NASA STS RECORDATION ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

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INTERVIEWED BY JENNIFER ROSS-NAZZAL
KENNEDY SPACE CENTER, FLORIDA – 14 JULY 2011

ROSS-NAZZAL: Today is July 14th, 2011. This interview is being conducted with Stephanie Stilson at Kennedy Space Center, Florida, as part of the NASA STS Recordation Oral History Project. The interviewer is Jennifer Ross-Nazzal. Thanks again for making time to meet with me today. I certainly appreciate it.

STILSON: Absolutely. It's a pleasure.

ROSS-NAZZAL: I want to start by asking if you could give me an overview of your career out here at Kennedy Space Center.

STILSON: Sure. I actually started here at Kennedy as a cooperative education student when I was in college at North Carolina State [University, Raleigh, North Carolina] back in '89. I had been to the visitor center as a child, in the third grade, with my father, and said "Oh, when I grow up I want to work for NASA." So I went into science and into engineering and eventually went to NC State. They were big on the co-op program with their engineering program there. So lo and behold, I'm looking through the opportunities, and there's NASA Kennedy Space Center. I immediately applied, and initially they were not accepting. They didn't have any openings. So I was like well okay. I just moved on. Let me apply to some other companies. Eventually I got a

call out of the blue that they had an opening, and would I like to come down to Kennedy. Of course I said yes.

So I started. The ironic thing is the first office I worked in as a co-op was called Mission Planning. It's actually the office that I ended up in as a flow director for *Discovery*. So I went full circle and came back. In the course of that I started off working mission planning, building manifests for the Shuttle to show it flying out to the year 2020. Here I was this young kid building these schedules to show us flying to what, at the time, we thought was the end of the program. That was 2020.

From there I spent three semesters—on and off back at school—working in Mission Planning, doing that same kind of thing, but I wanted to get more into hardware. The job I was currently in was all programming. I really didn't want to be a programmer. I was a computer engineering major. Lot of folks see "computer" in the degree title and think computer science, programming. I wanted to do hardware.

Based on some recommendations from some folks here, including Russell [R.] Romanella, I went over to the Spacelab organization and started working over there in payloads and spent some time there. Then eventually once I graduated I started full-time with the Spacelab Program as an electrical engineer. I double-majored in electrical and computer engineering. I was doing testing of experiments that were going to fly in Spacelab. That was really neat work, a lot of fun, but Spacelab was coming to an end.

So I hung in there, I wanted to be there until we were completely done with Spacelab. Then I just transitioned right over to Space Station and was working power systems for Space Station. Eventually I got to the point where I was what they call a test director for the multi-element integration test team, which is basically the team at Kennedy that processed all the

different components of Space Station and tested them on the ground to ensure that when we put them together on orbit they were going to work properly.

I got to lead that team, and that was real fun and exciting work. In the course of doing that I was actually spending some time in Huntsville [Marshall Space Flight Center, Alabama] testing out the US Lab component for the Space Station and met this gentleman named Mike [Michael D.] Leinbach, who I found out later had grown up in the Shuttle Program and was doing somewhat of a detail type of assignment with the Station Program.

I got along very well with him. Obviously he saw something in me that he liked because he started having some conversations with me, "Hey you might want to come over to Shuttle. We're doing great things over there, and you might really like that." So I saw that as a great opportunity. It was going to be a big change but a good opportunity. That's how I joined *Discovery*'s team. I went through the interview process for an opening that they happened to have. At the time it was a vehicle manager position, because we did not have flow directors at that point in time.

Kennedy had gone through a reorg [reorganization] where the position of flow directors, which we had in the past, was downgraded to a vehicle manager role. Eventually the flow director role was reinstated. So I started out as vehicle manager but was still the team lead from the NASA perspective of *Discovery*'s team.

ROSS-NAZZAL: How did you come up to speed so quickly on such a complicated vehicle?

STILSON: I was just talking about this yesterday with someone. There's no one person out here that knows everything about any of these Orbiters. That's what makes it such a team

environment, you really have to rely on everybody to know their little piece of it. There are over 30 systems on the vehicle itself. I don't have to know everything about the Orbiter itself, because I have such a strong team and they do know everything about their little pieces.

That's how we operate. So really I can't tell you the inner workings of every system at all. I can tell you on a high level what they do, but when we get into a technical issue or something that needs real down and in-depth discussion I turn to the technical experts to do that.

ROSS-NAZZAL: Did you have any sort of on-the-job training? Were you shadowing the person who was the previous vehicle manager?

STILSON: I somewhat got thrown right into it. It was really more like drinking from a fire hose kind of approach at the time. When I came into the first processing flow they were midway through the OPF [Orbiter Processing Facility] flow when I joined the team. The Orbiter Processing Facility flow is really the most complicated of the entire Shuttle processing flow that we have here at Kennedy. You've got the processing of the Orbiter, the boosters and the tank, which I'm involved with all of that, but the most complex is the Orbiter obviously because it's the most complex part of the STS. So the team was right in the middle of that.

I didn't know the people. I didn't know the acronyms. I didn't know the process. I went from an environment in payloads where I basically grew up over there—and if I didn't know the answer I knew exactly who to go to to get the answer—to being over here and really knowing no one. That was difficult. It was a very challenging time. I spent a lot of time just talking to people and asking questions. I knew that I was asking dumb questions, I'm sure to them. A lot of the people I worked with had been working Shuttle since STS-1.

My contractor counterpart at the time was Gene Nurnberg, who had been here since Apollo days. He is a wealth of knowledge, but because he was an old-timer, he wasn't real anxious to spend a lot of time training not just a newbie to the Shuttle Program but a young person and a female. He came from the old school. It was, I think, a shock for him to all of a sudden have a counterpart like me. I was very much inferior to him when it came to knowing what was going on.

So really it was just over time, just absorbing, talking to people. The other difference that was very challenging is in Station we had a different setup in regards to how the contractor operated. We didn't have a prime contractor. NASA pretty much ran everything. We had contractor support, but when I was a test director over there I ran all the meetings. I was the main person doing that part of the task. Where over here we let our contractor counterpart do that. So I'm a part of those meetings but I'm not necessarily the one running them or building the schedule or anything of that nature. I'm doing more oversight in Shuttle than I did in Station. So that was a big change for me, especially a type A personality like me that feels like I need to have full control. It was a big change for me to really feel comfortable with having someone else basically running things and me being able to stay engaged enough to really be part owner of that schedule, but that is what I had to do. We worked together so I had to sign up to that schedule, but I didn't know the down and in details to it like the contractor did. So that was a challenge.

Besides just spending time with the team, and absorbing what I could from them, it was really the basic OJT [On the Job Training]. There weren't really training classes that I took to say here's how you become a vehicle manager or a flow director or anything like that.

ROSS-NAZZAL: You mentioned something that I thought was interesting, and I did want to ask you at some point. Since you brought it up, you mentioned you were a woman, and you were working with these guys. It seems like this is very much a male environment with all the technicians here and the engineers. Are there many women who work in the OPF?

STILSON: It has changed a lot even since I've been here. I've been with *Discovery* for 11 years now, so I have seen quite a bit of change. In fact even now we have three female flow directors. That has never happened in the past. There was one point in time where all of our NASA vehicle managers, which is the next step down from flow director, were all females. In the past that had never happened.

Definitely at that time there were not a lot of females in the workforce, but there were more I think than maybe in some private industry companies because there were quite a few. Even technicians, we've got some great female technicians as well. But the males did outnumber females overall on the team for sure.

ROSS-NAZZAL: Tell us a little bit about *Discovery* itself. What makes it unique from all of the rest of the fleet?

STILSON: I get asked that question. I do a lot of media type events and so forth and interviews. I get that question a lot. From a vehicle capability perspective and how it looks, there's really not much difference. There are a couple things. From a technical perspective, *Discovery* has the Station-to-Shuttle Power Transfer System, which allows us to stay on orbit longer. When we're

docked to Station we can feed off their power as opposed to using our internal power sources. We have that and *Endeavour* has that. *Atlantis* does not. So that's one of the differences.

There's something called three-string GPS [Global Positioning System], which is a communications system, that *Discovery* and *Atlantis* do not have but *Endeavour* does. So there's some differences between the Orbiters like that. Really when I think about the difference in the vehicles, it's more about the team in the sense that I feel like *Discovery* basically lives through the team. That's what makes *Discovery* a living being. A lot of people think of it like that, think of *Discovery* as our child, and we've been taking care of it all this time. We nurture it and look after it. Soon we're going to be sending it off to college is how I've been looking at the fact that we're transferring it over to the Smithsonian [Air and Space Museum, Steven F. Udvar-Hazy Center, Virginia]. It's time to let it leave the nest.

So the team for *Discovery* and each vehicle, their team has a persona that's a little bit different. *Discovery* has been known as the workhorse of the fleet. There are several reasons for that. We've done both return to flight missions. We've delivered the Hubble Space Telescope. We're the oldest. We're the heaviest because of being the oldest. Some people call it the hog. I've heard that term as well.

In regards to the team I see us as a really get the job done, we're not here to mess around, let's get going, we've got a job to do, we've got to move on, let's get this flight under our belt and move on to the next one. That's been the impression I get from our team, and I like that. That's somewhat my attitude as well. So I think that's really how, when I think of *Discovery*, I think more about the team and all the work they've done and how they've approached the challenges that we've had over the years.

ROSS-NAZZAL: Walk me through if you can how you process the vehicle. It's a complicated machine. It takes much longer than they originally anticipated. They thought the OPF was going to be like maybe a day place for Shuttle then it was going to move on.

STILSON: Right. Yes. We use 125 days is what I'll call our baseline for the amount of time that the Orbiter spends in the Orbiter Processing Facility. I like to compare an OPF to a garage for a car, because that's really what it is. It's the best place, if you're going to do any type of work on an Orbiter, you want to do it in the OPF. That's its home. That's the best place to do it.

During the process of a normal flow through the OPF, the main thing we're doing is system testing and checkout to ensure that those systems are still functioning properly for the next mission. We spend a lot of time working towards requirements. We have set requirements, about 4,000 requirements for every flow that we have to go in and meet. We do that using written procedures.

Everything we do here at Kennedy, we're very much into documentation and records and being able to prove that here's what we were supposed to do and here's what we did. There are a lot of reasons for that. An obvious reason would be we want to make sure we do it right. Then heaven forbid if something were to happen and we had something go wrong, we want to be able to go back and see. Okay. What did we do? Did we do what we were supposed to do? Was that not the right thing to do? So we want that traceability as well. We're very in tune to documenting everything we do.

The first step once we tow from the runway into the OPF is to get that vehicle into a safe configuration so that the masses can come work on it, because initially there are hazards that are

still active on the vehicle. So we go through that process. Getting all the platforms in place. Getting access so the technicians can get into the ship.

Then a couple different things happen in parallel. We start the download of the payload from the previous mission, whatever payload flew before. If we have to remove a module, or change out panels, remove longerons, those kinds of things, that all happens right away. Then we start the process of uploading for the next payload. Preparing the payload bay for that next payload that normally doesn't get installed until we get out to the launch pad, but there's a lot of work that happens in the midbody as well as the crew module to get ready for the next payload that's going in.

In parallel with that is all that system checkout and testing for all the systems. We don't go in and test every aspect of every system. That's why we have requirements based on what those system experts feel are at a high risk of potentially not working properly or if it's a Crit [Criticality] 1, something that's very important that it works the first time. Those are things that we're going in and checking along the way.

We're also doing problem resolution. So if on orbit we had an issue, something didn't work right, obviously we're going in and fixing that or troubleshooting that to determine what we have to do to fix it. Then also along the way, as we're doing testing, we are finding problems. That's why we're doing the testing, to find and then repairing those problems.

Another aspect of the processing flow that takes a lot of time is inspections. We do a full inspection of the outer surface of the vehicle. That's blankets and tiles, reinforced carbon-carbon [RCC] panels and so forth. When I say inspections, technicians and quality inspectors are going in with a magnifying glass and looking at every thread point on those blankets. So every little knot of thread they're looking to see is there any fraying going on. The black tile, they're very

easy to break. So they're going in and looking for any damage that might have occurred. They're having to measure that damage and determine from the size of it, "Can we go in and just repair it, or do we have to replace that entire tile?" There's certain criteria that has to be evaluated before we can make that decision.

The critical path for us while in the OPF is usually through the aft. Engines are one of the first things that we do. Pull the main engines out. Send them over to the engine shop, and they recycle them over there. Then also the TPS [Thermal Protection System] work, the tile work, is usually worked throughout the entire Orbiter processing flow, and then sometimes even into the VAB [Vehicle Assembly Building], depending on how much we have to do.

We end up usually pulling—it's ironic. The number of tile that we usually remove from the vehicle correlates to the number of days we're in the Orbiter Processing Facility. I'm not really sure why that is. When we try to predict how much tile work we're going to have, that's the generic baseline that we use. So we spend a lot of time working tile throughout the entire processing flow.

ROSS-NAZZAL: You mentioned Crit 1 criticalities. What would be a Crit 1 criticality that you would have to investigate?

STILSON: Main one that jumps out would be landing gear. You're not going to be able to land if your gear doesn't deploy. We have a landing gear functional that we go through that ensures that that system is going to work properly. We have redundancy for I would say almost every system in the vehicle, whether it's double redundancy or triple. So in most cases your Crit 1 systems have triple redundancy.

Another thing would be when we jettison the tank from the Orbiter. Obviously if you're going up during liftoff and you can't release that tank, that's a bad day. So systems like that have critical functions. Opening and closing payload bay doors is another example, because once we get those doors open on orbit, if we can't close them, we can't return until we close those doors.

ROSS-NAZZAL: Tell me about that first mission where you were vehicle manager, and you were officially in charge, you started from the moment of landing until launch.

STILSON: The first one I actually came in in the middle of the OPF flow. Good or bad, I don't know. It was very overwhelming for me at that point in time. I really was more just in receiving mode as opposed to contributing to the team, because I really wasn't prepared to do that. Now obviously there were other people looking out for me. Kelvin [M.] Manning was my lead flow director, lead vehicle manager at the time. I wasn't completely thrown out to the wolves. There were many people that were keeping an eye on things. Not just for my benefit but ensuring that things were being done correctly.

That timeframe is all a blur to me. The main thing I remember is meeting the team, not sitting in the right chair during one of the first meetings. They had assigned seats, where I was supposed to be, and I didn't know that, and I was quickly told that was not my seat and I needed to move over here. I think it was difficult for the team also, because once again most of the people that I worked with had been working Shuttle their whole career. Not many people had transitioned from payloads to Shuttle.

We had plenty of people come from Shuttle to payloads. A lot of that happened when the Shuttle Program changed the contract and went to the prime contractor concept. At that point, Shuttle had a lot of NASA personnel but didn't have as much work for them as they had previously, so a lot of those folks influxed over to Station. But not many people transferred the other way.

Shuttle teams here take a lot of pride in the fact that they've been doing this work for a very long time. This is their life. So when newcomers come in it's not a real easy change for them either. But once again I had a lot of folks that were willing to help me and guide me and really create an environment that I could learn and understand things better.

We didn't have the best relationship with our contractor at that point in time, looking back on it now. Of course at the time I didn't know that that wasn't normal. There wasn't a lot of trust then between NASA and the contractor.

ROSS-NAZZAL: That's Boeing?

STILSON: That was USA (United Space Alliance). I don't know really why that was, because I came into that new. It was very obvious that it wasn't a comfortable situation, like we have now. So that's one of the things—we have really grown in that respect in the sense that it was, I want to say an us against them environment back then. The contractor wasn't real anxious to share with NASA. It was more of I'd have to really insert myself to gain knowledge.

Now I have a great relationship with my counterpart, and we share everything. We have that trust. If it's something that he doesn't want me to elevate right away, we work together to determine the right time to do that. It's a much more enjoyable environment. That's something

that has progressed. Some of that could be personality-driven. It could be environment-driven. Whatever it is, I'm just glad that we've gotten to where we are. Even though I'm speaking for the *Discovery* team, I know that's the same with the other vehicle teams as well. We all get along very well and work very well together.

ROSS-NAZZAL: Tell me about the lessons that you learned from that first flight that you applied then to the flight that you managed the entire flight.

STILSON: The main thing I learned from the first one was to really listen and be in receive mode. In my previous role before Shuttle I was very much in a transmit mode because of the function I had and because of the knowledge I had. That was a little bit of an adjustment for me, to really need to just sit back and listen, and not necessarily be the person in charge of the meeting, and be the person to point which way we were going to go. Sit back and let that happen. Insert myself when needed, but realizing that that need wasn't there as much as it had been with some of my previous roles.

ROSS-NAZZAL: How do you keep apprised of all the technical and engineering challenges that are occurring on the floor? As you pointed out there are plenty. There are major systems down there.

STILSON: Absolutely. The main thing that happens is we have a good communication structure that when something happens, if we find a problem, something's not working right, we immediately get that feedback from those folks. First of all the ones on the floor report it. The

technicians report it to the engineers. The system engineers then report it to our integration engineers, who then pass that along to me. I have an Orbiter Project engineer. Basically the way we're set up is your flow director is your primary lead for the team—I'm talking only the NASA structure—from the NASA side. Then I'll call my left- and my right-hand people: a NASA vehicle manager who covers the ops [operations] side of things, looking at schedule, looking at when tasks are supposed to happen, did they happen on time, why didn't they happen on time kind of thing, and then I've got the Orbiter Project engineer, who integrates all the technical work. He or she speaks for all those system engineers. So that's my conduit. The system engineers bubble that up to him, who then can really translate that to me. I don't need to know all those low level details. I need to understand what's the problem, and what do we need to do to go fix it, and how long is that going to take. The NASA vehicle manager and the Orbiter Project engineer work together to come to that answer.

ROSS-NAZZAL: Tell me about what impact budgets and schedules have on your position.

STILSON: I really have never had to deal with the budget side of things before now. That's something that's new now that I'm doing transition and retirement of the Orbiters. As *Discovery*'s flow director I was fortunate to really be sheltered from that. Pretty much what we needed we got. The only time we really dealt with what I'll call budget-related concerns would be from a resource allocation perspective.

When you have three vehicles flying, you have a top priority vehicle, second, and what we call third in flow. If you're the first vehicle, the top priority vehicle, you're pretty much going to get whatever you need, because it's our overall goal to ensure you make your manifest

target before the next one can fly. Being second and third, then you're taking what you can get in some cases depending on what resources are available.

Once again, I didn't really deal so much with budget. But as we're seeing now, as our workforce goes down because we're transitioning out of a program, and closing down a program, I'm having to deal with less resources, and that's always a challenge for someone in a job like mine. Resources are one of the critical tools that I use. So if you take those resources away from me then that obviously makes my job more complicated, because now I'm having to balance even more than usual. If we don't have the people to do it today, when will we have those people? What does that mean to our overall schedule?

As a flow director, that's really the primary function as I see it. We've been given an end goal to launch on a certain day. We're going to do everything we can to do that safely and with a sound vehicle. So that's the balance. We've got a certain amount of time that we anticipate needing to do the work. Does that fit with what the goal of the agency is as to when they would like us to launch? Then how do we manage that or maybe feed back to them, "Hey you didn't give us enough time and here's why? We hit this technical problem, it's going to take three weeks to fix, and my overall end date is going to move out. Therefore I have no contingency." As a flow director that's really to me the important thing that we manage and communicate. If I can do what you're asking me to do, great, that's easy. If I can't, how do I go explain that? What do I do to hopefully mitigate the impacts on the end?

ROSS-NAZZAL: How closely are you working with some of the other element managers? What impact might a delay with the SRBs [Solid Rocket Boosters] or the ET [External Tank] have on your processing?

STILSON: Flow director role starts from the minute the Orbiter lands, *Discovery* in my case, until *Discovery* launches again. Although my primary focus is on the Orbiter, I still have management responsibility for the boosters and the tank as well.

Now fortunately I have very capable people, a NASA vehicle manager for the ET and SRB that handles that for most of the time. When the Orbiter is in the Orbiter Processing Facility most of my focus is on the Orbiter unless there's a technical issue or something that arises that needs my attention on the boosters and tank. Until then, they pretty much operate stand-alone without much impact to me or from me.

Once we go integrated then I have more involvement with booster and tank. Just the nature of now you're coming down to the last month of the flow. We're putting all those elements together. They're all talking. There's more likelihood that now you're going to see a problem that can possibly impact your launch date.

If things are going well for the booster and the tank, I don't have a lot of involvement with those particular project leads or project managers. The vehicle manager assigned to that task does. But say for instance STS-133, where we had all the issues with the tank, I did have a lot of interaction at that point in time because of the high level impact of what that problem meant and what we were going to do to go fix that problem.

ROSS-NAZZAL: Can you talk some more about that flight and the external tank issues?

STILSON: That's definitely going to be one of my most memorable missions, not just because it was my last one, but because so much happened. Really I don't know if we jinxed ourselves or

what, but the OPF flow was very generic. It makes sense. It's our last one. You're not doing a bunch of modifications. Over the course of time a lot of the challenges for an OPF flow would be new modifications, late requirements, and things coming at the last minute. "Hey we've got to go do this, can you still make your rollout date?" Those were the challenges that we faced.

Obviously for *Discovery*'s last flow, we didn't have that. It was a pretty, what I call, vanilla flow. It went very well. We didn't have any real major challenges along the way. Then of course we go integrated. We find the issues with the tank, which surprised everybody, nobody was expecting to see that.

That was the first real big effort with the tank that I had been involved with of that magnitude. Once again, different people, people I wasn't necessarily used to interacting with. Different contractor in the sense of Lockheed Martin was now coming here and doing work. That didn't normally happen. So now we're not only just integrating with our USA and Boeing counterparts, we're now also integrating with Lockheed Martin as well.

It went really well. For the amount of work that had to happen and the challenges that were put in front of the team, I was just constantly amazed at how well everybody handled it. It was a very stressful situation. The work we do here is stressful. There is pressure. A lot of people don't like to use that "pressure" word. It's become—schedule pressure—a negative word with a lot of folks. I think I heard Mike Leinbach, the first person to say it, "It's not schedule pressure, it's schedule awareness." We have to be aware of the schedule. There are reasons we have a schedule. That's an important part of what we do here at Kennedy, is process to schedules. We shouldn't be afraid of them, and we shouldn't see schedules as a negative thing.

Now can a schedule become negative if you let it? Absolutely. If you put schedule above safety, above the technical aspects of the vehicle being your top priority, then of course.

It's that three-legged stool. You have to balance all of it together, but schedule is a very big part of that. We can't forget about the schedule. After the accident of course we had a lot of talk about schedule pressure.

One of the examples I used to give, talking to my team was—say you have kids. They have to be to school in the morning, so they have to meet the school bus. You have a schedule then, right? You have to get up at a certain time. You've got to eat breakfast a certain time; you've got to get out to the bus. If you don't have that schedule, you're not going to make the bus. You're not going to get to school. That's a bad thing. Schedule pressure is always there. It doesn't have to be bad. It really should be good, because that allows us a target to work to.

If we at Kennedy didn't work towards schedules, we'd never launch. You'd never get there. So I'm very passionate about schedules obviously. I want people to see them as the good that they are. But once again I will reinforce that schedules should never cause us to sacrifice safety or get in the way of the technical needs for operating the vehicle and mission success. We look at safety for the crew first, and then mission success after that. Then the ground processing would be third.

ROSS-NAZZAL: Did you ever feel any pressure from JSC [Johnson Space Center, Houston, Texas] or [NASA] Headquarters [Washington, DC] to get that vehicle off the pad? Or were they insistent that we have to fly safely, whatever resolution comes? If it comes six months later, then so be it?

STILSON: It was both. Definitely felt both, because I knew that they were expecting me to be ready by a certain date. If I couldn't, they were going to listen and understand why, but they

were also going to challenge. It wasn't going to be an easy task. If I were going to come in and say, "Oh guess what, guys, we need to slip launch a month," it wasn't going to be, "Okay Steph, that's fine. Let's just go slip launch." I was going to have to justify why that was and explain to them what options I had looked at and why there was no other option but to slip.

Now, it usually wasn't a month timeframe, maybe it'd be a couple days or whatnot. But they would also want to make sure that technically we were doing the right thing. The way we're set up is the folks in the Orbiter Project Office [OPO] at JSC are the requirements owners. To me it's a healthy balance because OPO is pushing that hey, we need to do this mod [modification], or we need to do whatever it is, this special test. That's their goal. That's their job, to make sure we're doing what we need to do from a requirements perspective.

It's my job to then push back and say, "Okay, if you want to do that this is going to be the result. Program, you need to weigh that risk and decide. Is it that important to do this modification, knowing that it's going to then impact this milestone? If it is, great, we'll go change the schedule, and we'll move it. But program, you need to understand my job is to tell you the impacts of doing this work."

We got into a mode after return to flight that I call the polishing the apple scenario where it was a real struggle, because we had become ultraconservative, obviously for a good reason. We had had an accident. We needed to be ultraconservative to make sure that did not happen again. As we continued to move forward and come up with new modifications and so forth, I saw where there was work that you really had to ask yourself, "Is this really necessary for safety of flight or for mission success?"

If it's not, do we really want to take the time and money to do this now? Or is it something maybe we can do on the next flight or a future flight? Of course, that point in time,

we weren't thinking about the end of the program. We were thinking we need to get back to flying again, and we'll continue to get better. Our goal was always to make that next flight better than the previous, always moving forward.

So to me we got, as an agency and as a program, in a little bit of a paralysis of feeling like oh my gosh if we don't do everything that people put in front of us then we're not doing the right thing. Well, if you take on everything, you're never going to fly again. I could sit here on the ground and continue to modify this vehicle forever. You've got to pick a point that says okay we've done what we need to do to lower that risk to an acceptable level. Now we need to fly.

That was a challenging time, especially for someone like me. It's my job to get the work done, tell me what I have to do, but at some point you got to quit giving me work if you want me to finish. That was difficult because before then we had not operated where we were getting so many real-time changes so quickly. Normally when we have modifications, there have been years and years of discussion as to what we're going to do, when we're going to do it, how we're going to implement it. We'd have that plan in place before we started that flow.

After return to flight, we were getting those modifications real-time because obviously we had a lot of big changes we wanted to make. So implementing those real-time was very different for us and quite a challenge.

ROSS-NAZZAL: Let's talk about [the Space Shuttle] *Columbia* [accident, STS-107]. What impact did it have on you? What involvement did you have in the investigation and recovery?

STILSON: The day the accident happened, I was actually doing some OJT, some training in the firing room for landing. I was sitting with the test directors learning what they do, what their role is for landing.

I really wasn't familiar with that aspect of it. I had not sat on console for landing previously. We were hearing, of course, the voice loop about the indicators that they were seeing. Nobody initially thought much of it. They thought "Ah, it's instrumentation." There's a lot of vibration going on when you're coming in. It's not surprising to have some data dropouts and so forth. I had no clue at all. Then as they kept discussing it, I was noticing that the people around me were looking more and more tense.

I could tell. "Okay, something's odd. Something's not quite the way it's supposed to be." The fact of having a catastrophe like that was nowhere in my mind at all. When we realized we weren't having any communication with the vehicle my first thought was. "Okay. They've landed out west in the desert somewhere. We're just not able to talk to them. We're going to have to go recover the vehicle and get out there, and get the crew out." Once again not thinking we would ever lose a vehicle or a crew or anything.

Then we got the call saying that folks were visually seeing the breakup of the vehicle and that it was on TV. Normally in the firing rooms we have access to all the channels, but during critical operations they block out the non-work related channels. So we just have mostly our video cameras, Weather Channel, things like that.

The test directors immediately said, "Hey we need to get this patched in" but it took some time. The people in the firing room were still not seeing the video. We still weren't quite understanding what was happening.

The launch director, the Administrator at the time [Sean O'Keefe], and the flow director at the time were already out at the landing strip. That's where they are at touchdown. So of course when we realize we're not landing, they send word that they're coming back. Well, because I'm the only person there that doesn't have a function, I'm just there to observe, they said, "Hey, Steph. They're all coming back here. They're going to need headsets. Run down to the comm [communication] room and get some extra headsets so we can have them tied in."

I go down to the comm room, and sure enough they've got CNN [Cable News Network] up. There they show the breakup across the sky. I immediately come back and say, "Guys, I just saw it on TV; it was a complete breakup." I was the one to tell them what was being shown out on the airwaves. We went into lockdown mode just like they did at JSC and reacted from there.

In regards to the recovery effort, I did spend some time out at Nacogdoches [Texas] as the, we called it the hangar lead for the recovery efforts. My role with that was to coordinate the team that was taking in debris as we received it, trying to classify it, if we could identify what it was. Get it packaged up to ship it to Barksdale [Air Force Base, Louisiana] where it then was shipped back to KSC. We had an assembly line process to do that.

Another big part of my job was to talk to the field walkers—and this was the part that I really enjoyed the most. Every morning I got to go speak to all the people that were walking the fields. Remember, it was cold and rainy and miserable. It was terrible. Even in the hangar we didn't have any climate control. We were bringing in big gas heaters to try and make it more comfortable for the team.

Everybody had parkas on. We're on a concrete floor. No chairs. No tables. We had all this stuff that we were trying to pull together just on the fly. So in the mornings I'd go to a stadium where I believe they held rodeos and bull riding. It was a big outdoor arena with dirt.

It had bleacher seats filled with all these people from the National Park Service and the fire walkers, and anybody who was a part of the process. Every government agency represented out there: FBI [Federal Bureau of Investigation], EPA [Environmental Protection Agency], FEMA [Federal Emergency Management Agency] and so forth.

I'd get to talk to them about basically what was the latest status. What had we found? Did it mean anything? Where are we concentrating our efforts? Those kinds of things. These people were sleeping in tents. By the time I got there they had been doing it for weeks on end.

You could tell a lot of them were just worn-down. It was my responsibility to try to motivate them, to tell them how important what they were doing was to NASA. They're walking through briars up to their armpits every day and looking for little tiny pieces of whatever they could pick up.

It was my job to motivate them and get them pumped up. "Hey, Nacogdoches is going to be the site that finds the key to all this. We're going to be the ones to figure this out so that we can find the problem, fix the problem, and start flying again." Meeting all those people, and seeing how there was such an outpour from every person involved at every level to want to help. Something as simple as bringing in ice cream for the team so they'd have a treat—the local vendors did things like that. It was a really good feeling.

It'll always be a fond memory. Even though it was a very tragic thing that happened I have a lot of good memories of that because of the way people pulled together. I think that really is a tribute to the crew and to what the crew meant to not just NASA, but to our whole country. Everybody was willing to stop everything they were doing and say how can we help get through this? It was a very emotional time, but also a very rewarding time, to be a part of that process.

ROSS-NAZZAL: What did you do when you came back to KSC?

STILSON: Ironically enough, *Discovery* was in its Orbiter Maintenance Down Period [OMDP], which is a scheduled maintenance period that we do. I believe it's every seven flights, eight years, something along those lines, I can't remember exactly when. We have a set period of time that we do it.

So we were already in the process of taking the vehicle apart to do in-depth inspections: wiring inspections, structural inspections to do major modifications. We were doing the MEDS, the Multifunction Electronic Display System, glass cockpit, and the other big one that was already scheduled. I don't remember; I'll have to come back to it.

We were doing modifications of all levels. Inspections and looking for corrosion, which was part of the structural inspections. We were already planning to be basically grounded for about a year, when the accident happened.

Initially all work stopped; we all stopped. Then we as the *Discovery* team quickly got back to work, because we were really the only vehicle team that could work. We had to complete the maintenance period no matter what. We had a huge amount of work to get as opposed to *Endeavour* or *Atlantis*, who didn't know when they were going to fly or what their mission was going to be. I think that was very fortunate for our team, because it gave us something to focus on. It wasn't just a matter of us sitting back waiting to hear what was going to come out of the CAIB [*Columbia* Accident Investigation Board], what was going to come out of the restoration effort here. "Hey guys we can focus on this. We have real good work to do here." I think that was very helpful to the team. That's what we did.

Once the CAIB report came out and we figured out what the problem was, that then drove a bunch of additional modifications that we did on the vehicle. The main one being installation of the Orbiter Boom Sensor System so that we could do the inspections on orbit that we had not been able to do in the past.

Also the Wing Leading Edge Sensor System. We went in and put sensors on the spar of the leading edges of the wings, underneath the reinforced carbon-carbon panels, that would allow us to detect if we had any type of impact. At least we would know that right after liftoff or on orbit if something happened to hit on orbit, and know where to go look in case there was a breach.

Reinforced carbon-carbon had a lot of scrutiny as to are we doing enough to test it and screen it to make sure there are no flaws that could cause a break in the carbon-carbon panels. So we came up with a thermography technique that basically scans and looks for any minute flaws. Then of course anything we found had to be addressed as to is this acceptable or not acceptable? That's all handled by the engineering team in Houston, but we did the work of doing the scans and gathering that data.

Last one I'd mention would be the Boeing Rigid Insulation tile, a new tile was created. It was a much stronger tile. Right now you can take a black tile off the belly of the Orbiter and tap it with your fingernail and that'll chip the outer surface of the tile. It's very breakable, very fragile, which is why we spend a lot of time processing and repairing tile after every flight.

They came up with this harder tile that we could put around the edges of the openings, the ET door openings, the landing gear door openings. Anywhere where there was a higher potential for a breach we were installing these stronger tile. Of course the first question is well why wouldn't you just put the stronger tile over the whole vehicle? They weigh more. So you

increase the weight of the vehicle. You decrease the weight of your payload. You increase the amount of fuel required to get you on orbit. Everything is a trade.

Also because obviously going in and changing out, there's 24,000 tiles on a vehicle, that would take a lot of time to go and change them all out. So it made sense to do it in the areas of highest concern. That wasn't something that happened in completeness during the return to flight flow. We did a majority of it then but then we continued to upgrade and replace tiles in those areas over multiple flows. That was a modification that continued for quite a while.

The other significant modification we were doing that wasn't return-to-flight-related was that Station-to-Shuttle Power Transfer System or SSPTS which allows us to stay on orbit longer. That's a wiring modification basically wiring from the tip to the tail. So it took a lot of time to do that, which was one of the reasons why our period of time for doing this maintenance was about a year, even before we had the return to flight modifications.

ROSS-NAZZAL: Tell me about getting that phone call. *Atlantis* was actually supposed to fly the return to flight, but it turns out that *Discovery* was able to do it. Tell me about getting that phone call.

STILSON: Scott Thurston had been the flow director; actually we were still vehicle managers back then for *Columbia*. After the accident he eventually became the flow director for *Atlantis*.

We all expected *Atlantis* to be the return to flight vehicle based on the fact that normally we somewhat try to plan the Orbiters' flights in a row. If [OV, Orbiter Vehicle]-102 [*Columbia*] flew then [OV]-105 [*Endeavour*], [OV]-103 [*Discovery*], [OV]-104 [*Atlantis*], then back to [OV]-102. That changes very often, but that's how we lay it out to begin with. Based on the fact

that *Atlantis* was the next vehicle that had been scheduled to fly, we all assumed that the order would not change and therefore *Atlantis* would be the next one to fly. They quickly, from a program perspective, realized that with *Discovery* already being in a maintenance period and then all these additional mods that needed to be implemented, it made sense to do those mods on *Discovery* first. Then obviously that would be the first vehicle that would be ready.

Scott was actually the one to give me the news. He was in the meeting or on the telecon [teleconference] where they made that decision. It was a late afternoon, and so I was already at home. He called me, and he was the one to tell me that. Scott is a great guy. I'm sure he was very disappointed. I'm sure he wanted it to be *Atlantis*, as I would have if I was in his place. He said, "Hey looks like you guys are up. We're looking for you guys to pull it through and take us back to flight." I was very excited about that. I was shocked, because I wasn't expecting it, but very excited because I knew it would be something really good for my team.

The KSC team as a whole, the NASA team as a whole—I want to look out for all of them, but my primary function is to look out for my *Discovery* team, that's part of my job. So I was very happy that they were going to get that, because once again it gave them that focus of, "Okay guys, we will never forget about this accident. But we need to focus on getting back to flying, that's what we do here, that's what we need to process for." I think that was helpful to the team.

ROSS-NAZZAL: Did you ever talk with the previous flow director for the return to flight following [the Space Shuttle] *Challenger* [accident, STS 51-L] to get a sense of what he or she might have gone through?

STILSON: No I did not. That would have been a really good idea. To be honest with you—I hate to admit it—I'm not even sure at the time who that flow director was. I am guessing it was "Tip" [John J.] Talone [Jr.]. I actually worked for Tip Talone when I worked for the Station Program. I did not know him when he was a flow director

Unfortunately I haven't had a lot of interaction with previous flow directors besides the ones that were still working Shuttle when I joined the team, like Kelvin Manning. I haven't had much interaction with those flow directors from the far past. We were trying to put together a history to show all the flow directors along the way. I hope that we're able to pull that together, because I love the job that I do, and I'm sure they felt the same way when they did it. "Pepper" [Philip E.] Phillips is another one. He was a flow director. He's still around and was the Deputy Director of Shuttle Processing when I was a flow director. So I've worked with and for him. Grant Cates was in my office. He wasn't acting as a flow director then, but he had been the flow director for 102. I had some interaction with the ones that were flow directors just before I came on, but not many of the ones from farther back.

ROSS-NAZZAL: Tell me about the media interest and really the scrutiny about what you were doing with *Discovery* and making sure that every I was dotted and T was crossed.

STILSON: There was a lot of media attention during the return to flight timeframe, I never thought about the media aspect of my job, but it quickly became a big aspect of being the flow director. Fortunately I had an awesome public affairs representative, Jessica Rye, at the time. She just got me through it and helped me prepare and feel comfortable. Without that I think it

would have been a very unpleasurable experience just because it was my first exposure to the media and it happened very quickly. Jessica really helped me feel comfortable and confident.

Actually I really enjoy that aspect of my job now. I did a lot public affairs events then and then it dwindled off. Now that I'm working transition and retirement, it has ramped up again so it is a large part of my job again.

In regards to the impacts of having all eyes on us, once again I pride the team for not letting that affect them too much. I think we put enough pressure on ourselves that any pressure from the outside was not going to even measure up. We all were so anxious to make sure that we were doing the right thing and doing a good job, and ensuring that *Discovery* had a great mission, when we had the return to flight.

Based on the CAIB report we had —I'll call it a "mods on the fly" kind of scenario. Based on the CAIB's findings the program was developing mods. We were implementing them almost immediately after they were developed. That was challenging. But other than that I didn't see any real—I'll call it a negative effect from the CAIB. Of course once again heightened focus on safety on making sure that we were doing everything we could to be as safe as possible, a huge responsibility on the team to get us back to flying. But I, once again, didn't feel pressure coming so much from the outside. It was more internal to ourselves and who we are and what we do.

I think the program did a good job of protecting us from a lot of external pressure as well because everything that we do here at Kennedy obviously has been approved by the program. We're really just the implementers. At the program level they were the ones having to go under the scrutiny of being asked have you done enough? Have you done the right thing? Is this all that needs to happen? The program helped keep those questions away from us.

ROSS-NAZZAL: Earlier you were talking about some of the challenges working with JSC, where they might want to implement something but it's going to drastically impact schedule. Was that something that you were dealing with with return to flight? Were there other changes that they wanted to make to the Orbiter to ensure that the crew would be safe? And you thought maybe this is too much or it's too much time?

STILSON: I think eventually we implemented everything that they felt we needed to. I saw more of what I thought was doing too much after we got back to flying, because we continued to obviously want to improve and do things better. At that point is where I think we were in an overkill mode, polishing the apple per se, as opposed to really balancing the risk of what we were doing. Yes, there were times where I felt like certain modifications and special tests were approved without a true necessity for doing the work. I can't, right off the top of my head give an example, but I felt that there were things that we did to the vehicle that we really didn't need to do. It wasn't necessarily improving the safety. Nor was it improving the success of the mission. Now, that's my opinion. The people that came up with those modifications and special tests I'm sure would argue vehemently that I am wrong. But, that was my perspective on things. I was anxious for the program to scrutinize some of those new requirements more than they did.

But I also understood where the program was coming from as well, and the pressures they were getting from the outside for ensuring that we were doing everything that we possibly could. Like I said, it's a balance. [N.] Wayne Hale was in that position [Shuttle Program Manager] because he could handle that. He's a pay grade much higher than mine and those decisions come with that territory.

Overall I was very impressed with the way things were handled, especially with Wayne Hale. I got to spend six months working with him in Houston on a rotational assignment. One of the biggest things that I learned from Wayne, or that I respected even more once I spent more time with him, was first of all his ability to make everyone feel important and to feel needed and necessary. He deals with thousands of people on a regular basis. I would walk around with him and see him take the time to stop and talk to the person from the janitorial staff. "Hey, how's your day going? How are things for you? Thank you for what you do." Really just constantly with all these pressures he had on his mind that he must have been dealing with to still take the time to make sure that everybody on his team felt that he personally needed them. I tried to learn a lot from him. I think he did a great job.

We also saw Wayne bring out the dissenting opinion. Everybody always knew yes, we have dissenting opinions. Wayne was very adamant about saying "I need to hear a dissenting opinion. We're not going to leave this meeting until somebody gives me a dissenting opinion, because I know there's one out there. We need to not be afraid to voice our dissenting opinions. We need to hear them." I think we needed that at the time. We were almost forced into that dissenting opinion so that now it's not taboo. Prior to the accident I think there was some feeling you were going to be shunned if you brought a dissenting opinion up in a public forum. Now it's very commonplace for anyone at any level to bring something up.

Now should you follow your chain of command and follow a process? Absolutely. We're not looking to change that. If you follow that process and still feel uncomfortable there's plenty of open forums where you can stand up and talk. I think that's been a real positive for NASA and something that I don't think that we'll get away from. I think that's been ingrained in us now. That has become part of our culture.

ROSS-NAZZAL: What other changes were brought about by the accident? Obviously there were new systems on the Orbiter. Were there changes in inspections in terms of what you were doing here in the OPF?

STILSON: Yes. The main thing that changed was the inspection process; I mentioned the reinforced carbon-carbon panels for one. Also in the past on the tile—I talked about the fact that you don't always have to change out a tile, if there's damage. You can repair it. One of those repairs is called a putty repair, and it's called that because you're basically putting a type of putty into the hole, smoothing it out, baking it, and then it's usable again.

Well, we went through a process of basically getting rid of any large putty repairs, because there was concern that they were going to come loose and could become debris that could damage another part of the vehicle. So that was a different mindset, because now you're changing the inspection criteria and then going in and removing what in the past had been considered a perfectly good repair technique. It still is but only for certain sizes. That was a big change not only in the fact that from now on with new damage you may not be able to use that putty repair anymore, but also going in and digging all those repairs out. Or removing and replacing the tile based on the fact that the putty repair area has become too large.

Another big change was the addition of the on-orbit inspections. That was a huge thing for the crew and Mission Control, but from a ground processing perspective the additional thermography and minute inspections were the biggest impact to us. Earlier I mentioned the blankets and the fact that, prior to the accident, we were not scrutinizing the blankets or the whole thermal protection system as much as we are now.

ROSS-NAZZAL: Any major challenges that you faced on this flight? I think it was your third flight. Is that correct?

STILSON: Yes it was. I thought back about that. It was over three plus years before we actually flew again. We spent just under 1,000 days in the Orbiter Processing Facility. I had to go look that up because I was wondering myself. Just under three years in the OPF. That's an enormous amount of time.

That OMDP was actually the first one that was being done at Kennedy, a full OMDP. We had done partials in the past, but previously full OMDPs were done at Palmdale [California]. So even going in, before we even got to the *Columbia* accident, we were under a lot of scrutiny because there was still a pocket of individuals that felt like that work should stay at Palmdale, that it shouldn't be done at Kennedy. Even before the process began there were a lot of discussions and us having to prove that yes we were capable of doing this work, and that it should be done here. We discussed the costs of ferrying back and forth to California, and how staying at KSC would avoid that cost. We've got the workforce here. We've got everything we need.

Once again I think we put a lot of pressure on ourselves because we wanted to, of course, make sure we did this right, because now we're going to be judged on, "Ah, well, if we'd done this at Palmdale, maybe it would have been done quicker," or something like that.

So that was already the challenge and then once you lay on top of that the return to flight modifications, and not being able to operate in as much of a controlled fashion as we were used to. The way we had operated in the past the program would have said, "Here are the mods,

you've got six months to go write the procedures for them and get the requirements defined." All of a sudden it was, "Okay when can you have the procedures written and get them executed and what is that going to mean to the schedule?"

Not the best way to plan a processing flow. Nominally an OPF flow—believe it or not—is about 40% unplanned work. That surprises a lot of people. It really surprised me when I heard the statistic. I think that goes to show how much the vehicle is still a developmental vehicle. Everybody wanted to think a long time ago that this was going to be a very routine thing like flying an airplane, and it's really not. That's because every time we process a vehicle we find something new, or the engineers come up with something, "Hey, maybe we can improve this system, maybe we should do this differently."

As a flow director, we go into a processing flow with a baseline schedule. "Here's what we have got to do." We have built in contingency, knowing that we're going to have some of that unplanned work. But you never know what it's going to be and what that overall impact is going to be.

If it's something small, okay, no problem, you can absorb that. We have built in contingency to allow that to be absorbed. If it's something major that drives you to go pull off an OMS [Orbital Maneuvering System] pod then that's a completely different activity. Then you get into the process of, "Can we do that work in parallel with everything else and still maintain our schedule?"

By saying that, if I go back to the return to flight flow, it was almost as if all of those things were happening at once at a very large scale. So opposed to having just a few little problems or modifications to add, all of a sudden we had these huge modifications to add, where we were waiting on hardware, because it was being developed real-time. Then sometimes

maybe that hardware didn't look exactly how it was supposed to. Once we got it here and tried to connect it into the ship it didn't fit right. Now do we send it back to modify it or do we modify it here, because we have some skills here that can do that.

It obviously took a lot more communication and work between Centers than we nominally would have to do, a lot more back-and-forth. The way we normally do it is we receive the requirements, and we implement them. Sometimes there are issues that require us to coordinate back and forth with the designers. During return to flight this was a constant day-to-day, hour-by-hour back-and-forth with the requirements developers that we didn't normally have to do.

ROSS-NAZZAL: Tell me about that communication. You're in charge of this vehicle but you've got responsibility to talk to people in Houston, the Orbiter Project Manager, the Space Shuttle Program, the ET Project Manager here. I'm sure there are plenty of people I can't even list. Talk about communication. Has that evolved over the years?

STILSON: It has. We got to a point where we developed what I call the core team for *Discovery*, and each vehicle has done that. It's comprised of your leadership folks from both an operational and technical side here at Kennedy on the NASA side, then also on the USA side, as well as Boeing. We have a Boeing vehicle manager and a USA vehicle manager. My main counterpart is a USA flow manager and then we have integration folks as well. There's also a representative from the Orbiter Project Office who is the JSC vehicle manager who is basically my counterpart with the Orbiter Project Office. We got to a point where we had a daily tag-up in the morning to talk high level issues, concerns, anything of importance. That allows us first of all to sync up

and make sure everybody understands where we are with processing, what's going on. Then communicate especially to Houston, "Hey, we need this from you guys. This isn't working the way we expected. We need you to go help us with getting the new requirement," or whatever it is.

So that's really helped. Then from a higher level, I obviously have management here that I report to. Then I also have the program that I report to, Mike [Michael P.] Moses being our program rep [representative] here at Kennedy is the person I have the most interaction with. For example if there's a new requirement that comes through, say a special test; a chit is what we call that. It's my responsibility to tell Mike what the impact of that chit will be. So JSC says, "We want you to go do this." Then I go back to Mike and say, "Okay, Mike, this is what it's going to take to do it. Do you want to approve it outside of board? Do you want to have them present you with the details of their request and have me present the schedule side of it?

We had a lot of that type of interaction with Mike. His involvement gets even greater once we go integrated, because at that point in time he's very interested about any additional work. The later you get in the flow, the less you want additional work that could drive something unexpected, because any time we make a change to the vehicle there can be negative fallout if it doesn't go as expected. That's why we at Kennedy somewhat have the reputation, especially to the folks at JSC, of not wanting to do work. We are often accused of "saying no to everything."

I understand why they say that, because we do. I also understand that we have that obligation to once again push back a little bit, because although a task may sound very simple, I go in to do it, and heaven forbid the technician drops a wrench on top of an RCC panel. That's over $1 million to replace and it takes a year. Things happen. As careful as we try to be, those

are the things that we have to think about. So I feel like we're almost like that conscience, "Let me remind you that although this sounds like a really good idea, we have to remember that unless we really need to do work on the vehicle it might be taking a risk that we as a program don't want to take."

So once you're integrated, of course, that risk goes up by three now, because when you do something on the Orbiter you could impact the boosters or the tank, or vice versa. You increase that risk. So Mike at that point becomes very interested and is not willing to take as much risk. In the OPF I can approve special tests on my own. If it's not a big impact to the schedule I can say, "No we're good to do this; we'll just take it on." I won't have to bother Mike with it. Once we go integrated, he wants to be bothered, even if it's something that I think is going to be a simple task and not take much of our resources or our time to do.

ROSS-NAZZAL: How closely was the RTF [Return to Flight] crew following what you were doing here at Kennedy?

STILSON: They were here I believe as much as they could be. Their training schedules I know are horrendous. They paid several visits to the workforce. I think for a couple reasons. I know they're interested in seeing what we're doing. Obviously they have a very big interest in that. So they were here in that respect. Even more importantly they were here to encourage the team and show they appreciated what we were doing, because that was a very hard time for us. It was a lot of work. We were working around the clock because everybody was so anxious to get done. We weren't overworking people. We have workforce rules that we abide by to ensure that

we're not overextending anyone. Still being an environment that's used to launching Space Shuttles and going that long without a launch, it weighs on folks here more than anywhere else.

Plus there was that unknown of will we ever really fly again. That even crossed my mind in some of those cases. A lot of the reason why it crossed my mind was going back to that "polish the apple" scenario. "If we don't draw the line somewhere we're never going to launch again, guys. We have to get moving." Although nobody talked about it much there was still in the back of everybody's mind, "Are we done; is the Space Shuttle Program done because of this accident?"

That's what made the actual liftoff of that mission so critical, well maybe not the liftoff as much as the landing. I think that was even bigger. The liftoff was great. Launch is always a great day, and we were excited because it was the culmination of our work. But to really prove that we had found the problem, fixed it and could fly again safely, we needed to land. So landing day was really more of a relief, I think, for the Kennedy team. "Whew, we did it. It really happened. We really got through this. We're back to where we should be."

ROSS-NAZZAL: Were you the person who signed off that said, "*Discovery* is ready to go when she leaves the OPF?"

STILSON: The process that we take, there's reviews all along the way. So the first review of that kind for me is the Orbiter mate review. Actually let me step back.

We have an ET mate review. So before we mate the tank to the boosters we have a mate review to ensure that we're okay there. If there were any technical issues along the way we talk about what they were and how we fixed them. Or if there's still open work, we discuss when

we're going to do that work and how we're still going to be able to mate on time. Or we need to move the mate date. That's the first one. That one is usually pretty benign. There are usually not a lot of issues with mating the tank.

The next one being what we call the Orbiter mate review. That's where we talk about what's been done on the Orbiter and that we're ready to roll from the OPF over to the Vehicle Assembly Building. Once again high level we talk about the work that was completed, any technical issues along the way. I don't sign-off for that review. I'm presenting data so that others feel comfortable to sign.

So now we've had these two mate reviews and we continue processing. The next big review that I'm involved with would be the launch readiness review. That is where I stand up and give a highlight of the flow for the Orbiter, boosters, and tank. I describe the challenges we've had and detail the remaining work in front of us. I discuss the contingency remaining and give my position on the likelihood of meeting the target launch date. When my part is complete the Orbiter Project engineer talks through any technical issues of interest.

After the launch readiness review then we get into the flight readiness review, which bumps up above me. Although I prepare the charts that the launch director uses, it's the launch director speaking for us at that point in time to say yes we are ready. So if I think about it, the only review that I actually sign off on myself is our internal launch readiness review. The external one to the program, my director for launch vehicle processing, she signs that based on what I've given her as information about where we are and how things are going.

ROSS-NAZZAL: Are you in Launch Control the days before mission and for liftoff?

STILSON: Yes. Actually we have the Shuttle test directors that run countdown. They basically lead the launch team. Although there are members of my ground processing team that are also members of the launch team, it's somewhat as if I'm handing control over to the Shuttle test director. I've done my part. I've got the vehicle ready to go into countdown. Now the Shuttle test director has to finish the job, get us through countdown and liftoff.

During the four days of countdown, I'm not in the firing room until launch day. There's really not a function for me during a nominal countdown. If something goes wrong, then I am back in the mix of things and depending on the problem I can potentially step back into the leadership role. It's a real close coordination between the Shuttle test director and myself, because if we have a vehicle problem then that immediately goes back to my responsibility of fixing it so we work very closely together through that process.

Then on launch day I'm in the firing room. The flow director doesn't have an active role with the launch team, which means we don't have a call on the net where we say we're good to go or anything like that. We do sit on console with the launch director and the assistant launch director and help them with anything we can help them with. One of the most helpful things we can do is assist with monitoring voice loops. In addition if there are targets of engagement, aircraft in the controlled area, the flow director will help plot their location. Basically if the assistant launch director is the launch director's right-hand man; the flow director is the left-hand man to pick up anything else that has to be done.

We are there more in the sense that we're the only person that has followed the processing flow the whole way through. We are the consistent factor for that vehicle. So the launch director, assistant launch director, they do all the launches, but they're not part of all the ground processing to get us there. If there is an issue that comes up, they're going to look to me

to say, "Is this something we saw in the OPF? Is it something you're familiar with, or is it something brand-new?" So it's a consistency role and a reward for being the leader of the team that has gotten us this far along.

ROSS-NAZZAL: Tell me about the landing. You said that that was probably the most memorable moment. You were out in the Shuttle Landing Facility [SLF]. Tell me about that.

STILSON: It was great. I've gotten to be at the SLF for every *Discovery* landing that I've been a part of. It's so quick. It's like you're waiting, you're waiting, you're waiting. All of a sudden it's there and then it's landing. It's hard for me to describe if someone's not seen one. You're looking; you're looking. Sometimes you can see it way overhead. When it's coming down it just seems to almost fall out of the sky and then it's on the ground. Obviously for return to flight, a lot of us were just very anxious to land. Prior to the deorbit burn we are in the firing room awaiting the "Go for landing."

We're listening to the voice loops and watching Mission Control on the television monitor. On STS-114's landing day it was decided that we were going to land out west so we weren't real happy about that because we were anxious for it to land at Kennedy. But that decision is made from Mission Control so we don't have any say in the matter. The reaction for the return to flight landing probably wasn't as impactful because it didn't happen here as it would have been. Still hearing they had touchdown, that was all great. Then we immediately head out to California and start processing for the next mission.

We leave for California the day after landing. Watch touchdown on TV from the firing room and then go home, pack, and get ready to leave. We usually plan to be out there two weeks

just in case, but it usually only takes about a week to get the Orbiter ready to ferry back. Flow directors are part of the ferry flight back as well. We lead the team that's out there processing, getting it ready to ferry back, and then we're on the Pathfinder on the way back. Based on weather the ferry flight could end up taking a week to get back so you're never really sure when you will get home.

That's the downside of being out there, from a personal life perspective. You can't say how long you're going to be there. It's like, "Well our schedule says we're going to be ready on this day but then we've got the ferry so maybe in a week we'll be home." We never want to land out west because of the risk of ferrying the vehicle cross-country. There's a lot of risk involved with that. Plus the additional time that it takes out of our processing schedule because we know there's always a chance to land out west, so we build in some contingency based on that. But we'd always like to have those days. If we can have those extra days for processing at KSC that would be great.

It's very costly, I should say that too. It's obviously costly to ferry the vehicle so we don't want to spend money that we don't have to spend. The fun part of being out there is it is even more focused than we are here in the sense of we're all out there to get this job done and get home. It's nice to have a little more close relationship with that smaller team while you're out there than we have here, because here you still have your distractions of your home life and things like that, where out there it's like night and day this is what we're doing until we're ready to go.

It's enjoyable being out there. The folks that work out there full-time of course love it. It's nice for them to get a chance to process the vehicle, because they're out there prepared and ready to go every time. We send people out as well. We actually have folks that go out there a

couple days before launch, and they stay out there until landing because they're required to be there in case we have an emergency landing. So they're already out there, waiting. I can imagine how they feel, because they go out every time, and they have to get everything ready to go, and then it doesn't land there. That's probably a little bit frustrating for them as well. I've only had two opportunities with *Discovery* landing out west. They've been good experiences though.

ROSS-NAZZAL: How many people end up going out there?

STILSON: There is a small group that goes out prior to launch. Then a couple of days before landing we send the first wave which I believe is approximately 45 people. Then we send about 60 more the day after landing. So over 100 folks are required since we're operating around the clock. We have to cover three shifts a day when we're out there.

ROSS-NAZZAL: What do you have to do to get the vehicle ready for ferry?

STILSON: There's some initial safing that we do, cryogenics and so forth. There are some things, mostly payload items that have to be removed from the forward—the middeck area, just like we would do here. The main thing is getting it to a position where we can lift it up and get the 747 underneath and mated so we can ferry home. There are some SCAPE [Self-Contained Atmosphere Protective Ensemble] operations which are hazardous. Initial draining and safing of the systems that contain hazardous commodities such as cryogenics, hypergols and ammonia.

We're also looking for any type of leaks. If we have anything like that we have to take care of it before we can ferry.

We have to put plugs into the water spray boiler and auxiliary power systems. Also we have to do inspections for the thermal protection system. Not only do we have thermal protection system requirements for launch and for the mission, but for ferry we have requirements to ensure we don't have any billowing blankets or things that as we're flying cross-country would rip those blankets off or do damage. It's a smaller team, but there are quite a few systems that are involved. For example, hydraulics engineers are required because we have to retract the landing gear once we lift up the Orbiter to mate it on the 747. They have to retract the gear and make sure the landing gear are properly closed out.

ROSS-NAZZAL: How did *Discovery* look when you got out to see her?

STILSON: That one, I don't remember there being anything that wasn't typical in regards to the tile damage. I expect I looked at it and said, "Wow this looks great. Obviously all these mods to the tanks and things have done well," but then when we got back to the OPF and they did the minute inspections, we had many repairs to do. I thought, "Wait a minute, it looked so clean." So that's been a running joke, because every time we have looked at *Discovery* on the runway since then we've always thought, "Gosh this looks really good, I don't think we're going to have much tile work." Then we end up with just as much if not more, because our eyes are not trained to look for what the experts are looking for.

The same thing happened after STS-133. That was a unique situation, because normally when I'm looking at *Discovery* after a mission I'm automatically thinking, "What is this going to

mean for processing? What additional work are we going to have to do? What is this going to mean to the schedule? What's the impact of what I'm seeing?"

Several times I had to shake my head and say, "Oh you don't have to worry about that this time," because we're not doing a lot of tile repair before we ferry it to the Smithsonian. I had to keep reminding myself to just enjoy what you're looking at. Once again it looked beautiful. I was very impressed. I said I thought it was the cleanest I had ever seen it.

We were really struggling to find any kind of tile damage. There just really wasn't any. Normally there are a couple somewhat significant gouges that are obviously from ice off the tank or some foam, but never anything that I was ever worried about. These were just turnaround issues we had to fix before the next flight. But after STS-133 the damage was very minimal.

It made me a little bit angry because it was so clean, not because I wanted to see damage but because it made me think, "Why are we not continuing to fly these vehicles?" We feel like we've really gotten a handle on the things that we needed to improve, and as soon as we do it's the end of the program. So a little bit of negative feeling there, but overall I've stayed very positive in that regard. I think I deal very well with change. It's not a decision I could affect. The decision was made. Therefore we've got to act on that decision.

It also helps that I'm getting to work transition and retirement. So I'm going to be able to work on all three of the vehicles right up until we deliver them. My team will be the team that actually delivers those vehicles to the display site. I'm very fortunate to have that opportunity, and it's been very exciting work so far. So I'm very fortunate for that.

ROSS-NAZZAL: Any other memorable missions besides 133 and return to flight?

STILSON: Yes. Return to flight actually, that stands out the most obviously because of everything involved with that—the amount of work that it required and the attention, and the media side of it. As I thought back over some flights, STS-116 was actually the shortest OPF flow since return to flight. It is still the shortest flow. It was a very intense time getting through that flow but also it was very rewarding. We're like anybody else that works in a team environment; we have some competitiveness amongst the different teams. To be able to say, "Hey we processed *Discovery* in the shortest time since return to flight," that was a big deal for the team.

When we roll out of the OPF—there's always celebration involved with meeting a major milestone. That's the first major milestone once you start a processing flow. Major milestones being: rolling out of the OPF, then rolling out to the launch pad, and then launch. So with that being the first major milestone, everybody was really excited about it. That was memorable.

Then STS-128 was a relatively quick OPF flow, not the shortest, of course, but quick. The real challenges for that flow happened after we went integrated. It ended up being a zero contingency flow. We normally go into an integrated flow with at least five days' contingency, at an absolute minimum three, but there have been some that we've had zero contingency based on trying to get to a launch date and other factors that are affecting that launch date. In the case of STS-128 there was a window of time right after our target launch date where the range was not going to be available to us and then there were other constraints such as beta angle cutouts. It was a situation where if we didn't make the targeted launch date the next attempt wasn't going to happen right away. A delay of that magnitude was going to have a ripple effect through the rest of the flows.

We did not, as the people responsible for preparing these vehicles, want to be the reason that we missed the target date. That's our job, to be prepared and be on time. Not to say that if something happens that makes us feel like we can't get there that we wouldn't speak up. If it comes to that then I'm going to be the first one to say, "John [P. Shannon, Space Shuttle Program Manager], we can't do it; we can't get there."

We had some technical issues during that integrated flow that were very challenging, things that we had not had to deal with previously. Each time a problem arises I work with my USA counterpart for the integrated flow, which is James [G.] Taylor to resolve it. We determine the impact, and then what that impact means to everything else in the flow. So we basically build schedules to show what would change. In each case that we had an issue come up, we were able to lay a schedule out that showed, at least on paper, that we could still maintain our launch date.

Understanding that the schedule is only as good as your guess on how long it takes to do the work. For the guys executing, we talk to them. "Hey, how long do you think it's going to take to do this?" That's what we'll use. We'll go from there. Now granted, engineers versus operations people don't always agree on times so we had some good discussions along the way. But the questions JT and I have to answer are, "Do we really think that we need to come off the launch date now? It sounds like we still have a chance to make it. If we do, why wouldn't we try? Why wouldn't we try to get there?" JT is a little more conservative than I am in regards to that. Granted, he's the contractor so he probably feels that he's going to be assessed more with that answer than I will be.

For STS-128 we discussed it and said "No, we can't in good faith say we really have to come off the launch date yet." Now can something happen tomorrow that drives us off of it?

Sure. So the way that we looked at it was if it's important for us to get to this launch date, and we still feel like we have a chance, then we should try. No guarantees, but we should try.

So that's what we did. Lo and behold, we got through some challenges, and we were able to make the launch date, which was a great thing. Afterwards there was some fallout in the sense that some folks felt that we pushed too hard to get there and that's where you get back into that schedule pressure discussion. We had a lot of lessons learned on how we communicate, and what the team's perceptions are, whether their perception is really what's happening or not. If that's their perception, that's real to them so we need to make sure that their perception is accurate. If it is not accurate then we need to clarify and discuss with them. So I'll say I took some heat for that. I did some self-assessment in regards to the way I communicated with the team and what I could have done differently. I would not have changed my recommendation to continue working towards the target launch date but I would have looked and listened harder for those perceptions. I think that we did the right thing, but you can always learn from any experience. Some people felt a bit uncomfortable with the level that we were operating at, and we did make some changes after that. We decided, "From now on we're not going to go into a flow with zero contingency." That's really not a smart thing to do. You really shouldn't because it does create pressure. The contingency days are there for a purpose, and that is to allow that if you have some stumbling along the way you're not immediately impacting a major milestone.

Nobody on the Space Center ever wants to have to impact the launch date. They're all as anxious to launch as anybody in the program is. So when you have those contingency days it definitely gives a little bit of relief to the team. We strategically put those contingency days after major operations, where we have a higher likelihood of encountering problems. We've gotten

very good at where we stage those contingency days. I definitely took a lot of lessons out of STS-128, but overall I was very happy with the results and proud of the way the team executed.

The only other flow I'd mention would be STS-133, which we talked about already. Not just because it was the last one, but because of everything it took for us to get there. On launch day, we had the issue with the range. I don't know how much you heard about that or followed that. We thought we were going to have to scrub for a range issue. For an issue that we were hearing was fixed, but we couldn't get them to say on the loop that it was fixed. I've had people say they saw me on TV while that was happening, and they could tell how frustrated I was.

I'm not very emotional. I am a very emotional person but I don't usually show that. Unless you know me very well you don't know that I'm an emotional person. I have somewhat of a rough exterior. So everybody kept saying, "Are you going to cry on launch day? It's the last one, you're going to cry." I really didn't feel like I would, because I knew I was working transition and retirement. So really my job with *Discovery* wasn't done. I felt I'd be more emotional when I take *Discovery* to the Smithsonian and then I leave her there. I think that's when it'll be an emotional hit for me.

On launch day of course I was thinking, "Am I going to feel emotional?" I wasn't sure how I'd feel. When we had five minutes left in the count, I was starting to feel a little emotional and then when we had the snag, and I thought we were not going to launch. Prior to that point, the launch director kept saying, "Nah, we're going to go today. They're going to get this resolved; we're going to go." Mike's words assured me it was going to be alright.

Well then it got to a point where Mike said, "I don't know, Steph. I'm getting worried now," because he didn't think they were going to get the issue resolved. I literally at that point started to tear up, because I thought to myself, "Don't put this team through this. They have

worked so hard to get to this launch. Weather is perfect. The vehicle is perfect. This is something completely out of their control. Don't do this to them." I could feel it in the firing room, everybody was thinking, "Oh my gosh, please don't tell me we're going to scrub a launch for something like this."

I had to get control of myself. Then once we got the go, oh, I was so relieved! Obviously my emotions showed through to people that were watching on TV, because I was getting very aggravated. I was literally thinking about everything that the team had overcome to get us to that point and then to have it taken out of our hands like that was going to be awful.

To have to start again that's such a letdown. Any time you have a scrub, no matter what the cause, it's a huge letdown, especially if now you've got to go do a bunch of work, like we did with the tank on the first scrub. My initial thought was, "Oh my gosh, now what do we do and how long is it going to take?" So thank goodness we got STS-133 off on the second try. The range came through for us in the end.

ROSS-NAZZAL: Tell me about how processing has changed over the past ten years. Are there significant changes or just minor differences?

STILSON: I think the main change that I've seen –we touched on it a little bit at the beginning— was that we've become more of a unified team, NASA-contractor team. That's so important. It can be hard, because obviously as NASA it's our responsibility to critique what the contractor does and to ensure that they're doing the right thing.

Of course we have to think about cost and schedule as well. If they don't do something correctly, we have to write them up and that goes into their award fee. That can potentially

affect their salaries. So we work so closely together. We're very much a family. Then to have to also score them that makes it difficult. I've really seen over the past 11 years us come to a point where there's better understanding of that aspect of our role and how we're not going to use that to beat them up. Award fee is a necessary thing we have to do. We all know it's there. We're going to do our best to make sure the contractor is successful, because if we're going to be successful they have to be successful too. So we want to help them be successful. Then they do stumble, depending on what it is, we're going to be right there with them. If the contractor makes a mistake, misses a step in a procedure, we're going to have to take that forward. Then we're going to work with them to figure out how to keep that from happening again.

I've seen the communication open up to where—in the past it would be very hard to ever get USA to share any information, much less share something that didn't go the way they expected it to. Now if something happens, I know I'll get a call immediately. "Hey, Steph, here's what happened. Here's what we're doing." They will also already be in the process of investigating and doing those things they know I'm going to ask them to do.

So it's like there's been an acceptance of this is the way we operate. They know what I'm going to ask. They know I expect a lot. They know that I'm going to be looking for answers if something doesn't go right, but they also know that I respect what they do. If they explain to me and just give me the information I'm looking for, it's going to be okay, and we're going to work through it together. I'm going to stand up and take an arrow if I have to, because I'm a part of the team. It's not us against them. So that's been probably the biggest thing that I've seen that's changed.

From a process perspective, we are constantly making changes to improve our processes. So I don't think there is any one thing I can point out. That improvement has stayed consistent.

We are constantly asking, "How can we do this better?" Lessons learned are critical. We have lessons learned discussions after every major task. If something does go wrong we have a process to evaluate the situation. We determine how to fix it and how to ensure it doesn't happen again. I've seen us continue to improve that process. Another process improvement is the increased focus on dissenting opinions which we already talked about.

Then lastly, John Shannon always says "Stay hungry." Mostly he's talking to the engineering community in the sense of asking are there things that we need to do to make the vehicle safer. We at Kennedy—we're a part of that process, because we have expert engineers that are very knowledgeable about their systems. And then from an operational side I see us constantly looking for ways we can do things better. Be more efficient. Be safer with what we do. Be more proactive about things. That's something that I hope that we continue to do. I've felt that it has progressed over time, at least the time that I've been here.

ROSS-NAZZAL: You had previously mentioned there was some competition between the teams. Can you talk about your relationship and your work with the other Orbiter flow directors and other teams?

STILSON: Sure. The flow directors, we of course have interaction. The main thing that we want to ensure that we do is if there's something that happens on *Discovery* that could potentially affect the other two vehicles, it's my responsibility to make sure they know about it right away. So that's something that we do. If one of the other flow directors is in a meeting and a topic related to *Discovery* comes up, they'll make sure I know about it and vice versa. There's good close-knit communication in that regard.

We have to be tied together closely because of sharing resources, and the fact that when we're processing three vehicles, anything one person does on one vehicle can ultimately affect the other two vehicles. So there has to be coordination. Now do we always agree? No. Especially with Dana [M. Hutcherson, flow manager for *Endeavour*] and Angie [Angela J. Brewer, flow manager for *Atlantis*], I almost feel like we're like siblings in the sense that you don't always get along with your sibling. You can be completely different. We are, all three of us are completely different in our styles and in the way that we manage our teams.

But in the end you're always going to look out for your sibling. You're always going to be there for them when they need you and get their back. So to me that's the way our relationship is. Like I said very different styles, not that one style is better than the other. I could never use the style that Angie uses, because we're very different in how we approach leadership and what we do, and what our talents are.

So she leverages what her strong points are to function the way she does, and I leverage my strong points. Dana, I think, is in the middle. I'm more off-scale high in the sense of I'm a type A, very much get the job done. We're here to do a job. I think Angie is more on the emotional side of, "This is the team, and we need to take care of our team." I don't remember what letter that is, but she's that type more of the emotional side of things.

Then Dana is in the middle. She can tip the scale my way or she can go more towards the emotional side. So she's probably the most balanced, in my opinion, in how she operates with her team. I like that we are all so different, because it allows me to learn from them. I'll never operate exactly like either of them do, but there are certain things I can take and say, "Ah, I can use that, I can put that in my toolbox and really learn from that."

I think the style of the flow director really permeates through the team and influences the way the teams operate. We all do the same function, but how we get there is different depending on the team. From a workforce perspective we even interchange team members. You have your core team which pretty much stays with a vehicle. But the technicians, safety representatives, and quality inspectors, they move between vehicles. So you have that continuity to keep us from being very separate teams.

The way we're set up is the engineers and operations folks are tied to a tail number, tied to OV-103 *Discovery* or OV-105 *Endeavour* or OV-104 *Atlantis*. The technician workforce and the quality and safety personnel are tied to a bay. Once again they can move, but there are technicians that are assigned to OPF-2, OPF-1, OPF-3. When we had four vehicles and three Orbiter Processing Facilities, the vehicles were constantly rotating between those Orbiter Processing Facilities, so the technicians didn't become as attached to a vehicle, as much as the engineering and operations teams.

After we lost *Columbia* we had three OPFs and three vehicles. *Discovery* was already in OPF-3 and pretty much stayed there for the remainder of the program. And then *Atlantis* and *Endeavour* stayed in OPF-1 and 2. At that point we had more of a dedicated full team to an Orbiter. That environment built up a little more of that, "Hey this is my Orbiter," as opposed to, "This is my bay."

They still worked multiple vehicles but I think anybody you talk to will claim one Orbiter as theirs based on which one they worked on the most. It became a little more of individual teams as opposed to crossing amongst them. For instance, having the shortest Orbiter Processing Facility flow was something that the team really wanted to do. They wanted to say, "Hey our team did this over in OPF-3." If something doesn't go well, like for instance—and I hate to say

it because it was *Discovery*—we had an instance where we were towing *Discovery* back into OPF-3. Because we had changed a process—we thought we had enhanced a process for the towing operations and the spotting operations. We ended up not being able to get spotted. We had to back up and try again, back up, try again. We ended up doing it 11 times before we got correctly spotted.

So of course we got teased a great deal by the other teams. "Oh can't you guys get spotted? What's going on? Don't you want to start your flow?" Once again nothing's ever mean-spirited, but there is that competition of wanting your team to be the best and be seen as the best.

ROSS-NAZZAL: Let's turn to the transition efforts. We've got a few minutes here. You're currently preparing OV-103. I did see her yesterday go over to the VAB. Tell me what's been happening with the Orbiter.

STILSON: As the transition and retirement flow director for the Orbiters, I will oversee all the safing activities and the preparations for getting those vehicles ready to ferry or to tow over to their display site. I will also be leading the team that does the offload from the 747 at the display sites. We turn over responsibility and ownership of the vehicles after we offload from the 747 and place the Orbiter on the ground. At that point, the display sites are responsible. We won't have much involvement after that. However, we are working with the display sites to help them, to give them our knowledge of the best way for them to handle the vehicles once they have ownership. But our true responsibilities will end once we demate the Orbiters.

Discovery right after landing rolled into OPF-2, and started what we call down mission processing. Down Mission Processing is the same no matter whether you're going to fly again or not. We always go through down mission processing. Basically it's the initial safing, gaining access to the vehicle, starting the processing flow. That has happened on *Discovery*. The difference is we also pulled some of the safing activities into the Down Mission Processing timeframe. The portions that we pulled in were removal of the forward reaction control system [FRCS] and the OMS pods. We performed these tasks as soon as we could because processing of the FRCS and OMS pods is the critical path for getting all three of the vehicles ready to go to the display sites.

The reason for that is those are the most hazardous systems on the vehicle. So here's our new goal. We've been processing these Orbiters to fly in space. Now we're processing them to be safe to the general public. There are hypergols, cryogenics, ammonia, Freon, pyrotechnics, all of which are systems that we have to get into a configuration so that they no longer have any of that hazardous commodity. Other commodities, like hydraulic fluid, are not truly hazardous, but we'll drain down to the lowest possible level to decrease the likelihood of having any leaks while on display.

For processing of the OMS pods and the forward reaction control system, we have a separate Hypergolic Maintenance Facility [HMF] here at KSC. So we removed those modules from the Orbiter and took them to the HMF. One reason for this is that a lot of the work just can't be done in the OPF. The facility is just not set up to do it. Also, the safing of the pods and FRCS is a hazardous operation requiring technicians to wear a full body breathing suit. Only those specially trained personnel involved with that task can be in the bay during the operation. All other work is put on hold.

Once at the HMF we did the initial draining and deservicing and then shipped those modules off to the White Sands Test Facility [WSTF, New Mexico]. White Sands is where *Discovery*'s modules are right now. WSTF personnel are doing the full decommissioning, which means they're completely draining the systems, cutting out lines, cutting out tanks, removing or cleaning anything that has any hypergol residue on it. Once complete the decontaminated modules will be sent back to us to be reinstalled on *Discovery*. From the outside it'll look exactly as if it was on the runway after its last launch, but inside it'll be pretty much gutted. That will allow it to be safe to be displayed in public.

In the meantime we'll continue to safe the rest of the vehicle and then also do the display preparations. Meaning, for instance, we pull out the potty and the galley every time we start a new processing flow. They reservice them in Houston and then send them back to us and we reinstall. Well, the display sites will have the choice of having us put those reserviced systems back in or leave them stand-alone so they can be shown to the public. The public will not have access to the inside of the Orbiters once they are on display. So there will be some things that the display sites choose to keep out of the vehicle.

The Smithsonian wants to keep *Discovery* as flightlike as possible because it is the vehicle of record. So they want most everything reinstalled when possible. They can't have everything because there are some things that as an engineering community NASA wants to keep. There are a couple reasons for this. One is potential reuse of the hardware. A good example of this is the main engines. We think that we'll have use for those main engines in the future. So instead of reinstalling flight engines on the vehicles we're going to go with what we call a replica Shuttle main engine. It's a real nozzle, a nozzle that has flown before or was used

in testing. But it is what we call on a nozzle on a stick. It doesn't have the turbopump and all those things that makes the SSMEs so special. The powerhead is not there.

From the outside you will see the nozzles. It will look like a real SSME. But if you were to look into the aft of the vehicle, it's going to look very different because of the powerhead being replaced by an adapter. So even though Smithsonian would love to have the flight engines installed, they're not going to be able to because we're going to reuse them.

The other rationale for keeping some things is for testing. This is hardware that has flown in space. In *Discovery*'s case 39 flights for some components that have never been changed out. So we want to do some research—I call it science projects—with avionics boxes, valves, wiring, and so forth. So basically engineering came up with this wish list of, "Here's all these things we'd really like to have," and then the program reviewed it. Based on cost and schedule the program agreed to keep some components.

So we still have that type of work to do with *Discovery*. In the meantime *Endeavour* has landed. It's in an OPF, and it's still in its down mission processing phase. We have removed the forward reaction control system and it is down at the HMF being processed. We're getting close to being ready to pull the OMS pods. That'll happen at the end of the month. We actually have a hazardous operation which we call a SCAPE job this weekend to do cross-feed drains, which allows us to be in a configuration to remove the pods. That's not something we would do in a nominal processing flow unless we discovered a problem with one of the OMS pods.

So we have been processing *Endeavour* and *Discovery* at the same time. Well, you saw us roll *Discovery* out of the OPF. The reason for that is when *Atlantis* lands we've got to get it into an OPF right away, because it's got to immediately go into its down mission processing. There are certain aspects of down mission processing that have to happen right away, so we had

to make room for *Atlantis*. We're no longer using OPF-3. We turned that over to the Center to be used for a future customer and we're in the process of decommissioning it. We'll be done with that work at the end of this month, and then a new customer will take it over. I don't have details as to who that new customer is, but we evaluated releasing OPF-3 and got approval from the Space Shuttle Program to process the decommissioning of the Orbiters through two OPF bays. We're just going to have to have one sitting in the Vehicle Assembly Building until *Discovery* leaves for Washington DC.

As soon as we can finish the upfront work on *Endeavour*, being the pods and the FRCS, since that's critical path, we'll back out *Endeavour*, bring *Discovery* into Bay 1, and then let *Endeavour* sit in the VAB for a while. *Discovery* will be the first one to ferry out of here, because Smithsonian is basically ready to get it as soon as we can get it to them.

It'll be somewhat of a shell game moving vehicles around based on priorities. I also have the new challenge of dealing with contracts, which I mentioned in the beginning. I've never had to worry about contracts or budget. We're still in negotiations with United Space Alliance on what it's going to take to do this work. So that's the other half of my job, evaluating contracts and the proposals from USA. We give our government estimate, and then procurement takes it from there. USA proposed more than we as the government think they need to complete the job, so the negotiation phase is in progress now to get us to a point where we both agree on the amount of money required.

The other hard thing about the current situation is we just don't have a lot of money. This isn't a situation where we can say, "Okay however much it costs we'll have the money." No. Here's this bucket of money that we have, so we have got to figure out a way to make it

work. The size of the workforce will go down. It'll take about just under ten months to get *Discovery* ready.

That's a good baseline for the other vehicles. So unless I have additional requirements, or unless we can't resolve the contract issue and we get delayed, it'll take each one about ten months of work to be ready to leave KSC.

Although we are processing three vehicles, I only have one team. It's going to be one very small team to cover all three Orbiters. So the challenge for me then as the flow director is basically moving that team from vehicle to vehicle depending on what the priority is. Right now the priority is *Endeavour* so that's where the team is focusing. As soon as *Atlantis* lands, *Atlantis* is the priority. Will I still have some work I can do on *Endeavour*? Yes, but the majority of the people will be on *Atlantis*. Then we bring *Discovery* back. Once we get through down mission processing on *Atlantis* then I can focus everybody back on *Discovery*. It'll be a constant moving of resources. Besides just the vehicles, that same workforce is going to be responsible for decommissioning facilities as well.

For example, I will also have to share resources to decommission Pad A. We're done using Pad A so it's important that we get it off our books as soon as we can. It's going to be a new situation for those of us that have been working the Shuttle Program and only had to worry about processing vehicles.

To be clear, my primary focus is the vehicles. There are other people looking at facilities, but now I'm going to have to go lobby in some cases to make sure I'm getting the resources I need for the vehicles. Because it could turn out that based on cost it makes more sense to shut down Pad A as soon as possible so then you might want to move everybody over there. Well, what does that then do to the vehicle schedule? Does that hurt me or is that okay

based on when the display sites are ready to take the vehicles? A lot of coordination will be required. It's been great. I've really enjoyed it already. Dealing with the display sites, we've had some site visits, talking with them.

They're so excited to get the vehicles. Granted there are a lot of people that were very disappointed that they didn't get a vehicle. I can completely understand that. Once again, this is something beyond our control, so we'll just deal with it and go do the best job that we can. It's a complicated operation, the offload of the vehicles once we get them to the display sites. It's about 30 days of work with probably about 45 people. We're still negotiating how the work is going to lay out. Thirty days to get everything there and set up. We have this big wind restraint system that connects to the Orbiter. We will have two heavy-lift cranes holding on to a sling lifting up the Orbiter. If there are strong winds it's like a sail. It can catch the wind, and prevent us from being able perform the off-load.

To mitigate this we have the wind restraint system that is made up of four masts with taglines that connect to the sling. The system controls the lateral movement while we're lifting the Orbiter up, moving the 747 out, and then setting the Orbiter down on the ground.

ROSS-NAZZAL: So you're not going to be using the mate/demate device.

STILSON: We will use it here to onload, but we won't have one at the display site. So you're exactly right. The wind restraint system takes the place of the mate/demate device. It's actually a system that was designed to be used at TAL [Transatlantic Landing] sites. If we ever landed somewhere where we didn't have a mate/demate device, that's how we would have offloaded. Fortunately we've never had that happen. So we actually just did a dry run recently to make sure

we knew how to properly operate the equipment. This stuff hadn't been out of boxes since we used it in '85 when we took *Enterprise* to Smithsonian. That was the last time we used it. Before that it was used when they were offloading *Enterprise* in Mobile, Alabama, for the World's Fair. That was '84 I think.

Yes, all this equipment has been in a box. Procedures have been on the shelf. We've been going through the process of dusting them off. We set it all up out at the SLF and made sure we understood how it works. We are still updating procedures and improving hardware. Neat work.

ROSS-NAZZAL: Cool job.

STILSON: Yes, I'm very fortunate.

ROSS-NAZZAL: We have just a few minutes. Anything else that you want to add? As we talked we really hit on most of the questions that I had thought about.

STILSON: I think the only other thing—you had asked me about being in the Launch Control Center and then maybe Mission Control during the missions. I wanted to tell you a little bit about that. For a flow director, on-orbit time is really our only down time when you think about it, because at that point we've handed control over to Houston. At that point all we are doing is preparing for the vehicle to come back and start over again. So that approximately two-week timeframe for me is usually when I take some time off.

We do have the opportunity—I know Angie Brewer who's the *Atlantis* flow director is there now—to go and be in Mission Control and support the mission. There's no requirement to do that. It's more of a perk, "Hey you've got us this far, would you like to come see how things work here." Because I spent six months in Houston I've never gone like Angie has done this time, because I was fortunate enough to spend time in Mission Control when I was there.

For me like I said, that's usually when I try to catch up on some stuff at home before the mad pace starts again. We're of course paying attention to what's happening on orbit. The main thing is—if we weren't at the end of the program—the main thing I would be concerned about is if there is anything that's not working. Hopefully that's not going to impact their mission. Hopefully they can still accomplish their mission goals. If it's not working what are we going to have to do here to get it working again? So we're already thinking about that if they have an issue.

Like recently I think it was [STS]-131 we had the Ku-band failure. We were saying to ourselves, "What? It worked fine here; what's going on?" When something like that happens we start thinking what kind of retest are we going to have to do. Are we going to have to change out an avionics box or the whole Ku-band antenna? Do we have a spare? So we've already started that work prior to landing. We're interested in hearing how things are going so we can determine what it is going to mean for turnaround for the next launch. Luckily 133 was a phenomenal mission.

I was so happy that the crew had no issues to work in regards to the Orbiter. Being on the runway after landing, that's one of the perks of being a flow director. We get to greet the crew when they get off the vehicle. For 133, each one of them, when they got off, said

Discovery worked phenomenally. They had no concerns, no issues. Of course I'm lucky enough to hear it directly from them, and I get to go back to my team and pass the message along.

That's what we were hoping for. Of any of the missions, we wanted the last one to be where the crew didn't have to worry about *Discovery at all*. They've got work to do. Plus it's their last one with *Discovery*. It's their last one as an astronaut on an Orbiter. They get some free time up there. We wanted their free time to be free time, not, "Oh we have to go work on a Ku-band antenna" or something like that.

So I was just so happy that every single one of them made a point of saying gosh it was just perfect. What a way to go out, that's exactly what we wanted, was to end on such a positive note. We're not done yet because we've got to get to Smithsonian. That's a big job, but I'm confident that we will stay focused and do just as good of a job on that as we have in processing *Discovery* over all these years. I'm really impressed with the team, especially because it's a hard time for the contractors. We've got a lot of people that are leaving that don't want to leave, and they don't have a choice. That's tough. A lot of my very good friends have already left or are leaving next week.

So to remain focused through that, the folks that are still here. Even the ones that are staying don't feel real good about it. If their buddy is leaving and they're getting to stay, they don't feel great about that. I've never been through a mass layoff like this before. It has definitely been a hard time. But I think that United Space Alliance has done a great job of trying to help the workforce find new jobs and not be left out in the cold.

USA didn't have to do a lot of the things they did, but they did those things because that's how much they care about the workforce. Even talking to USA employees that are leaving, they'll say the same thing. "Gosh, we've been given every opportunity to find new jobs.

All the assistance we could even ask for. Do we want to leave? No. But if we have to at least they've made it as painless as they could." I think that says a lot, not just about USA, but also about NASA because I'm sure we have influenced that as well. This wasn't USA's decision for the program to end. I think that we as an entire agency team have handled it very well.

ROSS-NAZZAL: You're going from a team of how many down to how many?

STILSON: Normally our full processing team is about 1,000 people at Kennedy for a whole processing flow. I don't yet know how many people I'm going to have on my transition and retirement team, because of the contract negotiations, but it will be much less. I'm guessing probably 60 or so. So it's going to be a real small team. There's good and bad about that. It'll make us closer. When you have a smaller team it's easier to be closer, but that means a lot of work for people that normally we would have spread out over multiple people.

ROSS-NAZZAL: Tough time, but I'm glad to hear you're positive about it. Exciting though too to have the Orbiters in different parts of the country where people can see them up close.

STILSON: Exactly. That's going to be great. It's going to be neat to go back after it's all done and they're in their final display configuration and see them there, because that's going to be several years down the road before they have them displayed how they want them in their permanent facilities. I think everybody will enjoy doing that. From what I can tell, all the display sites, all four of them, are really conscientious of representing the team. Not just,

"Here's this incredible vehicle here that flew in space. But here's the team behind it, and what they did to make all this happen."

So I've been very happy to hear them already talking about that. Asking for ideas of how they better convey that to the public. It's not just about the hardware, there's a heart and soul behind it. That's the workforce that has cared for these vehicles for all these years.

ROSS-NAZZAL: Are you working moving *Enterprise* up to New York?

STILSON: Yes. When we drop off *Discovery* we will pick up *Enterprise* and immediately go up to JFK [John F. Kennedy International Airport, New York, New York]. Actually it'll take us about a month before we can get all the equipment and people there to offload. So the Intrepid Sea, Air & Space Museum [New York, New York] will have to keep *Enterprise* in a hangar on top of the 747 for about a month. We're refining schedules right now, but it will be about a month before we can actually offload. Then once we offload they're going to store *Enterprise* at JFK until they have their permanent facility ready. So they'll have it at JFK for a couple years, but they're setting it up so that they can bring the public in to view it there.

That was a stipulation that NASA gave them. You need to, within a year, be able to display these vehicles. You can't take three years before the public can see them. All of the display sites are having to abide by that. California is the same way. They're going to have a temporary display site. As well as the Visitors Complex here at Kennedy. So all of the sites except for the Smithsonian are going through the process of having a temporary site while they're working on their main site.

ROSS-NAZZAL: I look forward to seeing them. Thanks very much for your time today. Appreciate it.

STILSON: Absolutely.

[End of interview]