

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

PAUL F. MARSHALL
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is July 19th, 2016. This interview with Paul Marshall is being conducted for the Orion Oral History Project. The interviewer is Jennifer Ross-Nazzal, assisted by Sandra Johnson.

MARSHALL: Hi, Jennifer.

ROSS-NAZZAL: Thanks again for taking some time. We definitely appreciate it, know you guys have a very busy schedule these days.

MARSHALL: Sure, my pleasure.

ROSS-NAZZAL: So tell us how you became involved with Orion.

MARSHALL: I had been working on Space Station for quite a number of years, in one form or another, for actually 22 years before that. It was late in 2005 when I applied for—at the time it was called Crew Exploration Vehicle (CEV)—one of the CEV integration jobs and was selected and came over in November of 2005 as just a career move out of Space Station and into this new and burgeoning part of the human spaceflight program.

ROSS-NAZZAL: I read in your PP&C [Program Planning and Control] interview that you were working on establishing organizational structures and working on relationships with the contractors. Can you elaborate on that?

MARSHALL: One half step behind that, I originally came over into an SE&I [Systems Engineering and Integration] role within the organization that existed at the time. It was shortly after Skip [Caris A.] Hatfield became Program Manager that he asked me to come join him on the staff. In that role one of the things that he was doing was shaping the organization and aligning it with some of the other organizations that were forming up. The Project was actually created and developing before the overarching Program was created; it was called Constellation later on. There's a little bit of reshaping that was required there. Plus, there was an administration that actually was trying to drive different kinds of relationships around the Agency.

There were a number of things that the Agency and the Program were asking of this organization, and that's one of the things that Skip needed, my help in helping to create some of the structures but also shaping some of the expectations of how the organization would look, how we would interact with the industry, which came online about a year later in August or September of '06 with the prime contract. That's one example of what I was asked to do in this Assistant Program Manager role, staff role to the Program Manager. It's a pretty broad role with no definition, and it changes from day to day.

ROSS-NAZZAL: Sure, yes, and a very new Program as well.

MARSHALL: Yes, at the time, that's right. It was a brand-new Program, so it was relationships. It was processes. It was communication within the Agency, and obviously as I said with this new Program that we fell underneath as Constellation started emerging. It was a lot of forming and storming of making the organization come together.

ROSS-NAZZAL: You mentioned communication. I'm wondering how did the *Columbia* [STS-107] accident impact the type of communication that you were looking at at that point. Did it impact that in any way?

MARSHALL: I'm thinking about the context of your question.

ROSS-NAZZAL: Probably not, based on the way you're looking at me.

MARSHALL: I can't think of an example of how we deliberately shaped our communications. As far as communicating with the Program, with [NASA] Headquarters [Washington, DC], that was '03, this was '05, '06. A lot of what was asked of the larger organization was already in place, I would say. Clearly as an organization shaped with highly refined safety culture and that sort of thing, we were very much already sensitized to the need for organizational communications with the Program Manager for decision making that was intentional about drawing in all sides of a discussion, working with dissenting opinions. I really actually can't think of an example of how we changed things based on the *Columbia* accident by the time we were standing up a Program Office.

ROSS-NAZZAL: How much did Station influence your ideas about how the organization should be structured, having worked for Station for 22 years?

MARSHALL: That's a great question. Station is a very large, very complicated organization. Obviously a prime contractor, lots of international partners, so there's some key differences. One of the things that was instinctual to me is how important it is to build a Program organization that truly is an integrated workforce. My experience, and maybe it wasn't fully experienced at the ISS [International Space Station] level completely, but my experience was we had a lot of process separation between the NASA part of the organization and the prime contractor part of the organization in ISS, which served us well in a lot of respects, but it also created a cumbersome decision process. Things moved from one side of the street to the other and back again as decisions were being made. Things took a long time. It was an expensive, slow process in many respects, very deliberative.

Skip, coming from Space Station also, one of the things that was important to him, important to all the Program Managers, is we had an opportunity as we brought on a prime contractor to create an organization that was tightly integrated between the NASA side and the contractor side. We were deliberate about setting up teams, about as much as we could, common processes, such that NASA and contract teams were interleaved and made decisions together, [where] we didn't have a lot of duplicative processes at equal levels of organizations. When we set up IPTs [Integrated Product Teams], they were IPTs that were jointly held.

I think we were intentional about establishing close relationships, a partnership with the prime contractor that served us well actually as we got into the Program, and particularly into the stormy waters that we got into in '10. Which is probably more of where I drew from my Space

Station experiences. When national policy here changed, that affected us in 2010 with the proposed cancelation of Constellation, a lot of things were very hard on this organization. Going back to that last conversation, we had a strong relationship with the contractor that actually was very important in helping us navigate through the complexities of that, because it's real easy for an organization to spin apart if you hadn't really invested in relationship by that time. I think it served us well, and it'll probably come up again in this discussion.

For me personally, it felt a little bit like the second act of the same play. I was a senior member of the Program Management organization for Space Station *Freedom* in Reston, Virginia, at the time that the *Freedom* Program was canceled back in '92, '93 timeframe. Similar circumstances, change of administration, change of party within that change of administration, a major executive branch government change. Very similar point in our developmental life cycle, in other words *Freedom* had just finished its PDR [Preliminary Design Review].

It's a vulnerable time in a program anyway, because costs are going up. The process still hasn't fully committed to building hardware. They're still doing the engineering aspect. A lot of similarities. Lo and behold, the decision process on the executive side made a similar decision where in 2010, it's the second year of a major change in executive branch within the administration. We had just come off the tail end of a presidential commission and in a very surprise move, with the delivery of the budget in 2010, the President proposed canceling Constellation, which obviously the Orion CEV was part of at the time.

That had a very familiar look and feel to me, having experienced it in much the same way on the *Freedom* side. As the Space Station was going through a similar upheaval in policy, it

overall found a way to navigate through the complexities and still proceed into development and actually obviously now is very successful in serving its mission.

In a senior role in this organization, I drew a lot from my experiences, my observations from those days. I think we were able to in some respects draw from that to help guide some of our thinking about how to navigate through the politics and the storm and the policy that had a different light shined on it at the time. What we as a Program could do to one, serve—we serve our bosses—but also to see that we, with the most control of this Program, can keep the least amount of wasted activity if you will from occurring while still keeping the thing moving, even though it was all uncertain.

That was our role at the time. I know personally I felt like I'd already been through a very similar catharsis and probably didn't experience it exactly the same way a lot of the Orion folks did at the time.

ROSS-NAZZAL: That must have been quite challenging for so many of the people. When we spoke with Carol [L. Webber], she talked about how a lot of people just stopped coming to meetings over at Lockheed. It was really challenging to keep things going.

MARSHALL: Sure. It's a trauma. There's an enormous amount of human energy that goes into these things. It's true on the NASA side; it's very true on the Lockheed side. It's not a stretch, it's not hyperbole, to describe Lockheed's efforts as spanning way more than a decade actually in preparing to compete to do this kind of work. Those are very dedicated, creative people that are putting a lot of themselves into this, and we were well into it. We were marching forward. We were doing great things, putting a lot of energy into it.

Just like in the *Freedom* Program, it is a major-league sucker punch to have that pulled away from you. It's very personal. It's very personal. It's hard not to experience it that way. For the first several days there was an awful lot of margaritas drunk. Again, it's people experiencing adversity, and through that having ideas percolate that we actually started drawing from and used to start navigating through the way the policy was being articulated again. [I give Lockheed Martin leadership enormous credit in leading both the industry team and in shaping our perspective (on the NASA side) in envisioning what was possible in the choices we still had available to us.] So there's a lot of things to be said about how it came about.

My personal perspective on that was from afar. It was a surprise. Everyone who was in a position where they should have known didn't. There was a lot of things about it that were unsettling far beyond just our level of the organization and those of us helping to make this Program go. It was just much larger in terms of how the decision came about in 2010. Our part of it was responding to that and deciding do we stop or not. We clearly decided not to, while the uncertainty was resolving itself. It spoke a lot to the resilience of the organization, the leadership of Mark [S.] Geyer and [Mark A.] Kirasich as his Deputy and others.

The broader organization really did have to find a way to compartmentalize what we were seeing in the news or otherwise in the aerospace debate versus what we chose to do in response on a day-to-day basis.

ROSS-NAZZAL: You had Pad Abort 1 coming up. Would you talk about the idea and the percolation leading up to the idea for EFT [Exploration Flight Test]-1? How did that come about, and what role you may have played in that?

MARSHALL: Pad Abort 1 is an interesting thing, because just as soon as these decisions were made—[a decision] has a way of making an Agency like NASA choose sides, and factions form. There was an awful lot of pressure on us to stop, to not fly that flight, to literally not keep going. There was a lot of pressure on the other side for us to keep going. I've forgotten exactly the timing of some of these things, but we were able to keep the team focused and moving forward for that flight. It became a really really important moment for the Program, to have that level of success on such a complicated test flight, at a time when our progress wasn't altogether welcomed by all parts of the Agency.

It tests our political skills, and yet it was very clear that we were moving forward towards an objective that the new narrative was talking about. We were building a spacecraft fundamentally for human exploration beyond Earth orbit, which is what the administration was talking about in 2010 with the proposed cancelation and the new budget and the policy moving forward. It took a while for us to rationalize and for us to demonstrate that what we were doing is really what the policy is saying it needs to do. That's a process that took the better part of a year and a half actually. I think there were reasonable minds that prevailed about the flight test in May of 2010. It was a very important moment in time for Orion. That was a big deal.

With the changes that occurred in the national space policy—again it was focused on beyond Earth orbit exploration. It was about cislunar or lunar orbit missions, missions to asteroids, mission to Mars. It was about finding new ways of doing business; it was about driving cost out of the system. It was talking about the necessity to draw in the international partnership and extend the relationships that we'd built through Space Station with the international partnerships, all of which were things that we could do and that we were doing. For me fundamentally, our strategy for reformulating the Program but also for EFT-1 emerging out

of the dust cloud was really just listening to the words, listening to what was important, and showing how we addressed those things.

It was about finding new ways of doing business and driving towards lower costs. We were laboring under heritage expectations of what program management inside NASA [looks like]. All of us knew that there are more efficient ways of doing things. Change is very hard. Change is very hard in human spaceflight. In some respects it's a gift to have a crisis thrust upon you. At some point, you never want to let a good crisis go to waste, in doing things that are possible anyway, and sometimes are enabled by the uncertainty that a crisis brings.

It challenged some of our engineering expectations, our organizational expectations, how we relate to the prime contractor, and the things that we felt that we had to demand of the contractors that maybe were lower priority, and we could find different, less expensive ways of doing things. It created an opportunity and challenged a lot of things. That was a time where we could greatly reduce the number of civil servants that were involved in the Program because that flight test was over. There was a lot of civil service that was part of that, and we were able to draw down the numbers.

On the contract side they were being forced to draw down their numbers. Turns out in 2010, think about February, and then nothing quickly happens, especially that traumatic, in the federal government. We were halfway through the fiscal year before we knew what hit us. Part of what hit us was they're taking half of our annual budget away. We're halfway through the year, and half of our money went away. We had a real problem to get through 2010 and into 2011 given what was thrust upon us. We were all working to get smaller, to compress.

Of course the majority of that pressure fell on the contract side. It was very, very traumatic as people were laid off and work had to stop. We had to make choices about what

work was the highest priority to keep going forward. That's the dust cloud. What we chose to keep going forward is really the core of what turned into EFT-1. We knew no matter what the country decided to do with the policy, to whatever extent we are going to do human exploration of the solar system, we were going to need a spacecraft that was fundamentally safe.

There was a number of critical systems that represented the highest safety risks. We knew through the maturity of preliminary design review where our highest safety risks were; what are the things that are hardest to test and prove on the ground. Those were the things that we kept going at the component level of development if you want to think about it that way: the separation systems, the heat shield, the parachutes, the computer systems, software, the things that are the core of any spacecraft. We were able to keep those things moving forward.

Part of that was intentional that says somewhere down the line, even while there's still uncertainty, these things really can be cobbled together as a spacecraft and as a first level demonstration of the most critical systems that the spacecraft needs to have well proven before we can fly people. That ended up being the core of EFT-1. The things that we were forced to do actually put us on a path to create an argument for EFT-1 based on those safety-critical systems that ultimately we demonstrated on EFT-1. If that makes sense.

ROSS-NAZZAL: What was your role in ensuring EFT-1 would actually occur?

MARSHALL: I don't know how you really put [it into] words. It was always a new day. A lot of it was maintaining a close tie to our Lockheed partners, to the senior leadership within Lockheed. We all spent a lot of time together that gave us the tools to know what was possible. We were able to formulate how we talk about the programs through the various channels that we all had to

talk, within the Agency, within the companies, the discussions inside the Beltway, have a number of different pathways. I'd say a lot of my role was to help keep that strategic focus on the communications. We spent an awful lot of time performing trade studies again in that reformulation of the Program.

Actually [let's take] a step backwards. When we were operating under Constellation we also operated under a Headquarters organization that ended up also being dissolved eventually, ESMD [Exploration Systems Mission Development] under Doug [Douglas R.] Cooke. Again I don't have the timing fresh in my mind, but in the course of 2010, 2011 there were a number of study groups that were created at Headquarters to study different aspects of the policy. A lot of the challenge in the architecture studies were focused on the rocket, because that's where the battle really was. We also needed to articulate how the spacecraft was compatible with different rocket options but also was compatible with these mission definitions that were being discussed. We had to establish, if you will, the acquisition strategy for playing the Crew Exploration Vehicle forward both as a spacecraft but as a contracting mechanism and as an engagement with the industry.

We had to reestablish the best interest of the government with this new formulated Program. That's the 18 months it really took to get through some of this, 12 to 18 months depending on which decision you might be talking about. We spent an awful lot of time doing these studies and then writing it all down, and then spending time up with the Administrator and the senior leaders of the Agency talking about this. They called it the Analysis of Alternatives process. That was the core of the reformulation of the exploration enterprise if you will. Late in 2010 there was an authorization bill that gave the spacecraft thing a new name, the MPCV, the Multi-Purpose Crew Vehicle.

Our challenge was to establish that everything that was expected of this MPCV is what this Orion CEV was doing, that we were fully compatible, that it was in the best interest of the government to keep it moving forward, etc., etc. So that's what we did for quite a number of months.

ROSS-NAZZAL: What did you do once Charlie [Charles F.] Bolden came in May of 2011 and said, "We're moving forward with MPCV"? What's your day-to-day role in seeing how we move forward on EFT-1 from there?

MARSHALL: Again, my role is a grab bag of things that amounts to giving the Program Manager a little bit more wingspan. We didn't change our organization very much. We ended up getting agreement that our contract organization was much the same. We had a different enterprise structure as ESD [Exploration Systems Development Division] now, the new organization within HEO [Human Exploration and Operations], came into play.

I recall spending a lot of time on those issues. How the relationships of these three new programs played together, and how they related to this overarching organization at Headquarters called ESD, which ultimately was led by Dan [Daniel L.] Dumbacher and now is led by Bill [William C.] Hill. In that was part of this discussion of finding new ways of doing things and less expensive ways of doing things. In the—gosh, I guess '11 and '12 timeframe we spent a lot of time together as an enterprise talking about how the programs can integrate. Within Constellation the integration was this monolithic autonomous integration organization that spanned over a number of projects. It was also an organization that cost a couple hundred

million dollars a year, and it had many hundreds of people that were in the role of performing a rigorous systems engineering process and integration process of all forms.

Such a large integration organization ultimately has to draw from all of these projects. We had to invest all kinds of people and hours to feed such a large organization. Of course that cost us a lot of time and money. It was a very large, in many respects inefficient integration process that stood over us. Having gone through this crucible of being told how slow and ponderous and costly we are, some of us had some passion to say, “Well, it doesn’t have to be that way.”

There’s a certain opportunity that I think a number of us at SLS [Space Launch System] and GSDO [Ground Systems Development and Operations], and at ESD, saw to address the fact that at some level integrators within the programs ought to be the front lines of integration. We saw the opportunity of having a much smaller number of people even within the organizations, within the programs, involved with integration. We certainly wouldn’t have to create a large autonomous integration organization on top of us when we could start with the fact that we had very capable integration skills within each of the programs where we could realize the synergy between the integration you need to do within a program and the integration you need to do across programs.

I think we’ve been very successful with that. That’s one of those areas where we were very nontraditional in the way we ended up formulating our integration process across programs. It raised an awful lot of concern within the oversight bodies, the Aerospace Safety Advisory Panel, and the standing review boards, but also the Chief Engineer within the Agency, and a lot of folks with deep deep Shuttle heritage and Space Station heritage. Change is hard. It’s always hard.

We had to put a different [approach for] doing this into the context that it's still rigorous, it's still complete. We are doing all aspects of integration. We're doing it differently, and we have a different way to make the organizations relate. Of course that's evolved over the last four years, but it's still pretty much intact.

ROSS-NAZZAL: Can you give an example? An example of, this is something we would have done for Shuttle or Station, and here's how we're doing it differently with MPCV.

MARSHALL: I'm sure you're interviewing some folks in the Vehicle Integration Office. Those folks live it all the time. One example is integration teams. Pick a subject: interface definition, environments controls. We as an Agency know how to do those things. In Shuttle, the Shuttle Program had an SE&I organization. They had teams set up that reported only to them that had all the right skills for controlling interfaces or controlling environmental requirements.

Each of the programs have environmental requirements imposed on them. We all have skills that do that. Instead of setting up separate teams with different people, we actually established teams that have representatives of every program. We chose by mutual agreement who made the most sense to be the leader of such a team within the program representatives that were part of it. That was the team. These were people that were all being paid for by the programs. Typically, ESD chose also to have an individual from the group that they were supporting also become part of these teams. So they typically were supported by four parties, one or more from each program, and a representative from ESD, all comprising these integration teams. Together there's some 25, 30 of these teams for all different topics, all different aspects

of the integration, drawn from representatives of the programs largely, as opposed to separate organizations altogether.

The savings come in that largely we tried very hard to start with the skills that we were already paying for that were doing integration within the programs. We have a relatively small fraction of the budget that we have to dedicate to integration, and that means together across all the programs we have more money to buy hardware. We found that it works. It works partly because people experienced the trauma of the proposed cancelation, and folks feel a real motivation to make this reformulated process work. There's a lot at stake in our success, and folks are motivated by that.

ROSS-NAZZAL: We're getting close to time, so I'm going to have to ask Rachel [L. Gauntt] if maybe we can schedule another half an hour. I'm curious what you thought was your most significant challenge as you were working through all of these changes that were going on.

MARSHALL: We've talked about them. Keeping an organization motivated in light of the enormous pressures. The disturbing language of cancelation within the political realm, it's very hard on a workforce. We're engineers. I had the benefit of spending seven years in DC, so I have the benefit of having some direct experience about how the game is played. But most of us don't have that experience. To have the barn door shut on you like that is hard on an organization. It's hard to then redirect the attention back to the job of doing the already hard work of building a spacecraft with some confidence that we really are leading to an outcome that's going to bring this thing to life.

That's the biggest leadership challenge that I think we've faced and proven that the organization is very resilient when it's motivated by a clear vision of doing something great, even in adversity.

ROSS-NAZZAL: I think that might be a good place for us to stop today.

[End of interview]