NASA JOHNSON SPACE CENTER ORION ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

DANIEL DUMBACHER
INTERVIEWED BY SANDRA JOHNSON
INDIANAPOLIS, INDIANA – JUNE 23, 2016

JOHNSON: Today is June 23rd, 2016. This second interview with Dan Dumbacher is being conducted for the NASA Johnson Space Center Orion Oral History Project. Mr. Dumbacher is speaking with us today by telephone from Indianapolis, Indiana. The interviewer is Sandra Johnson. I want to thank you again for taking some time with us today.

We've talked about the budget and the design decisions, the constraints because of that, some because of the basic laws of physics as far as the design, as well as how the budget drove the schedule. Are there any more decisions that you believe impacted the development, the policy operations, the cost during your tenure with the program that we haven't talked about already?

DUMBACHER: Actually there are probably several, Sandra. We talked about how Orion and the first crewed flight and its date was driven purely by the schedule and the available budget. We also talked a little bit about how the chosen configuration for the Space Launch System [SLS] was driven by the budget constraints and basically a tradeoff that had to be made between the budget constraints and at the same time meeting the technical requirements that had to be met, even though we could have exceeded those technical requirements, but there wasn't enough lingo in the budget constraint to do that.

The other one actually is an interesting discussion that could take a lot of time if we wanted, is how we managed the program, and how we did the integration across the three major

programs. The three major programs again being Orion, the Space Launch System, and Ground Systems [Development and Operations] at KSC [NASA Kennedy Space Center, Florida].

We knew we had to get lean and mean. We knew that we couldn't do things the way we had done them in the past and that we were going to have to rethink it, recognizing that we did not want to sacrifice, or could not sacrifice the safety, and we still had to meet the technical requirements, but now we also had to meet the cost requirements. Now it's a little bit harder balancing act.

The way we approached it, I'll start with Orion, because that'll maybe exemplify it a little bit. Mark [S.] Geyer and Mark [A.] Kirasich and Julie [A.] Kramer-White, all of those guys. I just got to do this. In that list you got two Purdue [University] grads and a [University of] Notre Dame grad. The Purdue grads are Geyer and Julie. We always felt like we had Mark Kirasich cornered the way he needed to be. Those guys did an excellent job of working with the Johnson Space Center Engineering Directorate, I think Steve [Stephen J.] Altemus and then Lauri [N.] Hansen, in coming up with and recognizing that they had to rethink the level of involvement and the level of activity from an engineering perspective, and that we couldn't just go get everything because we wanted to, we had to recognize that there was only so much money available, so how do we do this.

I think the Marks and Julie did a tremendous job of working with Engineering in getting the number of deliverables required from a contractor reduced, making sure that the deliverables that were on contract were ones that were actually needed and not just extra stuff that was going to end up on a bookshelf somewhere, and three—and this is probably the most important one—is they figured out and came to an agreement with Johnson Engineering about what level of approval was going to be required by Engineering, and they actually increased the level of

approval. By that I mean instead of Engineering having approval at what I will call the subsystem level, they brought it up to the system level, so the environmental control and life support system level, the communications level. Mark could describe it much better than I can. But they worked hard to come up with a more efficient, yet maintaining our safety and our technical needs, mode of management for Orion, and they implemented it.

They implemented it on EFT-1, and they implemented it on the EM-1 vehicle, and I'm assuming it's continuing to be implemented along the way. When I say that, this is not a static discussion, you do it once and it just stays that way. The management thought process has to evolve based on the program life cycle and where you are in that life cycle. It's going to look different over time.

Orion did that. They were actually a little bit of a ringleader on that front in terms of working with the contractor. The Space Launch System team took some of the lessons learned from Orion and started to apply it to their activity as well with their multiple contractors of Boeing, ATK, now Orbital ATK, Aerojet Rocketdyne, etc.

We were working on trying to get efficient with the contractors and what we were expecting from the contractors and the level of involvement with the contractors, which on a cost-plus contract drives cost, or it certainly has a lot of influence on cost.

The other thing we did—and this is probably the bigger one that got me in as much trouble as anything, but I still maintain it was the right thing to do so I really don't care that I was in trouble—is we went with a less infusive or less intrusive, smaller integration activity than what was typically used on either [Space] Shuttle or [International] Space Station or Constellation for that matter. I think the direct comparison is Constellation, the program

integration activity, that is the systems engineering activities and all of the integration work, totaled some $500 million annually to the tune of 400, 500 people.

With Exploration Systems at NASA Headquarters, that including SLS, Orion, and Ground Systems, we dropped that number by an order of magnitude. The way we were able to do that was by making sure that the programs were held responsible and accountable to work with the other programs. For example when Orion has to work interfaces with the Ground Systems team at KSC, they do it directly, not through another integration arm of the program that takes the Orion input and then goes and drives that down onto the KSC activity. We opened up the pipeline so that Orion and KSC would work more of those issues than needing an integration activity to do those issues. Hopefully this is making some sense.

JOHNSON: Yes.

DUMBACHER: We did the same thing on Orion to SLS. We purposely made sure that we minimized as much as possible the interfaces between Orion and SLS, because the number of interfaces is directly proportional to the amount of integration cost you have. We purposely tried to keep those interfaces simple and to a small number. We also went to more of a peer review approach where the programs peer-reviewed each other with Exploration Systems [Development Division], the overall systems integration activity, having a primary function of making sure we were doing the right things and getting the right things done properly and technically correct, and just as important is that we were doing the right things at the right time, because cost can come in because I either do things too late or I do things early. There was a timing aspect to this.

The integration approach that we took, because of the relatively less complex integration interfaces when you compare an Orion/SLS configuration to a Shuttle configuration for example or even a Station activity, those interfaces are less, and therefore we took advantage of that and then took this hold each other accountable approach to make sure we were getting the technical stuff done right, so that we had the two programs that needed to do the technical work anyway and didn't have two or three other people repeating that work and having to pay for it.

In that process I felt like to the day I left the Agency that we were maintaining our safety and technical capability. We worked this very very closely with Safety and Mission Assurance and the Agency Chief Engineer's Office so that we made sure we got the peer review and had our homework papers graded instead of us grading our own homework. Making sure we were doing the right things and not missing anything. Standing review boards in place to make sure we weren't missing anything. All the Agency reviews to make sure we weren't missing anything. In that we worked to this more efficient model.

That model again has to evolve as you proceed through the program life cycle. There will be more integration activity as you get closer to flight. But in the development era you're able to let the programs have a little bit more freedom to go do things.

The other thing we did from a management perspective is Constellation held all of the program funding reserves at the program level. We took a different approach. We took the approach where we gave each of the programs program reserve funding within their budgets, and allowed them to manage that reserve as they saw fit with a reporting and an accountability where they had to describe how they were using that reserve funding through our monthly review, quarterly review process. It wasn't open-ended; it did have review on it. We did this mainly because we were trying to get the decisions made as close to where they needed to be made as

possible and also to increase what I always call decision velocity so that we were able to make decisions, make the right decisions with the right people in the room and the right expertise applied, but make them as timely and quickly as possible so that we could keep moving on.

One of the stories I used to use is in Constellation the launch vehicle guys proposed a bolt pattern change to an access panel and it took us a year and a half to get that approved through the way the decision cycle was set up on Constellation. No need for that. The SLS guys, if they needed to make that kind of a change, they had to make sure they worked with whoever it might affect if it affected another program. If it didn't, then it was all within their program. Those decisions could get made in a matter of days or weeks as opposed to a year and a half. That's an example of what I mean about decision velocity.

JOHNSON: Do you have examples of any that got made that quickly as compared to that year-and-a-half approval process? Anything that comes to mind?

DUMBACHER: Yes, there was one in particular, and this actually comes across from two different directions. The SLS guys realized that if we gave up a little bit of payload performance to orbit we could actually make the launch vehicle cheaper by not using the aluminum-lithium material for the tanks, but if we just used standard aluminum 2219. The reason for that is NASA is the only one that uses the aluminum-lithium material system, and therefore we get stuck paying the bill for all of the infrastructure and the supply chain to supply that material. Aluminum 2219 is used by all of the aerospace industry, so that infrastructure cost is spread across a larger market. Therefore the cost to SLS is less.

It meant that the tanks were a little bit heavier, it meant that we lost a little bit of payload, but it was a decision that got made basically by the SLS guys, with a little bit of involvement from the mission planning people from a top level systems integration perspective, because when SLS brought the story to us we were willing to give it up. I think we made that decision in a matter of weeks as opposed to a major decision like that taking a year and a half.

This is always an interesting conversation because part of this is you're changing the culture. Believe me, when we first started going down this road, the people that were used to Shuttle and Station were not happy campers with me. But I think over time—in fact I use Bill [William H.] Gerstenmaier as a little bit of a yardstick on this one. When we first started down this approach he looked at me. He let us do it. He'd say, "Okay, I'm just going to keep watching. Until you do something wrong I'll let you go. But we're going to keep an eye on you." Fine. I'm more than happy to have people watching this to make sure we don't miss something. Particularly something important.

By the time I left Bill was actually proactively defending us in public with the way we were doing things. When the standing review board would get in front of a group of people and say, "You're not doing it like Shuttle and you're not doing it like Station, therefore we have a worry," our first defender was Bill Gerstenmaier.

As far as I know I think the team is still trying to work that way, recognizing the evolution through the program life cycle. But, those were some of the key things we were doing in the way we approached the program management to also live within the cost constraints that actually became design decisions, like the change in material, the time to make that decision.

I think Mark could give you examples of how they had freedom to make design decisions that they could make within Orion, and they didn't have to go through extra levels of unneeded permission, that all helped save time and money.

JOHNSON: These ideas that you all implemented all came up in between when Constellation was canceled and then Orion began?

DUMBACHER: Yes and no. It's interesting. I was still the Director of Engineering at [NASA] Marshall [Space Flight Center, Huntsville, Alabama]. I was in Houston one day just before the budget that canceled Constellation was announced. Jeff [Jeffrey M.] Hanley and [Lawrence] Dale Thomas and a couple others pulled me aside, and we were having a discussion about what do we need to do about getting more efficient. We're taking way too long to make decisions, we have got to get better.

Jeff was actually on track to set a team up to go do a hard review of Constellation and try to figure out and to make recommendations on how we could be more efficient. That all got overcome by events when the new budget came out. I think Jeff and Dale Thomas recognized that they had a little bit of an issue. They recognized that things had a lot of room for improvement, and they were starting to take steps to do it, but then the whole budget thing took everybody's attention and we had other alligators in the pond to deal with.

JOHNSON: That's pretty interesting. I appreciate you adding all that because it clarifies some things. We can find only so much information because obviously a lot of it hasn't been gathered yet from you guys. That helps to understand some of that timeline.

DUMBACHER: I think if you actually—[R.] Marshall Smith and Paul [K.] McConnaughey. Marshall Smith is still at [NASA] Headquarters [Washington, DC] and McConnaughey is now at Marshall. Those guys, I thought there were actually a couple of AIAA [American Institute of Aeronautics and Astronautics] papers or something written to try to talk about how we were doing things more efficiently. I know I was taking part of that story up to the [Capitol] Hill to let them know what was going on and how we were doing it, mainly as self-defense.

JOHNSON: It's good to have this. I'll look for that information.

Let's talk about EFT-1 [Exploration Flight Test 1]. I know you left right before the launch for EFT-1. Did you come back to see the launch or did you experience any of those things that were happening during that time?

DUMBACHER: Yes. Through the great courtesy of Mark Geyer and the Orion team. I was invited to come back. I actually was able to get Purdue to pay for the trip. They gave me an invitation. My wife came with me, and through Mark's graciousness I actually brought four or six Purdue students with me so that the students could see firsthand what all this was about. Yes, we were there for the launch and the landing. I must admit I was just as emotional and high-fiving people as anybody else around.

JOHNSON: That's quite an accomplishment to see that happen when you've been working on it for a while. To actually see it come to fruition must have been satisfying.

DUMBACHER: It was particularly satisfying from the perspective that there were a lot of people who by the time we flew EFT-1 had actually left the Agency, but there were a lot of naysayers that didn't want us to do EFT-1, didn't want us to put it in the budget, for whatever reason. There were a lot of us. Mark and the Orion team carried the vast majority of this burden, but they executed, they carried it out, they got it done, they got it done right. It's always satisfying to do that. There was an element of pride in this from the standpoint that we had fought off the naysayers that didn't want us to do it and did it anyway and did it well.

JOHNSON: You did leave the Agency not long before that test flight. What led to your decision to leave NASA? I know you'd been with NASA a while, but what led to your decision to leave at that time?

DUMBACHER: That's an interesting question. It's probably an answer that most people don't expect. It's interesting how timing aligns. Throughout the course of my career my wife periodically would ask me, "What do you want to do when you get done with NASA? What's your next?" I always said, "I want to go back and give back to the next generation. I want to teach and help them get ready to go take the ball even farther."

It was interesting in that in the spring of 2014 Purdue called me up and offered me a job because I had told a couple of heads of mechanical engineering and a couple of heads of aerospace engineering when they asked me what we needed to do to improve the educational component of the students, I was not bashful about giving them my opinion. They came to me and said, "Hey, listen, how would you like to finally have your chance to help us fix it?" It was a little bit gut-wrenching from the standpoint that you've put in 33 years, you're on your way to

flying EM-1 [Exploration Mission 1], we're on our way to EFT-1, the hardware is starting to flow, things are starting to work, we're past the big political fight.

What happened was Purdue came in and offered me a position to do something that I always said I wanted to try. It was not an opportunity that was going to wait. In addition to that, about two months before Purdue called—I was on the old Civil Service Retirement System—I actually became eligible to retire. It was one of those gut-wrenching decisions about do you leave one thing you love and go to something you said you always wanted to try. Obviously you can tell what decision I made. That's the reason I left. It was not because anybody was kicking me out. It was not because of any bad feelings. It was just I wanted to go try something I said I always wanted to go try, and here we are.

JOHNSON: Sounds like you've made a good decision for yourself too though. You're able to help instill that interest in that next generation.

DUMBACHER: Yes, that's actually been one of the most satisfying parts. Although I'm starting to learn I'm a little bit slow on the pickup. It's taken me a good year and a half, two years, to figure out that these university politics are about the way people describe them.

You realize you come from a world that's very used to things getting done on a prescribed timeline. Once you make a commitment you live to the commitment because you're going to be held to it. That's not a world that is all that normal at the university. It works to a little bit different drummer.

JOHNSON: I've heard that. Little bit different timeline.

DUMBACHER: Yes. Sometimes it's a little frustrating.

JOHNSON: Have to learn to take things slower and not try to push it through so fast.

DUMBACHER: I keep telling myself that, but I'm not very good at doing that.

JOHNSON: Even though you did leave NASA you did testify before Congress a couple times even after you left. Do you have any worries because of what happened with Constellation with a new [presidential] administration, and we're getting ready to have another change, and in 2017 we'll have a new President, one way or the other? Do you have any worries that NASA will be redirected once again to change something since Orion has come so far and will hopefully be flying EM-1 soon?

DUMBACHER: Yes. Sandra, I do worry about that. It's a natural thing that when you get a new administration in you have to recognize that NASA is part of the executive branch. The NASA Administrator works at the pleasure of the President, with Senate approval in there, yes, but he or she works at the pleasure of the President.

Yes. You do worry about that. Particularly after what we went through from the 2009 to 2011 timeframe. I will be the first, and I will say it more than anybody wants to hear it publicly, I do not want to go through that again. It was terrible. It was gut-wrenching. It was hard on people and their families. Frankly in my opinion for no good reason.

It could have been handled much more professionally and much more efficiently. We just do not need to go through that again. I think one of the biggest problems we have in human spaceflight is that we keep thinking that there's always a bright new shiny object around the corner that looks better than what the hardware does. That will always be the case. We just need to quit chasing all the bright new shiny things and go get stuff done. It's going to be hard along the way, but get it done, and then move on to the next step.

I think the beauty that we have this time around that we did not have in 2009, 2010 is as you pointed out we are further along on the hardware. There's an EFT-1 success behind it. There are engine tests behind it. There's Orion tests at [NASA] Langley [Research Center, Hampton, Virginia] and parachute tests and testing up at [NASA] Glenn [Research Center, Cleveland, Ohio]. All of that is in place and working and demonstrating that the hardware is meeting the requirements. That is all in the good. Can the policy change? Yes. But it's going to be harder to make a big change to the policy when you have so much progress being made, granted, not quite on the schedule we predicted five years ago, but not that far off.

I think the big thing here is the NASA industry team has demonstrated their capability. They've gone off and they've done what they needed to do. The one thing I tell them all the time whenever I get the opportunity is don't worry about the politics because you can't really control that. The one thing you can control is getting your hardware built on schedule on budget. You can control that. So, if you guys make that happen, which you can control, you've just made the politics problem harder for the people that want to change it. You can influence that other discussion by making sure you do well at what you can control, so go control it.

I think all of the exploration team, Orion, SLS, Ground Systems, and all the industry contractors, they've done a great job of doing that. Later this month we're going to have another five-segment booster firing out in Utah. It's going.

Yes, I'm afraid, I worry about it. The other thing I think that's going on is I think the Agency is preparing itself better for the transition. In 2008, 2009 we didn't prepare ourselves very well for that transition. I think that weakness has been identified and understood and that the Charlie [Charles F.] Bolden and Gerstenmaier and everybody, they are working hard to make sure that we are better prepared for that transition this time around.

JOHNSON: That's good to hear. Working toward EFT-1, I know we've talked about today the work you did to make things more efficient, but would that be it or would you consider anything else to be your most significant contribution to getting the Orion Program off the ground?

DUMBACHER: First of all, it's not my contribution. Everything we talk about here is the team that's doing it. I just happened to be the mouthpiece. I do this in chronological order and then I'll cycle back. The chronological order, and frankly I think this is the most important achievement, was getting ourselves through the transition and having the perseverance to develop the next strategy for human exploration in the form that it's in today. It's not the perfect form. It's not the best form, but it's in an executable we can do it form.

Getting to those two public announcements, the one in May 2011 on Orion and the one in September of 2011 on SLS, with the public approval from the administration to implement those programs and approval to proceed as we had them defined at that point in time, that was an

accomplishment from the team across the board. It took a lot of people a lot of work in a very challenging environment, a very emotional environment, to work through it and get the job done.

I think EFT-1 is the next round of accomplishment in the sense that it demonstrates not just the hardware and how well the hardware is designed, built, fabricated, and tested, it also demonstrates how well the team worked together. We don't talk about that a lot. We like to talk about the hardware and all the fancy stuff we do. In my book it's just as important that the team that executed EFT-1 has now set the standard for what Exploration Systems and Orion and SLS need to do for the future.

When I look back on those days, there are a lot of people saying, "Oh, you can't do EFT-1, it's a stunt, you don't have enough money." I look back on that timeframe now. I am really glad that a few people listened to the logic that said it was important for us to get a flight test because we needed the data, we needed the engineering, we needed to exercise the team, give the team something good to focus on. I think EFT-1 did that.

It's been a rousing success along the way, and I think we're going to see the benefits of EFT-1 in the EM-1 design and the EM-2 design. The weight is going to come down. The capability is going to go up. It's all in the right direction.

I think the other accomplishments that the team pulled off of getting SLS under contract as quickly as they did was a big deal, because that got us getting into the hardware development quicker. The ground systems guys, they're the quiet ones in Florida, but it was tough on them to tear down all that Shuttle hardware off of 39B [launch pad] and get it cleaned up, start getting it ready for Orion and SLS. They have done a fantastic job. The VAB [Vehicle Assembly Building] is getting prepared with the work platforms. Just across the board I look at the team and how well they're hitting their marks and they're doing things, it's just great.

I know there are GAO [Government Accountability Office] reports and other things out there about the possible problems ahead and some of the problems that they're having now, yes, all true to some degree. But, this is hard technical work on a scale that hasn't been done since Apollo, on a budget that is not anything close to what Apollo had. I think this team is doing fantastic.

JOHNSON: You mentioned the word perseverance. One of the quotes that we pulled was from Mark Geyer. He said that the Orion Program learned to persevere. It sounds like you agree with that statement.

DUMBACHER: Undoubtedly. Mark says it much more eloquently than I can.

JOHNSON: We've talked about also your challenges. Is there anything that stands out? Even if we've talked about it before, which one, or if there's something else we haven't talked about, as far as what you consider the most significant challenge you had during your time working with Constellation and Orion.

DUMBACHER: That's a good question. The biggest challenge, Sandra, is that we had to work through probably the most difficult political environment that this Agency has ever seen, particularly around human spaceflight. That 2009 to 2011 timeframe was really really tough.

I can remember a conversation I had with Jack [Thomas J.] Lee. He retired. He left NASA as the Center Director at Marshall. Jim [James L.] Odom, another one of my mentors, he was the Hubble [Space Telescope] Program Manager. I looked at those two one day, and I said,

"So either you guys did a really good job of hiding all this crap from us when I was a young engineer working on Shuttle and the engine, just having a good old time, you guys either did a really good job of hiding all this crap from us, or it didn't exist."

Both of them said, "Dan, it's never been this bad. This problem didn't exist to this extent. Yes, we always had political problems. Yes. But nothing like this," that would compare with the 2009-2011 timeframe.

Getting through that and getting that done, that challenge and overcoming that challenge, was difficult. If you've got a little bit of time, I got a little bit of a story on Mark. One day we had a telecon going in the morning and we were going to break for the telecon to go up to have a meeting with Charlie Bolden and all of his direct reports on strategy, and then we were going to get back together on the telecon after that meeting with Charlie.

Mark was not happy with me and the way we were having to do things. He was rather frustrated about the way we were having to approach the strategy conversation. He made it clear to me that he wasn't happy with how things were going. We went off and had the strategy meeting with Charlie and we came back downstairs. Mark gets on the phone before we started the telecon. He just got on the line. He says, "Now Dan, I have to apologize. I now understand what you're trying to tell me." Because the strategy meeting with Charlie and his direct reports was interesting to say the least.

The team pulled together. The team worked it through. We had our debates. We had our differences of opinion, but in the end everybody was rowing and pulling in the same direction and we got there. I think this team demonstrates not only—well, perseverance is a great word for it. I think also the height of professionalism in terms of being able to pull together in rather difficult times and get done what needs to be done. I have nothing but high praise for

Mark and his team and the SLS team and the Ground Systems team. We had our differences of opinion. I don't want anybody walking off thinking it was all cookies and cream because it wasn't. But we all trusted each other. We all knew that each other had the best intentions at heart. We were all trying to do what we all thought was the best thing for the Agency. In the end I think we'll be proven right when we get EM-1 and EM-2 flying.

JOHNSON: We've talked about a lot of people and a lot of different things that happened during that time. Are there any other people or any other memorable moments or people in leadership roles or even people not necessarily in leadership roles or any of those other moments that we haven't talked about that you'd like to talk about before we go?

DUMBACHER: Man, I could give you a whole list. I'm going to start at the top and I'm going to work my way down. At some point you're going to probably have to tell me to shut up and cut me off. If it weren't for Chris Scolese, Doug [Douglas R.] Cooke, Bill Gerstenmaier, we wouldn't be where we are today. They helped us navigate. They gave us good guidance. They gave us great support to get things done and to get through the challenges both politically and technically, programmatically. I cannot say enough. What's going on in the world today would not be done without those three guys by any stretch of the imagination.

Another one that I think really deserves a lot of credit but nobody ever talks about him publicly because he always worked quietly behind the scenes, and that was Mike [Michael] Ryschkewitsch in his Chief Engineer role. If it weren't for Mike and his support from the Chief Engineer's Office we would not have made progress as quickly as we did. It was an interesting relationship with Mike. Mike and I didn't live far from each other in Maryland. When we knew

we had an issue to work, one of the two of us would call the other one up and say, "Okay, it's time for a meeting in the car driving home tonight." We would have our argument in the car where nobody else would see it or hear it. Then we'd come in the next day with whatever the issue is basically worked out and ready to go forward and get things moving again. Mike did more of that kind of thing and he did it quietly. He helped make the case for what we were trying to do, recognizing we were trying to do things differently within the Agency. We wouldn't be where we are today without Mike Ryschkewitsch.

Then I start to go to the Exploration Systems team. Bill [William C.] Hill, Cris [Christina] Guidi, Steve [Steven W.] Clarke. All absolutely essential to go make this work. They were the troops on the ground working with all the Centers making this work.

Then there was a series of three guys that actually helped put the integration approach together that took on all the swords and arrows that led us to what I consider still the efficient model of systems integration. That was Frank [H.] Bauer, who has since retired, Chuck [Charles] Smith, who followed Frank, these three guys were all the Chief Engineer for Exploration Systems, and Chuck when he left Headquarters he retired as the Acting Center Director out at Ames, and then Paul McConnaughey, who's now back at Marshall. Those three guys, I can't say enough for how they had to work through some difficult expectations just from a cultural perspective if nothing else on how to go about problems and how to go about integration. They did a tremendous job.

I couldn't have done what I did without Bill Hill. I'm going to stop here for a second and recognize that when I talk about these people, I'm also talking about their families, because their families allowed all of the extra time, all of the extra road trips, all of the other stuff to go happen. She's not in the room because she's out of the house right now, but if it weren't for my

wife Lee, she's just as much a part of this as anybody, because she helped keep things going behind the scenes. I know that's true for Bill Hill. I know that's true for everybody. They all had their family support network of one form or another that helped make this happen.

I think back and I look at the programs. Pepper [Phillip E.] Phillips, Jennifer [C.] Kunz at KSC. Tremendous job. [Philip J.] Weber. They did great. We've talked a lot about the Orion team. Mark Geyer, Mark Kirasich, Julie. There's one other guy in their Program Office [Paul F. Marshall]. Poor guy had to handle all the GAO/OIG [Office of Inspector General] audits, and he did a tremendous job with all of that, making sure that worked.

Then the SLS team. Todd [A.] May, Garry [M.] Lyles, Jody [A.] Singer. You don't do these things by yourself. You do these things with a group of people. I have to say that we had probably the best group of people in the right places to go pull this off. I can't imagine doing it with another team of folks that would be any better.

The danger in these kind of questions, Sandra, is I'm leaving people out. There are the unsung heroes at the working level that maybe I didn't see that often but other people did. Without the engineers at all levels, the administrative assistants at all levels, the procurement people, the legal people, it takes the whole team. If it hadn't been for that whole team, and I haven't even scratched the surface with the contractor community.

I could be here all night giving you a list of names if my memory would hold out that long. I look back on those days, and as tough as they were, having the opportunity to call those people friends and colleagues makes all the difference.

JOHNSON: It's really interesting because some of the things you've said, especially about the families, we've heard that from so many people over the years that if it wasn't for the families

nothing could have been done. Also that feeling of teamwork, it makes a big difference in the amount of work and the type of work you can do.

DUMBACHER: In our line of business it's absolutely essential. When I say that I mean for all of us, because I look at this as all of us are trying to make this happen because the History Office is just as important in my book as anybody else, because if we don't learn from the history, we're bound to repeat it. I love nothing more than making the young people go back and read the history, because they've got to learn it somehow.

JOHNSON: We appreciate that. I know that you said that you did go look at those early Apollo documents on management. Somebody has to save those.

DUMBACHER: That's why you can tell Mark I'm unhappy tomorrow.

JOHNSON: Okay, I definitely will. I appreciate it. Is there anything else that we haven't talked about that you can think of?

DUMBACHER: I will tell you, Sandra, I probably will think of about 10 things over the next week after we hang up the phone that I wish I'd done this or I wish I'd said that. If I can remember them and write them down I'll put them in the transcript or we'll figure something out. I appreciate you guys doing what you're doing, because I think this is really important for the next generation to be able to go back to these kinds of things.

I did my own version of oral history once when I spent a day with George [George E.] Mueller. Basically I did that because I was trying to get his insight before I got too far into this job at Headquarters. Actually now that you mention it, I do need to give George credit for a couple of things. In that conversation there were several key points. Number one is the situation is always evolving. You always have to keep watching out for the team. You always have to keep working on the team and making sure the team dynamics are what you want, or they're at least headed in the right direction. Don't ever think that the teamwork is static. That was a very good reminder from George.

The other thing that I learned from George that we implemented actually to help us get through some of the challenges is George told me that in Apollo he instituted discussion forums with the Office of Management and Budget [OMB] at least once a month, if not every other week. He did the same with the House and Senate committee staff. With the idea being that if you keep them up to speed with your progress, keep them up to speed with where you're having problems and what you're doing about them, you make them all part of the team. They start to help as opposed to just being defensive.

We took that to heart and we had biweekly telecons with OMB. Early on we were briefing the Hill staff every other week. Then it went to once a month. In some cases depending upon which committee you're talking about, Senate or House side, it might have gone to once a quarter. But be that as it may, it was essential that we got those lines of communication open with those key stakeholders. That was all part and party to being able to accomplish what we did.

That leads me to some names I need to add to the previous list. I told you I was going to forget somebody. Ann Zulkosky on the Senate side. Jeff [M.] Bingham on the Senate side. If it

hadn't been for those two. Senator Kay Bailey Hutchison. Senator [Bill] Nelson. Without those guys we wouldn't be where we are today.

On the House side Dick [Richard M.] Obermann and his team on the House Science Committee along with all the members of the House Science Committee. We just wouldn't be where we are today. Everybody likes to label Congress as the holdup. In this case they were the ones that were helping. I think what I learned from George led to building the relationships with Ann and Jeff and Dick and others that allowed us to continue to move forward the way we did. I think that was important.

Another thing we did on the communication side of things is the contractor Washington ops team, we met with them at least once a month. We actually tried to do it every other week so that they were in touch with what we were doing, we were in touch with what they were doing. Obviously you can't give them everything. They can't give you everything. They can't share all the information, but you try to keep the key surprises down so that people weren't caught off guard. We tried to do that. I know Bill Hill and the team are still doing that kind of thing.

It was all those people. A lot of it came from sitting down with and spending eight hours with George in his condominium in Seattle [Washington] one day.

JOHNSON: It's nice to know that these guys that worked so hard and did things without any direction and accomplished so many wonderful things, you can take that and go forward with it instead of having to start over and reinvent the wheel.

DUMBACHER: Yes, I figured I'm no dummy. I'm not the sharpest tool in the shed, but I can figure out to go talk to the guys that have already done it. Their situation may be different. I

may not be able to do everything they did and they may not have been able to do everything I can do, or what we can do in this current environment, but I know one thing. We can certainly learn from them, and then we can figure out how we apply it.

JOHNSON: That's right. I appreciate you talking to me again today.

[End of interview]