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EDITED ORAL HISTORY TRANSCRIPT

BRYAN D. O'CONNOR
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is August 3, 2011. This oral history with Bryan O'Connor is being conducted for the Johnson Space Center Oral History Project in Houston, Texas, and is the fifth interview conducted for this project. Sandra Johnson is the interviewer.

I want to thank you for coming to our office for a change today. We appreciate it.

O'CONNOR: No problem.

JOHNSON: At the end of our last interview, we were talking about the [Space Shuttle] *Columbia* [STS-107] accident and the investigation and some of the work to address those issues that were determined to be the cause of the accident. Today I'd like to talk about the return to flight [RTF] in July 2005 and some of the challenges that your office in Safety and Mission Assurance [S&MA] had and your role in getting that mission ready to fly and certifying that safety of the [Space Shuttle] *Discovery* for [STS-]114.

O'CONNOR: My memory of this return to flight, as compared to the post-*Challenger* return to flight [STS-26], was that there was a slight difference in the degree to which we re-certified the vehicle. I remember after the [Space Shuttle] *Challenger* accident [STS 51-L] we did basically a full-up design certification review where we re-baselined all the paper, went back and reviewed

every single hazard analysis report, every single FMEA [Failure Modes and Effects Analysis] CIL [Critical Items List].

We did something similar to that after *Columbia*, but I don't think of it as being quite as detailed. I think one of the reasons for that is we had done such a good job of detailed re-baselining of certainly the Safety and Mission Assurance products, the FMEA/CILS hazards and risk analysis the first time through, that we didn't have quite as much work to do to re-baseline them after the *Columbia* accident.

Both of those accidents were remarkable in that we didn't just focus on the actual cause of the accident itself and leave everything else as though it was okay. We stepped back quite a bit and said, "You know, if that thing got us, I wonder what else is hanging out there." I remember the [NASA] Marshall [Space Flight Center, Huntsville, Alabama] guys, Mike [Michael U.] Rudolphi, his title was Deputy Program Manager for Propulsion at Marshall. I might have that wrong, because he might have been Chief Engineer too. [He became Director of Engineering in November 2005]. He and I had a couple of discussions about how the acceptance of an unacceptable situation had really gotten us on *Columbia*, where we rationalized the foam as being something routine and expected and probably okay, and, yes, we'll take a look at it and we'll record it, but we shouldn't worry too much about it because it can't really hurt us. That's the way we characterized it. And we were wrong. It was obviously catastrophic, but only in retrospect did we really understand how badly we had mischaracterized it.

Mike Rudolphi's action at Marshall probably represented one of a thousand such discussions and reviews that people were doing all over the program. If we fooled ourselves on this, I wonder what else is out there waiting to get us that we maybe have mischaracterized or underestimated.

I remember he was talking to me about the chapter in Diane Vaughan's book [*The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA*] on the *Challenger* accident that talked about the normalization of deviance and how this had a huge effect on him personally. He got his folks there at Marshall in the propulsion systems to dig around and see what else was there that might be another problem waiting to get us somewhere else, in the main engines, on the tank, in the solid rockets, whatever. They came up with something like twelve or fourteen candidates, if I remember right, of possible issues that were not acting the way we hoped when we designed it, but we were calling it okay. Everybody knew what these were, it's just that he said, "I want you to pile those up on a table, and one at a time really look at them."

They came up with seven steps that they would go through, which have since become baselined in the Shuttle Program as the way to approve technical issues for flight. They are called the Seven Elements of Flight Rationale. These are good, solid systems engineering-type questions that you ask whenever there's an issue that comes up where something's not acting the way it was designed to.

I think we had learned from the *Challenger* accident the difference between, and how to be careful about, things that are in-family but outside of design intent. When we look back at the *Challenger* timeframe, at the same time during its return to flight, that was one of the things we discussed quite a bit. We had characterized a lot of issues as in-family and, therefore, okay. But we decided that that wasn't good enough back then, and so that discussion reemerged here during post-*Columbia*. Challenge something that's acting in a way we did not design it to, even if it is in-family. Don't just accept in-family as a rationale. That kind of thinking and that kind

of philosophical approach to issues was characteristic of the return to flight activity and getting ready for the next mission.

Of the twelve or fourteen candidate things that they looked at, they (Engineering and S&MA) went through these seven steps and other things, too, depending on what they were, and got very comfortable with all of those issues and were able to say to themselves and to the program that we don't think there's another normalization of deviance waiting in the bushes to get us here in the propulsion systems. I thought that was a really robust and reconfirming discussion that we had during that time, and I'll never forget it. The team really did turn to and, I think, take a page from that accident and learn from it. And this was well beyond what the accident investigation board was recommending. This was really good, solid self-analysis by our team. That's just one of the things that I remember.

There were a lot of other things we did during the return to flight period that were more root-cause kind of things, like better communications and making sure that we had the ability to get other assets if we needed to have pictures on orbit, but the Seven Elements is the one that I remember the most.

JOHNSON: Were you involved or were you there when they were doing the tests in San Antonio [Texas]?

O'CONNOR: No, not personally. There were JSC S&MA folks there though.

JOHNSON: Were you surprised by those test results?

O'CONNOR: When they fired foam at the wing?

JOHNSON: Yes.

O'CONNOR: I remember it was on the seventh test that they broke it, and I wondered, "What if we had quit at six?" This would have come down as a big unknown, and "We still don't know what happened." But on that seventh one, they were able to put a big hole in the RCC [reinforced carbon carbon] leading edge, and that became the smoking gun, and we could now say, "Okay, here's what we've got. We've got a high-speed big chunk of foam that has enough energy in it to damage this RCC, catastrophically damage it, and here are the pictures."

Everybody was just amazed, because everybody has their own experience of driving down the highway and somebody's got some kind of a 7-11 beer cooler in the back, and a piece of it flies off. It might be six inches by ten inches long, maybe an inch and a half thick, very lightweight white Styrofoam, and once it gets up into the air, it immediately stops its own relative motion with respect to the highway and therefore becomes very high speed when it hits my car because I'm going sixty [miles per hour]. It has immediately gotten to zero, so I hit that thing at sixty miles an hour and you don't even hear it, it's so light. It hits you right in the windshield and it scares you a little bit, but when you think about that, you wonder, well, how could that thing bring down a Space Shuttle, something like that? But it did.

JOHNSON: I know from some of the other interviews we did, people were very surprised when that happened. Nobody expected that.

Did you feel any time pressure during that period to return to flight?

O'CONNOR: No, I didn't. I didn't sense that there was pressure on NASA to hurry up or even within NASA to hurry up. I was watching for it. Now, schedule is an environment. It's not really a risk. It's just an environment we live in. You have to have a schedule if you're a program. The first priority, of course, of the program is to fly safely, and to fly means you're actually going to do something. You're not just going to hide. And doing something involves a schedule. So realistically, there's always schedule pressure, but it was nothing compared to some of the cases we had had before *Columbia* when people were really concerned about schedule pressures and posting websites on the NASA site with countdown clocks to ISS [International Space Station] assembly complete, and all the pressure that people felt to get these Shuttle flights up and down quickly. There was nothing like that at all.

You could probably find some people who will tell you that there was schedule pressure for their particular task that they were doing, and I wouldn't be surprised at that, but it was not a pervasive, real driving thing. The program showed many times during that return to flight time that they were willing to back off a bit to give people time to do things right.

JOHNSON: The launch went off in July of 2005 with Eileen [M.] Collins as the commander, and when they got to the ISS, she did the flip and flipped the Shuttle over and they took photos. I know they had cameras onboard, too, during the launch and everything that had never been flown before.

O'CONNOR: Yes. A lot of photography on this flight.

JOHNSON: Were you involved in getting any of that set up?

O'CONNOR: Well, not operationally, no. Of course, my particular job was at the management level overseeing these kinds of things. We had lots of advice from the *Columbia* Accident Board on making sure you had enough photography and radar and all these various things to be able to characterize what's going on in ascent and to make use of photography in flight any way you could.

The team took that advice, but they created a system that I thought was very robust, and in retrospect, we should have been doing since STS-1 and just weren't smart enough to know that we needed to. But it is the right way to characterize something that has the sensitivities as the Shuttle as far as the skin and the TPS [Thermal Protection System] and the inherent vulnerabilities of it. We've been using it to this day to see how the vehicle is doing and to investigate the leading edge of the wing and to do the flip and see if there's tile damage.

One of the things a lot of people don't realize is, yes, we have all these cameras and we have this photography, but were we really prepared on that flight in July to analyze all that stuff? Today I'd say no. We did the best we could, but the analysis of the photo and radar has improved significantly since then, and I think it's really topnotch today as we finish up the last flight.

The safety folks have a meeting called the SPIT [Shuttle Problem Investigation Team], and it's a team of folks that prepares the safety community to go and represent SR&QA [Safety, Reliability and Quality Assurance] in the MMT [Mission Management Team] meeting that's coming up, chaired by the program manager or deputy program manager. In the SPIT meeting, in the first few days of each mission they talk about what they've seen in the photography, in the

film and radar and all these other things, and the analysis results for the damage that might have been caused by tile strikes, RCC strikes and so on. As this goes through the first four or five days, they get all the raw data down from the Shuttle and then they run through these analyses, including modeling. That's the other thing, the analysis includes models that they have, and these models were pretty preliminary on that first mission after RTF.

The other day when they were looking at the [STS-]135 results, and even though the 135 mission was relatively clean, in fact, I think it was one of the cleanest flights we've ever had as far as damage goes, they did still have some tile nicks and hits that they needed to clear. I think there were six or seven of them that got on the list. They have a chart that shows the tile in one column and the characteristic, if it was a ding or a hit or a scrape, and then there's another column that says the quality of the modeling that is being used, or the pedigree of the modeling, and it ranks as A through D, A being the best.

What they do is they say, for this type of tile in this particular place on the orbiter, we have a modeling technique that we use to determine how deep it is and what the risk is. If that model is a really good model that we have validated and can say it's really good, it might have an A. What that means is that you can pretty much clear the tile just from the model results. If you have a C model or a D model, it means that the model isn't all that good. We'll use it, we'll see what it says, but we're not going to base our decision just on that model. We have to use something else in addition.

The early flights in return to flight, some of these models were not As. They were B, C, D classification, and we needed to do a lot more thinking and analysis besides the model to clear the tile. By the time we finished up the program, though, these models had been improved so much that all seven of those TPS hits [on STS-135] had As. They were able to clear every one

of those seven by a well-validated model, and so it was fairly quick and efficient, certainly thorough to use that kind of quality of a model. I just thought, boy, there's a real indicator right there of how far we've come since return to flight. And it was, in my opinion, sort of an indicator of the culture, because you remember one of the criticisms we took on the *Columbia* accident investigation was the lack of safety culture and the lack of engineering curiosity. And using poor outdated and un-validated models was part of that story.

We beat ourselves up after the accident about all these things, but I can tell you the program, from [William H.] Gerstenmaier on down, right up until the very last flight, kept pressure on the system, the engineering team, to keep improving this system. Don't just freeze the design, don't just freeze where we are and say that's good enough just because we're in our last year, for example. They kept pressure on them to keep improving right up to the very last flight. That was as good a metric for me as the seven As there in the TPS list column.

JOHNSON: I imagine keeping that pressure on to keep improving, with people working in an environment where they knew the end was near and possibly not having anywhere to go after that, that might have been difficult keeping the morale up to keep pushing safety.

O'CONNOR: Yes. Starting a couple years before the last flight, we knew this was going to be a challenge, and the team really bent over backwards to go look for ways of keeping people focused. As we started winding down some of the work, releasing some of the production people that weren't needed for that last year or two because all the hardware was built, and then certainly in the last six months when a lot of operations people started coming off the program, they really wanted to make sure that the folks that were left were not distracted. One of the ways

they did that was they said, "Let's treat the ones that are leaving with a great deal of respect and care and let them know that we really appreciate what they've done, and although we may be losing them before the program is over, that we are here to help them out to find other jobs and to thank them for the tremendous work they've done over all these years."

I've never seen anything like it. And we've had independent experts look at that whole process. A couple of members of the Aerospace Safety Advisory Panel [ASAP] were briefed on what was going on with NASA and the contractors, especially the USA [United Space Alliance] operations folks down there at KSC [NASA Kennedy Space Center, Florida], to help the people come off the program with respect and dignity and keep the people who were remaining focused. They said they'd seen other programs phase out in the Defense Department, and they were rocky and there were issues, and there were concerns and there were people taking their eye off the ball, and there were angry moments and all these other problems that they can talk about. We had very, very little of that with the Shuttle phase-out. These people in the ASAP were really impressed with our process, and they said that we've set a new standard for how to phase out a program where the stakes are high and you can't afford to make a mistake right up until the last flight.

JOHNSON: I imagine the culture of NASA, which people have found problems with, but also that NASA culture of everyone focused on a mission, and I know from the people we've talked to at KSC, USA, their main focus was making it safe, making it fly. There's that other side of NASA culture that sometimes people don't know about, and I think that may have possibly led to that clean transition.

O'CONNOR: Yes. The Space Flight Awareness Program was a big part of our process. The idea was to go out of your way to let the workforce be a part of it, bring their families in, giving tours to family members that we really hadn't done before. Once they started doing this near the end here, they said, "Why haven't we always been doing this?"

And we got legislation at [NASA] Headquarters [Washington, DC] to allow NASA HR [Human Resources] people to help place contractors who were coming off the job, help them find other jobs outside of NASA. Normally, we're not supposed to do that (without special legislation). The contractors do that; we don't. We facilitate civil service placement maybe, but not the contractors. So we needed legislative relief to do that, and we got it. There was a lot of that kind of "bending over backwards" going on. Again, and it blew the minds of these ASAP people. They'd never seen that stuff. I thought that whole thing was done very well, and it was consistent with the human space flight culture that we like to think we've always had, and that is that people really are aware of the stakes involved when you're talking about human space flight and try not to become distracted, and really keep their eye on the ball.

JOHNSON: Going back to [STS-]114, they did have some dings and things, and as you were talking about the flights since then, they had the protruding gap fillers that they actually went out on an EVA [Extravehicular Activity] and pulled out.

O'CONNOR: Right.

JOHNSON: Then it was another year before we flew again because of some of the issues that they needed to go back and look at.

O'CONNOR: Yes.

JOHNSON: Were there any concerns in your area that there were going to be more problems with those following flights, or did you feel like it was being addressed the way it needed to be?

O'CONNOR: We had some issues and we had some discussions and some of them disagreements on things at the lower levels. There was a lot of concern about these poppet valves (main engine high pressure pumps) that were breaking. I remember that was one of the things that happened in the last post-RTF timeframe. That really was a tough job. The NESC [NASA Engineering and Safety Center] had their best people on it helping the program. We had our best people in S&MA working with the engineers really trying to figure out why this thing was breaking off, because it could really potentially cause a big problem if you had a piece of metal flying down that line under pressure with a gaseous environment and possibility of a fire.

Then, of course, we had all kinds of follow-on problems with foam coming off the tank. The PAL [protuberance air load] ramps, we had to fix all that. That took a while. Then the ice/frost ramps. The ice/frost ramps was one that included a dissenting opinion that actually got to the highest agency levels. The program was ready to go fly, but they had what we call a "red risk." I don't remember the details, but the ice/frost ramp story hadn't come together quite as well as our community, my safety community, would like to see, nor the engineering as well. We were actually "no-go" at the flight readiness review.

The program felt like it was an acceptable risk, even though it was red, and Bill Gerstenmaier was okay, but the Chief Engineer and I both believed this is one of those where

there's enough uncertainty that we ought to elevate this to the [NASA] Administrator level. So [Michael D.] Griffin came to the FRR [Flight Readiness Review], sat through the entire briefing so we wouldn't have to do it separately with him, and he determined for himself that this was acceptable risk. The basis for his acceptance was that he thought the analysis had some conservative assumptions and so it probably wasn't quite as bad as people thought. Certainly it was high risk, but maybe not as high as people were characterizing it just out of caution because of some conservative assumptions.

I thought that process went pretty well. It really showed that here you have folks who are called the Technical Authorities, Safety and Engineering Technical Authority, and they have the ability to raise something to the highest level in the agency, even if the program disagrees. In a way, the program appeals to the Administrator in a case like this if the Tech Authority actually owns the requirement, or in my case, if it's a safety risk story, and I, as Charlie [Charles F.] Bolden's safety authority, say that I believe the risk is unacceptable to be accepted at that level, the program level or the directorate level, then the program can appeal to the Administrator if they disagree.

The whole thing of dissenting opinion, the appeal process got to the Administrator level and in that same meeting was dealt with. The record will show that we had dissented and had no plan to appeal—I think maybe it's a little tongue-in-cheek, but I remember saying something under my signature that said, "I have no plan to appeal above the Administrator." I mean, who would I go to anyway (other than HR for a resignation form)?

JOHNSON: Right. [laughs]

O'CONNOR: I think what it says is that we've got a system that has the ability to go to the highest levels. We exercised it once during that post-*Columbia* timeframe, and it worked out okay. In retrospect, as time went on, they improved the models. They were able to work on some of these assumptions in the ice/frost ramp area. The risk analysis work was improved. The engineering was better understood. A year or so later, we realized in retrospect that it was okay to change some of those conservative assumptions, and when we did that, the risk posture actually improved for that very same issue, ice frost ramps.

Now, we also modified the ice frost ramps, but it shows that, in retrospect, Griffin was correct that it was conservative assumptions. I just wasn't smart enough at the time to say that, and my community wasn't willing to go out on a limb and say that either. We sensed that it probably was conservative, but we couldn't really prove it, and so we, in retrospect, realized that that was okay, what we did there was okay. That's a better outcome than the other one, where you say, "We think this is okay," and then later on you find out that they were not conservative at all, made a big mistake, and you killed the crew. So, two pieces to that; the final outcome was good, and, number two, the process worked okay.

Some people complain that maybe we spent too much time on it, that in fixing these ice/frost ramps, there was a lot of wasted work because it wasn't as bad a problem as we thought, but I don't buy that. I think in the end, the system was improved and met the design intent. The design intent from day one before the first flight of the Shuttle was that this thing shouldn't come apart in flight. I think we never actually quite got there, because even on the last flight we had little pieces of foam coming off the tank. It shouldn't happen at all, but we were much closer to the design intent by the time we finished up this program.

JOHNSON: Let's move on to another discussion of NASA culture. In 2007 the Lisa [M.] Nowak arrest happened, and because of that, Mike Griffin commissioned an independent panel, the NASA Astronaut Healthcare System Review Committee, to examine how well NASA attended to these mental health issues with astronauts. Of course, in the initial report they talked about the possibility of astronauts flying under the influence of alcohol, and they had testimony or information about that. The Space Flight Safety Review Committee was established to review the independent committee's findings, and you were a part of that.

O'CONNOR: Yes.

JOHNSON: Do you want to talk about that period of time and what you did as far as part of that panel and your involvement in that investigation and how long it took?

O'CONNOR: Yes, that was a big chunk out of my time. I learned a few things about how the preparation for flight had changed since I'd been through that process twenty years earlier, and also about the Soyuz, when we prepare an astronaut to fly in a Soyuz and how all that works out, where they stay and how they interface with the flight surgeons. So it was a good learning experience for me to see how we're actually preparing for these missions from a crew member viewpoint. I was convinced when I looked at that that this was all red herring, it was bogus. It was probably good to challenge the system and just see how it stands up to a challenge like that.

I felt bad about the actual challenge, the nature of the challenge, was on NASA crewmembers flying under the influence of alcohol. It's kind of a slap in the face of the system when you allege something like that with no evidence. In a way, you really shouldn't be going

off and chasing something like that unless you have a little more evidence. When this panel suggested that this could be a problem, it was based on one of their members interviewing some person or a couple of people behind closed doors, by themselves, and then asserting what they had heard. I just thought that was a pretty flimsy way to go out and then turn around and formally challenge the astronaut corps and the space flight health community with an accusation like that. It's a real affront to character and integrity and shouldn't be done lightly, and for that I felt bad.

We got this official group telling us that we need to go take a look at this, and my boss has asked me to do it, I'll go do it. So I interviewed a lot of people, talked to people who were on these various flights, went down and talked to, or emailed, or discussed with people face to face, by email, some of them had left NASA, and just asked them outright, "Were you aware of any misuse of alcohol?" I talked to the flight surgeon community, and came up with all zeros. Some of them were appalled that I was even asking the question. I got to be the messenger there, but that's okay. I think they realized that I was just doing what I was supposed to do.

Now, I suppose you could say, well, of course, if somebody was aware of this, they may be hesitant to say something, so I didn't swear people in. We could have done that. If we really wanted to make a big deal out of this, we could have done it on a legal basis, but they didn't. They just asked me to go and talk to people as the safety guy, and safety guys don't swear people in. They just say, "What do you know about this? If this is an issue, we'd like to prevent it in the future."

It could be that maybe there was something there and I just didn't pick up on it by talking to people and listening to what they were willing to say, but I believe that there's nothing to it. It was a red herring. There might have been somebody who had a chip on their shoulder and used

this committee to vent a little bit about something. Maybe they exaggerated. Certainly there is alcohol in the crew quarters and over in Russia as well, but the idea that somebody would be influenced by alcohol on the day they're flying, it just turned out to be a big negative. So I wrote my report and, as far as I'm concerned, that finished that up.

JOHNSON: Were there any ramifications from it? Did anybody question your report?

O'CONNOR: No. I have a feeling that people realize that the way a safety guy investigates a question like that may not be the best way to do it. If you really want to get to the heart of a matter like that, you may have to use legal methods and have people swear on a Bible and do that kind of stuff, and because that's not one of my tools, I couldn't do that. There could be some people who might think that way, or maybe the IG [Inspector General] ought to look at it, because they carry guns around, badges, and they can swear people in. But that's just not how safety investigators operate, so I'm comfortable that we're okay, and if anybody thinks otherwise, they haven't stepped forward.

JOHNSON: It was in the news when all of that was happening, but we haven't heard much since then. Was there anything else that came out of that independent panel that you had to address, as far as safety, as far as mental health safety?

O'CONNOR: No, mine was just looking at that, at the alcohol thing. Again, I was pretty impressed with the flight surgeon community. There's always been a healthy tension between the flight crew and the flight surgeons, but a lot of that carried over from the military. The

Mercury astronauts didn't like hanging around docs [doctors] much. They saw the docs as being there to ground them. They actually did. Deke [Donald K.] Slayton was grounded, [Alan B.] Shepard was grounded after his flight, took him many years before he was back up and ready to fly again. I'm sure that there was a tension between those two communities that was very familiar to the fighter pilots, because that's the way they treated and were treated by flight surgeons when they were flying fighters in the Navy, the Marines and Air Force.

When I got to NASA in 1980, there was some of that there, but I didn't sense that it was nearly as bad. There seemed to be more camaraderie. We had medical doctors in the astronaut corps, and you would think that that would help cement some of that, but actually some of it didn't. We had some medical doctors in the astronaut corps who seemed to be biased against the medical community themselves. Maybe it was professional differences. We used to laugh that some of the worst offenders in the crew office on health matters were the medical doctors. When I showed up in 1980, there was one smoker in the astronaut office, and it was a doc, a medical doctor. I won't tell you who it was, but I'm sure people could easily figure that out.

There was a story going around about how one of the medical doctor astronauts got hurt, actually cracked a bone playing softball, and didn't report it to the flight surgeons, went out and talked to another doctor out in town, outside the system, so as not to be grounded. Shenanigans like this were just signs of this healthy tension, I think.

The medical community that supports today's astronaut program is world-class, and although there might have been some friction here and there and maybe some rare occasions where there was unprofessional stuff, by and large, those people are all about not grounding the astronauts, helping them to fly. They have to ground them sometimes because that's why they're there, not just to make people healthy, but to see when they're not and make sure they don't fly

when they're unhealthy. They have to do that too. I learned a lot more during that study about that history and about where they were then with respect to the crew office and keeping them healthy.

This thing about mental health was an offshoot of that whole area. There's always been an issue, or there had in previous times been an issue with the mental health side of the medical community being a little bit isolated from the flight surgeons, and due to medical privacy, and trusting that the medical guys would share what they were learning from their work when it was appropriate with the flight surgeons, but not everything, just when it was appropriate. There's a little bit of trust there that the mental health guy is going to talk to the flight surgeon when it's the right time to do so, but will also probably not tell him everything that they know if they don't think it's relevant. There was still a little bit of that there when I talked to the medical community about that, and I think that was one of the key things that they were looking at in the broader review, not mine particularly, but the broader review of the health program at NASA.

The Lisa Nowak thing was a combination of medical support and also mental health and family mental health and all these other things that are a part of that, and that's a tough thing to integrate. There's a lot of sensitivities there and privacy concerns by people, and if they think you're talking to a mental health professional and all they're going to do is transmit everything you've got to management, they're going to clam up. They're not going to say anything. There's a lot of trust that's part of that process and always will be. So, again, I got another taste of all that and saw how that works, and I was pretty impressed.

JOHNSON: Was it significantly different from when you were flying?

O'CONNOR: I know back when I was flying there was a lot more friction between the mental health guys and the management, the life science management, about sharing records. There was a lot more tension in there that I was aware of, not really part of it, but just aware of when I was here in Houston. This second review, I didn't see as much of that. It seemed to be they had figured out how best to share data and how to keep it private without causing a lot of concern or angst in the management. My guess is over the period of time of human space flight, this has been one of those areas that's fluctuated up and down. What's too much sharing and what's not enough? I did sense that there was some improvement there when I looked at it, from what I remembered back in the eighties.

JOHNSON: It's a sensitive subject, the issues of privacy and how much people are willing to share about their privacy.

O'CONNOR: Yes.

JOHNSON: I can imagine it would be very tough.

O'CONNOR: Also, they have the family involved. This isn't just the medical or the mental health professional and the astronaut; astronaut families, too, are part of this. They treat it as a family system, and if an astronaut's family is having problems that could translate to performance of the astronaut. A lot of that is pretty private stuff that is not appropriate to be shared with all these managers, who may or may not even have mental or even medical backgrounds, and yet it could be relevant to the flight surgeon who's preparing a crew to go fly

and needs to be aware that someone's under a lot of stress because of a family medical problem or a family mental health problem. This isn't really straightforward stuff, and it's tough, but I think they do a very good job today.

JOHNSON: Yes, it is very interesting how they handle that and especially for long-duration flight and preparing the astronauts and their families for that period when they're basically out of pocket. They can talk to them every day if they need to, but it's a different situation.

O'CONNOR: Of course, this was a big deal, not the mental health part, but the big deal about the family health on STS-134 when Mark [E.] Kelly was trying to decide whether he should go fly his mission with his wife, Gabby [Congresswoman Gabrielle Giffords], in rehab from the Arizona shooting, and still relatively early in the rehab, he's going to be going off training eighty hours a week and trying to care for her. That must have been a tremendous stress on that family.

JOHNSON: I imagine it was.

O'CONNOR: I don't know all the details and certainly would never second-guess his decision, but I wouldn't have been surprised if he'd have said, "I'm just going to back out of this flight. I've had a good career, and I've got to put my wife on front burner here." But then his own situation was such that she was in the care that she needed without him particularly and that he was comfortable with that, and that he was still able to get home at night and all these other things. He had to put all that together and figure out what to do, but it was one of those situations where I'm sure the flight surgeons were concerned about him because of a family

situation, not his own particular health, but just the effect it could have on him and his performance and his morale.

JOHNSON: Yes, it's quite a balancing act.

O'CONNOR: Yes.

JOHNSON: The changes in NASA that are happening now with the commercial operations and industry partners for astronaut transport, you had a statement before the Senate Subcommittee on Space and Science in March 2010, and you talked about some of those challenges of providing crew safety and requirements and standards that would apply to these commercial or industry partners. Since that was over a year ago, do you want to talk about some of those concerns that you had and if there are any plans or any standards in place?

O'CONNOR: No, I still have similar concerns. It's going to be tough. It's new for us to do such a thing. There's this real pressure on us to—let me put it in a simple way here. It might be an overstatement, but to get transport to and from low-Earth orbit on the cheap, that's really what it amounts to. We've got to do it cheaper. The way we do stuff when we do an acquisition is very expensive, usually takes longer than we thought, and although you can argue that we do a pretty good job technically, we have had failures, and so people are looking for something new. Why don't we let commerce handle that? And when you read our press releases, we talk about how we can focus on exploration and trust the commercial guys to get our astronauts to and from low-Earth orbit.

Now, that all sounds wonderful and it sounds like an easy way to get this done cheaply because you're going to have commercial people who are doing similar work for commerce unrelated to government civil space, but making money on commercial rides to space and therefore they'll be able to charge less for us to do it, and we'll be able to get cheap rides to and from [low-Earth orbit]. Also, it allows us to not have to depend on our international partner, Russia, for transportation to the Space Station. So those are all sort of in this strategy.

When you get down to the tactical part, I don't think we've figured it out yet because it is pretty new. Just the idea of buying a commercial service sounds reasonable, but when there isn't one yet, how do we get from A to B? It sounds like we're going to develop a service. We, NASA, are going to participate in a development of a commercial service so that then we can buy it later, and it might even be cheaper, assuming that this development winds up with a commercial service that they can actually go and make money on in a commercial environment. Since none of that's happened yet, it's all based on the possibilities of commercial service.

I remember wondering, why we are doing this? Isn't NASA about doing missions and then those missions are done in a way that according to the [National Aeronautics and] Space Act we're supposed to do spinoffs? That's part of our job. Spinoffs aren't just gravy that we just happen to come up with and we use to sell ourselves. Spinoffs are really inherent in our charter to go do missions, and in doing those missions that are unique to NASA, do them in a way that it has a benefit to commercial. But this sounds like we're turning that around, to me. It sounds like go and develop a commercial thing so that the spinoff could be our mission. Our mission becomes the spinoff now and the spinoff becomes our mission.

I remember thinking about it that way, and I was sitting there looking at the coffee table in my office, and there's a copy of the last *Spinoff* magazine, and there's a copy of the [NASA]

Strategic Plan. The Strategic Plan, every year when we put one of those out, it always has a picture of Mars on it. The *Spinoff* magazine has these little squares or rectangles with little pictures of things that people are doing out in civilian life that have their roots in something that we were doing in our mission. I envision somebody coming to NASA and saying, "Hey, let's tear the covers off those two magazines and transpose them. From now on, NASA's mission is spinoffs or commercial stuff. We're going to develop commercial stuff and then the strategic plan is going to be to accomplish our mission based on spinoffs from our commercial work."

I thought that's interesting and a real challenge for my community, certainly, and NASA in general. We're supposed to develop this capability, not just simply go buy it off the shelf. In looking for advice on how this will play, because I've got a little bit of vertigo when I think about it sometimes, I went and looked at the last version of the National Space Policy. There's always a place in the National Space Policy that talks about making use of commercial capabilities when they're available, but this particular version is worded slightly differently. The last go-around on this, there was a change in it, and it says—and I'm going to paraphrase this—"NASA shall not develop capabilities that are commercially available, or will be." So in the past, it has had other types of words, like "You shall not develop capabilities that are commercially available when needed," for example, but this one doesn't say "when needed." It says, "or will be," and it's open-ended.

If somebody comes up to Washington and has a bunch of viewgraphs that say, "I've got this idea for a lifter that'll take astronauts to low-Earth orbit, and here's my viewgraphs and here's a picture of this hardware we're prototyping, and I plan to have this available in 2020," and they are persuasive, then we find ourselves at NASA saying, "Well, there's an 'or will be' case right there, so don't develop something for low-Earth orbit. Buy that thing."

We turn around and say, "Well, okay, but it's not available yet. We can't buy a service yet because there is no service. They haven't even designed and developed this thing yet that's human-rated."

"Okay, that's a minor point. Go ahead and do something to make sure that that happens, but by all means do not develop anything of your own now."

So this is how the game is being played, I think, in Washington right now is that we're trying to push too hard to develop things that are commercially available. The dilemma for me is we're going to participate in a development activity, but doing it in a way that makes it sound like we're buying something commercial off the shelf. In other words, back off a notch, don't go in and have a bunch of NASA people doing design drawings. Let the commercial guy come with his concept and interface with him at a higher level. Don't create a great big program that has tentacles down to lower levels, Level Two and Three and Four and Five, and giving direction at element levels and project levels. Just back off and get to a high level, what I call Level Two, where our program manager talks to the commercial program manager and then we develop something together.

They're using Space Act agreements to facilitate their early development work, and you can only do so much with those, because by law we're not supposed to be using Space Act agreements to buy a service or a product. It's supposed to be a mutual activity where we are the investor and both get some benefit. If we're going to buy a development (as opposed to facilitating one), at some point we have to get serious and use contracts, and this is what we've decided.

What kind of contracts should we use? That's another big debate. Commercial contracts? Well, there isn't any commercial product yet. You use commercial contracts to buy

stuff that's commercially available, and it isn't yet. This is an R&D [research and development] activity. This is a development activity. Shouldn't we use contracts that are meant for that? And there are big debates to this day on all this.

We're bending over backwards trying to make this look and sound and taste like some kind of commercial activity going on, but there isn't a service yet. There isn't a capability yet. There's people launching rockets and having some successes and what I consider to be early prototypical development activities, but we don't have NASA requirements in place to verify. We don't have a human-rating activity going on yet. Nobody's really gone too far in developing abort and escape capabilities yet, and all these things that we're going to need. These are the things I worry about, is that it'd be a lot easier if we just said, "Look, this is going to be a NASA development for a NASA mission, and then we're going to spin off commerce from it," because that's our comfort zone. That's what we're used to doing.

This business of transposing the covers of our magazines is really tough, and I worry that we might miss something, that we might understate the need for insight or we might not be able to make some decisions that we really should since we're still going to be accountable for safety for our crewmembers. I think the nation will hold us accountable for safety for the crew. No matter what we say about buying a commercial service, it's not going to be like US Air[ways]. I'm a NASA employee and if I fly on a US Air aircraft and it's certified by the FAA [Federal Aviation Administration] and it's regulated by FAA for passenger safety, NASA's off the hook on that. Charlie Bolden is not accountable for my safety on that flight.

We're not going to get away with that on space flight. We're not going to be able to say, "That's an FAA-licensed activity. We're just flying our astronauts on these commercial launchers that fall under FAA responsibility. Then if we lose astronauts, our hands are clean

because this is a commercial thing. Go talk to the contractor or to the commercial vendor about this. We're just passengers." I don't think we'll be able to get away with that for a long time to come, so I don't know why we keep trying to operate as though that's the environment we're in.

JOHNSON: The operation is already moving that way, but the environment isn't there yet, and as far as safety, and it's not just passenger safety or astronaut safety, it's safety of whatever is developed, docking with the ISS, and also launch safety or accidents. The one thing I've thought of through all of this, and it worries me, and I'm not involved in safety like you are, but I think of *Columbia* and what happened with *Columbia* and the fact that it disintegrated over a populated area, and it was very fortunate for everybody no one was hurt.

O'CONNOR: It was a close call, though.

JOHNSON: It was a close call. What happens if that is a commercial vehicle? Who's accountable for that, the safety? Are those issues being addressed?

O'CONNOR: Yes, they are. We're having arguments about who should be responsible for public safety for these commercial activities. Even if we, NASA, are accountable for crew safety, the FAA has all the capability and authority they need to regulate for public safety. So do we sort of bifurcate the oversight; we do the crew and FAA does the public? That could be confusing and a little bit cumbersome to have two government agencies overseeing the contractor for different aspects of safety. There are people who want to do it that way, but I'm not sure that's the right way to do it. We don't do it that way for ELV [expendable launch vehicle] launches. When we

buy a commercial ELV launch, we, NASA, are accountable for public safety, and we deal with the range. The FAA is not involved.

Now, if that same company flies the same Delta IV for a commercial vendor and it's not a NASA or an Air Force launch, then the FAA knows how to, and has been for years, regulating commercial private launches for public safety, and they have the authority to do so. But to mix it up so you've got both NASA and the FAA involved, I think would be, at the very least, a little confusing to the launch people, because we operate differently.

FAA is a regulatory agency. They work with the launch company. They tell the launch company, "Go and work with the range [safety]. The Air Force Range, for example, has a bunch of rules and regs [regulations]. You've got to follow all those. But we, FAA, are operating with the launch company." If that launch company is a NASA contractor, and we are accountable for public safety and we work with the range, we don't just tell the contractors to work on their own with the range; we do it. So we operate differently from them, and all that stuff could be real confusing if we're not careful.

JOHNSON: In the public perception of it all, as far as safety, if something happens, and, again, with *Columbia* the response of those communities in that recovery and the goodwill between those communities and NASA, you wonder if that would be there in a commercial situation, because people want to feel like they're a part of NASA, because they are, because of their tax dollars.

O'CONNOR: Yes. Now, the commercial folks who talk about orbital flights are talking about landing returning crews in the ocean, so the chance of having a breakup in flight and debris

hitting land is much less. I remember the *Columbia* was a 39-degree inclination orbit, which put the track right over the southern United States, and we haven't done one of those since. All the entries into the Cape [Canaveral, Florida] since that flight have been, with maybe one exception where we came in from the north, I think, have been from the south coming across the very narrow part of Latin America, very little time spent over land on entry and then coming up into Florida across the Gulf [of Mexico].

The whole idea of what our role, what the FAA's role would be in this thing we're calling commercial space is up in the air right now. I just think we're kidding ourselves a little bit to think that we can relegate our responsibilities by simply calling something commercial when it really isn't yet. The FAA has no authority to regulate commercial yet, not until 2012, and when 2012 comes, they're allowed to put out regulations, but they're not being encouraged to, for crew safety, not public safety. They've been doing public safety for years, but they've been told by the Congress to back off. "Stay out of the way of these commercial guys. Let them make mistakes. Don't put a lot of regulations for commercial passenger safety on these guys yet." So there aren't any. They're not allowed to.

There's some thought that maybe that will be extended to keep the FAA away from regulating these guys, in order to allow them or take away some of the barriers to their success. But we can't operate that way. We're going to fly our people on these things; we have to put our rules in place. We have to certify that they're safe. Just because the FAA's not allowed to do so, doesn't mean that we can't or should not. That's the dilemma we're in here. We're being asked to do something that's cheap, and where NASA's out of the picture relative to what we've done in the past, so we're staying out of their way, but, oh, by the way, make sure it's safe. That's tough. I'm not smart enough to figure that one out yet.

JOHNSON: Do you feel like they're putting time pressure on this so that we're not relying on our international partners?

O'CONNOR: Yes. There's a lot of pressure to get away from Soyuz as soon as we can, and this gap that we've got where we've got to get American transport back to low-Earth orbit as soon as possible. We even use that word "soon as possible" sometimes. If somebody asks my opinion on words like that that we say in public or in testimony, I'd get rid of that "possible" thing. Even when they say, "Make something as safe as possible," I don't like to use that word, because "safe as possible" is don't fly. Safe as practical. Or as soon as possible, no. As soon as possible means you don't do any safety. We can launch something as soon as possible, but I can't guarantee it's going to work. So we should quit using that word. Everything's a trade. Everything has to be worked together. I usually scratch that word "possible" out, but the PAO [Public Affairs Office] guys love that word. It's a nice word. It makes the public feel comfortable that we're working really hard at something when we use that word. That's just one of my little pet peeves. But there is some pressure there that we need to get this thing done sooner, not later, and get off the Soyuz.

JOHNSON: Do you think this will really play out the way it is planned at this point? I know all of that depends on the next [presidential] administration and what they decide, what stamp they want to put on NASA during their administration, but do you see NASA really moving that direction in the future?

O'CONNOR: More commercial?

JOHNSON: Yes, more commercial.

O'CONNOR: Yes, yes, probably. I just hope people realize that there's a difference between buying a commercial product or service and developing one, because that second thing there really put us on the spot. Basically, I don't really think that's our job. Now, you can argue that it is, and people are doing that.

It's a philosophical discussion that's going on about NASA and why we're here and what we should be doing, and I've always thought that we ought to do NASA-unique missions. That's what we're here for, and we're challenged by the Space Act to do it in ways that have benefit to commerce. I worry that if we change that around and we become an agency that develops commercial stuff, that there's only so much that we can do, and if that's what we're going to do, then maybe we don't have enough money to do our unique missions. And if we're not doing unique missions, anybody can pass money from the [U.S.] Treasury to some commercial guy who wants to do something commercial, doesn't have to be NASA, and we may find ourselves being questioned as to why we're even here.

JOHNSON: There are those unique missions still going on.

O'CONNOR: Yes, we do.

JOHNSON: We're still having unmanned launches.

O'CONNOR: Yes. Thank goodness for the science side. Now, you could say that aeronautics does a lot of commercial stuff, and they do, but it's R&D. They're doing research and development things that have benefits to government and commerce, and they're doing it for those purposes. They don't have missions, as such, in Aeronautics. They don't go out and do missions, but human space flight has always been about missions, unique missions, and so it's a different track we've been on. I worry that if we get out of that and get into the business of NASA doing nothing but R&D that has potential to be used by commercial folks for commercial space activities, that we're going to suffer in the budget wars even more than we do already, if that's possible. I might be wrong on that, but I just wonder.

JOHNSON: When we did our interview for the NASA at 50 project, we talked a lot about your position and what you've done since 2002 and the challenges to your position and the outlook for your position in the future. You made the decision that you're going to be retiring at the end of the month.

O'CONNOR: Yes.

JOHNSON: What do you see for the Safety and Mission Assurance area that you're in charge of now and whoever's going to follow on after you? What do you see for that future, and what advice would you give to the next person in your position?

O'CONNOR: Well, lots of things, but one of the themes of a job like mine is what I call truth to power. You need to have the capability to see what we're doing and to characterize the risks involved and to transmit them and communicate them to the leadership, the decision-makers, in a way that lets them operate with their eyes open. Let's not fool ourselves. Let's not allow ourselves to be blind to vulnerabilities. Let's not step into things that are going to hurt people without discussing it.

Whoever takes this job really needs to be able to, and have the confidence of the leadership to allow them to speak up in meetings and say, "Have we thought of this?" or, "Do you realize this thing that we're about ready to do here bumps into about six lessons learned? Let's talk about those." You don't want somebody who's just sort of sitting there taking notes and watching. They have to have the ability, the experience, and the capability behind them to be able to bring truth to power. I think that's the most important thing about this particular job.

When I look at my own failings in the past, I think of it in terms of where have I fallen short in that task? Where did I miss something? Where did I not tell leadership something that I should have? Where did I keep something in because I didn't think it was important, and later it turned out to be? Where did I damage my credibility by waving a red flag when it wasn't appropriate? It's a fine line there. If you're thought of as a Chicken Little, nobody will pay any attention to you when you actually bring something important up. So you can't be that way, but then you also can't just let things go on for fear of being a Chicken Little and being too quiet.

I think somebody in this particular job really owes it to the Administrator and the leadership to be cognizant of that, understand a little bit that that's where they need to operate, and that there are two boundaries there. One is ***irrelevant*** and one is ***irreverent***, and those are the two fences on the side of the road you're supposed to walk on. The irreverent Chicken Little is

going to lose credibility and nobody will pay attention. The irrelevant person is the one that just doesn't ever speak up about anything. I can't say that's an easy job. I've struggled with it a lot of times as I've gone along, kind of wavering back and forth down that road.

Hopefully the next person will be aware of this challenge, and I'll tell them about my own lessons learned and failings from the past in those areas, and also remind them that it's not just up to them personally. They've got to use their staff and their team throughout the agency to help them with these things, and delegate and empower and make sure that they're constantly getting good people in the SMA community.

I've seen a lot of progress in that area. Center directors are key to getting good engineers to serve a stint in SMA. Center directors can squelch it easily or they can enable it. When they're enabling it, then you get good people assigned to SMA. Some of them don't really want to. They're reluctant. They see it as a dead-end job, maybe. These are the stereotypes about SMA from the past, and I'm seeing some of that disappear. I'm seeing really good people assigned to SMA, even if it's for three or four years and then go back to engineering or ops [operations]. They benefit from it, and SMA benefits from it, and the agency benefits from it. That's one of the key things I'll pass on to my replacement, is make sure that the Center directors are consistently encouraged to put good people in the SMA organizations. Yes, Engineering hated to lose somebody over there to that "stupid SMA outfit," you know. There's always some of that going on.

I have yet to talk to someone who served time in SMA and regretted it. When they go back to Engineering, they all say, "You know, that was a good experience for me. It was about systems engineering, and it got me out of my rut that I'd been in in engineering, and I was very

comfortable in that rut and didn't know it was a rut until I got out of it. Went over to SMA and I saw, wow, there's a lot of stuff going on."

And it's a broad look at things, not a deep look. SMA is about broad looks at things. It's about systems engineering as opposed to discipline engineering. So you've got a guy who spent his whole life in thermal, he goes over to SMA and he learns about electrical and mechanical and ops and flight crews and all these things that he was aware of, but really didn't work with much. He goes back to thermal now as a systems engineer, and looking at engineering differently now, having served that time over here. I think it's good for people to do this, and it's certainly good for SMA.

So those are the two things, I think, is to get good people behind you and remember there's a narrow road you've got to negotiate.

JOHNSON: Stay on that path.

O'CONNOR: To do your job, yes.

JOHNSON: Do you think having the background you had as a pilot and then as an astronaut allowed you to have a unique perspective on safety and mission assurance?

O'CONNOR: Well, it's a perspective that maybe some other folks who haven't done those things might not bring with them. Sometimes I think it comes in handy, and maybe it's because you have put your own personal life on the line when you flew in an airplane as a test pilot or when you flew on the Space Shuttle as a pilot or mission specialist. You strap into a vehicle, and

you're depending on 20,000 people to do their job right. It's a little different mode than most of us have been in in the past, and maybe is a little bit of a different motivator for what's really important and what's not, and can help you stay in that road, by the way, between those two barbed-wire fences.

So I think it's good. The guy before me in this job was Fred [Frederick D.] Gregory. He had that same background. The guy before him did, too. There's only been three of us so far in this job since it was created after *Challenger*. George [A.] Rodney was the first one, and he was a test pilot, a very experienced test pilot from Martin [Marietta Corporation]. He wasn't a NASA guy; he came from industry, where he did a lot of high-risk flight-test work. He was used to that idea of putting his butt on the line and depending on engineering and ops and safety to do their jobs properly.

So, I don't know. I think lots of different people can do the OSMA [Office of Safety and Mission Assurance] job, but when human space flight is such a big deal, I think it's incumbent on the leadership to take a look at some of the flight crew folks who have acquisition and safety and mission assurance credentials on top of that as prime candidates for that job.

JOHNSON: The Administrators that you've worked with have had varying backgrounds. Dan [Daniel S.] Goldin; Dick [Richard H.] Truly; Sean O'Keefe; Mike Griffin; and then Charlie Bolden, especially since Charlie was a colleague of yours in the astronaut corps. Can you talk for a minute about working with these different Administrators, different personalities, and maybe compare some of the challenges or some of the things you noticed?

O'CONNOR: They're all a little different in various ways. Each one of them has their own unique approach to using their staff. I think Dick Truly probably more than all the rest of them would defer to people's opinions. He would actually go out and proactively ask for them. The rest of them depended on the system that was in place to air all the opinions and not personally spend so much time asking people one-on-one what they thought. And that's fine, because if you have a good system that allows for the right people to be sitting in the right places at the right times and getting their say-so in there, then it saves the Administrator the hassle of then having to go and pulse people and ask them. If he's done his job right, he's put all the people he trusts in these places so that he can hear them in those fora. It could be in Truly's day the governance was a little lacking and he found himself needing to go and ask for people what they thought, so it could be that that's why that was the case.

One of the things I notice about some of our Administrators is that in order to be even asked to do a job like that, they tend to be people who are quite accomplished. They have high credentials from outside, they may come with quite a bit of confidence in their abilities to lead a big organization, and with that confidence there's an ego that goes with it that sometimes can get in the way of asking for advice or reaching out for it also, so that could be part of it.

The reason I'm bringing this up is that in a job like mine, one of the things you have to do is look at the Administrator that you serve, try to understand how they communicate and how best to communicate with them, and figure out whether you're going to be proactive or reactive with this person. Are you going to find yourself being asked at the right times the right kind of questions by this person, or are you going to find yourself having to interject yourself periodically because they either don't know to ask or they think they're smart enough that they

don't need to ask? Sometimes that's where the ego thing comes in. You have to figure them each out individually.

As each one comes in, they're all different and some of them are more open to a proactive safety advisor or any kind of advisor, open-door. "I'm glad you came in. I didn't even think of that. Thanks for bringing that up." Some of them maybe are a little bit more defensive about it. "If I needed to hear from you, I'll let you know."

Each of them had little bit different characteristics in those areas, and it's up to me to figure that out. Of course, when Charlie came aboard, I knew him from a long time ago. I didn't have to learn a brand-new person. I also knew Mike Griffin a little better than I did some of the others. Sean O'Keefe I did not know at all, and so I had to figure him out pretty quick, especially since within the first half a year, we had this big accident. So I had to learn to work with him both in nominal times and in off-nominal times. Sometimes people operate differently depending on the environment they're in too.

There's no excuse for the safety advisor to just sit in his office and wait for a call. You have to figure out how proactive you need to be and when to go in and bring truth to power, because they may not think to ask. They may not know they need to. And it's no excuse. If something bad were to happen and I were asked to go and testify, "How did you safety guys let this happen?" the worst thing that I could do is say, "Well, you know, I was there. If they wanted my advice, I could have given it." That's unacceptable. "I thought something was wrong, but nobody asked." Well, that's an unacceptable answer. I could never give such an answer, because as an SES [Senior Executive Service] and this level, you can't do that. You have to figure out when to go and be proactive. The proper response for something like that would be, "Well, I didn't know. I personally didn't draw the line there. I didn't go and advise

my boss on this because I didn't think it was a big deal." That's the only acceptable response to a failure like that.

JOHNSON: What led to your decision to retire? Was it the end of the Shuttle?

O'CONNOR: Lots of things coming together. I've been telling folks for about a year and a half or so that the end of the Shuttle Program is a good time to transition, especially when they cancelled Constellation and it looked like the next thing was going to take a while to get up and running. Then that really told me that the timing was going to be right, because at the end of Shuttle, that's a good time to collect all the lessons learned, have a new person come in, hopefully somebody's who's knowledgeable of NASA, has worked with NASA or for NASA or is in NASA, not going out and starting from scratch like we did with George Rodney. That wouldn't be my first choice. It would be to get somebody who understands what's going on enough to where they don't have to learn all that the first few weeks.

Let them get their imprint on these new programs early, because they're the programs that they're going to be being the SMA guy for some years to come. If you can get them in early when they're still in the conceptual phase or like commercial crew, they haven't even started that acquisition yet, they're doing these CCDev [Commercial Crew Development] things, but the real commercial crew program development activity starts next year, and they're establishing the framework for that right now as we speak. This is the time to get somebody new, to get their imprint on there, to understand it, to be invested in it, and then to carry it through.

I'd hate to go for two more years, for example, and we've done all the development work and we're two years from operations, and then you bring in a new SMA guy right in the middle

of that, who had nothing to do with the development and yet inherits all the pros and cons of it and then has to carry that in. To me, that's not an ideal time, and that's what would happen if I said, "Well, I'll stick around until the end of this administration."

As a Safety and Mission Assurance guy, I don't tend to think in terms of administrations; I tend to think in terms of where are we in the big programmatic activities going on. With the heavy-lift thing early in its conceptual design and architecture, hopefully that will get up and running soon, too, and there's another major program that would be good to get somebody in on the ground floor, rather than inherit something just because of administration turnover.

Now, as the advisor to the Administrator, I should be thinking in terms of his term. I'm Charlie Bolden's safety guy. I ought to stay with him through his term. Now, he may be here for another [presidential] administration, too, but let's assume that, like as usually happens, he resigns at the end of the four years, and even if he's asked to come back, let's say that his thing is over two years from now, the tradition of the OSMA job has been that it's one of the very few that has lasted through administrations. It's one of the few that has given some stability to the NASA top-level leadership, because AAs [Associate Administrators] have tended to come and go with Administrators, and some of the other political appointees, of course, by definition come and go, whereas the safety job tends to be one of those that hasn't had that happen.

Unfortunately, the chief engineer job has been very temporary also. I think [Michael] Ryschkewitsch is setting records. He's been here three years. But just in my nine years as OSMA, I think we went through about five chief engineers. Well, there's a stability problem there that we've got to deal with, and I think OSMA has been—like I said, only three guys have been in that job since 1986, when it was established. And that's the other point, is that I'm the longest-serving OSMA guy. I'm way past getting out of there. You really do need not to squat

in a job for nine years. I think that's pushing it. So those are all the things I'm thinking about. It's time to get on and let the new guy come in and transition across the next administration.

Of course, there was maybe a little bit of a selfish motive in staying until the end of Shuttle. I didn't have to do that. I could have retired last year and let the new guy come in at the end of Shuttle, too, especially if it were somebody that knew Shuttle. But I have this plaque in my office that says "The second greatest thrill to man is flying. The first greatest thrill to man is landing." I thought of the last Shuttle flight as the landing. It's a good landing, and I'd really like to see that through, having been through the RTF [return to flight] and the cultural changes we've made to the safety and engineering organizations, and then watching them carry a program through its termination and through the last flight, I thought was important for me to do. Even if there's a little ego in there, I apologize for that, but it seemed like the landing was the last Shuttle flight, and now I can go home and play with my grandchildren.

JOHNSON: That's what I was going to ask you. Do you have plans or are you going to take some time off?

O'CONNOR: No, I'm going to take leave. That's what I tell people.

JOHNSON: That's good. That's good. I think you deserve it.

O'CONNOR: I'm old. I'm sixty-five. [laughter]

JOHNSON: It's time.

O'CONNOR: It's time.

JOHNSON: Looking back over your entire career with NASA, what would you consider the most challenging aspect of your career or the most challenging time?

O'CONNOR: Well, if I step back and say for Bryan O'Connor, one of the most challenging things was work and family. I used to get pretty worked up on my job and focused on it, workaholic-type tendencies—didn't take much leave. When my family was having problems and troubles, I wasn't there for them emotionally sometimes. I was distracted. And there's some damage that happens to relationships when that goes on that you regret and you try to work on for the rest of your life, basically. I look back on that with some regret, that I wish I had been better at balancing those things and having the ability to do my job but also the emotional availability, not just to my family, but also just in human relationships. I've always felt like I was more of a loner and maybe not as sympathetic with people's concerns as I should have been. So there's one thing.

The other is just the horrendous losses we had with the Shuttle accidents. People just worked themselves almost to death and worried themselves on top of that and had this guilt feeling on top of that, and I was one of them. I had no reason to look at myself as part of the problem on *Challenger* because I was so removed from it. I was a flight crew guy. I wasn't in management. I wasn't in safety. I wasn't participating in design development activities for the Shuttle at the level of accountability that might show up in an accident investigation. I was just a

crew member, a test pilot, and had flown a mission but had no reason to feel guilty, really, about some proximate cause to the accident, nevertheless I felt that way. I just felt very guilty.

It might explain a little bit the story I told you about Rudolphi and those guys. They felt like, "My gosh, what else are we doing wrong here?" And they really looked inside and well beyond the proximate cause of the accident. That's what I saw myself doing after *Challenger*. I think back and remember times when I was hearing something strange in a meeting that I was going to and not speaking up, saying, "Hey, you know, this doesn't sound right." I could have done that. I was qualified and capable. They didn't just hire somebody right out of college when they got me; they got somebody that had years of experience in acquisition. I had no right to sit there and be quiet if I heard two engineers talking past each other on an important topic that might have safety implications, and yet I had done that just assuming, well, this is NASA. They must know what they're doing. After all, they put a man on the Moon.

That bubble really burst for me after *Challenger*. It was like, hey, I was wrong there, pal. This agency was involved in a horrendous accident and mistake, and part of that was misleading ourselves as to what the risks were, and there's no excuse for someone like me to just sit and watch all that happen. So it really was a slap in the face for me.

After *Columbia*, I realized that I'm still not there. I remember standing up at an FRR and making a point about something on loss—this is before *Columbia*—about loss of some foam from bipod ramp that we had in—I think it was the [STS-]113 FRR from 112—and not really pursuing it enough. I pursued it to some point and then I thought, "Well, okay, I guess it's okay." And I look back and I had the authority back then to say no go. There was enough uncertainty there if I'd have really looked at it the way I have now after the accident, if I'd

looked at it ahead of the accident to the same depth that we have now, I could have had a case to be made that said, "Let's stop here. This could be really bad."

That may not be fair. We didn't have the models and really were underestimating the risk of foam, and I'm not sure where I would have come up with enough rationale to convince people to stop flying. But, still, I don't think I pursued it enough, and it's one of those things about where was I on that road between the two barbed-wire fences. I wasn't right on the middle there. I was somewhere off to the left side there, being a little too quiet.

I can look back on those and say those were difficult times for me personally. This business of family and work and then looking back and wishing I had done a better job in my job at work also, those are the things I look back on and say I wish I'd have done better at those.

JOHNSON: On the opposite end of that, what do you consider your most significant accomplishment or what are you the most proud of?

O'CONNOR: I'm proud of the folks that work for me. I'm proud of the Center directors for giving us good people at the Centers to do SMA work. I see a capability in the SMA community I didn't before. I'd like to take credit for that, but really all I did was just poke at them and make them feel guilty and tell them that it's to NASA's best interest to have a good, viable SMA organization. Otherwise, you may as well get rid of it. If we're not going to support it properly, let's make it go away. You can't do this middle ground, saying, "Well, we're going to satisfy the critics by having an SMA outfit, but, by God, we're not going to put anybody important in there or anybody capable." That's just not going to cut it.

I was kind of a nag on that, and they came through, and, by and large, we've got much better people in SMA now than I've ever seen in this agency, and hopefully that's helpful. I just hope we can have useful work for them to do as time goes forward. They're all wondering right now, "What are we going to do?" Because you don't need much SMA if you're doing commercial investments or R&D stuff. Early research-type things, there's not much need for it, but if you're going to do real missions, you're going to need a good, viable organization.

We've got better training for them now than we've ever had with the STEP [Safety and Mission Assurance Technical Excellence Program] up at the Safety Center. We've got a Safety Center that helps us with our mishap investigations and our lessons learned. I'm proud of that. I'm proud of the NESC. They've done a tremendous job in the last five, six years. That belongs to the chief engineer, but it used to belong to me and we got it started out of my outfit and got them a kick-start, and I think they've done a great job. Ralph [R.] Roe has been a terrific asset to the agency in that regard. So I'm proud of those guys.

My own staff up in Headquarters has done a terrific job. They're always under pressure to reduce the number of "shall" statements in our requirements, and that's a tough job because every time we have an accident, more "shall" statements come out of it. Every time the ASAP meets, they say, "You guys need to standardize everything." Well, that's a bunch of "shall" statements out of my shop. So there's pressure to increase and there's pressure to reduce, and they've done it with good humor and real thorough, dependable work, not fast, and it's too slow sometimes to some, but to me it's been good work. I think our requirements are in much better shape than they were before the *Columbia* accident. Those are just some of the things that I'm proud to brag about for my people.

JOHNSON: Is there anything in all our many interviews that we've had together now that we haven't talked about that you wanted to include before we end?

O'CONNOR: I wouldn't be able to think of anything now. I'd have to go back and reread everything. I think we've captured a lot of stuff. I appreciate your interest and the way you've set the table on it. Sometimes I come into these interviews and I think that I don't know if I can just, from scratch, be useful to you, but what you have done is you've picked out some questions that get me thinking, and doing your homework has helped me do a better job for you, I think.

JOHNSON: I appreciate that. We do try to do that before we do interviews. Oral history is different, and we try to approach it that way.

O'CONNOR: So I really respect how you folks do that, and the fact that you're doing it, period.

JOHNSON: Thank you.

O'CONNOR: It's going to be useful, too, and I hope people read these things some day.

JOHNSON: We do too.

O'CONNOR: Maybe not mine, but some of the good ones.

JOHNSON: I appreciate it, and I appreciate all this time that you have given to this program and this project.

O'CONNOR: Thanks.

[End of interview]