not something I had signed up for.

Right away, I'm going, "Uh-oh, we've got to figure this thing out." Those who say I was opposed to the President's plan, if you want to say I didn't particularly care for the way that it turned out the first time I rolled the budget out, they're right. I didn't think we did it the right way. I was going to support whatever the President wanted to do, but Congress is a partner, and the American people are partners.

We came out with this plan and we had engaged no one, and so the worst day of my administration was rolling the budget out. The other thing was because nobody in the Executive Office of the President trusted me, to be quite honest, at least people who were formulating everything, nobody wanted me to talk as part of the post-rollout press events. I think they were afraid that I might say, "I didn't know anything about this." I rolled the budget out and then I stepped off stage, and then my deputy and somebody from OSTP [Office of Science and Technology Policy] who was an unidentified White House official, the two of them did the rest of it. We didn't do a rollout like we now like to do, where we go to the [NASA] Centers and we have a video. It's television to the world, the way we like to do it now, but it was all phone-in and everything else [then].

We had these two people responding on the NASA budget and explaining why this was the way the nation should go and really castigating Constellation and a lot of other stuff that turned out to be horrible for the agency. They just completely disregarded the people, as if all we were talking about was machines. What we did instantaneously, in one fell swoop, when we rolled out the 2011 budget, was we alienated the entire NASA family and the entire NASA workforce, whether they had really been a human spaceflight person or not.

Because of the way that [former Administrator] Mike [Michael D.] Griffin had developed the Agency into 10 healthy Centers, and they talked about it all the time, every single Center in NASA had a piece of Constellation. There were a lot of things, but the one great thing about Constellation that anybody who was there then will tell you today, was it brought the people of the agency together in a way that they had not been before. It knocked down a lot of the competition that you had. Every Center felt like they had a part in Constellation and they were playing a role, and there was a lot of crosstalk, and cross-pollenization. It was all in human spaceflight, but still, everybody had a role in it, even the science centers.

When I became the Administrator and I started doing Center visits, the one thing that all the employees said was, "Look, we know this is going to happen, probably," they weren't sure because Congress still had a say, "if it's going to happen, one thing that we ask is that you don't take us back to the way it was pre-Constellation." We tried that. Over time, what happened was I started looking at the road we were going to take. Commercial Crew was a thought, a concept.

Commercial Cargo was doing pretty well. Mike Griffin, I am told, had given Alan [J. Lindenmoyer] and the guys, said, "Okay, here's $500 million. Take it and go with it and don't bother me. I'm busy building a rocket." Alan Lindenmoyer and his team went off and they built a Commercial Cargo Program. They had that $500 million kitty, and they could use it to give it to industry as they saw fit, and they used it to do milestone payments under the Space Act Agreement—the way that it was organized. We subsequently ended up with a Commercial Cargo Program that now has two viable competitors.

Commercial Crew was harder. In the budget, we requested $1 billion for Commercial Crew; the $1 billion was based on the fact that we were using 2011 cost estimates. We wanted to be flying by 2015-2016, and so it was going to take us $5-6 billion over that five years to stand

up a viable Commercial Crew Program. There's no magic in the numbers. It was going to be $1 billion a year, and by 2015-ish, we would have a working Commercial Crew Program.

Congress thanked us by saying, "Okay, we'll give you zero," and so they roundly rejected the President's budget proposal, and the fight was on. That fight lasted the first two years, where any time the President put anything for Commercial Crew in his budget and there was less money in the budget for a heavy-lift launch vehicle than had been appropriated by Congress or suggested by Congress, then Congress said, "Okay, the President's taking money away from heavy-lift." We weren't doing that at all. We were just trying to get money into Commercial Crew.

That battle went on, but over time, thanks to the leadership of Bill [William H.] Gerstenmaier, mainly, and the folks at JSC and [NASA] Kennedy [Space Center, Florida], we started doing some reorganization in the agency. The first thing I said I wanted to do—we were going to eventually be out of Shuttle, so I needed to have everything that had to do with human spaceflight under one person. We had Doug [Douglas R.] Cooke leading Exploration [Systems Mission Directorate], Bill Gerstenmaier leading Space Ops [Operations Mission Directorate]. Space Ops focused on Shuttle and [International Space] Station, Human Exploration Systems focused on the development of a follow-on vehicle. They had been Constellation, but now they were going to have to transition to whatever was going to follow them.

Contrary to, again, urban myth, Congress didn't give us SLS [Space Launch System]. We came up with the concept of SLS because I kept going back over to OMB and OSTP and pleading to be allowed to: "I know you said terminate, but we have too much at risk in industry and in expertise to just throw that away and come in with a totally new system five years from now."

That's the way, theoretically, it was going to work. NASA was going to dedicate itself for the next five years, for the next budget horizon, which is a five-year period of time, to developing the heavy-lift engine, the LOX/RP engine, which would serve the nation because the Air Force really needed one. They had made a number of attempts to get out of utilizing the [Russian-built] RD-180 for the Atlas V, so everybody knew that this day was going to come. They didn't know how, but everybody knew that at some point, we were going to have problems with the Russians. Didn't know how it was going to come, but nobody was ever comfortable with being totally reliant on a Russian rocket engine for the nation's heavy-lift capability. Rightfully, President Obama and his team wanted to get us away from reliance on a Russian engine, and so they turned to NASA. The Air Force had tried it for several years.

Right after I retired, I went to work for a company called TechTrans [International], a language services company that you all know very well. TechTrans was the interpretation company, interpretation and translation, and we were Lockheed Martin and the Air Force's supplier of interpretation and translation capabilities. We received all the design and production documents for the RD-180 from [NPO] Energomash, and we translated them into English and gave them to Lockheed Martin to co-produce an American version of the RD-180 engine that the Air Force could use. Sounded good. The Russians gladly gave us everything. There was always this trust but verifying—there were people who, even back then, said, "The Russians are never going to give you everything. They're going to hold back something."

The Russians did hold back something, and they told us what they were holding back. They said, "We're going to give you every document we have. We have craftsmen. This is a hand-built engine. You can't do it." That's what they said. "You're fooling yourself. If you

want to try this, we'll take your money and we'll give you every design document we have. You can't build this engine."

They were absolutely right. The Air Force, after spending all the money they wanted to spend on Lockheed Martin, and Lockheed Martin saying, "We're almost there. We know we can do this,"—I think working with Pratt & Whitney, the decision was made, we give up, we're not going to do this. They walked away from it and we said, "Okay." We convinced ourselves that it was okay to be reliant on a Russian engine, and that's where we were. But the need for a LOX/RP capability in the nation did not go away.

This doesn't have anything to do with Commercial Crew, but from a historical basis, when the U.S. decided that they were going to phase out of Apollo, another one of these critical decisions for the nation, we decided, "Okay, Apollo has run its course. We can no longer afford to pay that kind of money for exploration. We're going to go to another way of doing it, and it's going to be this thing called the Space Shuttle." It was first briefed to President [Richard M.] Nixon, 1971-1972-ish; this is a source of great argument. If you were to go to Bob [Robert F.] Thompson today down at Houston--I'm watching him and John [M.] Logsdon carry on this eternal debate from what was really going on—John Logsdon, as a historian, a policy person, gives you the Washington perspective, which is the Washington perspective. Bob Thompson gives you the Houston perspective, which is an industry and NASA perspective, on the development of the Shuttle Program.

Their stories are pretty much alike, except for some minor differences—which are major, when you really get down to it. Because we couldn't do Shuttle and Apollo, then the decision was made that the nation will phase out of Apollo and essentially phase out of exploration.

We'll pick it up again in several years, once we have a space transportation system developed that will be a three-pronged system that will provide a vehicle—not a Shuttle, wasn't called a Shuttle at the time—that will provide routine launch and access to low-Earth orbit, some vehicle that will be low-Earth orbit to provide the basis of infrastructure for going on into deep space. We can no longer build these giant rockets—we're going to assemble them in space, for which we need a station. Then, we need a third vehicle, and that is an Orbital Maneuvering Vehicle or an Orbital Transfer Vehicle, because one station's probably going to lead to another, and so we'll need a way for astronauts to get back and forth, so we'll make this Orbital Transfer Vehicle. By the way, if you've got a vehicle that's based out in space, boy, it sure will be a lot easier than trying to launch from Earth every time you want to do something, so we'll take the crews to the Station and process whatever we have to do. That's the way we're going to go back to the lunar surface and that's the way we're going to go to deep space. We're not going to launch from Earth to go to deep space—we're going to actually start the journey from an orbiting space station.

That was the concept briefed to President Nixon, and this is where Bob Thompson and John Logsdon's stories go like this [gestures in opposite ways]. As John Logsdon said, the decision up here was, "There's no way in the world we're going to afford that. We'll be back in another Apollo Program, so NASA, take your pick. Develop one piece of that program, and then we'll go from there." I think it was up to NASA, and NASA said, "Shoot, of course, you've got to have a way to get to low-Earth orbit, so we'll go with a vehicle," and they came up with the Shuttle. Something that was reusable, because it was going to cost less, and there came the imperative that we make it look like it's going to cost less. That was where people came up with the Shuttle is going to fly 50 times a year. That was the original story. When I came into the

Astronaut Office in 1980, we hadn't flown the first Shuttle flight, but we were going to fly 50 times a year, and that was going to make it economical. People saw that Apollo cost so much because we flew on Apollo once or twice or maybe three times a year, at some astronomical cost.

That was the beginning of our problems, and we had trouble getting Shuttle flying. We finally flew it three years later than it was supposed to fly. I have to remind all my Shuttle friends who talk about Commercial Crew and Cargo being late, Shuttle was supposed to have flown in 1978. We didn't even have a Shuttle built in 1978. When I got down to Houston in the summer of 1980, Rockwell was really trying hard to finish up Shuttle out in Palmdale [California]. When they flew it from Palmdale to KSC, tiles fell off. Here we were with this program, and it was a nightmare. It was sort of like when we had a Shuttle engine blow up on the test stand down at [NASA] Stennis [Space Center, Mississippi]. I think John [F.] Yardley was in charge back then, and Bob Thompson was coming on to manage the Shuttle Program. It was all bad news.

This is a sidebar: if you get a chance go down to KSC, to the *Atlantis* Pavilion; if you haven't, it is incredible because it tells this story in a snippet. It's actors. There's this guy that plays Max [Maxime A.] Faget, who comes into his laboratory at JSC, with a balsa wood model of a Shuttle. I don't want to tell you the whole thing, but he floats it down, and all of his engineers are looking, going, "What the hell is that? That looks like an airplane."

He tells them, "This is what we're going to do. This is going to be our new vehicle. This is our exploration vehicle." It kind of skips through history, but it goes through the dark days of Shuttle. The engine blows up on the test stand, programs are delayed a year, tiles fall off the Shuttle, program's delayed another year—1978 is not going to happen. We finally roll around to the spring of 1981, and ironically, we don't get off the first day, April 10. We end up on April

12, 1981, the anniversary of Yuri Gagarin's launch, the first time a man went into space. What do we do? We launch this beast called the Space Shuttle. You could not have written a script better. We were off, and for 30 years, we did amazing things with Shuttle. Lost two, which was not to be unexpected. I think we were lucky that that's all we lost, considering.

Going back to 2003, after we lost *Columbia*, the decision was made, "Okay, we can't continue to do this. The nation just is not going to accept losing a vehicle every so often, and so we've got to come up with something that is safer." Administrator Sean O'Keefe was leading the Agency through the ordeal of recovery from the accident and he invited President George W. Bush to NASA HQ where he spoke to the workforce and the nation and presented his Vision for Space Exploration that addressed returning the shuttle to flight as soon as possible in order to complete construction of the International Space Station and then retiring the shuttle to move on to a new system, a Crew Exploration Vehicle, to allow us to go back to the Moon and on to Mars. Sean began reorganizing the Agency to accomplish the goals of the Vision but following a disagreement with his decision to cancel the final Hubble [Space Telescope] servicing mission by a National Academy of Science study committee, he decided to leave the Agency and accept a position as Chancellor at LSU [Louisiana State University].

His successor, Mike Griffin, came in and cancelled the plans under development under O'Keefe and introduced a new plan for human exploration. That's where Constellation came in. As far as I know, until Mike came in, nobody had really thought seriously about how we're going to do this phase out of shuttle and move to a new system for deep space human exploration. That was the beginning of the concept of a Commercial Crew and Cargo capability to get to low-Earth orbit but using two NASA-developed vehicles to go back to the Moon and on to Mars. His vision was for a crew vehicle called Orion to carry crews and two separate vehicles

– Ares I, a smaller launch vehicle to carry Orion and Ares V, a heavy lift launch vehicle to carry all cargo and lunar landing/exploration vehicles.

You have to remember why we did this: we were complying with the *Columbia* Accident Investigation Board that said, "Thou shalt not put crew and cargo together." We took it to an extreme, and we decided, okay, we'll build a small Ares I, a little one to carry the crew, and then a big Ares V to carry all the cargo. We're going to take the crew to the International Space Station, and there, they will wait and prepare to get aboard whatever Ares brings up, marry them together, and we're off. In the meantime, industry is going to produce this other way to get people to low-Earth orbit; that will become your Commercial Crew Program.

I asked the question, when I became the NASA Administrator, because I got so much pushback on Commercial Crew, I said, "Okay, damn it, you all were a part of the leadership team here—how did you let this happen?" Bryan [D.] O'Connor perked up—Bryan is not one to bite his tongue—and Bryan said, "Because Mike [Griffin] told us to shut up. He said 'Commercial Crew is never going to happen, so just don't worry about it. Our job is to get Constellation going because that's all we can count on. We can't count on industry. They may get cargo, I gave them money, but I'm not giving them any more money for crew.'"

It didn't happen, and then President Obama said, "No, we're going to do it, and we really are going to phase Shuttle out. Here's what I want you to do: I want Shuttle gone in 2010." Over time, as we looked at how we were going to do this stuff and went over and continually tried to coax, cajole, and convince—the White House is a building, but I'll use the term "White House" to mean the people over there—them that we can do what the President said, but can you let us use some of the reusable components of Constellation on which we will build our

exploration program? We'll really put in concentrated focus on Commercial Crew capability. That's what we started doing.

That August, we announced that we were going to go out and ask for—we didn't send out a request for proposal. I can't remember, was it August 2010, or did you say August of 2009? I didn't think I had done it that early.

WRIGHT: The Commercial Crew and Cargo Office had put that first feeler out for CCDev in August 2009.

BOLDEN: That may be so because they were told to do so. They started this before I came in—they were already told, "Go make this happen." That was the way that they were told stuff, "Just make this happen."

WRIGHT: The end of that year is when they made the selection. Actually, [Geoffrey L.] Yoder signed off on it in January [2010], but it was part of the announcement at the [National] Press Club that you announced the five winners. Want to pick it up from there, that those five companies were chosen?

BOLDEN: That became CCDev. That was the Commercial Crew Development Program. That was the first time that NASA really put money on the table for commercial crew. I'm glad you reminded me of that because I had forgotten. I was thinking all this stuff happened after the budget.

I had gotten it before pass-back, but I had just gotten the shock about termination of Constellation. We hadn't announced termination of Constellation because that was a budget issue, and we weren't allowed to talk about budget issues. I couldn't go to the [Capitol] Hill and talk to the members of Congress who were going to crucify us. I couldn't go to industry, I couldn't go to anybody. I was not allowed to talk to anybody. This was a decision that had been made, and we were going to make it happen. I could go talk about Commercial Crew development because although that too was a budget item, they were able to take some of the money that Mike Griffin had put in the kitty for Commercial Crew and Cargo, but he really meant for cargo.

I think what they did was they took a little bit, and what did we take, $50 million? We took $50 million out of that $500 million that Mike Griffin had put on the table for Commercial Cargo because they were doing okay. I think Alan and the guys, and Bill Gerstenmaier, felt, "Okay, we can afford $50 million." We announced that there were going to be five commercial companies who were going to receive varying amounts of funds for a Commercial Crew Development Program. The Commercial Crew Development Program was to have commercial companies not bring us a system at all—they each were going to do some specialty.

WRIGHT: It was ULA [United Launch Alliance] and Paragon [Space Development Corporation] and Blue Origin, Sierra Nevada [Corporation], and Boeing.

BOLDEN: I think Paragon and ULA were going to do—you can correct me if I'm wrong—I think they were looking at the autonomous fault detection system. [1] They just wanted to be able to look at an Atlas V, really, because that was ULA, that could detect when it was having problems because it was going to have a crew on it. They wanted to be able to tell the crew, "Okay, we're getting ready to throw you off because the rocket's getting ready to blow up, or something else, and so we're going to activate the Crew Escape System and we're going to fire you off." They wanted to be able to do that autonomously. Sierra Nevada, they knew they were going to go with a winged vehicle by then, so I think they wanted to do some development of a system that needed to be aerodynamic. Everybody had some unique thing that they were going to do.

I announced at the National Press Club that NASA was going to embark on the first leg of our adventure to American astronauts being launched from American soil. We were going to do this program. It was too early to tell, but we were probably going to follow it on with a CCDev 2 that would advance the evolutionary process toward getting a human [launch] capability.

We did. We followed that up with CCDev 2 [April 2011], but there, we took the work that had been done in CCDev 1. That was the beginnings of a real thinking about going out and letting companies compete to build the system.

That was when SpaceX, Sierra Nevada, Orbital, at the time, I think was still in it because everybody thought the contenders were going to be Orbital, SpaceX, and Sierra Nevada. Nobody thought, at that time, that Blue Origin was for real. He had the [New] Shepard, but I

[1] *Sierra Nevada Corp. -- $20 million for the development of the Dream Chaser; Boeing -- $18 million to develop the Crew Space Transportation (CST)-100 capsule; ULA, a joint venture formed between Boeing and Lockheed in December 2006, received $6.7 million for an Emergency Detection System for human rating its launch vehicles; Blue Origin -- $3.7 million for its "pusher" Launch Abort System and composite pressure vessels; Paragon Space Development Corp. -- $1.4 million for a new modular Environmental Control and Life Support System*

talked to Jeff Bezos. Jeff said, "I'd love to participate in this thing and I'm going to do my part, but I'm not on anybody's timetable." Jeff eliminated himself from competition for Commercial Crew because, as he told me, he said, "The first people to fly my vehicle are going to be my son and me. I'm not flying until we're ready, and so I can't make a commitment to meet any milestones because I'm not flying until I'm ready to take my son with me on the first flight. That was Blue Origin.

They later decided that they wanted to work on engines, but never a whole vehicle, never a whole system. Sierra Nevada was in it to win it, as was SpaceX, and SpaceX had a very unique concept. They were all alone, just vertically integrated, they didn't even have subcontractors. They didn't want any. Their big thing was, "We're going to do it for less than anybody in the world. We're going to challenge the system." They were a big favorite and it caused us some difficulty because they were a big favorite of some people in the White House. I never had any conversation, *never* had any conversation ever with the President about anything having to do with space, other than the time I did my interview, and then before he went down to Florida in the spring of 2010 to announce that we were going to send humans to an asteroid in 2025, and to Mars by the 2030s. Which came as sort of a shock to me because as the NASA Administrator, I didn't get a chance to do what you might expect. I didn't get a chance to proof the President's remarks. Somebody over here had—I'm not sure who had—but not me.

I was happy with that part of it. The part that really disturbed everybody was his announcement that we were going to use Orion as a Crew Return Vehicle. That just set everybody back on our heels because right away, we knew we couldn't do that because we would be violating one of the basic tenets of Commercial Crew, and that was that NASA would not compete with industry in producing a commercial crew vehicle. I had already taken Orion

out of the mix as a consideration for any kind of commercial crew capability. I had told people, "Orion will not be capable of going to the International Space Station." We were going to make it so robust that, yes, we can send it in an emergency, but it would be an extreme waste of the taxpayers' money if we sent Orion to the International Space Station. It is going to be on whatever launch vehicle we pick, and that means we're taking a deep space exploration vehicle with a deep space exploration capsule, and we're sending it at 250 miles above Earth. That would be stupid and a real waste of the taxpayers' money.

For people who want to argue about America having a capability to get our own people to space, yes, we can do it, but we are not building this vehicle to get astronauts to the International Space Station. That became a real sore point with the Southern congressional delegations. Alabama was up in arms, Senator [Richard C.] Shelby was up in arms, because they insisted, "Okay, the President said this is going to be a Crew Return Vehicle, and you're telling us," again, here's the NASA Administrator out of step with the President. Now, I'm trying to dig this Administration, of which I am a part, trying to dig us out of a terrible hole that we had put ourselves in because we're violating a promise that we made to industry that we will not compete with you. Industry, immediately, everybody thought that this was going to be great news that the President was announcing. It was horrible news for the Commercial Crew people because they were saying, "See? We knew this was going to happen. They're not serious. They got us hanging out here now and got us bidding to provide cargo and crew, and they're not going to let us do that. They're going to send NASA astronauts on Orion and nobody's going to fly with us if NASA astronauts are flying on Orion."

Boeing said, "We're out of here," and Boeing initially did not bid for Commercial Crew, not initially, which was a blow. The one thing on the Hill, nobody up there believed it, in the

first place. There were no proponents of Commercial Crew. Not even Dana Rohrabacher. Dana Rohrabacher was a big fan of commercial space, but Dana Rohrabacher is not a big fan of people going to space. Dana Rohrabacher is a big fan of robotic space exploration, really wants cryogenic propellants, he wants fuel depots because whenever industry decides that they want to go to space on their own, they should be able to refuel somewhere so they can then take humans to Mars, if you want. This was Dana's attitude, "I could care less about humans going to Mars. I don't care if it never happens, but when it happens, it's going to be something that has evolved and enough people down here on Earth want to go. NASA shouldn't be in that business."

We're not in favor with anybody. This is where we are. We got a Commercial Crew Program that we know is vital, we're in disfavor with the Congress, we're in disfavor with the White House—with people over there—because here we are, trying to figure out, okay, how do we back out of this?

We're also worried about going to an asteroid, by the way. Great idea, but when the President said it and we started thinking about it, we started scratching our heads. The NASA Administrator was the number one person scratching his head because I wasn't smart enough to know that asteroids are farther away than Mars, most of them. That's where you go. If you want to go to an asteroid, unless it's one that's coming toward Earth, you go to the main asteroid belt, and that's safely orbiting the Sun, away from Earth, and we don't ever worry about those. Almost everybody in NASA and in the scientific community, the planetary scientists, they exploded with joy because, "Okay, we're finally going to get some worth out of the Human Spaceflight Program." NASA's going to build a big rocket to send humans to an asteroid, and then we'll get a double bonus because they'll figure out a way to come back from the asteroid

and go to Mars. As we thought about that, we said, "Man, there is not enough money in anybody's budget to do this. You're talking about another Apollo Program."

At the same time, we were being challenged, for some reason, people were starting to become aware of NEOs [Near-Earth Objects]. I think we had had a couple of asteroids or meteorites hit places, or it had explosions, near-misses. This interest in asteroids arose, and Congress woke up and remembered that NASA, we were overdue on showing them that we had identified 98 percent of all possible Earth-threatening asteroids, from tiny all the way up to a kilometer and bigger. NASA had done a pretty good job of identifying all those a kilometer and bigger, like 98 percent, but our success rate in identifying small asteroids was abysmal. It was less than 10. Yet, I think by 2010, we were supposed to have shown 98 percent. There were smart members in Congress who came back and said, "Okay, you guys are supposed to do this, you've not done anything. What have you been doing? How have you been spending the $10 million we gave you?"

The good thing was the President recognized that, and so the first thing he did was put an additional $10 million in NASA's budget, so he doubled the amount of money for asteroid identification and characterization. Then, he came back, when we introduced the Asteroid Redirect Mission and the Asteroid Mission in earnest, in the 2014 budget submission, which caught everybody by surprise again because of the way we do stuff. He quadrupled the amount of money invested in asteroid identification and characterization. In the $105 million that we identified for what was called the Asteroid Initiative, and has subsequently been called the Asteroid Redirect Mission, which is more than just one thing, $50 million of that was to be dedicated to enhancing our ability to identify and characterize asteroids that are 140 meters and smaller. Little asteroids that are big enough to get through the atmosphere, but not big enough to

destroy civilization. They can wipe out a city—if a 140-meter asteroid gets through the atmosphere, it's going to wipe out a city. It won't destroy civilization like the asteroid that struck Earth and destroyed the dinosaurs.

Now, we got another challenge, and so the team came up with this concept of the Asteroid Redirect Mission. Let's think about this. If we can catch one of these bad boys coming inbound and we can demonstrate that we can nudge it, over some period of time, if we can nudge it long enough, say, over a year's period of time using solar electric propulsion as our propulsion method—because chemical rockets, that's eight minutes, max, and then you're out of fuel, so you're not going to use a chemical rocket—you could use nuclear or you could use solar electric propulsion, and since we're going to be doing all this stuff in the Earth and Moon vicinity, let's use solar electric propulsion. We are very experienced with that. We've got this asteroid mission called Dawn, that has now reached an asteroid, and it's been orbiting Vesta for a whole year. We've demonstrated we can get to the asteroid, and we can study it.

We had a lot of data to go on, and we started homing in on what this thing was going to be like. We haven't gotten to Commercial Crew yet, but these are all the pieces starting to come together on how we are going to do this exploration mission. As 2010 started rapidly approaching—a lot of stuff happened my first year—2010 was getting close, and several things were happening. We knew that one, the administration had gotten rid of Orion and Ares, so we didn't have a capability to get astronauts to the International Space Station. The International Space Station was not complete, and looking at the projections for a completion date, unless we continued to dedicate every single Shuttle mission to construction of the International Space Station, we were not even going to finish it by 2010, which meant, okay, now even a thought of carrying an American astronaut to the Station on Shuttle is out of the question. Everybody on

deck needs to be working on construction, so we're going to go totally reliant on the Russians to get the crews to the International Space Station.

That had started before I came in. I think that was actually started, like, in 2005 or 2006. Total reliance on the Russians for transportation of crews and dedication of every single Shuttle mission except one, by the way. I got involved in this one before I came back to NASA, and that was the final Hubble Serving Mission, STS-125, was one that Sean O'Keefe canceled. Sean put on his risk aversion hat, and on advice of other people, said, "We are not going to do that. That is too much of a risk. We're going to finish out Station; we are not going to send humans on the Shuttle. Sean was of the mind that Shuttle was not safe, and so he had been convinced, or at least he had been supported, by people in the Bush Administration, "Forget about that mission, that ain't going to happen." Little did he think.

Senator [Barbara] Mikulski said, "I ain't buying that. Think again." Senator Mikulski ordered Sean to fund an independent panel to look at the Human Robotic Servicing Mission. Ta-da!

I get appointed to chair the independent review panel for a Hubble Servicing Mission. I come in, I'm just trying to be a retired Marine Corps General Officer, but I was elated to be allowed to come back. We came in, in our panel, wanting to be fair, saying, "Okay, let's make a robotic mission work. We can do that. We'll side with the Administrator initially, unless we can find some other reason not to." What caused us not to, what caused us to oppose the Administrator in our recommendation was technologically we weren't capable of putting together a Robotic Servicing Mission. We didn't have the capability to do it, and so the conclusion we came to was, okay, if you really want to service Hubble, there is only one way to do it. That's to put a crew onboard Shuttle and take it out of the queue for building Station and

just let them go off and dedicate to doing nothing but Hubble servicing. It's going to be a monster mission. It's going to require five EVAs [Extravehicular Activities], which has never been done before, and they're going to have to do an EVA every single day, which had never been done before. You're only going to have seven crew members, and every single one, except for the pilot and commander, has got to be able to do a spacewalk. That became the Hubble Servicing Mission.

When we went and recommended that we do it to Sean O'Keefe, he was not a happy camper. He didn't throw us out of the office, but he was not a happy camper. The term he used in talking to me, he said, "You have just signed Hubble's death warrant because that is not going to work. You can recommend it all you want to." That was our recommendation to the NASA Administrator and to the Congress, and I guess the pressure just got so great that they said, "Okay, do it, but I'm absolving myself of any blame. If we lose a crew, it's not my fault because I said we shouldn't do this." We started working toward STS-125 and put together an incredible crew and an incredible mission. I have to admit that before we launched, one of our last tasks was to do the final review, and we started saying, "Okay, we need a communications plan for when we are unsuccessful in one or more of these servicing tasks. Hubble will be in great shape when we leave it, but there's no way in the world we're going to get all five of these EVAs off." We worked diligently with NASA to come up with a communications plan that would pre-brief people to limit their expectations. Expect it's going to be successful, but don't expect that there's any way we're going to get all five of these EVAs off.

Lo and behold, we got all five of them off. They were tough, but everything worked, eventually. We completely refurbished Hubble, and so we left Hubble up for who knows how long. A completely new instrument. Took this big old telephone booth-sized thing out and

brought it home, got rid of the old solar arrays and everything, and everybody was happy. We had completed Hubble, we were on the verge of completing the International Space Station, but then I came in as the NASA Administrator, and among the things that greeted me was, "We are not going to finish Station by 2010, and oh, by the way, we are not going to have a commercial crew capability even in the remotest, and we probably are not going to have a commercial cargo capability just yet." Bill Gerstenmaier and the guys said, "Hey, if we could just put some extra supplies on board, some extra spare parts and everything." It actually fit in with the science community because the science community wanted to fly something called AMS—the Alpha Magnetic Spectrometer—and it had fallen off the manifest because there was just nowhere to put it.

It got cute now because [STS-] 133 was supposed to be the last Space Shuttle mission, and there was a lot of jockeying to see who was going to be the commander for STS-133, the final Shuttle mission. The duty fell to the Chief of the Astronaut Office, to be quite honest, Steve [Steven W.] Lindsay. Steve Lindsay ended up flying STS-133, which was appropriate, that the Chief of the Astronaut Office should be the last human to fly a Space Shuttle. Before they could even launch, we got approval from the President to fly two more missions—tentative approval on STS-135, but definitely approval to fly STS-134, which was going to take the Alpha Magnetic Spectrometer. That's when Mark [E.] Kelly got assigned to be the commander for STS-134, and that turned out to be pretty good because now you've got the husband of the Chairman of the Subcommittee—I'm not going there, but it worked out really great. All of sudden, Mark is going to come in, the final Shuttle mission, then disaster strikes. His wife [Congresswoman Gabrielle Giffords] is shot. You're going, "What else can happen?"

Here we are, we're months away from flying, and I don't have a commander. I think we got Rick [Frederick W.] Sturckow to step in and be a contingency commander. I told Mark, "You go off and you take care of your wife and let us worry about this thing. We got somebody who can take your place if you can't fly this mission, and please, by all means, I know how much you want to do this, but you take care of Gabby." Several months before it was time to finalize, the crew was in their last few months of training, and so we needed to decide. Is Mark going to fly, is Mark not going to fly? We brought in psychologists, and we let them sit with Gabby and Mark and everything, and we got recommendations. Gabby decided she wanted Mark to fly this mission. It was important. I'm going, "Give me a break, here. I don't need all this drama."

Everybody said, "You can do that, he's going to do a good job. The team is ready and Gabby's ready." Mark joined his crew again, and he went off and flew what became the penultimate Space Shuttle mission.

Now, we've got to find a crew for the very last mission, and so, we decided, "Okay, what the hell? Let's not do anything fancy. This is going to be a really small crew because getting contingency supplies onboard the ISS is the only reason we're flying this." Everybody was on the safety thing—we are not going to put any more people at risk than we have to. We put together the crew of STS-135, and it's those four people right over there. When we moved from two-people crews, when we got rid of the ejection seats and we flew STS-5, I think that was a [four]-person crew. We said, "Okay, how small a crew can we fly? All we want to do is get pieces and parts and spares to Station. We just need something that can tide us over if this commercial cargo capability doesn't pan out before we terminate Station and bring it down." We came up with the four-person crew, and they were a bunch of superstars that nobody even

knew. You went from these high-profile crews to this bunch of, they were the guys that ended up being America's heroes. Which was great.

This was an emotional time for all of us, and it was the right thing to do. It was tough, so we said, "Okay, we're going to go ahead and do this." July of 2011 became the month for the launch and landing for STS-135.

We were far enough along with cargo that we felt pretty confident, then. We weren't positive, but we felt pretty confident. SpaceX was doing great. Orbital, actually, with their international composite vehicle (Russian NK-33 rocket engines; Ukrainian Antares launch vehicle; Italian Cygnus cargo module), was doing incredibly well but they had no place to launch. They had hitched their horse to the State of Virginia and MARS, the Mid-Atlantic Regional Spaceport with a launch pad at NASA Wallops Flight Facility. MARS had never built a launch pad and they experienced a number of growing pains.

Because a second cargo launch provider was considered critical for our cargo resupply program, we decided to extend an offer to them to provide volunteer assistance to get them over the hump to first flight readiness. Goddard and Wallops [Flight Facility, Wallops Island, Virginia], Kennedy, Johnson, Marshall [Space Flight Center, Huntsville, Alabama] and [NASA] Langley [Research Center, Hampton, Virginia] all provided volunteers as needed to offer technical expertise to MARS. Orbital also stepped up and invested their own money into the effort. That's another story—David [W.] Thompson, Orbital founder and CEO worked out an agreement with the State of Virginia to make a sizeable financial advance to Virginia and MARS to enable completion of the launch pad. We were determined to facilitate the success of our commercial launch and cargo resupply capability as we had promised, but it proved to be much more difficult than it had been advertised. All our heroic efforts required that we go to Congress

and brief them on the actions we were taking outside the original Space Act Agreements and that was painful, but all worked out in the end. It isn't magic, like people had advertised it, and it isn't cheap, the way people had advertised. At long last, we finally got MARS all put together and Orbital put Antares on the pad, and they launched.

WRIGHT: That was a good day, huh?

BOLDEN: It was not a good day. That was a great day. Everybody breathed a sigh of relief because they hadn't done their certification yet. That was just their first test launch. We knew at least they could get off the launch pad, which we hadn't known prior to first launch. At least the pad would stay together. Then, they flew their certification flight, and that was a good day. The irony was SpaceX struggled through their first flight. Most people think that it just went off like a breeze, and everything worked great. It was bad. From the standpoint of the team achieving the mission, it was full of problems. They weren't quite as smart as they thought they were. I was on hand in the SpaceX control center in Hawthorne, California, for their first launch, and after they recovered from the significant and potentially catastrophic problems they had during launch and orbital insertion, I told their team when I spoke to them, I said, "We came together as a team today." Everything imaginable went wrong, but working with our NASA team, they had recovered and completed a successful first flight. It again experienced problems on their second flight, but again, the team came together and they got through it. Yet people believe that SpaceX was this magic company, that as long as the government stayed out of it, everything was good. Not true.

WRIGHT: The government was able to provide the technical expertise.

BOLDEN: The government (NASA) was able to provide the technical expertise and the initial funding that, I don't care what Elon Musk says, to be quite honest, he wouldn't have been able to do this on his own. He will admit that now—sometimes. Gwynne [President and Chief Operating Officer Gwynne Shotwell] will tell you that all the time, Gwynne Shotwell will, if you've interviewed her.

WRIGHT: Yes, we have, and she did.

BOLDEN: Totally different people, as you have learned if you've done the interviews. Somewhere in Elon's mind, he still believes that he did this all by himself. Gwynne, who ran the company and didn't have to worry about Tesla, will tell you, "We struggled, and boy, if it hadn't been for NASA being there, don't think we'd have made it." David Thompson would have never told you that he did it by himself. David had a whole different set of problems because David had a Ukrainian rocket with Russian rocket engines, rebuilt by an American company. He had every nightmare imaginable, and we had no initial idea what how everything would work out for them. Up until recently, he was taking ULA to court over the RD-180, trying to get access to the RD-180. Thank goodness we didn't have two companies with that problem.

Where does that bring us in terms of Commercial Crew? We've gotten through all that other stuff. It was really important to demonstrate that a commercial cargo capability was viable, was doable. There are still things to be done. Just like I personally think that STS-2 was the most important Shuttle mission we ever flew, and you've heard me say this before, a lot of

people said STS-1, that was the critical—bull crap. We didn't know whether Shuttle would work, but we were confident that America can do anything. We weren't sure that we could launch the same vehicle back into space again, particularly after the damage that was done to *Columbia* on the first flight that we didn't anticipate. We had almost had a conflagration on the launch pad when the solids ignited. I think it was when the main engines ignited. We think about sound and most people just think it's annoying. It's a pretty strong form of acoustic energy, and we had this doggone acoustic wave that went down into the flame trench and came back up, and pow! Smacked *Columbia* and it shook it so hard on main engine ignition that it bent one of the support struts for the forward RCS [Reaction Control System] fuel tank. If the strut had broken, we may have lost the vehicle that day. We would have had an early *Challenger*, but only in the vehicle, instead of in the external tank. We turned around and we figured out the problem and we put in water sausages.

NASA has a solution for everything. I don't know if you've ever heard the story of the water sausages. If you talk to the Shuttle guys, they will tell you STS-2 was distinctly different from STS-1 at launch because when you walked up on the launch pad, you couldn't just look down in the flame trench because there were these bags that looked like half a hot dog stretched across the flame trench —it wasn't nylon, but it was a synthetic material holding ethylene glycol and water. They were strapped across the flame trench from one end to the other, completely across the flame trench, such that when the acoustic wave went down and bounced back up, for just a period of time, that wave would be attenuated until the vehicle lifted off far enough that it wouldn't get smacked again.

Plus, we put in the water deluge system. If you went down when Shuttle was still flying, you had these big rainbirds that were kind of about 4 feet above the launch pad. About 10

seconds before ignition, when they turned on what was called the deluge water, a lot of people thought it was for fire suppression. No, this was just to keep the acoustic energy from beating the vehicle up. We had water coming out all over the place, we had water sausages and everything. After that, we never had a problem like we had on STS-1. STS-2, that was the most critical flight we flew in the Shuttle Program, next to STS-26 after *Challenger*, and STS-114 after we lost *Columbia*. To get back on the horse and ride again, those are big things. That went okay.

When SpaceX flew their first really commercial flight, when they flew this communication satellite and some other stuff that we really didn't know a lot about. It was their mission, they had contracted for it, NASA didn't have anything whatsoever to do, other than I think we served as the agent. LSP [Launch Services Program], down at the Cape [Canaveral, Florida], served as the certifying agent for the launch customer, for I forget who it was, but it's an international commercial communications company.

WRIGHT: Was it the Orbcomm [low Earth orbit communications satellites], I think?

BOLDEN: It may have been Orbcomm. No, I think Orbcomm was going to be their first, which they put in a drink because that was their first demonstration mission for us, and we were primary. That was another little-known story which could have been a really bad news day. Orbcomm was promised, okay, we'll fly again, we'll get another chance. They lost their first commercial payload. It was put into a useless orbit, so it was unsuccessful. The first commercial attempt, first truly commercial attempt, failed because although Dragon got to Station (after the launch problems discussed earlier), they had to make a choice because they had

an underperformance on first stage and maybe even second state. Orbcomm was not in the proper orbit to be released and get to its orbit, so they just kissed it off. The customer said, "Okay, we got it, we knew that" but Dragon got to Station, so big news. They completed their primary mission. They came back, and they got their first successful commercial flight off, which was a geosynchronous satellite, which was a big, big, *big* deal. That was the true demonstration—not proof, demonstration. I caution people all the time, we're not home free, yet. We haven't had a loss of a vehicle yet, but we will have a loss of a vehicle.

If SpaceX or Orbital or other people can continue to fly after they lose a vehicle—a colorful loss of a vehicle, where you lose the ascent vehicle and not just what they did with Orbcomm; nobody ever knows they lost Orbcomm, nor does anybody care, except Orbcomm—if we can survive the first loss of a vehicle and come back and fly again without taking two years off, like we did for Shuttle, then Commercial Cargo is truly viable. I think it will be. They'll get enough experience with us that by the time they lose their first vehicle, my hope, they'll know how to spring back and it'll be an occupational loss. Commercial Crew is another story, and so, that brings us to almost where we are today—not quite. Now, we've got to go back to continue the fight on Commercial Crew. We kept trying to do as much as we could to promote Commercial Crew and get Congress on board, and we were going nowhere.

The first time, we got zero, the next time, we got $525 million. The President quit asking for $1 billion, and I think every subsequent budget, we asked for $850 million. We figured, okay, let's compromise. Let's reach a compromise with our Congressional appropriators. The President will take $150 million away from his Commercial Crew Program and put it against heavy-lift and everything else, which is what he did. Whether Congress agrees or not, the President took $150 million reduction from the second time he put it in a budget on through. We

have never asked for $1 billion again, when, in fact, we knew we needed $1 billion to really guarantee that we could have competition and we could have approval.

We gave up on 2015. I think my second budget, we said, "Okay, 2015 is out of the question." This came up in my hearing last week, when once again, Congressman [Morris Jackson "Mo"] Brooks from Alabama wanted to rewrite history. I said, "No, I'm not going to let you do that; 2017 is not our first time saying we're going to fly Commercial Crew. You all blew through the first time, that was 2015, and this Congress gave us no money, and then $525 million when we had budgeted $1 billion. You gave the President half of what he asked for, the second time around. We need $1 billion, and that's why we put $150 million in the President's Opportunity Growth and Security [Initiative]. You're probably wondering, why the hell did you put $150 million in there? It takes it up to $1 billion."

If we want to be able to guarantee the nation that we will have a competitive Commercial Crew Program, that's more than one provider, and fly in 2017, and that's calendar year—we get cute around here—we're not talking about fiscal year 17 anymore, we're talking about calendar year. I now say the same thing for the first flight of SLS and Orion. We now say, "In fiscal year 2018," because that gives us a little more leeway than fiscal year 2017. Fiscal year 2017 ends in 30th of September, and we probably won't make that in either SLS Orion or Commercial Crew. We're now saying fiscal year 2018. If we get the money, we are confident that we can launch with more one provider in that period of time, but we've got to get the money. We can't do magic anymore. Then, here comes the next—it wasn't really a disaster, to be quite honest—the Deputy [Administrator] leaves. The champion for commercial spaceflight, the champion for Commercial Crew leaves, and OMB is now in a tizzy.

There is no more champion for Commercial Crew, Lori Garver is gone, and Charlie Bolden hates Commercial Crew and wants to bring the Shuttle back, and all this other kind of stuff. I'm going, "I wish I really had the role in this play that everybody thinks I do." Ironically, what having Lori leave did for Commercial Crew was it actually freed us up to go spend more time on the Hill because she couldn't go to the Hill to talk about Commercial Crew for a variety of reasons, just couldn't do it. Now, we've got the real team that's really trying to do exploration, that understands that Commercial Crew is a vital part of exploration. That if we don't have an American capability to get our crews to the International Space Station, where exploration is really going to start, we're done. We just can't make it without that.

We have started winning Congress over, very slowly. We have way more people now who even give us the time of day on Commercial Crew than had in the past, and that's just been our persistence that, okay, we're not going to make you any promises. We're not even saying it's going to be cheaper. You're not hearing that from me—that's Elon's business. If Elon wants to say that he's going to launch for less than anybody in the history of humankind, the proof will be in his delivery.

I'm not promising that, but I am telling you that we are giving America a Commercial Crew Program. That is not NASA's program. We're facilitating the success of Commercial Crew, which was a sore point to some people in the White House because that's not the story they were telling. They wanted the story to be that NASA was developing a Commercial Crew Program, and I said, "That's not true." We have changed a lot of the things we're doing, and this is where, I think, you probably didn't get to question number two, I'm getting there, what I want you to do is tell how we got to where we are today. Lori was still here, as a matter of fact. We got to the end of the Space Act Agreement on Commercial Crew, so that was the end of CCDev

2, and the end of CCiCap [Commercial Crew Integrated Capability]. CCiCap was still a Space Act Agreement type activity. CCiCap, even, wasn't a FAR [Federal Acquisition Regulations]-based procurement type activity, so we were still working under the restriction that we couldn't levy requirements or standards or anything on the commercial providers.

By now, Boeing has come into the fray, whole hog. Their board has bought in. If you want to credit somebody, you want to crown king or hero or medal of the nation or something on somebody, that's Brewster [H.] Shaw. Brewster went to the mat with the board, as I am told because I wasn't there, I am told that Brewster staked his whole reputation and his career on going to the board of Boeing and saying, "We got to do this. I know we can do it. We may not be the winner, but if we don't do it, nobody's going to do it." He was absolutely right. When Boeing put their hat in the ring and said, "Okay, we're going to compete," they were way behind, woefully behind.

SpaceX is years ahead of Boeing. Orbital had already dropped out. Orbital originally, the two vehicles that everybody thought were going to be the competitors for Commercial Crew, were Cygnus and Dragon. Orbital had so much trouble just getting to their first cargo launch that David said, "That's a bridge too far. As much as this pains me, I'm out of the commercial crew game." We kind of went, "Wow, man, what are we going to do now?"

Nobody, other than me, maybe, had any faith in Sierra Nevada because nobody knew Sierra—Sierra Nevada's been a contractor for NASA and DoD [Department of Defense] for 50 years. They have built airplanes, they built lots of satellites, they took a NASA design, the HL-20, and that is Dream Chaser. They didn't go back and create a new vehicle—they took a heritage vehicle that we had flown and we were going to make the Crew Return Vehicle for Station. That's what HL-20 was going to be, but HL-20 fell victim to everything that things fall

victim to at NASA: Congress changes, the administration changes, and they said, "Cancel that program." HL-20 was like X-38, X-37—you name the X's—X-33, you know them more than anybody, being at JSC. Every X vehicle goes the way of the great white buffalo because America has no patience, and Congress has no patience. When we change administrations, they run out of patience because they want to make their own mark on humanity.

We were no different. We were going to make our mark on humanity by shelving the Bush Administration's Constellation Program. It was the right thing to do because Constellation was very rapidly going nowhere. It was just becoming unaffordable. It was just a combination of things. I'm not sure whether you all have done the oral history of Constellation yet. Have you?

WRIGHT: No, just bits and pieces, here and there.

BOLDEN: When you do, or the bits and pieces you've done, people who are honest will tell you, they didn't know how they were going to get to the end with Constellation. There was no lander. When you talk about Constellation, that was the linchpin for a return to the Moon, for the Lunar Program. There was no lander because there was no money. Mike and the team had taken every dime out of every part of Constellation to try to get Ares V and Ares I finished, and they were going through this—where the launch vehicle and the payload become incompatible. You go through this battle, the payload blames the launch vehicle for these vibration problems—fix the launch vehicle. The launch vehicle blames the payload—fix the payload. We told you what you were going to get, and so we found NASA battling NASA, except it was ATK versus Lockheed because Lockheed was the Orion Crew Vehicle, and ATK was the rocket, and it was analytically

just shaking the dog stuff out of the vehicle. I was on the ASAP [Aerospace Safety Advisory Panel] at the time, and we really had concerns that the crew, they would survive ascent, but they would be useless due to vibration, due to just extreme vibration, by the time they got to orbit.

You had to fix it, and the Rube Goldberg solutions were unbelievable. If you go to Marshall today, Marshall has a whole building that demonstrates, in principle, how they were going to solve the problem with ATK. Marshall has a test cell, and the cell literally vibrates in the wind and everything else, and so this is a big old building, like that building right there. They can make this thing shake. What they have is this huge system of a piston and something else, and they can stabilize the vibration on the building by just, you add viscosity, you add more stiffness to the system, and it just physically won't let the building move. Now, at some point, the building may break, but it's not going to do like this. That was the solution for Orion and Ares I incompatibilities, so we weren't going anywhere.

That was an easy choice for me. Even if I had been asked to get involved in the decision, that's the decision I would have made. They made the right decision for the totally wrong reason, to say, "We're going to terminate this program because we need one of our own," essentially, is what some people said. We're going to go to commercial capability, we're going to scrap NASA's ability to do this stuff. That's where we were.

Now, we come into, okay, we're nearing the end of Commercial Crew Development, CCDev, we're getting ready to go into CCiCap, and you've got the notes there, so you let me know. My timelines, my milestones, are vague because I never thought about doing this interview.

WRIGHT: They all run together. Actually, August 2012 is when the awards—

BOLDEN: For CCiCap?

WRIGHT: Yes.

BOLDEN: When did I make the announcement that we were going to extend Space Act Agreements for Commercial Crew, that we were not going to award contracts? Was that prior to 2012? I think it may have been in 2012 and we went to CCiCap as my version of Bill Gerstenmaier's solution for not going to contracts.

WRIGHT: I believe it was at the end of 2011 because you had a workshop with industry right before that, talking about possible FARs. I think that's when you decided to go the FARs for certification, but yet stay with the Space Act Agreements.

BOLDEN: Have you ever heard of Technical Authority?

WRIGHT: Mike French had mentioned that term.

BOLDEN: This is something that the ASAP, the Aerospace Safety Advisory Panel, knows this intimately because they were the champions for Technical Authority. NASA has always operated with this thing in its governance structure called Technical Authority, but never more open and volatile, if you will, as when we moved into—when I came to the ASAP, we were still in the Constellation phase. The ASAP was vicious with NASA, and saying, "You guys, you've

got to be able to explain Technical Authority." The ASAP was hearing that there is no place for a dissenting voice in Constellation, and that's what the Technical Authority is.

There are a group of people, Center Directors are the top of the Technical Authority chain in the Centers, but the Center Director gets fed by that person's Head of Safety and Mission Assurance [S&MA] and Head of Engineering, and in the case of Human Spaceflight, Chief Medical Officer. Marshall, Johnson, Kennedy, they all have the Director of S&MA, the Chief Engineer, and the Chief Health and Medical Officer are technical authorities in the line of command. They can step in and say, "Stop." Anybody can say, "Stop," but they can step into the program, tell the Center Director, "You're not going another step until you demonstrate that you're not putting people or things at risk. This is technically unsound, this is an unsound practice you're getting ready to do."

I don't think Technical Authority was ever exercised in the Constellation Program, as far as we know. It's because the ASAP just kept getting this back word that you don't dissent. Constellation, the Chief Engineer is Mike Griffin, and you don't dissent. He is the Chief Engineer, he is the Chief Medical Officer, he is the Chief of Safety and Mission Assurance. He designed this vehicle and nobody knows it better than him, so don't waste your time dissenting. That's rumor, but the ASAP, that's the rumor that we were hearing. That's why we hammered on NASA to be able to stand up and defend Technical Authority, and put it in writing, what is Technical Authority and how is that process carried out? When I became the NASA Administrator, we still didn't have it to our satisfaction. The fact that now you had a member of the ASAP become the NASA Administrator, that was your other life. We're going to beat on you now like we did on Mike Griffin, and so, they did.

Immediately, they said, "Okay, you know what we're looking for, so you got to be able to tell us what Technical Authority is and you got to have it in writing, so that the average man and woman on the street understands and the average employee knows that if they have a problem with something you're doing, they can come forward. They can take it through their chain of command, and if the chain of command doesn't respond, they can go to the Technical Authority because the Technical Authority is the ultimate go-ahead with the Administrator. My Technical Authorities are the Center Directors; the Chief of Safety and Mission Assurance for the agency, Terry [W.] Wilcutt, right now; the Chief Engineer – used to be Mike [Michael] Ryschkewitsch, and now is Ralph [R.] Roe; and the Chief Health and Medical Officer then, Doc [Dr. Richard] Williams. If they disagree with something technically that I am getting ready to do, it is their obligation, their duty to step forward and say, "We object." I made the budgetary, programmatic, and technical decision, so I convene the whole team.

Lori and I sat down and we talked long and hard, and Lori was really happy with the decision because Lori—and I count her as a part of the ideologues in the commercial world—that it was going to happen, doesn't require a lot. Just turn industry loose, and they'll make everything happen. They care just as much about safety as we do, and it's a fallacy that NASA is the only people that care about safety. That's true, the industry cares as much about safety as we do, it's just that we don't do risk analysis, we don't do a cost-benefit analysis the way industry does. Industry, because theirs is a bottom-line thing, they can, in fact, say, "Okay, we accept that risk because we can pay somebody if something bad happens. If we wreck somebody's house, it is unlikely that we're going to damage more than 10 houses, and the median price of a house in that community is $1 million, $10 million is a piece of cake, we can do that."

There is no money like that in NASA, and because we're talking about human spaceflight, we're talking about a human life, and so we don't go into valuing a human life. We don't figure out the way automobile manufacturers do, and airplane manufacturers, they figure out, "Okay, what does the government say a human life is worth today?" I think today it's worth, is it $7 million? Somebody the other day, they were trying to figure out General Motors' decision to recall these millions of cars after Mary Barra became the CEO. General Motors had been going a number of years, knowing that they had this problem that was killing people, the ignition problem. Mary Barra, when she became the CEO, took a look at it and she said, "We're better than this. I'm not going to put a value on a human life. We're going to recall them and fix them." Big bucks. We don't have that luxury of saying a human life is worth this amount, we can pay for it if we're wrong.

I said, "We're going to extend our agreements with industry," because at the time, Boeing wasn't all in when I made this decision. I think you're right—I don't think we had announced CCiCap yet. I made the decision that, okay, we're going to extend Space Act Agreements, we're going to continue to work Commercial Crew Development under Space Act Agreements. We are not going to go out and compete it because, to be quite honest, there was only one prospective winner. Orbital had dropped out, Boeing wasn't in, officially. We didn't know where Sierra Nevada would come out. It meant the de facto winner was going to be SpaceX, and while I admire SpaceX, they haven't demonstrated anything. They have never made a vehicle that's had a human on it. Everybody else at least had a track record. Even Sierra Nevada—they may not have built a spacecraft that had a human on it, but they'd built airplanes, and they understood all that stuff. For me, it was both a technical and a practical decision that

said, "I'm not ready to put the nation's assets at risk by going into a contract and down-selecting to one."

We were getting a lot of pressure from Congressman [Frank] Wolf, Senator Kay Bailey Hutchison, from everybody—everybody wanted us to just get on with this Commercial Crew Program, down-select to one because you're not going to get the money you want and put all that money into one provider. We kept saying, "We can't do that, won't do that. We will lose competition. That one provider can jack the price up and we're back to working with the Russians, and we are not going to do that." When I made that decision, Mike Ryschkewitsch came in. He came in here, and I don't know if you ever met Mike Ryschkewitsch, Mike is a no-nonsense guy. He's retired now, but Mike came in, he said, "Hey, boss, my badge is going on the table." He said, "We're not doing this. We do not agree with this."

I said, "Who is 'we?'"

He said, "The Technical Authorities don't agree." I think Bryan [O'Connor] had left and Terry Wilcutt had come in as the Head of S&MA.

I said, "Okay, Mike, come on in, let's sit down and talk about this before we go to the big leadership team because I want to make sure I understand where you all are coming from."

To a person, they were united, they said, "We've got to get to a point where we can levy requirements and we can make the providers subject to human ratings standards. Otherwise, we can't guarantee that we're going to have a vehicle that we can put our crews on, if we can't put requirements on them, and we're not allowed to do that under the Space Act agreements."

I said, "Okay, I got it, but if we do this now, then that essentially is going to spell the end of the Commercial Crew Program because I have no faith whatsoever, I don't care what Elon Musk says, if we down-select to one, I have no faith that he will make any attempt to hold the

price down because now he is the market. At some point, he's going to have to make up his losses, and he'll do it on us. I'm caught, so here's what I want you guys to do: we're going to go into a meeting of all the leadership, and I'm going to announce that we're going to extend the Space Act Agreements, and you guys are going to stand up, as the Technical Authority, and you're going to say, 'We object.' Then, by the time you do this in this meeting, I'm going to put my head together with Bill Gerstenmaier and we're going to come up with a response to your objection. Then, we want you to take it off and we'll see how it plays out." We didn't know.

We go into this meeting and it's the leadership of the agency. I said, "Okay, for a variety of reasons," and I didn't get into personal stuff, I didn't mention any company, but I said, "a critical thing for us is competition. The other critical thing is for us to be able to, when it's time, levy requirements that we know we can hold a company to. I'm afraid if we go now into a sole-source contract, which is essentially what it'll be, we have lost. We can't guarantee anything because they're going to say, 'Okay, we're all you got. If you want this capability, then it's us.'" I said, "Okay, I got it." This was where the ideologues came out again.

This is Lori, and Lori's position was, "Who cares? If we're down to one, this isn't for NASA anyway. I know you keep saying Commercial Crew is to get astronauts to the International Space Station—get over it. That's not the purpose for Commercial Crew. Commercial Crew is to foster, to build up the economy, and to do all this other stuff."

I said, "I don't disagree with that, but it's the only way I got to get my crews to Station. When they fly for us, they got to be safe. I'm not responsible for the safety of a crew and civilians that they go out and fly if I don't have any NASA assets on that. I will tell anybody who asks me, I don't think that they should fly on it, but they're not going to fly a NASA astronaut until they comply with our standards."

"I hear what you're saying, but if we go this route, when I make this decision, I am also going to go over to the White House and I'm going to tell OSTP and OMB and everybody else who talks to the President that we are making a monumental decision here. I'm going to tell the world that no longer is Commercial Crew to provide transportation for American astronauts to the International Space Station. That is not our primary objective anymore. Our primary objective is to facilitate the success of a commercial crew industry that we feel can be made to meet our standards, and so we'll contract with them to get out crews to the International Space Station." What is the implication of that? It means that if they can't meet our requirements, at the end of the day, we're not flying on them. We're going to have an American capability that we're not flying, and we're going to continue to fly on Soyuz until they can meet our standard.

"Well, do you have to say it?"

I said, "You're damn right I do because I'm about to make a deal here with my Technical Authority." I asked the Technical Authority to go off and give me a whitepaper and list, delineate every single one of their concerns with extending Space Act Agreements, and it dominantly had to do with crew safety and reliability of the system in and of itself. It wasn't just crew safety—that was the big concern, but it was also reliability of our vehicles. Bill Gerstenmaier and I sat down with them and we went through, one by one, their concerns. We said, "Okay, here's what we intend to do." Bill and his team came up with the concept of CCiCap, where we would let—were they contracts? I think they were still Space Act Agreements, the CCiCap. Still Space Act, yes. We said, "Okay, here's what we're going to ask you to do under this next series of Space Act Agreements, and it's your last best hope. You're going to show us how you're going to meet our standards. You're going to tell us how you intend to demonstrate to us that you can meet NASA standards because the next thing we do is

going to be a contract, and it's going to be an intermediate contract." We didn't have the name then, but it turned out to be CCtCap, which is Commercial Crew [Transportation Capability].

We said, "We'll go a little bit longer with Space Act Agreements, and we'll try to let Boeing come up to speed. We will have three equally viable competitors, as best they can." SpaceX will always be ahead of everybody, and they are. They're ahead in terms of ideas and things that they are willing to do, as long as we continue to put money into the program. They're going to fly Grasshopper, at least the configuration, this next time they launch. Is it smart to do that? I don't know because when you look at vehicles, spacecraft, it is a significant change in the configuration of the spacecraft. It's got legs on it, which perturbs the aerodynamics around the vehicle. Bill Gerstenmaier and my Technical Authorities, however, say, "Hey, boss, we're okay. We've looked at it, it's been modeled in the wind tunnel, it's different. It is a different vehicle, just like the V-1, the Falcon 9 V-1 that they're flying now is not Falcon 9." We are doing a number of things in Commercial Crew that we would not have done ordinarily in a human-rated program. We're giving the contractors as much leeway as we can, so we are now letting SpaceX fly a second, changed configuration. Granted, this is a part of their CRS, their Crew Resupply Contract.

Without having them go through a demonstration of this configuration without cargo, we're saying, "Okay, we trust you. We've done the wind tunnel test. We think this will be okay." If the vehicle launches and goes in the ocean, we'll know, boy, we were really wrong. We'll be at fault because we accepted it, we certified it to fly, and that is a risk we're taking. This is all about risk. We came up with CCtCap, which says we are going to enter into a written contract with requirements and stipulations. It's going to be just like a regular, FAR-based contract, and you're going to have requirements, specifications, all this other stuff, just like you

do. You're going to have to show us under penalty—you're not going to get your money if you don't meet the requirements—you're going to have to show us, give us examples of your hazard reports, show us your hazard report process. How are you going to do all the things that NASA normally does itself to ensure safety, reliability, mission assurance? That's what they're doing under CCtCap. So far, they've got major milestones, and all of them are meeting their major milestones. Different paces, but they're all doing that. That's how we got there.

It was an agreement, a written agreement between the Administrator and the Technical Authority that, okay, I accept the fact that you don't accept my decision, but you are stipulating that you will go along with my decision pending satisfaction of your concerns. We'll tick them off as we go down the line, and if we don't meet a concern, if we don't satisfy a concern, then we're going to go back over and over and over again until we satisfy that concern. We are not going to go into the final selection of Commercial Crew providers until we have satisfied your concerns. We essentially have done that by entering now into the official FAR-based procurement process, which everybody's comfortable with. Now, is everybody comfortable? No, because even this process is different. Up until now, historically, any NASA contract, almost any contract written by the government, safety is a standalone provision of importance. Safety is indisputably the most important criteria that you have to meet, particularly in human spaceflight. In this case, in order to encourage the vendors to keep their bids down as much as they can, we said, "Okay, safety is still a critical factor for us, but it is not the only factor." We emphasized it is not the only factor.

Cost is a huge factor, and in fact, cost is, like, half in importance, which means right away that safety is not half. Safety is something less than half in the scoring, in the objective scoring safety is less than half, which means safety is not the principle factor in writing.

However, there are provisions in the RFP [Request for Proposal] that make it very clear that safety is paramount, and if we assess that your vehicle doesn't meet our safety criteria, you're not going to win. We don't care. You could underbid everybody by a gazillion dollars—you don't stand a snowball's chance in hell of winning because you haven't satisfied us that you're going to meet our level of mission success. Easy to say; now, we have to do it.

You asked me earlier about TCAT [Technical Capabilities Assessment Team], are we really going to do this? This is another one of these things where even putting it in a contract, if it's not the way people are accustomed to seeing it, ASAP is not comfortable with this. Neither is Congresswoman Eddie Bernice Johnson, nor is Congresswoman Donna Edwards. All the Republicans are happy because they don't believe in Commercial Crew, so they don't ever think it's going to happen. They don't care. The Democrats who support it are very concerned, and so they keep saying, they asked me last week, "How are you going to guarantee safety and mission success?"

I said, "Look, as long as Bill Gerstenmaier and Charlie Bolden are around, I can promise you."

They said, "Yeah, but you're not going to be around when we fly this."

I said, "You're right." What are you going to put in place that says this vehicle is going to be safe?

It is, in fact, the process that we have and the procurement process that allows for subjective factors that weigh in on any contract. Being the lowest bid almost never assures that you're going to win a contract because there are other factors. Compliance with small business, if you write in your contract no provision for small business, you're not going to win because that's a requirement of any FAR-based contract. That's a small percentage of the criteria for the

contract, but if you have no small business program, no program of diversity and inclusion, and you don't even choose to mention it, you're sending a signal. You're saying, "We don't really give a crap what you say. Our company doesn't go for that. It's all white males, and you're not going to make us change."

Then I say, "Thank you very much for your interest in national defense, you are not going to get my contract."

They'll come back and they'll file a protest and they'll say, "We were $1 billion lower than the closest competitor."

My team will go in, the lawyers and the procurement guys and the small business guys, and they will say, "Mr. Jones is absolutely correct. Their bid was $1 billion cheaper, but they made no attempt to meet this very important criteria for diversity. They made no attempt to meet this very important criteria for small business. Their safety plan is shaky at best—it's just a wink and nod—and they're going to cut costs. The reason that they are thinking that they can do it for this cheap is because they don't intend to comply with anything that we told them to do, and so we're not giving them the contract." We can do that, it has precedent, the lawyers tell us we can do it.

Again, I had to go off and say, "Okay, I need general counsel. You guys have got to tell me that this RFP as written is going to satisfy my criteria."

I went and sat down with the team before they released the RFP, and Bill Gerstenmaier was not happy with me. He said, "You're getting in my knickers, you're trying to tell me how to suck eggs."

I said, "Bill, you know I wouldn't do that. I'm the one who's going to have to go out here and say that I am not putting an astronaut on one of these vehicles if it doesn't meet our

mission success criteria and I'm not sure it's going to be safe. How am I going to do that if, in fact, when we issued the procurement request, I didn't say safety is the most important thing? How do I justify that?"

They said, "Look, here's the language in the RFP. We think this satisfies what you're looking for."

The lawyers came in, Bill [William P.] McNally and the procurement guys came in, they said, "Hey, they're telling you right. Based on procurement law and precedent, based on *law* law and precedent, based on protests we've defended before, we think you're going to be justified in awarding a contract to a higher bidder because they better satisfied your criteria for mission assurance."

I said, "Okay, I'm comfortable, so let's go do it." We released the RFP.

As late as last week, Congresswoman Johnson, in her opening statements, said, "There's still time for the Administrator to change his mind and revise the RFP."

And I had to say, "Congresswoman, I got it, I know what you're saying. I'm satisfied that I will fulfill your concerns. I'm going to answer your concern." Unless you've got other questions, or as you have other questions, I just gave you, in one big breath, what we've been through with Commercial Crew to get where we are today. The rest of the story, the critical, important part of the rest of the story remains to be told. We can tell that in August, and probably between now and August, there is nothing else to be told except to answer additional questions that you may have. If you still got time and you want to try it, we can talk a little bit more, till you get worn out.

WRIGHT: I was thinking of Bill Gerstenmaier was kind of put in the same position with COTS [Commercial Orbital Transportation Services] and CRS.

BOLDEN: I can't talk to you in words and help you understand what a critical role he played. You talk about single-point failures—we got a lot of great leaders, and Robert [M.] Lightfoot coming in here as the AA [Associate Administrator] when Chris [Christopher J. Scolese] went out to Goddard; losing Chris Scolese, for me, was emotional. Chris is a very good friend, a confidant. He engendered my trust. Nobody in the agency did I trust more or do I trust more than Chris, to be quite honest, but I needed him more out at Goddard than I needed him in here. The fights we were fighting in here, Chris really didn't want to be engaged in. We were fighting political fights in here, and I was punishing him by having him stay here. I wanted to see him happy, and out at Goddard, he is an incredibly happy camper. His workforce is incredibly happy.

Robert Lightfoot came in here, and Robert is a person who doesn't mind getting in your face. He is an engaging person who will take on any argument. He's not obnoxious in it, and he doesn't yell and scream at all. He's a very calm guy, but he just pushes back. He'll tell you very simply, "I'm from the Colonies, and I know I don't know everything about Washington, DC, but down at Marshall we wouldn't do this." Or "We would have done it this way." That is an incredibly calming influence to have here in the A-Suite, and it is an incredibly calming influence, although he's not a political appointee, Robert can go over to the Hill and talk to anybody. He can come away and people will trust what he said. They may not agree with what he said, but they will trust that he's giving them the straight scoop. The two people at the head of the agency have got to be able to do that. It wasn't Lori's fault that she couldn't do that, it's just

nobody on the Hill was going to let her in the door. For all intents and purposes, you didn't have a deputy for these really important battles that you were trying to do, particularly the one that she was the champion for. We're in a better place, to be quite honest.

Bill Gerstenmaier—there maybe be something that I don't know. I'm certain there is something about what he does that I don't know. I give him credit for everything. He may have somebody, just like I look at him as being a single point of failure, there may be somebody in his organization that's his single point of failure, and I applaud him for that. We probably all have it. The fact that I trust him implicitly and that I don't just accept what he says at face value without challenging, but when I challenge him, he comes back with something that I can believe. As a semi-engineer myself, I can rationalize that okay, that sounds right to me. He is a single-point failure in the agency when it comes to Human Spaceflight and Exploration. He just is. He has a way with doing stuff. He torques people off, over at OMB. I think if you were to go to OMB and say, "Okay, if you get rid of one person at NASA other than Charlie Bolden, who would you get rid of?"

They'd say, "Bill Gerstenmaier." It wouldn't be because they don't realize how smart he is and how he's right; it's just that he's right and they hate it. He doesn't just say, "We're going to do what you say to do." He doesn't let them bother him.

I've got other AAs that OMB drives them crazy because they don't know how to just let what OMB says go off their back. That's what they have to do. Bill does, and he just goes and presents facts. He doesn't try to rationalize, he doesn't try to get involved in a political argument, he just says, "Okay, I can do whatever you want me to do. Here's what's going to happen." He is invaluable. I don't know if you had a question in there about it?

WRIGHT: When you were talking about how to make the decision to stay with the Space Act Agreements because I remember him talking about the decision to know that he had to move forward with the CRS, even though the agreement had been that they wouldn't do that until, but he knew the ISS would need that resupply. I'm just curious about the conversations.

BOLDEN: It was interesting, his advice, his counsel, was opposite with crew because he knew not only did he have the luxury with Commercial Crew, but we also needed the capability, like, right now with Cargo. We had already added two Shuttle flights. We had now phased Shuttle out. It was critical that we get Cargo online. There, people won't say it, but we didn't have a human at risk, and there is a difference. A lot of people say, "Yes, but there's no difference, you got a $1 billion payload." Is a human life worth $1 billion? Yes! To me, it is, so I don't care how much the payload costs—a human mission, I'm going to put a little extra attention to it. I can buy another $1 billion payload. It may take many years to do it. I got a hard time explaining to a family why we let their crew go flying off when we knew something was not right, and yet we did it anyway. I've lived through those. He made a crucial decision with Commercial Cargo which turned out to be the right decision, and he at least helped me formulate the way that I was going to make a crucial decision in opposition to the input from the Technical Authority, that actually, truth be known, I think, I think Bill agreed with the Technical Authority.

He really would have loved to get on with it and get into the contract phase. He knew better than anybody that he didn't have the money to get into the contract phase. He's the guy that you can say what you want to say, but in the end, he's the guy who's got to tell his RMO [Resource Management Office] to write a check, and he knew he didn't have the checks. It was easier for him to help me formulate the rationale for staying with Commercial Crew Space Act

Agreements for just a little bit longer, to allow, one, us to get some legitimate competition, and give ourselves some assurance that these folk would really be able to, when they had to, they'd be able to meet our requirements. I think we're in a very comfortable place. He's probably more nervous than I am because he knows more than I do. This is the naïve me coming out—Gerst seems to be happy, so I'm happy. He's probably churning inside.

WRIGHT: You both understand the importance of keeping a crew on board, and you have to get them there. Why don't we stop for now? I'm sure we can find out more things to talk about next time you have time.

BOLDEN: We can do it as soon as you want or as late as you want, or whatever. Whenever we finish answering all your questions, then my belief is there won't be anything to talk about until we award a contract. Then, when we award the first contracts, then it's a new day. It's a whole different ballgame because then the companies are really going to have to deliver because they're under contract, and that is different. Because it's going to be a firm, fixed-price contract, we're going to be under a certain amount of pressure that we've never operated under in a Human Spaceflight Program. We have never, to my knowledge, had a Human Spaceflight Program on a firm, fixed-price basis. The government does it with airplanes, and it's not been good. It's been ugly. They just settled in court after 20 years—General Dynamics and [Boeing], over the A-12. The A-12 was a firm, fixed-price contract, and it got out of hand really quick. The government said, "We're not paying any more money," and the company said, "We don't have the money to pay to fix it," so they canceled the program.

Thank you all, thanks very much.

[End of interview]