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EDITED ORAL HISTORY TRANSCRIPT

ROBERT D. CABANA
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is April 28th, 2017. This oral history with Robert Cabana is being conducted for the NASA Headquarters Oral History Project in Houston, Texas. Interviewer is Rebecca Wright, assisted by Sandra Johnson. We thank you so much for stopping in today so that we could talk to you about your current role.

CABANA: My pleasure, Rebecca.

WRIGHT: We know that in 2007 you were at [NASA] Stennis Space Center [Mississippi] as its Center Director, and then just a year later they asked you to move to Florida and become the Center Director at [NASA] Kennedy [Space Center, KSC]. Tell us about what your expectations were at that time, and the goals you had for your new assignment.

CABANA: Sure. Well, I'm going to back up one year. It was October of 2007 when I left the Johnson Space Center, and Mike [Michael D.] Griffin called me. I was actually TDY [temporary duty] up at NASA Headquarters [Washington, DC] at a Nats [Washington Nationals baseball] game, and I got a call from the Administrator, Mike Griffin. He asked me if I would consider being the Director of the Stennis Space Center. I said, "Well, can I talk to my family and call you back?" He said, "Yes."

The first person I called after my wife was Roy [S.] Estess. Roy had been the Acting Director here at JSC [Johnson Space Center, Houston, Texas]. I had worked with him here, and he had been the Director at Stennis for a long time. He was a good mentor. After talking with Roy, I decided yes, this is something I need to do, and I have always done what I have been asked to do. I got asked to do it, so, “Yes, sir.” That year at Stennis was really good, and Griffin also told me, he says, “I wouldn’t buy a house.” “Yes, sir.”

But Stennis is very different from the Johnson Space Center in how they operate, being a federal city and everything. So even though I had been the Deputy here for three years—because both [Jefferson D.] Howell [Jr.] and Mike [Michael L.] Coats were coming in it from being contractors, a lot of the contract work I was responsible for as the Deputy. I knew the budget, and I knew how to run a large organization like JSC. Stennis is a lot smaller, because of the federal city aspect of it and all the tenants and everything, it was a little different way of doing business. It was good to be in charge of a small organization, and see that and learn that, and learn those aspects of being a Center Director.

Then I got asked if I would go be the Director of the Kennedy Space Center in October of 2008. I said, “Yes, sir,” and packed up and moved to Florida. At that time, in 2008, we had the Constellation Program going, we still had twelve [Space] Shuttle missions to safely fly out, and it was a hub of activity keeping up with all of that. But things changed rapidly.

One of the things that I did when I got to KSC and had my first All Hands [meeting] was I said, “The Shuttle Program is going to end, and we have to start planning for the future.” That wasn’t a story that people wanted to hear. Nobody wanted to see the Shuttle Program end, but we started thinking about, “Okay, what does this mean, and how is it going to impact us?”

Everybody's hope, of course, was in the Constellation Program, with the Ares-I and Ares-V [launch vehicles], and going back to the Moon and exploration. Then in 2010 the Constellation Program was canceled. We still hadn't flown out all the Shuttle missions yet, but now there was nothing after the Shuttle. Constellation was gone, and it was really a hit to the morale. But we had started working. We were looking forward to commercial cargo. The commercial resupply effort for the Space Station [Commercial Orbital Transportation Services Program] was coming into being. It looked like we were going to have a commercial crew program down the road.

We started saying, "What do we want the Kennedy Space Center to be?" We had a lot of strategic planning, but our goal was to transform it to be a multi-user spaceport, both government and commercial operations, crew and cargo, to and from low-Earth orbit and beyond. So we started planning toward that, but the main emphasis at that time was safely flying out the Shuttle.

It was an emotional time. At the end of the Shuttle Program, there were about 15,000 contractors and civil servants working at the Kennedy Space Center. About 2,200 civil servants and the rest contractors. After the Shuttle Program, we went from 15,000 down to 7,500. At least 6,000 people, contractors, laid off. In fact, [Space Shuttle] *Atlantis* landed on a Thursday in July of 2011, and that Friday 2,000 people got pink slips [dismissal notices] and walked out the door. But *Atlantis* was probably one of the cleanest missions we flew, one of the best processed vehicles. The team just did an absolutely outstanding job.

Then the Shuttle Program ended, of course after each of the Shuttles landed after their final mission, next was, "Okay, now how do we transition them to their second career of inspiration in a museum?" and deciding which ones went where. The KSC team was working on processing the vehicles to make them okay to send off to museums.

The Commercial Crew Program of course was starting up. The program office is at KSC, but it's 50/50 partnership between KSC and JSC as far as the resources and the people working on it. That was a really good partnership that we set up. That program today, even though it's at two different Centers, operates as one. It's really seamless. It's excellent the way it's operating.

That transition, how we did that, one of the things—we had authority for a bunch of different agreements. Right before I got to KSC, the state had finished up refurbishing the high bay in the Operations and Checkout Building [O&C]. This was funded by the state of Florida. They made a \$35 million investment to get Lockheed Martin [Corporation] in there to build the Orion [Multi-Purpose Crew Vehicle] spacecraft. When Constellation got canceled things kind of came to a stop, but Orion didn't really die. Orion stayed alive, and we ended up with the Space Launch System [SLS], which was a totally different rocket than the [Ares V]. [Ares V] was a 33-foot-diameter LOX [liquid oxygen] hydrogen core stage, and SLS is a 27-foot-diameter—same as the Shuttle external tank—LOX hydrogen. In fact, it uses Shuttle main engines for the core stage. So the core stage was different, but the Orion crew module transferred over to the new program. Lockheed Martin was in there as that program picked up, building the Orion spacecraft.

We flew the first Orion test flight in December of 2014, on Exploration Flight Test 1, EFT-1. I'll digress a minute—that was awesome. That flight, it was just so good to fly that flight. It launched on a Delta IV Heavy, and it went out about 3,600 miles away from the Earth, the furthest we had been in a long time, since we went to the Moon. Then it reentered at about 80 percent lunar reentry velocity to check out the thermal protection system and everything. But the flight was flawless. The vehicle just performed marvelous. I was standing in the control room there at Hangar AE when it landed, with our Administrator Charlie [Charles F.] Bolden

[Jr.]. Charlie took the words out of my mouth. After it was touched down and safely on the ground, he said, “I knew it would feel good. I didn’t know it would feel this good.” It just felt so good to be flying again. That was over three years since *Atlantis* had landed, and to get a crew vehicle back up in space—even though a crew wasn’t in it, on a test flight—it just felt really good, and it went so well. That was awesome.

Getting back to transforming the Kennedy Space Center. The first agreement that we put in place was Exploration Park, and it just kind of sat there for a while. Back in 200[3]—I think Roy [D.] Bridges [Jr.] was the Director at the time—in partnership with the state of Florida, they built the Space Life Sciences Lab at the Kennedy Space Center. It was state funded, but it was to do life sciences research for the International Space Station. It was going to be involved in the Constellation Program.

When it [Space Shuttle Program] ended, one of the things that we set out to do was create this research and development park at the Kennedy Space Center, on KSC property but outside the secure perimeter. We moved the fence. The SLS was inside the secure perimeter, and we moved the fence to our side of the Space Life Sciences Lab, partnering with the county to get some roads in there. Basically we signed this agreement using Enhanced Use Lease Authority, and gave land over to Space Florida [state aerospace economic development agency] for Exploration Park. We were using the Space Life Sciences Lab as the anchor tenant for the research and development park.

When we broke ground on Exploration Park [2011], it was really slow taking off. Everything was in place—they got all the roads in, and all the utilities—but they didn’t get any tenants in right away. Now they’ve brought some tenants into the Space Life Sciences Lab. NASA was not utilizing it anymore. We pulled out a lot of the stuff that we had there and

brought it onsite. Part of that was due to their fire-ex [extinguisher] system, the fire water protection system, failed and flooded the building. We had to move a bunch of stuff out, like the animal lab and some other things. It took a long time before it got back up where everything was operating again, so in the meantime we took some stuff out. This was all part of the plan to just say, “Okay, you just keep this and we’ll make it part of Exploration Park.”

Today—I’m going to jump ahead—not only have we gone from Phase 1 of Exploration Park, but we have gone to Phase 2. OneWeb [WorldVu Satellites Ltd.] is a commercial company that’s going to be building satellites for a space-based internet platform to supply internet to places around the world that have no access to the internet right now.

Blue Origin [LLC] in Phase 2 has built—they started January of this year, 2017, and it’s going to be operational in December of this year—a huge manufacturing facility for the New Glenn rocket that’s going to launch from Launch Complex 36 at the Cape [Canaveral, Florida]. So things are picking up, and more people are interested in coming there. It was a little ahead of its time, but the vision was there, and we got the infrastructure in place to support what’s going on now.

The next agreements that we put in place were for the Commercial Crew Program utilizing Space Act Agreements. At the time, well, we had a number of companies, but it was basically down to three: Sierra Nevada with the Dream Chaser [Cargo System]; [The] Boeing [Company] with the CST [Crew Space Transportation]-100 Starliner; and SpaceX [Space Exploration Technologies Corp.] with the Crew Dragon.

We were looking to get—and I digress again. Okay. After the Shuttles were done with post processing to get them safe to send to museums, the three Orbiter Processing Facilities were now vacant. In our plans for how we were going to move forward, first off, during the Shuttle

Program, the Space Shuttle Program basically paid for everything at the Kennedy Space Center. Just a huge number of facilities, the entire Launch 39 complex, both [launch] pads, all the facilities out there, everything. With the Shuttle no longer the active program to pay for everything, my Center Maintenance and Operations budget obviously couldn't afford all that. So we said, "For Constellation"—and then for SLS and Orion, for our exploration program—"what facilities do we need to support that? And if we need it, we are going to keep it. If we don't need it, we want to get it off our books so we don't have to pay the maintenance and operations costs, and we can reduce our footprint, and be more efficient."

We defined everything that we needed for SLS and Orion, "That's NASA." Then if we didn't need it we said, "Okay. Will it support commercial operations, to help us enable commercial operations?" Part of our charter. If it would support commercial operations, we kept it. If it wasn't suitable for anything, then we are going to tear it down and get it off the books, raze it. That really helped us define what we needed, and also to see how it can help with the commercial operations.

As an aside, I got my Safety and Mission Assurance folks together and we said, "Okay, what's the model that we're operating under?" We had at the time, during the Shuttle Program—the documents to operate out in the Launch Complex 39 off the pads and everything—basically, there was a safety document that had 2,200 requirements in it. "Shall" statement stuff. I said, "How many of these are actual requirements, and how many are just best practices that we are saying is a requirement?" So, we scrubbed all that, my safety team did. Russell [R.] Romanella started the effort. He was the head of S&MA [Safety and Mission Assurance] at the time. They just did an outstanding job. We took what was 2,200 "shall" statements, and we got it down to where if it was a NASA operation it was about 550.

If it was a joint-use facility, where we were sharing it with a commercial partner but we had NASA ops [operations] going in also, there were about 295. But if it was purely a commercial facility, where we were going to turn this facility over and only the commercial operator was going to be in it, there were only, like, 55 “shall” statements. Because requirements drive cost, and what we decided with the commercial partners—rightfully so—is that I don’t have to tell them how to meet OSHA [Occupational Safety and Health Administration] requirements. That’s the law, they have to do that. I don’t have to tell them how to meet environmental compliance requirements. That’s the law, they have to do that. So, we just necked it down to, “What do we need to make them safe here at KSC?” That was a huge shift in the way we did things—coming up with that model, looking at how we operated in the various facilities, and looking at the safety requirements.

The first facility that we looked to get rid of was OPF [Orbiter Processing Facility] Bay 3 and the engine shop for commercial operations. We worked it with Space Florida, the state entity. We have an agreement with them for—I think it ended up a 15-year agreement for them to maintain and operate the facility. We still own it, but we don’t pay any of the maintenance and operations cost for it. They are solely responsible for that. Then they were able to get Boeing in there to build the CST-100 and operate out of there. So Boeing’s agreement is with Space Florida. Space Florida has the facility because of an agreement with the Kennedy Space Center. They totally refurbished it, gutted it. I think Boeing invested some money with the state of Florida to bring those jobs to Florida and make that work. Now it’s amazing, the change in that facility, and just a great use of that asset.

Over in OPF Bays 1 and 2, we were able to get the Air Force [Boeing] X-37 [Orbital Test Vehicle] spaceplane in there. They have been totally refurbished and remodeled, and now the

Air Force X-37 spaceplane is going to operate out of OPF Bays 1 and 2. Great for our nation, much less expensive. Instead of landing at Vandenberg Air Force Base [California], and being shipped down to [Boeing facilities in] Huntington Beach [California] and processed, and then shipped to Astrotech [Space Operations] at Titusville [Florida] to be encapsulated, and then shipped to [KSC] Pad 41 to launch, it'll now land at the [KSC] Shuttle Landing Facility, be towed over to OPF Bay 1 and 2, processed, and towed over to the pad and launched. I'm pretty proud of that.

WRIGHT: Like the Shuttle has come back smaller and come back home.

CABANA: Same thing. Yes, much smaller. If you have never seen it, it's almost a quarter-scale model of the Shuttle. It's pretty cool. Except it's got twin vertical tails instead of a single vertical tail on it, but the planform of the delta wing is almost identical to the Shuttle. Pretty neat.

Not all of our agreements worked out. The Parachute Packing and Refurbishment Facility for the drag chutes and the chutes on the Orbiter, and all the parachutes at KSC—we no longer needed that, and we signed an agreement with a company. They had contracts with the DoD [Department of Defense] for parachutes to deploy cargo out of [Lockheed] C-130s [Hercules aircraft]. Bottom line is, in addition to the Shuttle Program ending in 2011, the economy went down the tubes after 2008, and this company didn't get some government contracts they thought they were going to get. Basically, they tried to make it work and it didn't, so the agreement ended and we ended up tearing down the building.

We had another agreement with Power Systems [Incorporated of Florida] to operate Hangar N and all the NDE [Nondestructive Evaluation] equipment, nondestructive inspection equipment that we had at KSC. I think that contract lasted maybe a year or two, and then they just couldn't make a business of it, and that one ended also. We ended up pulling all the equipment out of there and filtering it out to different places, and we gave that hangar back to the Air Force. That was over on the Cape side.

The next big agreement that we had after OPF Bay 3 was Pad 39A. We had done the analysis that for SLS and Orion, with one high bay in the Vehicle Assembly Building, one mobile launcher, one crawler-transporter, and one Launchpad, we could launch up to three times a year. Right now, the current manifests, we'll be lucky to get one flight a year. I am hoping for one and a half. So we did not need that other launchpad, and in that corrosive salt air environment at the Cape it would have just sat there and rusted away because we couldn't afford to maintain it. A lot of folks said, "What are you doing giving that pad away to SpaceX? How could you do that? We might need it one day." Getting the culture to change was really hard. But instead, we signed a 20-year use agreement with SpaceX, and now they are responsible for the maintenance and operations of that pad.

We are enabling commercial operations. Commercial crew is going to fly off that pad. The [SpaceX] Falcon 9 Heavy [launch vehicle] is going to fly off that pad this year, 2017. That was back in 2014 when we signed that agreement, and they have since flown three commercial flights off that pad, and there is another one going this Sunday. And our mission's going to be launching off that pad this Sunday. So just a great use of an asset.

The SLS and Orion, that's where KSC's focus is from a government point of view. Pad B is going to be complete in August of this year. It's been totally refurbished. All the Shuttle

infrastructure of course was pulled off. We have gone to what's called a "clean pad concept," where a mobile launcher or launch platform that is unique to the rocket has a common interface out at the pad for all the services at the pad. Our goal is, if we are only launching one flight a year with SLS and Orion off that pad, that's another 51 weeks out of the year it could be used for something else, to bring another commercial company in that would operate out of the VAB [Vehicle Assembly Building], utilizing maybe an old Shuttle Mobile Launcher Platform for their rocket, and going out to that pad and launching from that pad.

Right now there is interest. We are negotiating with Orbital ATK [Inc.] for them to utilize High Bay 2 in the Vehicle Assembly Building, and utilize that pad for launching. We'll see if things progress. If they end up winning this Air Force contract, then we can make that happen, too.

That pad has a state-of-the-art lightning protection system, refurbished water sound suppression system, refurbished propellant distribution system. Now, it's LOX hydrogen because we are using Shuttle engines. We are using more hydrogen than the Shuttle did. For the upgraded, enhanced upper stage for Block 2, we are going to need to put a larger hydrogen dewar out there, a hydrogen tank to support multiple launch attempts. But that's a little down the road.

That pad looks like a mound of earth and cement, but there's really a complex underneath there. It's got a refurbished Environmental Control System that provides conditioned air to the vehicle. It's got all-new computer systems. There is a tunnel that runs back to the Launch Control Center. All the copper wiring left over from Apollo and Shuttle that got added in there, all the copper wire was pulled out, and we made \$620,000 in scrap off the copper that we reinvested back into the project. It's all fiber-optic now. The catacombs down underneath the

pad, we are doing some reinforcement underneath there because the Space Launch System's heavier than Apollo and Shuttle. Right now we are finishing up new flame brick in the flame trench, and a new flame deflector. But, the pad modifications will be complete this August.

Of course, Space Launch System was supposed to launch in 2018. We were hoping for late 2018, but if you have been reading, with the tornado that hit [NASA] MAF [Michoud Assembly Facility, New Orleans, Louisiana] and everything else, core stage is a little behind and it's going to slip into 2019. We haven't set a firm date, but that'll be coming here in the next few months.

The mobile launcher, that's an interesting story, too. The mobile launcher was built for Ares-I for the Constellation Program, for the single-stick solid. When Constellation got canceled in 2010, Hensel Phelps [Construction Company] had not completed the structural steel, the construction of the mobile launcher, and it was less expensive to allow them to complete their contract than it would have been to novate the contract and stop them. When they were done, it was \$230 million of structural steel just sitting there.

We looked at, for SLS, "Can we modify the existing mobile launcher that we have to support the liquid core stage with four Shuttle main engines and two solid rocket motors?" We did the analysis and determined that we could. So we had to cut a bigger hole in the platform, plus we had to beef up the structure to make it stronger to support the heavier rocket. We pulled 600,000 pounds of steel out of it, but then we put another 900,000 pounds back in with all the reinforcements that were required. Now we are in the process of installing all the systems in it, because everything that supports the rocket is in that mobile launcher, and that's a complex vehicle. It looks like this steel tower and the rocket's just sitting on it, but underneath there it's all the communications, the computers, the air, all the services, you name it, installed in there.

That's going to be complete in September of this year. There are 10 swing arms and umbilicals that connect to the rocket—the crew access arm, the Orion upper stage umbilical, the interim cryo [cryogenic] propulsion upper stage umbilical. We have another facility that's called the Launch Environment Test Facility [LETF] that tests them all in the environment that they are going to see on launch day. So far, we have completed testing on 4 of the 10 umbilicals, and they have been delivered for installation on the mobile launcher. Three are in testing at the LETF right now, and three more are yet to be completed and delivered before testing. Our goal is to have the mobile launcher complete in September of this year.

Again, I said we only needed one high bay, so High Bay 3 in the Vehicle Assembly Building was totally gutted, and all the Shuttle platforms have been taken out. When I say “platform,” these things are the size of small houses. But it was totally gutted, and what's really neat—and I wish I could show you pictures—there are 10 platforms in there now that support the SLS, and these platforms are adjustable 8 to 10 feet up and down. They are designed where there are inserts in the platform that go around the rocket, because the outer mold line changes depending on where the core stage is and the solids are. And when you get above the solids, it's a different inset that goes in. They are designed so that they can be adjusted 8 to 10 feet up and down, and the inserts can be replaced as the outer mold line of the rocket changes as it grows.

So it's much less expensive. It's adaptable to the rocket as it evolves, and it's really a cool design. All those platforms are installed now. The contract is going to be complete here at the end of April—in fact, the next few days. There are still punch list items, and there is final outfitting that has to be done, but the major work on the platforms is complete. That's good. So I got the high bay done, the mobile launcher will be done, the pad will be done. The facility

where the solid rocket motor segments arrive when they get to KSC, that's been totally refurbished and redone.

The crawler-transporter—we got two crawler-transporters built in the '60s for Apollo, and they were also used for Shuttle. The crawler-transporter 2 has been totally refurbished. Because of the higher weights of the SLS and the Mobile Launcher, the wheel bearings had to be bigger. They got bigger bosses so they can have bigger wheel bearings, and that's all complete. New brakes, new generators, new jacking elevation and leveling cylinders, redid the cab where you drive it from with updated equipment. But totally rebuilt. We tore apart the gear boxes, everything. It's been totally rebuilt. So this will be the crawler-transporter that we go to Mars with one day that takes the rocket out to the pad. It'll be our crawler-transporter for the next 30 years, just like it supported Shuttle and Apollo. And again, we only did one because we only need one. One of the neat things.

The generators, when we replaced them—when you have diesel generators, there are environmental compliances that have to be met. The law was changing, and you can get grandfathered under the law if you already have one. But if the law changes and you buy a new one, then you have to modify it appropriately. So what we did was instead of just the big diesel generator for crawler-transporter 2, we bought two of them. We installed one of the new ones in crawler-transporter 1, and one in crawler-transporter 2. If we ever have a problem with the one on transporter 2, we are grandfathered, and we can just take the one out of crawler-transporter 1 and move it over there. When I say “diesel generators,” these things are like steam locomotive engines—that kind of diesel.

We've also completed modifications to the MPPF, the Multi-Payload Processing Facility. It's where the Orion capsule and command module are going to go. The command module and

service module, after they are assembled in the VAB, in the O&C high bay, they will go over to the MPPF for servicing of the hypergolic propellants and the ammonia. Then they go over to another facility, it's a vertical integration facility, if you will, where they add the abort rocket on the top of it. Then that whole thing rolls out to the VAB to get stacked on top of the rocket. MPPF is in final testing now. It's not a vertical integration facility. It's got another name, and I can't think of what it is right now, but basically the facility where they stack the abort motor rocket, on top of the Command and Service Module, that's complete also.

So from a facilities point of view, at the end of this year all the facilities that support SLS and Orion are going to be structurally complete. But, we still have a lot of testing that we have to do for the software for the controls and displays, and to make sure everything works right. We'll do some of that prior to the rocket arriving. A lot of testing is going to be done once we have the rocket at the Cape and we stack it up. That's kind of SLS and Orion.

WRIGHT: And while you are talking about facilities, I understand you are getting a new Headquarters Building, too. You have been able to upgrade that area as well?

CABANA: Yes. So as part of our plan to upgrade, we are building a new Headquarters Building. It was supposed to be complete in December of last year, and hopefully we'll get to move in in December of this year. But it's phase one. It actually has this core tower with two wings off it, and right now it's a core tower with one wing. If we get the money, we'll do phase two. I am not sure we are going to get the money for phase two. The unique thing about it is—so there were three buildings in a line at KSC. The new Headquarters Building is kind of out in front and between the old Headquarters Building and the Operations and Checkout Building. Just west of

the Headquarters Building was the CIF [Central Instrumentation Facility]. It was a computer communication facility, and it had, at one time, all these huge IBM mainframes in it. Then further west of that was the Base Operations Building. The Base Operation Building has already been torn down. The CIF is totally empty right now. They are doing asbestos abatement, and it's going to get torn down. There is a new data center in the parking lot up behind the Headquarters Building that's maybe, I don't know, a fifth the size of the CIF that's way more capable than the CIF ever was.

With the new data center and the new Headquarters Building, and tearing down the old Headquarters Building, the CIF, and the Base Operations Building, I save \$6 million a year in operating expenses. The new Headquarters Building will pay for itself in 10 years, and it's going to be around a lot longer than that. New LEED [Leadership in Energy and Environmental Design] Gold buildings are so much more efficient than the old buildings, and so much nicer to work in. It really is the right thing to do, as much as a lot of people really hate to see history disappear. We are going to do a lot of photo documentation.

Now, the Operations and Checkout Building—like I said, we already refurbished the high bay, and all the office space has been totally redone. It's like walking into any new, modern building. There is a lot of light coming in through the windows up above, there is not interior offices with no windows and doors. It's more cube space. It's just much brighter and more open and inviting as far as the office space is concerned.

Let's see. What other big thing is going on? Gosh, that's a lot.

WRIGHT: It is a lot.

CABANA: Oh, the Shuttle Landing Facility. There is another huge asset. During the Shuttle Program, it was about \$5.2 million a year to operate and maintain the Shuttle Landing Facility for Shuttle operations. With the Shuttle gone, I think I could have got it down to about \$1.2 million or so, but not having a requirement to land the Shuttle there, there is still a requirement for that runway there.

We worked with the state of Florida again, Space Florida, for them to take over the maintenance and operations of the Shuttle Landing Facility, and also utilize it. They could develop around it, for companies for space operations, commercial space operations, for horizontal launch capability and suborbital capability. There is a number of folks like Virgin Galactic doing suborbital flights that could be operating out of there. There are companies that are looking at horizontal launch capability, where you have the rocket underneath the belly of a large airplane. It takes off from there, goes out over the ocean, and launches it, very similar to how Orbital ATK does the Pegasus right now with the [Lockheed] L-1011 [Tristar]. They now maintain and operate the Shuttle Landing Facility, so that's off my books too, from a cost point of view.

I'm trying to think if we have got any other agreements. So we did this, we laid out our plan, and then we iterated it over time. Nothing happened as fast as I would have liked to have happened, but we have been able to accomplish everything we said we are going to do. I think it's amazing—if you look, in all of human history, only three nations have sent humans to space: the United States, Russia, and China. But right now, today, at the Kennedy Space Center, there are four United States commercial companies building spacecraft or infrastructure at the Cape to launch humans to space.

You have got Boeing with the CST-100 Starliner, operating out of OPF Bay 3, launching on an Atlas V off Launch Complex 41, which is also a Kennedy pad. That's on KSC property, but we lease it to the Air Force, and then they lease it to United Launch Alliance. You have got SpaceX with the Crew Dragon on a Falcon 9 launching off Pad 39A. And now Blue Origin is building their New Glenn rocket in Exploration Park at KSC, launching from Launch Complex 36, Cape side. I think that's pretty amazing, and all those operations going on at KSC. And of course Lockheed Martin is Building the Orion capsule in the O&C High Bay.

One of the huge challenges that we had was how do operate it as a civil spaceport as opposed to a government spaceport? How are civil launches handled? It's been evolving. I think it was like, I don't know, three years ago, maybe longer—at least three generals ago—I signed an agreement with the Commander of the 45th Space Wing [Air Force unit] that said, in principle, if you launch from the Kennedy Space Center on a commercial launch, you do not have to utilize the range assets, you don't have to follow the range rules, as long as you have an FAA [Federal Aviation Administration] launch license and meet those requirements.

Now, you can utilize range assets to do that however you want, but bottom line is operating on a commercial launch off KSC is not the same as—the Air Force doesn't control it. I'm trying to make it more efficient for the commercial customers. We have signed agreements. General [John E.] Hyten is not there anymore, but he directed how we do these operations, how the Air Force does, and they are leaning forward very much to make it simpler. So if you have a commercial launch license and you meet the criteria safety-wise for a commercial launch license with the FAA, it's the same criteria as for the Air Force. But the Air Force, when they have that commercial launch license, the Commander of the 45th Space Wing, he is not the launch decision authority. He doesn't sit on console anymore. It's the commercial launchers that have

the launch decision authority for their flight. They can't violate any FAA rules. If he decides to launch anyway when he shouldn't have, they are going to have serious sanctions, and maybe not get another launch license.

One of the things that has led to making things more efficient is we are now flying with an Autonomous Flight Termination System, as opposed to having somebody on console over on the Air Force side that would send a command destruct to a rocket if it were to veer outside its safety envelope. It's all autonomous to the rocket now, which I think is a lot safer. Rather than relying on humans, if it's tested and programmed and done properly, it's much better to have an automated system. That's cut down on the number of people the Air Force has monitoring.

There are just a lot of efficiencies that have been gained, and it was a long time getting all the agreements in place between the FAA, the Air Force, and NASA on how we were going to operate. For a commercial launch, I hold a Support Readiness Review, and it has nothing to do with the technical aspect of the vehicle, or the payload, or the launch. It's "is KSC ready to support this commercial launch?" Are we meeting all of, contractually, what SpaceX, for instance, is paying for out at Launch Complex 39A? From security, propellants, power, all the stuff that we provide them, are we ready to support them on their launch? It's pretty cool, having gotten three commercial launches off that pad now.

WRIGHT: While you are there in that mode of thinking, that is one of the questions I was going to ask, about the fact that these Commercial Resupply Services, that whole business has altered that part of the landscape of KSC in more ways than one. You just mentioned the Support Readiness Review. Those are some of the cultural pieces of NASA that are how we've always

done business. Are there other pieces, or is there more that you can say that you want to maintain and/or evolve to do those?

CABANA: Well, again, it depends on whose mission it is. If it's a NASA mission, there is more involvement than if it's a purely commercial mission. My Launch Services Program procures all the expendable vehicles for NASA's science mission. Now, if we are launching a NASA science mission off a Falcon 9 rocket, then we have my NASA team sitting on console with the SpaceX team. They have a vote whether they go or not, and they are following everything along from a technical point of view. And we have technical reviews that we do prior to launch. We have a joint SpaceX/NASA Flight Readiness Review, Flight Launch Readiness Review also.

Again, it's different. When we launch SLS and Orion off 39B, it's going to be closer to what Shuttle was like than a pure commercial launch. But for commercial cargo, SpaceX does that launch. We have folks that watch, but we are buying a service from them. They are responsible.

Now, I will also say any time a commercial rocket launches, my Launch Services folks monitor just to gather data, because it helps make informed decisions when we launch NASA missions on those rockets to better understand the vehicles. It's a different model, and it's different depending on if it's purely a NASA launch, if it's a commercial launch with a NASA payload, or if it's a purely commercial launch.

WRIGHT: You were quoted just recently talking about success for space exploration. It's going to be government and commercial, that both are needed to be successful.

CABANA: Absolutely. We can't have just one or the other as a nation. A lot of people want to say, "Commercial can do this." Or some folks just want NASA to be doing stuff. The bottom line is for us to really be successful, we need both, and they need to be integrated.

If you look at how we are doing the International Space Station, it's international cooperation, but we are also utilizing commercial cargo vehicles, and now commercial crew. NASA is buying services. We have helped develop those services—we have paid money along with the contractor to build and design those vehicles—but it's a partnership to maintain. So as we explore—when we go back to the Moon, when we go on to Mars—yes, NASA is going to have a large rocket and a crew vehicle, and the capability to get the modules and other spacecraft up there. But there is a role for commercial to provide maybe fueling, to preposition cargo. I think we are going to end up doing it jointly, and I really believe when we explore beyond planet Earth, we are going to continue to use the model that we used on Space Station, as far as international cooperation is concerned.

WRIGHT: You have mentioned a lot of historical buildings and launchpads, and some, as you mentioned, are staying, some are going. While you were there, you were also able to establish two very historical exhibits for the future, for the generations. Would you like to talk about *Atlantis*?

CABANA: Absolutely. So, things I'm proud of—I'm really proud of how *Atlantis* turned out. Man, we nailed it. It was exactly what I envisioned when I said I wanted it to look like it was flying in space, and that just turned out so well. The folks from the California Science Center [Los Angeles] were very envious. They said, "You set the standard."

It's actually pretty cool. The three Space Shuttles and the Approach and Land [Landing Test] vehicle. [Space Shuttle] *Enterprise* is up on the deck of the [USS] *Intrepid* [aircraft carrier] up in New York [City, New York]. [Space Shuttle] *Discovery* is the vehicle of record, and it's at the Udvar-Hazy [Center] facility of the [Smithsonian National] Air and Space Museum at [Washington] Dulles [International] Airport. And it looks like it landed and they just rolled it into the hangar and parked it.

I closed the hatch on each of the orbiters before they left KSC. *Discovery*, when I was inside it, it looked like it was ready to go fly in space. It's got everything. Everything is installed—all the lockers, the galley, the waste management system, everything is in it. I told you we are utilizing the Shuttle main engines for SLS. There are 16 of those engines in storage over at the Stennis Space Center. That's four flight sets for SLS, so we have got at least four flights before we have to build new engines. So there aren't actually engines in any of the Orbiters. What you see is the nozzle. The engine compartment, the engines are out of there. We pulled the main propulsion valves out so that we could use those also. In *Discovery* we reinstalled non-flight propulsion valves that were either over time or had some problem with at one time in the program. So it's got the propulsion valves installed back in it. Everything is there, it was really cool. But all of them were really cool.

So *Discovery* is the vehicle of record. [Space Shuttle] *Endeavor* is out at the California Science Center. It's in a temporary facility right now. A few years ago I went out and saw it. My son was stationed at [Marine Corps Air Station] Miramar in San Diego [California] and I think it was Memorial Day weekend, we drove up to Los Angeles with his family and went to see it.

I thought, “Well, this isn’t going to be impressive. It’s just sitting there on a transporter in a temporary building.” But you go through the predisplay, and you see the movies, and they have got hardware that’s not in the vehicle that you can see. Then you go in and you actually see it, and dang, it was. Of course, that was my last Space Shuttle, too. That was emotional. But it was still pretty cool. Eventually they want to mount it in the vertical on an external tank and solid rocket motors so it looks like it’s getting ready to launch into space. The way they are going to do it, it’s pretty cool. When you look at it, it’ll look like the payload bay doors are closed. One door will be closed, and it will look like it’s getting ready to launch. But on the other side, what you are not going to be able to see is one of the payload bay doors is going to be open. They are going to have a launch tower where you can walk up and see inside the payload bay, and they are going to have the side hatch open so you can look into the middeck.

It’ll end up being cool, but I don’t think it’ll be as cool as *Atlantis*. *Atlantis*, it just—and it’s amazing how close you can get to it. You can’t actually touch it, but you also feel like you can. It took me at least 10 times watching the preshow, and the show, and the reveal that I didn’t tear up. It is just really emotional.

WRIGHT: Were you able to give your input and your suggestions?

CABANA: Oh, absolutely. Yes. That was what I wanted.

WRIGHT: That was part of the deal, right?

CABANA: Yes, yes, yes. I got the title to *Atlantis* hanging in my office. Charlie Bolden signed it, and I signed it, and it says, “Title, Space Shuttle *Atlantis*.” So it’s mine. Which is unique. So we still have that one. The others, we turned the title over. We don’t own those anymore, but we own *Atlantis*. Delaware North [hospitality company] did an outstanding job. They captured my vision perfectly.

What folks didn’t know is that there was a space in there, and nobody understood quite what it was. There was this one walled-off area that it was just a blank wall, and there was empty space behind it—if you knew that the building was rectangular—and nobody realized that anything was in there or not in there. I had asked for space to be set aside for a tribute to the [Space Shuttle] *Challenger* [STS-51L disaster] and [Space Shuttle] *Columbia* [STS-107 disaster] crews.

When *Discovery* was inducted into the Udvar-Hazy facility, that day I briefed Charlie Bolden and Bill [William H.] Gerstenmaier [Associate Administrator for Human Exploration and Operations] on what I wanted to do and got their permission. What I wanted to do was go into the silo that had the pieces of *Challenger* in it, and I wanted to find the side wall that had the U.S. flag on it, and pull that out and make it part of this display. And I wanted to use the windows out of *Columbia* in the display.

Man, that was a labor of love. People could not believe we kept that secret, because it was—well, I’ll go back to finding the piece of *Challenger*. Mike [Michael A.] Ciannilli was working on this. He was my lead to go find this stuff. The silo, water had seeped into it. It was not good, and we couldn’t find that piece, and we were kind of running out of time. You had to move all this giant stuff—it was dangerous. It was not safe.

And it was on the last day of the three days that we were in there that we found it and got it. The company that restored the pieces of the [RMS] *Titanic* [ocean liner] that were brought to the surface, we hired them to restore and stabilize it. Not restore it to new, but to restore it to the condition it was right after so it wouldn't deteriorate at all anymore. So it's preserved.

Then we worked very closely with the families for a display for each of the crew members that explains who they are as a person, who they were. I remember when we opened it, I was so anxious. It was a Thursday night, and we had the *Challenger* families first, and they had an hour and a half. Then we brought in the *Columbia* families. I am there with them, and I have known June Scobee Rodgers and Jane Smith [Wolcott] for a long time. They are good friends. Lorna Onizuka is one of my closest friends. I was so worried how they were going to feel, and they just absolutely loved it. I was on an emotional rollercoaster that night, it was really emotional. I just can't believe how well they all liked it. It just turned out perfect. Kathie [Scobee Fulgham], Dick Scobee's daughter, came up to me at one point and said, "Can we just have a sleepover? Can we just spend the night?"

At one point the grandchildren were getting a little antsy, and the parents and children just didn't want to leave. We had to move on eventually to get the *Columbia* family in, but it was really emotional for me. I went up to Lorna and I said, "Lorna, can I have the kids for a little bit?" She said, "Sure." So I took all the kids, and we went down to the other end of the building where the slide is, and I opened up the slide. I ran safety on the slides, and the kids just had a blast, and it got rid of a lot of energy. I love kids, I just love playing with them. I'm a kid. So that kind of allowed them a little more time without a distraction of kids wanting something.

Then the next night when we had the dinner and they are underneath *Atlantis*, one of Lorna's grandsons came up to me, tugged on my pants. I looked down and he says, "Can you open the slide again?" I said, "Oh, I'm sorry. Not tonight."

Then the *Columbia* families came in, and they absolutely loved it also. But I don't know, it was a little different with the *Columbia* families. I think maybe it was because less time had passed. And the *Columbia* families were treated a lot different from the *Challenger* families. We did a much better job I think initially, and they were allowed to see [*Columbia*]*—the Challenger* families never got to see the vehicle afterwards, the accident. For them, a lot of it was closure. I think they got closure out of it.

Personally, I did not realize how much—I knew it affected me. I didn't realize how much *Columbia* had affected me as a Director of Flight Crew Ops—my first flight, when we lost *Columbia*—and I got closure out of it. Having done that, it made me feel good. It helped me get closure, and it helped me honor both of those crews, and both of those vehicles.

And to the folks at the Kennedy Space Center, the vehicles are much like a person to them—a real thing, a living thing, something that means so much to them—in addition to the crews. For them to be able to honor *Challenger* and *Columbia* in that way. When you walk in, you have got the *Columbia* crew on one side and the *Challenger* crew, and you read all about them, and you see these neat displays. Then you get this great quote by President [President Ronald W.] Reagan. Then you turn right, and you go into—I liken it to going into church, the music that's playing. It's really emotional. You have got the *Columbia* windows and the *Challenger* side wall there, and it just grabs you. Then you walk out of that, and if you'd have turned left at the end of the crews, you go into a display where it talks about the emotional

recovery, the physical recovery, and then the Return to Flight. If you take time to watch them all, it really tells a great story. It's amazing.

WRIGHT: How long had you been brewing up that idea to do that?

CABANA: When we knew we were going to build a facility for *Atlantis*, I wanted that in there. We just didn't talk about it. I started thinking about it in 2011, got approval to go ahead in 2012, and we opened it in 2014.

Then the latest one that we did this year I think is really special, too. We honored *Challenger* and *Columbia* at the *Atlantis* facility, where we tell the Shuttle story, and there was never any recognition of the Apollo 1 crew at KSC. This year was the 50th anniversary of the loss of the Apollo 1 crew on Pad 34, January 1967, so we wanted to do a similar tribute to the Apollo 1 crew, and worked with the Apollo 1 families to help make that happen. We didn't think it was appropriate to actually show the module itself. It's still in storage at [NASA] Langley [Research Center, Hampton, Virginia], and I don't think folks would have handled well looking inside that vehicle. I have seen pictures, and I have talked to people that were there after the accident. But what we did do is we have the three hatches off that vehicle displayed, and we explain what caused the fire, and how difficult it was to get out quickly with the hatch design the way it was.

Also at the Kennedy Space Center is the Apollo 18 command module that would have flown had we gone to the Moon [again]. It's on display. It used to sit at the nose of the Saturn V rocket, where you can see it and look in the window and stuff, and the hatch on the top was open. If you look at it now, there is no hatch there. There is just a Plexiglass plate. We took that hatch

and we put it inside the Apollo 1 display, and explained how we went from an inner-opening hatch that they said took 90 seconds to open—there is no way you could get that open in 90 seconds—to a hatch that opened in five seconds that opened out, with much better design.

But again, a tribute to each of the crew members, and we worked with the families to make that happen. And it tells more of the story. It tells the story about the folks that tried to rescue them, and what they went through. It's just very nicely done. Working with the families and then doing that on the 50th anniversary worked out just really well. The Whites were just very involved. Bonnie White [Baer] is so nice, and Ed [Edward H.] White III worked with—Sheryl [L.] Chaffee worked for me at the Kennedy Space Center. She just retired last year at the end of the year, and her mom [Martha H. Chaffee], just the nicest person.

And worked with Betty [L.] and Scott Grissom. Betty really didn't want anything to do with NASA. She wouldn't even set foot on the Kennedy Space Center. Every year we had a tribute at Launch Complex 34 at the time of the accident that the Air Force sponsored but NASA participated in, and every year she was there. Now, to have this, she appreciated it. I worked closely with Scott to get him to buy into what we were doing. We didn't want to do something that the families didn't want to do, or didn't have an input into anyway. We'd have done it, I think, even if it couldn't have got 100 percent agreement. But, I flew to Houston and talked to them. Last July, I went to Betty's house up near The Galleria [Houston shopping center] and talked with her, and explained what we wanted to do to her and Scott, and got buy-in, and then we made it happen.

Kelvin [M.] Manning, my Associate Director, I let him lead the charge on that. He did an outstanding job working with everyone, pulling that together. Again, I think we captured exactly what we wanted to do. It turned out really well. So, yes, I think *Atlantis*, "Forever

Remembered” for *Challenger* and *Columbia*, and the Apollo 1 tribute, they will stand the test of time. They are pretty cool.

WRIGHT: It’s a nice gift to the future generations that come through there.

CABANA: You can’t forget. You have got to remember. And that’s part of our history. You can’t ignore it; it’s part of our history. We have to learn from the past. We can’t forget it.

WRIGHT: I know that was a definite personal contribution from you that you thought out well, and we would like for you to talk for a few minutes about the last nine years on a personal basis. I mean, it was pretty grueling. You walked in the door with one expectation, of taking astronauts and sending them back to the Moon and on your way to Mars, then you have become a prime contractor, landlord—I am not sure how you would describe—

CABANA: I would describe it as a multi-user spaceport operator.

You know, there aren’t many times in your life when you can define what you want your future to be. You pretty much accept. Center Directors before me were just executing the Shuttle Program, and maybe processing Space Station modules, but it was pretty much Shuttle for 30 years at KSC. When the Shuttle ended, we had the opportunity to define. We didn’t have to do anything that we did. The only thing that I had to do was get Launch Complex 39, Pad 39B, ready to support SLS and Orion. I could have let the rest of it just rot away. I didn’t have to make any of those agreements with those commercial companies or do any of that, and I would have done what I needed to do.

But that wasn't the right answer. It would have been a shame to let those facilities go to waste and not enable commercial operations, and make us more successful. I think we are much better for it. The Space Coast [Florida] is much better for it. We have gone from being dependent on one government program to having multiple—like I said, not every commercial company made it, so some jobs came and went. But overall, at the end of the Shuttle program, 15,000. We were down to 7,500. I now have 7,800 contractors and civil servants doing government NASA work, all right? But there are well over 8,000 people working at the Cape, and there are more coming. And it's because of the commercial work that we have enabled. A much more vibrant, robust system than it was before, and I think it's going to continue to grow.

But I have got a couple more things I have got to get done before I go. I want to see commercial crew fly. I want to make sure that everything is in place for SLS and Orion if I don't make it until when it flies. And I have got a couple more agreements I would like to get signed. At least one more. There is another company I'd like to get in there, operating out of there too, again, make it a little more robust and share some of the costs.

WRIGHT: What do you think the government side has learned from working with the commercial people? With these public partnerships?

CABANA: Well, first off, public-private partnerships work. I think we have shown that. I think there is more than one way of doing business. First off, I hate the terms "NewSpace," "old space," "commercial." The bottom line is, every vehicle that NASA has flown to space has been built by a commercial company. It's just different ways of procuring it, different contracting tools. We utilize different tools. We had Space Act Agreements; commercial CSLAs,

Commercial Space Launch Agreements, unfunded Space Act Agreements, funded Space Act Agreements, Enhanced Use Lease Agreements, Enhanced Use Lease through barter agreements. We have had a number of tools that we have utilized.

The contract that we have right now for commercial services for commercial crew, it's a firm, fixed-price contract, as is the CRS contract, [Commercial] Resupply [Services]. We started with Space Act Agreements where the government put in some money for milestones that were met, but the company itself had to put in money. Now we have gotten to where we contract for those services. But again, it's a government procurement by a different method.

I am not sure SpaceX—they weren't any faster than we have been in the past. Everybody said, "Oh, it's faster." Well, it took them about eight years to make Falcon 9 successful, and that's about how long it takes to build a rocket and make it fly. But I think it's been good, and they do things differently from how we do it. I think they, in some ways, need to be a little more like the government, and the government needs to be more like them. I think we can do things more efficiently with fewer people. I'd like to see us be a little more agile and nimble in how we respond.

For example, John [F.] Muratore is the site manager for SpaceX. John was a flight director here. I worked with John when I was at JSC. John redid the control room when he was still working for NASA. He modified the pad to support the Falcon 9 out there at 39A, and after the first launch they had some issues with the pad. He went out and had them corrected within a week to be ready to launch. They went from a launch on that pad to three weeks later launching again. I just can't imagine NASA having issues with the pad and launching again three weeks later. We'd still be studying the design of how we were going to modify it.

Another example—when I was out there earlier on in the modifications to the pad, he had a problem with one of his contractors that was doing the refurbishment of the water sound suppression system out there. They weren't doing it right, they weren't happy with their performance. They fired them, and two days later they had a new contractor in there working. I can't do that. Legal would have been involved, I'd have had to have an SEB [Source Evaluation Board]. It just would have been very time consuming in order to make that happen, because we have to be fair, we have to meet socioeconomic goals, follow all the rules of the FAR [Federal Acquisition Regulation]. Where commercial companies can respond quicker and are a little more nimble than we are. I think we need to learn how to improve the speed of our decisions, and be willing to take a little more risk sometimes. But informed risk. I want to know the risk I'm taking.

WRIGHT: You have mentioned Space Florida off and on. What value do you believe it has been to NASA to have that relationship with Space Florida?

CABANA: Well, they are a state entity, but they are unique in that they can raise funds through bonds. They can offer economic incentives to these companies to help bring them in, and they can work with them to find financing. They are helping us fulfill our mission. They have enabled commercial crew, Boeing, to be in OPF Bay 3, and that's helping us. So, they are another tool to be used. My agreement with SpaceX is directly with SpaceX to operate off Pad 39A. It's not going through another intermediary. But there were some places where it made sense to work with Space Florida.

A lot of the agreements, the initial ones that we did, it was really hard. Nobody had ever done any of this stuff before, and to get everybody on board, and get legal on board, and the folks up at Headquarters on board. If I were to write them today, three or four years later, I would probably do it a little different than I did before. We are better at how we do it, but again, we use the right agreement for what we are doing.

WRIGHT: So if you are giving advice to someone who wants to become a Center Director at a NASA facility, what skills would you tell them to improve and enhance before they took on that role?

CABANA: Well, I think the most important skill is to be a good leader and take care of the people that work for you. If you truly believe in servant leadership, and you put the welfare of the people above yourself and take care of them first, then they will take care of everything else. So leadership is key.

The hardest challenge was it was a real culture change at KSC. People couldn't believe it—"What are you doing? Why are you doing that? We can't do that. Why are you giving that away? How can you support our competition in place of us?" You can read books, and to change the culture of an organization takes three to five years. We have turned the corner. Folks are on board with what we are doing now. But I think the most important thing is being able to communicate a clear vision of where you want to go to the team, and that they see it as something that, in order to enact change—nobody wants change. Nobody likes change. We are happy with the status quo, even if it's not necessarily the best.

One of my favorite movies, the *Three Amigos*—remember El Guapo? “Better the El Guapo we know than the one that we don’t.” But the monkey bar analogy—they are holding onto where they are, and they have got to have something good to reach out for before they will let go of the bar that they are on and pull to that new bar. Being able to communicate that vision and to get them to own it, to be a part of it, to get it to be their vision and implement that, I think that’s key. I don’t know if Yogi Berra actually said it or not, but I use it as a Yogi Berra quote. “If you don’t know where you are going, you are certainly going to end up somewhere else.” I didn’t want KSC to end up somewhere else, and so we were very clear about laying out what it is we wanted to do, why we wanted to do it, and to get the team to buy into it.

Then we iterated it over time. We laid out “This is what we want to do,” and we continued every year to look at “Okay, what we have we done?” I was talking to somebody, and I looked, and man, we did it. It’s operating and it’s growing, and it’s actually working. I said to somebody, “Geez, I could see exactly where we needed to go, and I saw what I wanted to make happen, and it just couldn’t happen fast enough.” They said, “Geez, for a government agency, I thought you did it pretty quick.”

WRIGHT: Listening to you describe the events that you had made happen, with all of the changes to facilities and getting things prepared, it’s almost as if you walked right back where you started. Now you are preparing for SLS and Orion to do the things that you thought maybe you were going to be doing when you walked in the door, but you are ready to do that.

CABANA: Sure, and we have been working on that for a couple of years now, for SLS and Orion also. So yes, it's a really good future. I think we have a very vibrant future. I think NASA has an awesome future, and I am glad to see KSC playing such a prominent role in that.

WRIGHT: So prepared for it.

CABANA: Yes.

WRIGHT: I want to tread on this one a little lightly because it's just come out this last week or so about the possible changes or enhancements—well, there was an article released in *Popular Mechanics* [magazine] this past week of [President Donald J.] Trump's transition teams, ideas or plans, which include having someone at Mars, and having a cislunar fuel depot, all these ideas. Are you already involved in that, and trying to get it all ready?

CABANA: We are working it all, absolutely. Bill Gerstenmaier has briefed what this path forward is, and it is so logical, it makes so much sense. Essentially, it's utilizing SLS and Orion and the enhanced upper stage to establish—I call it a “gateway”—in lunar orbit, a Deep Space Gateway. It's essentially where you would go and dock with the Orion vehicle. You need SLS to get all this stuff up there, but it would have a lander on it that would be reusable, that could go back and forth to the Moon. But it could also go into a highly elliptical orbit, and you could depart from it going to Mars. It's much more efficient to leave from that point on a lunar orbit than it would be from low-Earth orbit. It just shows how we would learn to operate there in

cislunar space, establish the systems and get better at operating there, and prepare us to go on to Mars in the 2030s. We just need to make it happen.

It's very difficult with the funding that we have, because we never get what we ask for, we always have continuing resolutions, and it's difficult to plan a program when it's like that. The budgets aren't going to go up. We got a one percent cut this year, and it's basically flat for the next five years. So we have got to figure out how to do what we are doing within a flat budget, which is really a decrease when you consider inflation. I laid out a very logical plan to help make that happen. I am excited about it.

WRIGHT: Are there additional plans for Station that you know of?

CABANA: Well, right now it's good until 2024. It can be extended beyond that, so we will have to take a look at that. Ideally, just from my point of view, it would be neat if we could totally commercialize it, but we have to have a destination for these commercial companies, for Boeing and SpaceX and Blue Origin.

I know Robert [T.] Bigelow [founder of Bigelow Aerospace] would like to get his own mini-space station up there. He has got a module on the ISS [International Space Station] right now testing it. But I think we need to keep something up there in orbit in order to have a destination for these folks. CASIS [Center for the Advancement of Science in Space] is working hard to be able to commercialize science and utilize the ISS as a National Lab, and get science up there. This is something we are going to be able to do once we have the Crew Dragon and the CST-100, to fly more people to the ISS, have a crew larger than six so that more time can be devoted to science. I would like to see maybe not career astronauts but back to the Shuttle model

where we had payload specialists, where these scientists go up, operate on the Space Station for a short period of time, and come home proving their science. I don't know, we'll see. But it'll be around a while longer.

It's pretty cool, Peggy [A.] Whitson now the longest time for an American to be in space. Peggy is awesome. Don't mess with an Iowa farm girl.

WRIGHT: That's what I hear.

CABANA: I have known Peg for a long time, and she is pretty amazing. But it's pretty cool seeing the Space Station utilized the way it is, and yes, I like that.

WRIGHT: Well, it's exciting to hear all the things going on at Kennedy. Are there more things that you'd like to share with us today?

CABANA: Oh, gosh. Man, let's see.

WRIGHT: And I have to think too, as a pilot you must be excited about all of the different ways that your Center can offer aerospace. Like you mentioned, from the flights that could come off of the Shuttle landing strip, and the Air Force plane. All that's just right there in your backyard to go touch.

CABANA: It's pretty cool, but I don't get to fly it, that's the problem. I have my own little 1978 [American Champion 8KCAB] Super Decathlon aerobatic aircraft that I keep at Merritt Island

[Airport, Florida] that I go out and fly upside-down, and do loops and rolls, and have fun in on the weekends.

WRIGHT: Take your own tour of the Center?

CABANA: Well, you can't fly in the restricted airspace. The industrial area is in the restricted airspace, but you can make a low pass down the Shuttle Landing Facility, and you can fly over the Visitors Center and circle it and see the Rocket Garden. When I have folks come visit I will take them up there and fly them over it so they can see it, and they think it's pretty cool. And when you are flying down the Shuttle Landing Facility you can look across and you can see the VAB and the launchpads, and the new mobile launcher being built. It's a pretty good tour that I give.

WRIGHT: Yes. Well, I'm sure it's good for you as well to be able to see all of that.

CABANA: If I can't fly, I don't know what I'm going to do. Yes, I need that, and I'm a pilot more than anything.

WRIGHT: Don't tell the people at Kennedy—they think that you're the Center Director. Well, thank you so much for coming in.

CABANA: Thank you. I think we have a very exciting future in front of us, and I think we are well positioned for it. It's been a really hard transition. It's been taxing.

WRIGHT: And full. I used the word “grueling,” but there was just so much.

CABANA: And it seems to never end. But then you look back and you say, “Wow, that’s amazing. We did that.” I can’t wait for SLS to fly, and use that Charlie Bolden quote again. “I knew it would feel good. I didn’t know it would feel this good.”

WRIGHT: Yes. Well, we wish you the best of luck.

CABANA: Thank you.

WRIGHT: Thank you again.

CABANA: It’s always nice to come home to JSC.

WRIGHT: Well, we’re always glad to have you back.

[End of interview]