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SUZAN C. VOSS
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is August 4, 2015. This oral history session is being conducted with Dr. Suzan Voss at the Johnson Space Center in Houston, Texas, as part of the International Space Station Program Oral History Project. Interviewer is Rebecca Wright. Thank you again for taking your time out of your day to come and visit with us here.

You have been with NASA for more than 30 years. If you would, please start today by telling us how you first became involved with the International Space Station Program.

VOSS: First, I would say you have to be hired at NASA. It can be a very interesting process for individuals to have the opportunity to be hired at NASA. My undergraduate degree is in mathematics, and I had an MBA [Master of Business Administration] at the time. I'm talking about 30 years ago. They were only hiring what they called AST [Aerospace Technologist], which means you must have a science, math, or engineering degree. Because of my master's in business, I was actually hired in financial management, but they could not have hired without me having a degree in mathematics. I was learning a lot there, and it was enjoyable, but I knew that I wanted to work in the technical side of the house.

So I thought, "I need to get an engineering degree also." I started taking night classes in engineering. I had to take some background classes because I didn't have an undergraduate in

engineering, and then go into my graduate work. Then I applied for the Johnson Space Center [JSC] Fellowship Program and I ended up getting my Ph.D. in engineering through this process.

After that I moved to the [Space] Shuttle Program Office and I worked in the Shuttle Program Office for about five years in various areas. We looked at the vehicles and their mass properties, CG [center of gravity] analysis, and the flight program, the scheduling, and looked at the vehicle itself as far as the middeck cargo capabilities, and the configuration and compartments there. After a number of years there, I was very fortunate, because while we were still in the early stages of Space Station I was asked to go and work in Moscow [Russia]. I went to the Moscow Technical Liaison Office—we called it MTLO—and worked there for one year. I think if you're going to work in an international program such as International Space Station, it's of great benefit to understand how the partners work.

While I was over there, I supported the EVA [Extravehicular Activity] team. I also supported the ECLSS [Environmental Control and Life Support System], which is the environmental systems team, as well as other crew resources. When they had technical meetings I would support them and follow up on all of their requirements so that they were appropriately documented. Occasionally if there was some hardware exchange I would go and look at how we did that process and sign off for the hardware exchange. But it was extremely interesting learning how the Russians work, learning how they negotiate. They're very good negotiators.

Then, about I think a month before I came back, I was nervous about what I was going to do. A lot of times when you go into a special assignment, you don't necessarily know what you're going to do when you return, but then I got a call from Rod Jones, and he asked me if I wanted to come back and be the deputy launch package manager for the U.S. Laboratory Module [*Destiny*], and I was thrilled.

I had a home when I came back, and it was also on a part of the Space Station that I was very excited to work on. The U.S. Laboratory Module is the heart of Space Station from both a systems perspective as well as from the science perspective of being a laboratory. After about a year being back in Houston working at that, Rod moved to deputy manager of the office, and I was selected to manage the launch package for the U.S. Laboratory until launch and that was a thrill. I learned more about integration, and I spent a lot of time over in avionics—because of all of the systems and the avionics on board—to understand how it was progressing. The role is really an integration role across all of the program, but also across [NASA] Centers. It is how we are going to integrate this module, get it ready for launch, and then integrate it into Space Station.

WRIGHT: Tell us what shape and what phase of development *Destiny* was in when you came on to work in this new role.

VOSS: I came on there in ’97, and it launched in 2001. Of course it takes a very long time to establish the requirements, build the physical module. But, more than building the structure, it’s the interfaces—the interfaces to the other modules as well as the interfaces of all the systems and hardware within it. All the requirements had been defined, it was just in the final build integration test phase.

WRIGHT: What were some of the challenges that you faced as you moved to get this module ready for launch?

VOSS: As always, schedule is a challenge. You have to be flexible, because the schedules on complex programs and the testing—if not everything goes exactly as planned, then you have to look and see where it is—either you can make up the schedule, or where it is, can you can adjust for the longer term—because the most important thing is, of course, is to have it right.

WRIGHT: Talk some about that ’97 to 2001 time period. You did have a schedule. There was an expectation that *Destiny* was going to become full-fledged, and as you mentioned, become the heart of the Station. Walk us through some of the more significant achievement, and the goals and accomplishments, and even some of the failures that you encountered getting that package ready to go.

VOSS: There were two aspects to it—like I said, the software and the avionics, and having that at the level that it needed to be [in order] to be tested. A lot of that testing was actually done here. Then there was the physical interface testing, which was done at [NASA] KSC [Kennedy Space Center, Florida] with the module to understand the physical interfaces. Schedule is always a problem—certainly it did not launch as planned when I came on, as far as the timing. But it got there very successfully, was integrated successfully, operated right away, and of course is still operating successfully on orbit today.

WRIGHT: You mentioned Centers earlier. Did you have a working relationship with [NASA] Marshall [Space Flight Center, Huntsville, Alabama] at that time, or was that afterwards?

VOSS: We did work with Marshall a good bit. We worked of course with KSC a good bit because a lot of the testing of the physical hardware was done down at KSC. I'd say those were probably the primary interfaces that I had.

WRIGHT: Were you there, here, there, and everywhere, going from place to place as the manager of the module? I know you had a team.

VOSS: Right. I would say a lot of the work that I did was from here, because a lot of it was more of a program-level integration versus integration of the subsystems and the detailed technical work. A lot of it was done from here. I would say the place that I would travel occasionally would be to KSC.

WRIGHT: Of course as you were getting ready for launch, that wasn't really the end. That was more the beginning, because *Destiny* would be going up to make its place in history. What were some of the other duties and responsibilities that you were working on that you needed to take care of while launch was being prepared for, and then eventually that you moved into after *Destiny* was up?

VOSS: My responsibilities on *Destiny* ended when it was launched and integrated. We worked real-time ops [operations] just during the actual flight until it was integrated onto Space Station. But then my role moved to other flights after that.

WRIGHT: Tell us about those and then how those eventually led to where you are now.

VOSS: I was Launch Package Manager; that is what they called it for [ISS Assembly Flight] UF-1 [STS-108], one of the MPLM [Multi-Purpose Logistics Module] flights. That was needed, because after *Destiny*, after the core part of Station was there—even before that with the core Russian modules—we first launched crew. Then of course as it built, we not only needed things for the crew and their operations, but for any of the other modules that were coming up, any interfaces or any equipment that needed to be up there, as well as the science that we were conducting.

A lot of the science initially was short-term science, and it would come up and down on the Shuttle. Some of it would be transferred to Station and then come down on the next Shuttle mission. Basically I worked that area for several flights, and then I went and started managing an office, which was initially the Cargo Integration Office, which had a lot of the same responsibilities, actually, similar responsibilities to what I manage today. Sometimes we changed names, but the Cargo Integration Office was managing the contracts as well as the flights that supplied the science, the logistics, the utilization for Space Station.

Today I manage the office that is called Visiting Vehicle Integration and Operations. The key thing on that office is we manage integration of all the pressurized cargo for the flights that go to Station—all the science, all the technologies, all the supplies that are required for Station. The vehicles include U.S. commercial resupply and international partner vehicles. Until recently there was the ATV [Automated Transfer Vehicle cargo spacecraft], which was from the European [Space Agency], but they have flown their last flight. We have an HTV [H-II Transfer Vehicle cargo spacecraft, Japan Aerospace Exploration Agency (JAXA)] launch in two weeks, HTV-6, which is carrying some very critical science and logistics.

Then we have our commercial resupply flights, both SpaceX [Space Exploration Technologies Corp.] and Orbital [ATK, Inc.], and of course the Russian flights. We still send cargo over to Russia and fly it either on the Soyuz [spacecraft] with the crew or on the Progress, the cargo vehicle. We deal with all the [international] partners still, as well as the commercial resupplies, the Orbital and the SpaceX corporations.

WRIGHT: Instead of an air traffic controller you're a space traffic controller.

VOSS: Yes.

WRIGHT: You were talking about contracts. The ones that you just mentioned are each a different entity on their own that have their own rules and requirements. If you could give us maybe some examples about how your office manages to make everything seem seamless, make it look like it just falls right into place, although you've had to deal with delays and you've had to deal with disappointments on the [launch] pad and cargo not reaching [orbit]. Share with us some of the complications, the complexities, of what your office has to deal with, and then how you're able to resolve those.

VOSS: I would say of course the biggest problems this last year have been the failures of some of the resupply vehicles to get to orbit, when there was a failure on an Orbital vehicle, a Progress vehicle, and a SpaceX vehicle, which just shows us how difficult it is. It wasn't one entity. Spaceflight is just very difficult.

When you do have those occur, for instance on the last one, when SpaceX [Cargo Resupply Services (CRS)-7] was not successful, you look at your next flight. HTV-6 is our next flight, and so we do have a late load there. We started working with the Japanese right away, telling them that our priorities were going to change. We were going to have to send some new cargo; we were going to have to displace some cargo that was already on the vehicle.

That took quite a bit of negotiation with them because, as you know, everybody likes to keep their schedule and their process, but we were able to successfully do that with the Japanese. They understood, they were cooperative, and they actually found a few extra locations on the front of a rack where they could get a little bit more cargo on this flight. So, you just work with the circumstances that you're dealt. Then you see what the priorities are.

Then of course Station is very resilient. We do our planning ahead. We have typically four to six months of critical spares, crew supplies, science, so that if a flight is delayed you're able to still accomplish your mission all the time.

WRIGHT: Along with schedule you have cost. When you have delays in schedule, sometimes it impacts cost. You have so many entities that are absorbing those costs or having to deal with those costs. How are you able to help them? Or how is that part negotiated? Where are your boundaries that you're allowed to negotiate what those costs are, and how does it all come together where it works out where everyone's in agreement to move forward?

VOSS: If it's something within my realm of responsibility, say for instance the Cargo Mission Contract where that comes under my area, then we certainly can adjust. They did have to work some overtime to allow us to get cargo to Tanegashima [Space Center, Japan] quickly for the

HTV launch. If it's broader, with all of the international partners, that's worked out of a different area. That's our External [Integration] Office, and we just give inputs to them, and then they will work the agreements.

WRIGHT: That's good to know. I'm sure that helps you some along too. What kind of impact did it have a few years ago when NASA began its different way of business by making agreements through a public-private partnership with these new companies that were coming in to be part of the International Space Station for the first time? We were using Space Act Agreements to bring these companies in to help bring cargo up. Can you share with us what were some of the discussions, and how you folded those into these other transportation vehicles that you already had in place?

VOSS: I think it's like anything when you make a change and people are used to a certain process. It takes them a little while to adjust. It's true on the commercial vehicle side—whether you're talking about SpaceX or Orbital, they had certain expectations also. It really is sitting down and talking to them. They've turned out to be flexible where they needed to, and where it was not appropriate, they would tell us.

You have to stay in this CG box, you have to stay within these mass parameters. You have to give us the data before we do this set of analysis. Every vehicle. It doesn't matter whether it's a government-owned NASA vehicle or whether it is a commercial vehicle. They all have their own technical constraints, and you have to understand those. But outside of that they've been very good and very flexible on accommodating additional cargo. After their first flights—everybody's conservative on your first flight, and you should be. Your products need to

be a little earlier, they need to be a little more controlled. Then later you understand what your capabilities are, how you can load your vehicle, when you need the products. Then you will adjust and make the schedule a little bit more flexible and the parameters, as far as the mass CG-type parameters, more flexible where it's appropriate. It's been a great experience.

WRIGHT: It sounds fascinating. I want to ask you about the science elements. You mentioned being so involved with the Shuttle cargo going up. First it was short-term projects that would come back on the Shuttle, and now of course the Station is involved in long-term projects. Can you share with us when you believe you saw that transition, where you saw more and more long-duration projects going up onto the Station? Give us your thoughts about how the science and research has evolved over the years that you've been involved with Station. It was very little early on because there was very little time and folks on board to do that, and now we have a full-fledged floating orbiting laboratory that's able to do so much.

VOSS: We've always initially, even early on, done what I call the human science. You could easily bring back, say blood samples or do your exercise protocols in certain ways, and then take different measurements, because it didn't require as many laboratory and other resources.

But I say the big, the huge change has come with assembly complete, because during the assembly phase people were still focused on, "We have to get this complete." I've been involved since last year in what they call RISE, which is Revolutionize ISS for Science and Exploration. This is a team led by Ryan Prouty, but I'm one of the members of this team. I led the part that you might think would be appropriate—plan and process cargo—on this.

The key to this was to relook at the way we do requirements, relook at the way we do verification. When you're conducting science in a laboratory it's completely different than when you're building a vehicle that has to last 20, 30 years. We have really gone in and looked at how we can streamline the requirements, make them appropriate as far as being safe for the crew and safe for the vehicle, but not worry so much about mission success. That is to the payload customer and the payload entity to worry about that. We used to have books, and we still do, of requirements that everyone has to meet to fly to Station, but we've looked at that and we're seeing how we can reduce that.

From my side we're looking at what we ask of them and the time that we ask of them. Many of the science customers need much later access. They may have late-load type of requirements where they're limited life. They also are not prepared to be added to a flight until much later in the process. They haven't known for years they're going to Station; they've known for six months that they're going to Station. You have to adjust your processes in order to change and accommodate the types of science that you need.

WRIGHT: I have to believe there's been such a variety of choices to be able to send up on Station and no matter what's going up, you get the opportunity to know all of it because you're in charge of the cargo. Are there elements of what you have done that have been surprising? Have there been some cargo pieces that have gone up that you're thinking, "Wow, I never thought this would go up on Station?" Or those that you find you're looking forward to the results of that research?

VOSS: One of the more recent things that have gone up that has drawn a lot of attention is the rodent research. That did take a lot of special attention, because it's not just the habitats. The rodents—for them to be comparable and to do the research—they have to be at a specific time in their lifecycle. They have to prepare them a certain amount time before flight so they're in that cycle. Also we learned a lot. We knew we needed a powered habitat for the rodents, but even things like how we were going to ventilate it appropriately, how we were going to have the airflow right in the vehicle—that took a good bit of time and effort.

All of our conditioned science—we call it cold stowage—has a limited life, and so we spend extra attention on that. We're going to send up, and we have sent up, other large facilities like the Microgravity [Science] Glovebox and different types of facilities to operate in, whether it's for materials science or for life science. But, our rodent friends have been one of our top priorities recently.

WRIGHT: That's really interesting because again it's that word of "integration." You've got to have the environment correct, you have to have facilities correct. Everything has to be like you would do for a guest, you have to have everything ready to accept them. I think I read the other day, if I'm correct, there may be some whiskey samples going up for aging. Is that correct?

VOSS: To be honest, yes. I did actually read that myself. I believe this is on HTV, and it is to look at how the aging is different. Actually they're going to be on orbit, some of them, for one year and some for two. Then they will get the results and test them.

WRIGHT: I'm sure that'll have a big story after that. I just thought well, that's odd.

VOSS: It was a little unusual. It didn't take any special handling from our perspective.

WRIGHT: Are there other aspects or elements throughout your lifespan working on the cargo part that have been maybe disappointing, that you worked really hard to make sure things got up? And that you had to go back and rethink, and that ended up in a process that maybe got enhanced or improved for the next time something got sent up?

VOSS: We did have some trouble with the NanoRacks [LLC] CubeSats [miniaturized satellites] on the deploy. The various teams, not just in my area, worked with them to make sure that we have the requirements right, and they have tested them appropriately so that they don't have any problems in the future with them.

WRIGHT: Seems like the word you use a lot is "teams." You really work with a lot of people. What's the common ground? Is it a series of meetings or a series of requirements? What seems to be the working piece that makes it work well?

VOSS: My visiting vehicle leads for each of the flights typically have team meetings every week or every other week, depending on how close they are to flight, or how close they are to some milestones that they have to meet. They have representatives from the vehicle office, they have representatives from the EVA office, and they have representatives from science, the utilization office. Anyone that flies on Station, you would have your representatives.

Now obviously not all your experimenters are going there. That's why they interface with the Research and Utilization Office. The Research and Utilization Office essentially brings us their requirements, when they want to fly, what they are, do they have any unique handling, do they have any unique timing requirements. Then they go out and work with the details as far as the science goes.

WRIGHT: All good plans sometimes don't work out, because someone that is not even involved makes a decision or change, and you're not maybe given that information. Or it could be a political change. Or it could be an international cooperation change. Have you had to deal with an unexpected decision that came down the line that impacted what you were doing that you had to make a change in getting something on Station? Or something that you changed the process because of a decision that was made either organizationally or politically?

VOSS: There are always some changes. That's why flexibility is one of the key things. It is for Space Station. You have to be flexible. But typically, as far as the cargo on flights, the biggest change comes if they have an on-orbit failure. You need to get up something quicker that you did not expect, and so then again you look at your priorities. What do you have on that you need to take off in order to accommodate this other hardware or cargo or payload or whatever the hardware is? Then sometimes people think they will be successful in getting it there, and then they're not.

We always have some other cargo what I'd call the more standard logistics available—your crew provisions, your food, your laptops—things that we have multiple items of that we can

substitute in order to, of course one, fully utilize the vehicle, and two, make sure you stay within your mass properties that you told the vehicle you were going to be within.

WRIGHT: You've been involved in all these processes and the whole environment for so long. You have been for a while serving as the chair of the Mission Integration and Operations Control Board. Do you find things to be falling into place because we have been doing this for so long? Or do you feel like there's much more to do? I think you mentioned earlier the simplification of the processes. In your leadership position, how are you hoping to move forward to get these more streamlined?

VOSS: First, I'll say I don't chair that Mission Integration and Operations Board. My manager does, Greg [Gregory] Dorth, but I'm on the board obviously for my area. The thing that I'd say that we had hoped would be more stable now would be the sequencing of the flights. Therefore you could decide the flight manifest, what you were going to fly on each of the flights with few changes, but unfortunately this last year there were a number of failures on the vehicles. And whenever you have the instability, that causes a lot more rework, and a lot more look at what's the real priority, because then you're trying to fit 10 pounds in a 5-pound bucket. Instead of having the same number of flights you have fewer flights in that timeframe, so you have to make sure that you have the right things.

For the Mission Integration and Operations Office another key area is increment management. They have their whole increment plan on what science they're going to conduct, what EVAs they're going to conduct, what hardware needs to be repaired and replaced during their increment just as a standard part of the process of maintaining systems. Those plans for all

the onboard operations are significantly impacted by the vehicle failures also, but they're doing an excellent job as they move forward.

WRIGHT: Lots of details to get in lots of rows. A change that's going to be coming soon will be the commercial crew.

VOSS: Yes. We hope very soon.

WRIGHT: You will have yet again another vehicle to work in. Are you already making plans? If so, what types of work are you putting in place to be ready?

VOSS: We do have someone in my office that is overseeing and reviewing the requirements as they come on, both for [The] Boeing [Company] and for SpaceX. But again, in my office today this is looking at it more from what powered payloads, what other logistics. It's a relatively small volume for the cargo, but it's a very critical volume, because it'll go up and down, just like any of our return vehicles, whether it's a Soyuz or the SpaceX. The competition on the return is to get the science down, or on a larger flight like SpaceX if we had a failed ORU [orbital replacement unit] and we wanted to do an investigation to make sure that we understood what the cause of the failure was so that for the future we would make adjustments.

I think the commercial crew will be very exciting. We will have a piece of it, and we do have a piece that I have people in my office already assigned to looking at the requirements and when they need products. We look forward to it.

WRIGHT: Speaking of return, the [SpaceX] Dragon [cargo spacecraft] allows you to bring things back from Station. You also coordinate the return of those vehicles as well? Can you share maybe some of the details, and the challenges that are involved with making sure that that gets down the way it needs to?

VOSS: I would say the return is often more challenging than the launch, because we all understood how to deliver cargo to a point, whether it be in Florida, whether it be in [NASA] Wallops [Flight Facility, Wallops Island, Virginia], or whether it be overseas. The return, of course, of the Dragon—today it returns in the Pacific [Ocean], and they retrieve it. They take the powered payloads, they put them on ground power on the ship, and they take what we call "cold bags," our conditioned science, and put them in a freezer.

Generally it's been more or less, but basically the plan is 48 hours from splashdown back to the port. We do have our cargo mission contractor who meets them at the port, takes the early science and brings it back to Long Beach Airport [Long Beach, California]. Then some of the science will actually be handed over at the airport, especially if you have a customer like [NASA] Ames [Research Center, Moffett Field, California] that's on the West Coast. They don't want us to bring it back here [to Houston] and then have to go back [to California]. Depending on what the requirement is and the customer, they may hand it over there.

Most of the powered payloads or the cold stowage will go in ground freezers or ground refrigerators, depending on the type of temperature it needs to be conditioned. Actually we have a contract right now, CMC [Cargo Mission Contract] does, with Kalitta Air [LLC]. They have aircraft that we have all the GSE [ground support equipment] on. It flies back to Houston that

day, and then is either turned over or given to the right people, or put in the appropriate laboratories here until all the handover can happen.

Just establishing those processes and making sure they were all appropriate took a while. Although they may change. We're just hearing they may change and land in the Atlantic [Ocean] in the future and come back to [Cape] Canaveral [Florida].

WRIGHT: As you mentioned, things are always changing, you have to be flexible. If I can stay on the future for a few more minutes, I understand that in some of the work that you've done you were able to handle cargo or some experiments that went up that impacted some work that was done for Orion [Multi-Purpose Crew Vehicle].

VOSS: I will apologize here, because I don't know. I know that we have done some work that will help Orion, but I don't have the specifics today.

WRIGHT: That's okay. You've talked about one of the most memorable moments was being able to work with *Destiny*, getting it ready and then watching it launch. Do you have any others that you'd like to share with us that seem to stand out in your memory?

VOSS: I think probably the first launch of every vehicle. The first launch of ATV—making sure it was successful, the docking was successful, and it appropriately brought all the cargo. The first launch of the HTV, the first launch of the SpaceX, first launch of Orbital. I think all the first time launches are very special in that you do have a lot more coordination and integration, but you also are a lot more nervous initially. So you want to make sure that everything goes well,

and they have done very well. It's not just the launch. I say launch, but obviously the important part is either the docking or berthing to Station and successfully carrying out the mission, because you've got to have the science and the other logistics delivered.

WRIGHT: Are you here watching? Or are you somewhere else?

VOSS: I have not gone to one of those launches. There are a few people that have. For instance in my office I do have a few people that go to KSC for the late load. They process it at KSC because KSC has some laboratories that can be used for the L minus 24-hour [24 hours before launch] late load. Then they just truck it across the causeway over to the Canaveral side, so I do have a couple of people who work for me that have seen a SpaceX launch.

WRIGHT: Maybe something to put on your list, right?

VOSS: Yes.

WRIGHT: We started out by talking about where you started. You mentioned that you had spent that year in Russia and getting to understand how important it is to understand the international partners. Of course Russia was the first one and now you're working with the Japanese and you've worked with ESA [European Space Agency]. What do you feel are some of the lessons that you have learned by working with these international groups that work well for all of those, or just work well for you? What can you share with us as important lessons when you're working with international partners?

VOSS: I think it's the same with anyone—good communication. When you don't speak the same language sometimes that is more difficult. One of the techniques that one of my team members uses with the Japanese which I think is very effective—they go ahead and make the charts and the questions ahead, send it to the partner so that they will understand what the question is, what the issue is, what will be discussed. They can go back and forth before they actually have the telecon [teleconference] or actually make the agreement.

It's like with any people. Communication is one. I find all partners, ourselves as well as all—whether we're talking about the Russians or the Japanese or the Canadians or Europeans—you have parameters you have to work within. There are certain things that different levels can and cannot agree to. It depends. You've got to work at it and understand what the issue is if you're not coming to an agreement, so that you can focus on that area.

WRIGHT: You also shared with us about your professional background, that you have business and math behind you, as well as an engineering degree. As we've talked, it seemed like you were able to utilize bits and pieces of each of those to be successful in what you were trying to accomplish at the time. Can you talk about possibly why it has benefited you through these years of negotiations and schedules and cost to have a diversity of understanding, and how you were able to apply that?

VOSS: I do think that different types of backgrounds can be helpful. Again the mathematics was just the core, what I call a "core and basic," sets the stage. The business degree helped me not only initially as far as getting on and working in the financial management area, but it's helped

me when I manage contracts. Today I manage various contracts and budgets, and so even though it's been quite a while ago, there are different pieces of that that I've used over the years.

As far as the engineering degree, it helped me really talk to other engineers.

WRIGHT: Who have a language of their own.

VOSS: Who have a language of their own. I don't know the depth of your technical specialist, but I understand the principles, and so that's where I really think it is. Then you have to just look at what your skills are and where you think those can best be utilized.

WRIGHT: We forget sometimes that it's more than hardware and software, it's the business side that can bog you down, especially now that you've got so many entities that you have to coordinate to get vehicles. I thought that was an interesting piece.

Thirty years seems like a long time. But I think things have gone pretty fast during those 30 years, and they certainly have evolved from where you started working with the Shuttle Program and then where you are now with the Station, and it's not over yet. What do you think when it moves into its next phase? When part of the Station becomes history, what do you think its legacy will be?

VOSS: First of all, I'm thrilled that we've extended it to 2024. I would think it would be unfortunate not to fully utilize it. Where I really think it can help, and where it is going now, is really helping us to go beyond low-Earth orbit, first, as well as helping science and new discoveries that will help on the Earth.

It has two legacies. When it's over—whether you talk about the science or the technologies used or the experiments on board—transferring that information to the people on Earth and making practical applications of it, that's one of the biggest legacies of Station. The other one is looking at technologies such as your reclamation systems and your regenerative type systems. How can you make them work with essentially no additional resources? You start out with a resource, but what do we do? We reclaim urine and we process it and it becomes drinking water.

If you're going beyond low-Earth orbit—if you're going back to the Moon, if you're going to Mars—you're going to have to have smaller, more condensed systems, so you don't have to have as much logistics, and you're going to have to have a lot of things that are regenerative in nature. Your air, your water, your environment—you need those to be regenerative so that you don't have to have new resources all the time. We're going to be doing more technology demonstrations on these, and see which types of systems are more effective. As well as the human, the materials science, the additional science that we transfer back to Earth and have those applications apply to everyone.

WRIGHT: One question I saved mostly for the end, because you don't have to answer it. This morning in the *[Houston] Chronicle* [newspaper] it talked about NanoRacks possibly having an association with China to put a DNA [deoxyribonucleic acid] sample on a future flight. I was wondering how you felt about maybe having yet one more partner, in a sense that it would be one more experiment that'll go on, and yet one more cargo that you'll have to do. I thought it was an interesting revelation this morning that there's a possibility that you may be reaching even further to extend that.

VOSS: I think that's the purpose of an International Space Station. That's what the "I" stands for. We are a global community. International Space Station is a global cooperative effort. I have not read that specific article, but them reaching out to get science from other different countries and parts of the world I think is a very good thing.

WRIGHT: It's a nice common language to share, science in itself.

VOSS: Absolutely.

WRIGHT: Are there any other thoughts or any other comments or experiences that you'd like to share or talk about while we're here today? Anything personal or professional that you've shared, or something else that you've learned that maybe would be a good thing to pass on to others?

VOSS: I think mainly people need to keep pursuing their goals. You don't necessarily get your ideal position the day you come, and it may not even be the best fit. But if you know what your goal is and you keep moving towards it—just as I did when I went back and saw what I needed to do to move over into first the Space Shuttle and then the Station—you just have to understand what your goals are and then keep taking the steps in order to achieve them.

WRIGHT: We should watch and see what you're going to do with Mars. Is that what you're saying?

VOSS: I would love to see what we're going to do with Mars. I would just love it. We definitely need to go beyond low-Earth orbit. Station is going to be an excellent—I think like you say the legacy, it'll come a little bit later. Usually people don't understand all of the benefits initially. It does come a little bit later. But I hope one of the legacies is that it did help us to do human exploration beyond low-Earth orbit as well as the science that helps the individuals on Earth.

WRIGHT: Thank you for coming today and for doing so much that you've done and sharing that with us. Appreciate it.

VOSS: Thank you very much. Everyone does a lot.

[End of interview]