

**NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
COMMERCIAL CREW & CARGO PROGRAM OFFICE
ORAL HISTORY TRANSCRIPT**

GEORGE C. NIELD
INTERVIEWED BY REBECCA HACKLER
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HACKLER: Today is March 20, 2013. This oral history interview is being conducted with George Nield at the Headquarters of the Federal Aviation Administration [FAA] in Washington, DC, for the Commercial Crew & Cargo Program Office History Project. The interviewer is Rebecca Hackler, assisted by Rebecca Wright.

Dr. Nield is the FAA's Associate Administrator for Commercial Space Transportation. We'd like to, first of all, thank you very much for your time this afternoon, and we'd like to begin by asking you to briefly describe your background and how you came to this position and what your role is here.

NIELD: Certainly, and I'm happy to participate in this. I think it's a very worthy and important project. I went to the United States Air Force Academy in Colorado, and later on I got my Master's degree from Stanford [University, Stanford, California] in Aeronautics and Astronautics. As part of my Air Force career, I served as an aeronautical engineer working on various Air Force space projects and then had the opportunity to go out to Edwards Air Force Base [California] and go through the Air Force Test Pilot School as a flight test engineer. It was a fun opportunity for me.

At that time, the Space Shuttle Program was just getting started. There were calls out for potential astronauts to apply, and I thought that would be a fun thing to do. I applied and made

the finals to come down for an interview and the various tests and so forth at JSC [Johnson Space Center]. I did not make the final selection, and thought a good thing to do to improve my chances going forward would be to go back to school and get a PhD [Doctor of Philosophy]. So I went back to Stanford.

As a follow-on assignment I taught at the Air Force Academy in the Astronautics Department and then was assigned down at the Johnson Space Center in Houston, working on the Space Shuttle Program. I was there for 16 years actually. Most of that time was working in the Shuttle Program Office, including a number of years as Manager of the Flight Integration Office there. In 1999 I left NASA and went to work in industry for Orbital Sciences Corporation in Dulles, Virginia. I worked on different projects there, then in 2003 I came to the FAA. I was the Deputy Associate Administrator, and then when my boss, Patti [Patricia] Grace Smith, retired I was selected as the Associate Administrator.

Looking back at my career, I've had a chance to do a lot of very interesting and fun things. I never would have predicted the exact pathway, but it turned out that a lot of the experiences that I was able to have in the Air Force and with NASA and in private industry contributed to my understanding of what's going on today in commercial space transportation. I feel like it's been a real great preparation for my current job.

As Associate Administrator for Commercial Space Transportation, I lead one of the four lines of business in the FAA, along with Aviation Safety, the Airports Office, and the Air Traffic Organization. We have a great group of folks, and it's our job to oversee all of the exciting things going on today in commercial space transportation.

HACKLER: Before you joined the FAA, as you mentioned, you were at Orbital Sciences Corporation. We know there were some precursor efforts to get commercial cooperation with NASA in place before the COTS [Commercial Orbital Transportation Services] program—I'm thinking specifically of the Alternate Access to Station effort—and I was wondering if when you were at Orbital you had any awareness of that specific program, or just general efforts to get commercial spaceflight started?

NIELD: I wasn't involved in that particular project, but there are some related programs that I was involved in. When I joined Orbital, one of the things I worked on was the STAS program. That's Space Transportation Architecture Study, which was a program that NASA had back in that timeframe which was designed to look at what happens after the Shuttle. That was an interesting and wide-ranging effort. There were a number of different ideas that were put forth by different companies in the industry at that time, ranging from, "Let's just keep flying the Shuttle, but we'll continue to improve it. We'll have liquid flyback boosters and great avionics," and things like that that can hopefully bring the cost down.

Lockheed [Martin] put forth their ideas for the VentureStar and the X-33 [spaceplane] to have basically single-stage-to-orbit access to space. Orbital was looking at a variety of ideas, including a small spaceplane that looked a lot like the Shuttle, but would be launched by an expendable booster at the beginning. Then over time it would fly on top of two-stage reusable systems, so that was a neat precursor to some of the things that we see happening today. I was involved a little bit with that.

You mentioned the Alternate Access to Station, and I think that was a pretty narrow project that not a lot of people had understanding of or necessarily support for at the time.

Orbital actually was pushing the idea that there might be some very important, high-value equipment that we have to get up to the [International] Space Station right away. They had the Pegasus rocket that they thought would be a good candidate to provide that type of transportation service for relatively small items, but I think there was enough concern on the part of NASA of “Can we really allow these companies to come close to the Space Station, and how much does it cost? The Shuttle is working pretty good right now and so we really don’t need that type of thing,” so that went by the wayside.

The other program that was going on in those days was the second generation Reusable Launch Vehicle program [Space Launch Initiative], and again, that was trying to look beyond the Shuttle and what kinds of things would make sense from industry’s perspective to follow on after the Shuttle is retired. I had a little bit of involvement there, but I actually left Orbital before COTS itself was established.

HACKLER: What was the atmosphere like for commercial space when you joined this office at the FAA in 2003? What sort of initiatives were underway, and how did those evolve as you spent your years here?

NIELD: There are several different aspects to that question. If I just look within the FAA, that was a challenge in and of itself. Originally the Office of Commercial Space Transportation was formed in response to President [Ronald W.] Reagan’s executive order back in 1984, and the passage by Congress of the Commercial Space Launch Act. But at that time it was a staff office reporting directly to the Secretary of Transportation.

Then, in 1995, the office was moved to the FAA, and of course the FAA is a huge organization. They've been around for many years and they pretty much knew how to do things. You'd just bring your certification request in and they'll evaluate that and inspect the aircraft and keep the planes flying safely and everything's great.

Of course in the space arena, it's not quite so routine or cut and dried. Everything we're doing is brand new, first of a kind, "Let's figure out what the right approach is." It's been interesting to help people understand that we don't all fit in the same modes of doing business. In the rest of government I think it was recognized that commercial space had its place, at least in terms of launching telecommunication satellites and things like that, but there was a tacit assumption that the government would continue to do most of the important things, whether it's for exploration or space stations or national security needs.

In fairness, there have been some oscillations of feeling about commercial. Back in the '90s there was a big push when people thought that Reusable Launch Vehicles were really going to be an important part of the space program going forward, and the market sort of fell out of the bottom during that timeframe. It didn't really come to pass, at least at that time.

Looking today though, you can really see a lot of activity starting to happen and just over the horizon, ranging from the Richard [C.N.] Branson Virgin Galactic [LLC] space tourism activities, to supplying cargo and crew to the Space Station, to the Google Lunar X Prize contest to have people send a robot to the lunar surface, to the Golden Spike project, where private folks try to sell expeditions to the Moon to do research. Recently we had Inspiration Mars [Foundation] with Dennis [A.] Tito saying he can put together a privately-funded effort to send people on a flyby within 100 miles of the Mars surface, so an awful lot of things going on and a very exciting time for commercial space right now.

HACKLER: How did your office work with commercial companies to encourage that sort of development?

NIELD: We are a unique government organization in that we have a two-fold mission from the Congress: first of all, to ensure public safety; and secondly, to encourage, facilitate, and promote commercial space transportation. We're not going to compromise on safety. We handle our launch license applications and our inspections as very important activities, but at the same time we try not to be rigid, bureaucratic, lots of red tape. We're always looking for how to do things better. It's our goal that these companies can be both safe and successful going forward, and that's the way we try to do our work.

HACKLER: I understand you also attend a lot of the NewSpace conferences to talk directly with the companies.

NIELD: That's right. Especially when I joined the office, I think there was a lot of suspicion and skepticism about, "Are these government bureaucrats here to help us?" and "I'm not sure if we should talk to them or listen to them or believe them. Gosh, if we start talking, it will just take a lot of time and effort and they probably won't let us do what we want to do." I think over time we've built a trust and an understanding and recognition that not only can they be successful working with our office, but it can be a good thing. It can be helpful to them in sharing information and understanding best practices going forward.

HACKLER: You do have the dual role of balancing the regulation and safety with also trying to encourage innovation. What are some of the possible benefits for the companies of having regulation?

NIELD: Again, we don't ever compromise safety, but if you look at the encourage/facilitate/promote role, we're trying to listen and understand what kinds of policies or activities the government is doing that are turning out to be obstacles to the industry. Whether it's procurement systems or ITAR [International Traffic in Arms Regulations] or how the paperwork is handled, what kinds of things add cost or delay or frustration to the industry. And if there are things that we can fix, then we try to do that.

We're also very plugged into the interagency community and have regular meetings with the White House and the Office of Science and Technology Policy and the National Security Council, the State Department, NASA, DoD [Department of Defense] and so forth. Things like the National Space Policy and what needs to be in there and what kind of messages do we want to send, and what kinds of things do we as a nation want to do to have a healthy industrial base and to have a successful space program.

HACKLER: You mentioned procurement can be a barrier to commercial companies. We've heard that the FAA was a stakeholder in the first COTS selection process. Did you attend any of those selection meetings or help choose which companies would be selected to develop their technology under this new way of doing business?

NIELD: We were involved. One of our engineers who had experience working at the Johnson Space Center was a consultant, if you will, in the initial review of the proposals. I was a so-called “ex officio” adviser during the selection meetings. That meant I was invited to sit in and hear the briefings that were given to the NASA selection official prior to the decisions there. I didn’t get a vote, but I think it was very helpful to NASA and very interesting to us to be a part of that process for a couple different reasons.

First of all, we work every day with these companies, and so we had a pretty good sense of their capabilities, their plans, their safety culture, their professionalism and so forth. We could share that, rather than just trying to glean all those things from a proposal if you are not familiar with a particular company. Then, second, a huge part of this whole initiative is changing the way the government does business. Part of that is for the government, for NASA, to back off from its normal looking-over-your-shoulder oversight and dictating every decision on the design and the development and the operations, to more of an understanding of how they’re doing it using Space Act Agreements.

There was a requirement in the Space Act Agreement that the companies would need to get an FAA launch license. That was a brand new mechanism for many in NASA, and we were able to provide answers to their questions on how that works. What does it mean, what are the requirements, is that a big deal or not, is it hard, how much does it cost, and so forth. We could help NASA understand what was really involved in getting an FAA license.

HACKLER: And in the selection, what sort of specific capabilities or qualities were you looking for in the companies’ proposals to help make the COTS program successful?

NIELD: Again, I was not a voting member of the board, but certainly it was important to see that these were credible proposals. That these companies knew what they were talking about, and they had the demonstrated or at least the believable capability to design, build, and operate these systems. That was an interesting task. Most of the established, large companies either were not interested in being part of this project or were skeptical of what it would mean, or their cost structure was such that it really wouldn't be able to be successful if they charged the government the amounts and the ways that they were used to operating.

You saw a whole new set of smaller, entrepreneurial companies that were coming forward and saying, "Hey, we can do it," so the task was to figure out which of them could really do it, and which were really just good proposal writers or good salesmen or good travel agents that could bring together some people, but they themselves really didn't have the capability to do what the government needed. That was really what the challenge was all about.

HACKLER: Did you have any input into how the program was put together as far as making the new Space Act Agreement friendly to commercial interests?

NIELD: We had a chance to read through the drafts of the proposed Space Act Agreements and the call for proposals and made comments, mostly to clarify what it meant to get a launch license and to help NASA understand this different way of doing things.

HACKLER: Since you've mentioned it, what is involved in getting a launch license and reentry license for these companies?

NIELD: We have actually licensed more than 200 commercial launches since the office was established. Going back to the very beginning, it was important for us to have a credible set of requirements that the companies had to meet. What we did at the time was work closely with the Air Force on the Eastern and Western Ranges. They had 50 years of experience launching things and had developed requirements that companies had to meet in order to launch from Cape Canaveral [Air Force Station, Florida] or Vandenberg [Air Force Base, California] and so forth. Not all of that was written down. A lot of it was just, “Well, this is the way we’ve always done it,” or it involved verbal direction or assumptions.

We worked for many years with the Air Force to try to make sure that as we wrote this down in our regulations, which were going to be part of the Code of Federal Regulations that anybody can see, that we had it right. We’re not going to see word-for-word duplication of what the military has, but every requirement that they have has something that meets the intent on our side so that we have common safety standards.

The first round of that project was to see if we could clearly document in writing what a company had to do in order to ensure public safety if they were launching from, say, the Eastern Launch Range. Although it took a while, we were able to do that. That means we have a big, fat book of regulations, but at least the companies understand exactly what’s expected of them. If they can’t meet it for some reason then they need to ask for a waiver, and we work closely with the Air Force to make sure that the government has a single position in terms of what’s required.

To get back to your question of what’s involved, our top-level goal is public safety, so we don’t try to look at every system and subsystem of the rocket. We look at what can go wrong, where is it launching from, are there people or high value facilities or other things on the ground in the surrounding area, and what happens when something does go wrong. For an unmanned

rocket, there will be someone sitting there in the control room, and if it starts to go off course then they can push the big red button and blow up the rocket so that it doesn't end up landing on a schoolyard or something like that.

That's our primary concern, public safety. We have requirements that the expected casualties from this launch—Ec as they call it—has to be less than 30 in a million, so a very, very low probability of something going wrong that would result in a fatality to the general public.

Of course that's very different from what the military or NASA does because, in addition to being concerned about public safety, which they are of course, they need mission success. That is a good thing, but it results in a lot more oversight, a lot more questions, a lot more paperwork, a lot more cost in order to get that final product. Our concern is to ensure public safety, and a customer, whether it's a communication satellite developer or NASA in the case of COTS, can decide about mission assurance and what they need to do and want to do in addition to the public safety piece.

HACKLER: We understand there are different types of permits and licenses—experimental launch, reentry, and then also an operator's permit. Can you explain about those?

NIELD: We have a basic launch license, and if a new company comes in and says, "We have a rocket. We want to have a commercial launch," then what we would typically do—if we're satisfied that they know what they're doing and have a good safety culture and it looks like it's going to be safe—then we could give them a license for a single launch.

After they've demonstrated that they know what they're doing and they have a good track record of a few successful missions, then we're going to entertain having an operator's license such that they can launch as many times as they want with the same basic rocket on the same basic trajectory from the same location and so forth. United Launch Alliance and others have an operator's license. They have done a number of launches, and we're satisfied that they have good systems and good procedures going on. New companies would typically get a launch-specific license to start and then over time could get the operator's license.

The other tool that we have in terms of authorizing activities, as you mentioned, is an experimental permit. That was put in place in 2004, when it was right in the middle of things like the [Ansari] X Prize and we were starting to see hybrid vehicles that looked a little like airplanes and a little bit like rockets. There was a thought that maybe what we need to have is something that's more akin to an experimental airworthiness certificate that's used in aviation, and so Congress gave us the ability to issue experimental permits.

They are intended to be a little bit easier to get, a little bit less data required, a little bit less burdensome. It's intended basically for research and development testing. Once you've completed those tests and you want to conduct those launches for compensation or hire, and you want to sell the launch as opposed to just doing testing on it, then you would need a full license.

HACKLER: In rough numbers, about how many companies have those licenses now? Did you see a big increase in people getting experimental permits to develop their vehicles for commercial capabilities? The companies that worked on COTS—have they moved on to getting their operator's licenses?

NIELD: It goes up and down. We don't actually have to have someone with a license in place until they want to fly, so we're talking to, say, half a dozen companies on the suborbital side that are all planning to do space tourism. We've only given out one permit so far, to Scaled Composites [LLC], but there are other companies who, as soon as they're ready, will be submitting their applications.

Similarly for Orbital. Orbital already has their launch-specific licenses, and since it's a new booster, the Antares, even though they have experience—after they get a few launches under their belt there, then we can talk to them about an operator's license. SpaceX [Space Exploration Technologies Corp.] has had several licenses on a mission-specific basis. We've talked to them about getting an operator's license. As it turns out, they're basically in the middle of changing their rocket significantly. The next launch that they do, which will be out at Vandenberg in California, will have significantly larger, higher thrust engines. That really isn't a true derivative of the Falcon 9 that they've been flying, so we'd like to see those fly a few times before we move to the operator's license.

HACKLER: I was just thinking it must be interesting for you to return to working with Orbital Sciences since that's where you were before.

NIELD: It's an exciting time. We're seeing lots of innovation, fresh thinking, new ideas, new ways of doing business, and I think that just benefits everybody. A lot of folks have talked about, "We need to downselect, we need to get one good system and stick with it," but competition has proven itself to be a good thing. When you have a technical issue or a grounding from an accident or financial difficulties on the part of a particular company, to be

able to say, “That’s down for a while, let’s use another system,” that’s great. Also, by having competition, you’re challenging the existing companies to always improve their product and make it safer, make it lower cost, make it more reliable, and incorporate new technologies, and that’s a good thing.

HACKLER: You have mentioned your cooperation with the military and, of course, NASA. Can you expound a little bit more upon how you work with other federal agencies in this new world of commercial space transportation? You’ve got the FCC [Federal Communications Commission] for communications and the Department of Transportation.

NIELD: There are several aspects of our cooperation. Each department or agency has their own responsibilities that can overlap a little bit at times. You mentioned the FCC. They have responsibility for the radio broadcasting that is done for missions, and NOAA [National Oceanic and Atmospheric Administration] has responsibility for Earth observation, but in terms of the transportation and the safety of the activities, we’re the lead.

At the beginning of the process when a company applies for a launch license, one of the things we do is we do a policy review. That basically involves summarizing the plans that the company has, and then sharing those with other government agencies—NASA, DoD, [Department of] Commerce, and the State Department—and trying to identify any particular issues or concerns that anyone has about what they’re attempting to do, and making sure that folks are not surprised when you get to the end. That’s the formal part.

When you get to the mission, everybody has their defined role and we certainly try to work closely together. I mentioned NASA in terms of supplying the Space Station. You could

think of them as being the customer really. They have a lot to worry about, but we try to make sure that we're there to support so that the mission can be successful for them. I mentioned working with the Air Force. If there are waiver requests or issues as we head towards the launch date, we try to work behind the curtain, if you will, with the Air Force so that the government has a unified position and the company doesn't say, "Well, the FAA told us this and the Air Force told us that. Which do you want us to do?"

We try to make sure that we're on the same page and can present a united front to the companies involved. I also mentioned the interagency activities during things like the development of the National Space Policy, and the National Space Transportation Policy. We have regular gatherings of the government space community to talk about how things are going. Any problems, any issues, what kinds of things do we want to say to keep the nation moving in the right direction in terms of our space program.

HACKLER: What sort of issues do you anticipate as space traffic increases, with more and more companies developing their vehicles? How do you have to work with the other government agencies on those?

NIELD: First of all, there's the question of overall workload. If we start seeing hundreds of suborbital launches every year, which I think we will very soon, there is just a lot more to do. So we'll have to take a look at the resources we have available, trying to ensure that there isn't a waiting list or delays because we can't do our safety evaluations quick enough.

We also may see the nature of the job changing. Today our regulatory responsibility is pretty much limited to launch and reentry, and there really is no government entity that has the

responsibility for overseeing what happens on orbit. It's pretty much the Wild West, and there is a good reason for why it's that way if you think back to the beginning of the office. The primary focal point was supposed to be public safety, so when are the times when someone could get hurt? Well, during launch or when it comes back to Earth. There is nobody out in space, so there are no members of the public that could be in danger, and we don't need to have any government involvement in that.

Now we've got the International Space Station up there, a huge, expensive national asset. We want to protect that. We've got a lot of satellites. We've got programs underway to take people into orbit and a lot of them will be going to the International Space Station. Some will be going to other destinations like the Bigelow [Aerospace] station [Next-Generation Commercial Space Station] and other commercial destinations, so we're going to have lots of people there and lots of expensive satellites.

Does it make sense for the government to have some kind of oversight or involvement in those activities? I think you could make that case, and so we're in discussions with other parts of the government right now. We'll see whether Congress decides that it's appropriate to designate an agency as being responsible for ensuring that we minimize the chance of collisions or additional orbital debris being generated during all of the activity, and we can keep people safe.

HACKLER: One of the other areas of activity your office is involved in is the development of commercial spaceports. The Mid-Atlantic Regional Spaceport, where Orbital is launching from—could you talk a little bit about the various issues there, with it being private-owned but having government involvement, and the various politics around that.

NIELD: As you mentioned, we do have responsibility to oversee commercial spaceports. We actually have eight different licensed spaceports in the U.S. today, and they're all different. There is not one standard architecture. The first four are your traditional launch sites with a launch pad and a gantry, and that's the way we've always launched rockets. The other four, that have been granted their licenses more recently, look more like airports. They have runways and hangars, and they're designed to accommodate horizontal takeoff and landing vehicles that might be developed.

In each case, we're not dictating, "This is what you have to have, you have to build your spaceport just like this." It's either a state or a local community or some other entity that is deciding, "We want to be a part of this, and here's the market we're going to go after. Here's the kind of vehicles we want to have operating out of this location."

It's interesting as a point of comparison to look at Spaceport America in New Mexico. Out in the boonies—that can be a good thing for safety. There are not a lot of people and buildings and things around. It's a very beautiful area. There is an interesting story that I used to hear Governor [William B. "Bill"] Richardson tell about why they were getting involved in space. He used to ask the question, "Do you know what the most important export is for the state of New Mexico?" He used to say, "It's our children." Because they would grow up, and there are no jobs there and there is no future, so they would go somewhere else.

He was able to convince the New Mexico legislature, "We need to have a program that incentivizes people to stay here, with jobs and technology and reasons to study math and science and engineering." It can be the Gateway to Space, which is what they've named their terminal hangar facility out there. That will be the headquarters for Virgin Galactic when they complete

their testing. It's pretty interesting, and a very different type of a setup than you'll find at Cape Canaveral or at the Mid-Atlantic Regional Spaceport [MARS].

In the case of MARS, we've got the NASA Wallops [Flight Facility, Virginia] there. They've done a variety of things over the years with aircraft testing, and a lot of suborbital sounding rockets, but now the state of Virginia wants to be a big player and they have put together this attractive package for Orbital to fly their missions out of there with their Antares rocket.

There are a lot of great, smart, experienced NASA employees and contractors that are already there, but this is a big rocket now, and it's a little different than some of the activities that they've had in the past. There have been some challenges in terms of getting the launch pad itself ready to go. Larger vehicles than they've had in the past, and these are liquids instead of just the solid rockets. It's taken a lot longer and has been a lot more expensive than Orbital, and many others I think, were hoping for at the beginning of the program, but now we're getting very close to their first demonstration launch and hopefully all the challenges are behind them.

HACKLER: How have you worked with them to help overcome those challenges?

NIELD: Orbital is very motivated to have the facilities that they need to conduct their launch, and MARS has responsibilities in terms of overseeing the facilities and the hardware that they're responsible for. NASA, being the host, if you will, is also very involved. The state of Virginia wants to make sure this is acceptable too, so everybody is trying to work together.

This is not a program that we are managing; we're not spending our money. We're not on the hook to have a particular spaceport be successful, or even a particular company or a

particular rocket. We try to be objective and helpful, but we're not asking for the latest schedules and demanding test data. It's basically, "Prove to me you're ready to go and I'll give you the license," and go forward from there. It's really not our role in this process to have on-time, on-budget completion of the program, although we're certainly rooting for them to get it done as soon as they're able.

HACKLER: I have one more question I'd like to ask you before I turn it over to Rebecca to see if she has any follow-up questions. Since you've been with the Office of Commercial Space Transportation the last 10 years and you've seen the COTS program through from beginning to end, in your opinion, from your perspective, what has been the role of COTS in helping get commercial space transportation started?

NIELD: I think COTS has been a fantastic program. It's been a new paradigm. It's been a new way of doing business. It and the X Prize, I think, have been the two key factors in helping commercial space show significant progress in recent years. Now I am an optimist, and I strongly believe that commercial space transportation is going to do great things and be successful going forward with or without the government, with or without the FAA, with or without NASA.

It's just going to happen, but the government can make a huge difference in how fast that future comes about, and doing things the COTS way is the way to have them happen most quickly and most successfully, in my opinion. This is not the way we've always done it, and there have been a lot of challenges. There have been a lot of skeptics. There have been a lot of

critics, but each step of the way it's becoming harder and harder to criticize and to argue against this way because we're getting some fantastic achievements for minimal tax dollars.

HACKLER: How do you address those skeptics when they express their criticisms?

NIELD: I serve as a member of Aerospace Safety Advisory Panel, ASAP, which advises the NASA Administrator and the Congress on the safety of things. Again, a great team. I really enjoy working with them, but we have a lot of folks on the team that are used to doing things a different way. I try to present the other side of the argument to show what's been happening. The only way really to win the argument in the end is to demonstrate it. "See, it happened. You didn't think it would, but it did."

We can look at SpaceX with their three missions to the International Space Station, and Orbital is getting close to demonstrating their capability to do the same kind of mission. We've seen great progress in similar programs with the Commercial Crew [Program]. I really think there is a lot of merit for this type of approach, both for NASA and for other government agencies. It's getting very difficult in today's budget environment to continue to do things the same old way. We have to look for new and better ways to operate, and this looks like a way with a lot of potential for me.

HACKLER: I did have one other thought—you mentioned the Aerospace Safety Advisory Panel, and one group that your organization works with is COMSTAC, the Commercial Space Transportation Advisory Committee. How do you work with them?

NIELD: That is a group that meets twice a year and they provide us advice and counsel. We get together and share the things that we've been working on, and then we listen to questions and concerns and recommendations that industry has on how we're doing business. We try to be a learning organization and listen to the feedback that we get, and so we're always interested in how industry feels about it. We think we have a pretty good sense for how folks are feeling about our regulations and our policies and our procedures, but if people aren't happy then they'll tell us and we'll see if we can address their concerns.

The other thing we try to do is we may be working on a particular project, and we may not know what is the right approach. We'll actually task the advisory committee to come up with a recommendation on how should we handle this particular issue because, as I mentioned before, many of the things we do are being done for the first time. There is no template. There is no cookbook that we can just pull off the shelf and say, "This is just another one of those, we've done that several times before." We're having to figure out what makes sense. Again, safety is at the top of the list, but we want these companies to be successful too. The only way to absolutely guarantee safety is not to launch at all, and that's not the right answer.

HACKLER: Do you have any specific examples of recommendations that you were able to implement?

NIELD: Most recently we've been starting to look ahead at Commercial Crew and how that's going to work. Congress has passed what is sometimes called a moratorium that says they don't want us to issue any new regulations to ensure the safety of the crew or spaceflight participants until industry has had some experience flying those missions. At the same time, they've told us

they want us to talk with industry about what industry would like to see or what things would concern them.

We've worked with COMSTAC to have monthly teleconferences with the public, with them as facilitators, and the key technical experts to try to look at some of the issues that are involved with the kinds of regulations that we might end up needing for a commercial human spaceflight. To have the feedback on, "Do we want a numeric target for safety, what kind of medical requirements would make sense, do we need to have a certain level of redundancy as a requirement from the government," things like that. There are different opinions, so we're interested in what does industry think, what does the public think, before we actually start to draft something that could eventually become a regulation.

HACKLER: Thank you. I'd like to turn it over to Rebecca Wright.

WRIGHT: A couple of questions—you mentioned that COTS has been fantastic on the return on investment from the tax dollars invested because of the way they've chosen to do business. Can you point out a few things where you feel that the way that they have structured the program has been beneficial for the overall scope of commercial flight?

NIELD: It's really a new way of doing business. The typical way of doing business in aerospace—which by the way is different from the rest of the U.S. economy—is that there will be a cost-plus contract and the government will dictate every detail of how they want the design and when they want it done and how to achieve the desired result. You'll hear people say, "We've had industry working with NASA for 50 years. What's the big deal?"

The big deal is we're doing business a different way. The government is not deciding how to design an Antares, how to design a Falcon 9, what kind of systems they need to have. They're just saying, "Here's the product we want. Here's the service we want to buy, and we're willing to do that on a fixed-price basis. We'll tell you the requirements that you have to meet. If you successfully meet the requirements, then we'll pay you. If you don't meet the requirements, then we won't pay you."

And so this is a great value for the taxpayer. Instead of the typical aerospace program, where there are inevitable delays and problems and issues—if you're on a cost-plus contract, then that just means there's a schedule slippage and the overall program cost continues to increase. The well-intentioned companies are happy with that because they continue to be paid by the government to find the problem and continue to work. Even though they might not have chosen a particular design, if that's what the government wants and the government is willing to pay for it, then they'll do it.

Not that anybody is bad—there are good people involved—but it's a question of what are the incentives. Are you open to new ways of doing business? Are you open to innovation? Are you open to American ingenuity? If you structure a program such that—instead of how you want it done, you just say what you want done. "Deliver this amount of cargo to the International Space Station, we'll pay you if you do it. If you have problems, you'll have to try again. Otherwise, you won't get the payment." That's a completely different way of operating and I think it's proven to be very successful.

We've also been able to keep some competition. For the last several years, we've seen some downsizing, some mergers, some companies go out of business in aerospace, until you've basically got a monopoly with one launch provider. They're doing a great job and they have a

great record, but if there is no one to compete with then I think that takes the edge off of things. Maybe it will cause you to take your eye off the ball and not be thinking about, how can I make it better, how can I make it more reliable, how can I make it safer, how can I make it lower cost.

NASA is in the same situation right now with delivering people to the Space Station. We have only one way to do that, and that's to buy seats on the Russian Soyuz. Now that the Shuttle has been retired, if the Russians decide they want to increase the cost, we have no other alternative. As soon as we can get some U.S. companies demonstrating that capability, I think we'll be in a much better position. I'm hopeful that we can continue to use the same basic model that we used in the COTS program as we go forward on commercial crew development.

WRIGHT: You just gave a great explanation about the cost savings regarding NASA by involving commercial space groups, but if you take the space agency and its benefits out, what are the benefits for this robust space industry for the public? How does it benefit the government to be so involved in promoting this new industry?

NIELD: I believe great things are going to happen in space, but today and going forward the government doesn't have enough money to pay for all those good things. We're not going to have the government pay for multiple rockets for many different purposes. In fact, NASA has barely had enough money to keep the Shuttle operating back and forth to the Space Station over the last number of years. Does that mean we're constrained in terms of what kind of space program we can have? No. Only if we say, well, everything has to be done by the government.

If we can open up our horizons and say the government can be the anchor tenant or the prime customer, or focus on exploring—it can be the leading edge. We can demonstrate new

technologies and then we can have other people come behind. Then industry can continue to grow. There can be more activity. What do I mean? If NASA can get comfortable with private companies delivering cargo, like SpaceX and Orbital on COTS and CRS [Commercial Resupply Services], then we can use NASA funds and NASA people to do the hard stuff, the new stuff, like going back to the Moon or going to an asteroid or going to Mars. Without having to have the rockets, the engineers, the control room, everybody focusing on going back and forth to low-Earth orbit. That's something we've done for 50 years.

Now it's not easy. It's hard, but we've done it. We know how to do it, and we have good companies that are stepping forward to say, "Hey, give me a chance." I think that's the secret. If we can have the government focus on the new stuff, the hard stuff, and allow industry to help, you can leverage your investment and end up with a larger market and additional funds, all of which potentially can benefit the public at large.

Examples—the suborbital segment has almost no government money invested in it. Yes, the government has done demonstrations. They've learned all the things about rocket engines, vehicles, and all the rest. We've had the X-15 Program and so forth and so on, but these companies are using their own money and developing systems to take people up to the edge of space and back. I am absolutely convinced that in the next few years, we're going to see multiple companies launching suborbital space tourism flights to the edge of space hundreds of times a year with thousands of people getting a chance to personally experience spaceflight. Now think about that for a minute. I mean, yes, it's suborbital, so some people say it's not a big deal. Well, it was a big deal when Alan Shepard did it, and that was billions of dollars and thousands of people. Now we're talking about small companies doing this and opening it up.

It's fascinating to me to compare the development of aviation with what we've done in human spaceflight. If you look at the first 50 years after the Wright brothers, gosh, what a tremendous growth. Hundreds of companies building airplanes, thousands of different models and millions of people being able to buy a ticket and go fly somewhere. Yes, there were a lot of accidents along the way, but we've learned a lot from that activity and so today aviation is the safest way to travel. It's a rare event when you see a commercial airline accident, which is a tremendous place to be.

How did we get there? We had a lot of activity by the industry. Eventually we had government regulations and oversight incorporating best practices, lessons learned, common sense, ways to design things. We don't have that kind of experience today in space, and we were never going to get there by flying the Space Shuttle six times a year. We're going to have to learn what's important, what makes sense, what kinds of ways do we need to and want to develop and operate these space systems in the future.

When we get there, it's going to open up space to anybody who can buy a ticket. Right now it will be very expensive, but as soon as we start to see competition that price is going to come down. You know it will. These companies would be silly to lower the price now because there are people lining up to buy them at \$200,000 a seat. So you've got the whole suborbital industry.

We see other examples like the Google Lunar X Prize, Inspiration Mars, Golden Spike, and the B612 Foundation [dedicated to protecting Earth from asteroid strikes]—a lot of groups with academia and industry, mining companies that want to go capture an asteroid and bring back the goodies. It's not just because it's a NASA program. NASA can help, NASA can facilitate, NASA can advise. NASA can incentivize and encourage, and I hope they will, but it

doesn't all have to be NASA programs. If we can get over that thinking, I think NASA and the government and the public can all benefit.

WRIGHT: Do you see an evolution in the overall thinking of the National Space Policy because of the emerging markets that are coming through now?

NIELD: We're seeing more and more emphasis on and talk about commercial space transportation in the national policies, so the National Space Policy from 2010 and the new National Space Transportation Policy which will be coming out soon both have a lot of discussion about commercial space and the fact that this is a good thing and the nation wants to encourage it. Yes, I see that growing over time. At the same time, NASA will appropriately focus on exploration, and get beyond the back and forth routine transportation and do the new, hard things.

WRIGHT: When you go to testify on the [Capitol] Hill or when you talk to [Congressional] staffers, do you get a lot of push back? Or are you getting a lot of encouragement, as in questions on how best to move commercial spaceflight forward? Or, are you getting a lot of questions from skeptics of why we should be pushing this down?

NIELD: There is a range of opinions. I see my role in this position as being someone who can tell the story in a way that helps people understand what's involved, what options does the nation face, and how commercial space can help NASA. Typically in the past when you would say "space" you meant NASA, so people who like space stuff just assume that that means NASA.

That's fine, but I think we're learning today that it's not just NASA, and we need to look at what else can happen that can be of benefit to NASA, including lower costs for more reliable systems, and leveraging the government investment and taking care of things that NASA has already demonstrated so that NASA can focus on the other things. It's a challenge. Not everybody has the same viewpoint. There are different approaches that we can take, but I'm pretty excited about the direction we seem to be heading.

WRIGHT: The last question is just a process question about getting a permit. What's the cost?

NIELD: We don't charge anything. It's just a question of do you have staff members who know what they're doing, and how long does it take them to gather together the appropriate information and submit that to us. How long does it take? Well, it depends on how much experience and knowledge the people have.

By law, we're required to evaluate and make a determination on a launch license application within 180 days, but it has to be complete by the time that clock starts. A permit is similar, but it's 120 days. We encourage people to come to us as soon as they start thinking about what they want to do so that they have a better understanding for what we expect of them, what the requirements are, and what the process looks like. They can give us drafts and we're happy to give feedback along the way.

WRIGHT: I guess the thing that has changed the most in the last few years for permits is the reentry side. Lots of people were launching rockets for satellites or for commercial ventures in

the sense of communication, but now you have the X Prize and the tourism factor. Are you having to see how the vehicles are going to impact the nation as they reenter?

NIELD: The suborbital segment is really brand new, and it's going to be a significant part of what we do going forward I think, for the reason you just mentioned. Actual reentry from orbit is still rather rare. Right now SpaceX's Dragon is the only system that can bring back cargo from the Space Station. Even Orbital is just delivering things, and then they will reenter the trash. The Soyuz is not able to bring back any significant amount of material or experiments. The capsule is just too small.

WRIGHT: And the last question is, what do you do when you have a company like SpaceX? You've been working with them, but they've decided now they're going to launch somewhere else. Does the FAA have jurisdiction into what they're doing if they're not doing it on U.S. soil?

NIELD: We sure do. Under U.S. law, any U.S. citizen or company that wants to conduct the launch of a launch vehicle anywhere in the world has to get a license from us. So that's an interesting thing. A lot of people did not understand that, and in COTS there were companies who thought, "I don't want to have to deal with the FAA. We'll just launch somewhere else and then we won't have to worry about a launch license." Wrong! The law says they still have to come to us, and we'll work with the host nation in terms of any particular requirements they have.

We've had Pegasus launches based from locations outside the U.S, there have been launches from Australia that have gotten an FAA license in the past. That's not a way to get out

from under regulations. Similarly, any non-U.S. company that wants to launch from the U.S. or to reenter to the U.S. also needs a license from us. The idea is that under international treaty, the launching state is ultimately responsible if damage is done. How can the U.S. protect itself from being sued or having to pay damages in the future? Well, it can ensure that it's done right and is as safe as we can make it. We do that by requiring somebody get a license. That's the law.

The only exception to that is for launches that are conducted by and for the government. NASA did not need one for the Shuttle, but now NASA is not operating these systems. Now it's SpaceX and Orbital, so they need to get a license even though they're being done for the government. The government is not doing those operations. That's why there's a difference.

WRIGHT: Although NASA, through the COTS program, views the commercial businesses as their partners, the FAA does not see them as such because you've given a license to those commercial industries. So NASA is not liable if there is an issue with the vehicle when it reenters or when it launches?

NIELD: That's right. We're the regulators and we hold the company responsible for safety. Now there are certainly people, including many people in NASA, who are nervous about that, and maybe appropriately so, that the public will blame NASA if something goes wrong. That may well happen, but from a regulatory viewpoint the FAA holds the company responsible for safety.

WRIGHT: Thank you. That's very interesting.

HACKLER: In your role as the AA for AST [Office of Commercial Space Transportation], what do you see as your biggest challenge?

NIELD: Well, we have a lot of challenges going forward. Certainly the whole issue of commercial human spaceflight is going to keep us busy in the years ahead. Frankly, I think one of the most important things we're going to have to do as a community is think about the accident that is going to happen. We know that, as Congress has said, spaceflight is inherently risky. If you look at any mode of transportation, we have accidents every day. Thousands of people lose their lives in automobile accidents, airplane accidents, boating accidents, train accidents.

We shouldn't think that because in aerospace we're smart and we try hard and we value safety that we're going to escape without any accidents in the future. We need to think about that. We need to be prepared for that. We need to ensure that the public, the Congress, and the media have realistic expectations that we're going to do the best we can, but we want to be able to have these operations take place. If there is an accident, we investigate, we figure out what went wrong, we fix it, and we get back and continue to operate instead of grounding the fleet for three years and thinking about whether we should do this at all because somebody got hurt. That's not the way America was formed, and I don't think that's the way America should be.

HACKLER: Thank you. Are there any final thoughts or important pieces of information you'd like to share before we close out today's session?

NIELD: Just to reiterate that I'm a big COTS proponent. I think that the idea was excellent. It probably went under the radar for a number of years and people were not paying much attention to it, but now we can start to see the results. Especially in the challenging budget environment, I think that it will be a great case study, a great role model, and a great reference for how to operate successful, forward-looking government programs in the future.

HACKLER: Thank you very much.

[End of interview]