NASA JOHNSON SPACE CENTER SPACE SHUTTLE PROGRAM
TACIT KNOWLEDGE CAPTURE PROJECT
ORAL HISTORY TRANSCRIPT

RALPH R. ROE
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is April 29, 2008. We are at Hampton, Virginia, to speak with Ralph Roe, who is the Director of NASA's Engineering and Safety Center located at the Langley Research Center. The interview is being conducted for the JSC Tacit Knowledge Capture Project for the Space Shuttle Program. Interviewer is Rebecca Wright, assisted by Sandra Johnson. We thank you again for letting us come into your schedule. We know how busy you are. We'd like to start today with you giving us a brief summation of how you first started to work with the Space Shuttle Program, and then how your duties evolved to where you are now.

ROE: I was hired fresh out of college [by] the Kennedy Space Center [Florida] and worked as a Systems Engineer in the Shuttle Processing Directorate. Then I [moved] up the ladder of management in Shuttle Processing—Section Chief, Branch Chief, Division Chief, until I got to be the Engineering Director. [From there] I also served as [the Space Shuttle] Launch Director, and that was a span of 16 years at the Kennedy Space Center. I moved to the Johnson Space Center and was Orbiter Project Manager for four years before coming to the [Langley Research Center to start the] NESC [NASA Engineering and Safety Center].

WRIGHT: Tell us about the NESC, because from what I have read, so much of what you're doing really ties into so much of what the project's trying to collect.

ROE: The NESC was established after the [Space Shuttle] *Columbia* [STS-107] accident to provide programs like the [Space] Shuttle Program an independent organization that could provide them a second technical perspective on difficult issues. We put a team together of [technical] experts from across the [Space] Agency that can help [programs with their most] difficult issues. [The NESC was started in response to the Columbia accident but we wanted to broaden its responsibility to provide independent engineering support across all of NASA's Missions]. But we were started because of the Shuttle [accident, so we have been actively] engaged with the Shuttle Program.

WRIGHT: The different positions that you had as you were coming up through the ranks of NASA were founded in the Shuttle Program. You basically have spent your 25 years in the Shuttle Program. Each one of those positions had a different line of responsibilities and duties. Can you share with us the challenges that you met with each one of those, and maybe some of the lessons that you learned from each of those? Or some of the memorable ones that you brought up with you as you went through?

ROE: I think the most memorable ones, obviously, were Space Shuttle *Challenger* [STS 51-L accident] and *Columbia*. They had the most impact on me and provided the most important lessons learned. I think both of them had a common lesson learned in that we allowed—from my perspective, anyhow—we allowed our success, our continued successful missions, to keep us from clearly seeing and investigating critical problems. The *Challenger* was O-ring blow-by, and in *Columbia*, it was debris from the external tank. When you're in a large program like that, and you're successful, and you're working very hard to go from mission to mission, it is obvious

in hindsight now that we failed to [properly] investigate two critical problems that we should have. I think those [tragic events], obviously, had the most impact on me and the most memorable lessons learned. In the future, we don't want to let our successes blind us from seeing problems that we need to stop and investigate further.

WRIGHT: Did you find yourself developing processes or procedures that will help you look into those types of manners or questions as you go through?

ROE: Yes, the whole concept of the NESC is to ensure that if a program is stuck in that mindset and isn't investigating something critical, the NESC is there to ensure that somebody is. That's the concept that we've really started with, so that's why I feel like it's so important. [Over the last four years we have established our team as a "value added" technical resource that anyone, from technicians and engineers to the Administrator, can request our participation.]

WRIGHT: What are the criteria that you have, or standards?

ROE: Really, we're a limited resource, so we have to focus our attention on the most critical issues from an Agency perspective. We have literally been involved in most of the issues that the Administrator would be concerned about, and that's kind of how we view it. If it's an issue that the Administrator would be concerned about, then we need to be involved and make sure that there's an independent perspective that's being provided.

WRIGHT: I'd like to talk to you about lessons in regard to a number of areas within management levels—especially since you mentioned you were involved with *Columbia* and *Challenger*—the lessons that you've learned based on risk assessment. What you're doing now is a product of those things, but along the lines when you were coming through, what are some of the other things that you've learned that you would share? Before it gets to you, what are you asking people to do to check for risk assessment or risk mitigation?

ROE: The safety philosophy that we've used in the Shuttle Program I believe we inherited from the Apollo Program. It has three main tenets: strong in-line checks and balances, which is the engineers checking each other, healthy tension between our organizations and the third tenet is value-added independent assessment. I think it's critical to maintain those checks and balances, that healthy tension, and to provide value-added independent assessment. We get in trouble, I think, when one organization doesn't fulfill its role to provide that check and balance. Or if one organization becomes too strong or another organization becomes too weak.

I think the Program Manager can make his [/her] best decisions when different perspectives are provided [on any issue] in a balanced manner from different organizations. Maintaining strong in-line checks and balances, healthy tension, and value-added independent assessments is critical for a [robust] risk management [process]. If you have all of these in place and your organization is well-balanced from that perspective, then the [critical] risks will flow up to you, and you'll hear all [perspectives on the issue and be in a position to make a well-informed decision].

WRIGHT: You mentioned earlier that you have limited resources. So what are some lessons that you have learned in regard to planning and program efficiency?

ROE: I think this is very critical, also. To me, it's all about building strong relationships and trust. In a program as large as the Shuttle Program, [that's also] geographically diverse, it's important that the team [has the opportunities to build strong relationship and trust with each other so they can work together to solve their most difficult challenges. To do this it is important to bring the team] together periodically in a face-to-face environment. They get to know each other, they get to trust each other, and they can build strong relationships. When [challenging] problems occur, if you haven't already established those strong relationships and built trust [across the team], you're going to have a very difficult time, [and you may not get to the best solution]. So I think it's critical, up-front, to spend as much time as you can building the strong relationships you need to be able to work through the difficult issues that are going to come down the road. That, to me, is really critical. I think Tommy [W.] Holloway, Ron [Ronald D.] Dittemore [and Bill Gerstenmaier] were great examples of [leaders who know how to build teams with strong relationships and trust, and I think that's a great example of a best practice that other leaders should follow].

WRIGHT: You have a unique situation on your team, because like you said, you pulled experts from everywhere to do that. How do you pull that together to have a good performance from this group of experts? As you mentioned, to build that trust and those relationships, but if they're scattered everywhere and you bring them into work, how do you get them to talk to each other and communicate?

ROE: I really [tried to emulate] what Tommy, Ron [and Bill] had started in the Shuttle [and Station] Programs. We had a Space Shuttle Program Council, [and a] Chief Engineers Council. [In these forums we brought the] team together periodically at one of the centers, to discuss issues and [share experiences]—but more importantly, [to build those strong relationships and trust across the team].

So I [established similar] forums in the NESC, and on a quarterly basis, since we have employees at all ten centers, we get together at one of the centers and discuss what we're working on, but more importantly, build those relationships. It took much longer than I thought it would. It was probably the better part of the first two years before we actually had the kind of relationships [and trust] we needed, because not only were we the four Human Space Flight Centers, but the six other Centers, Research Centers and Robotic Space Flight Centers. So [we had] very diverse experience—[people] that normally didn't work together are now working together on our team, and it took a while to build those relationships and trust.

In fact, some of the first few issues that we worked, when we brought that forum together and we voted on what the right solution was, we voted according to our backgrounds [and experience]. Human space flight voted in one direction, and robotic space flight voted in another direction. It was obvious then that we still hadn't gotten there, but now, four or five years into it, we've done a pretty good job of building the right relationships. [I believe the diverse experience base of the NESC represented our most significant challenge at the beginning but now it represents our most valuable asset. Forming that diverse experience base into a strong team required time to build those relationships.]

WRIGHT: After *Challenger*, were there any types of, these same types of aspects set up that you remember?

ROE: I was so [far] down on the chain I'm not sure I had the [best] perspective [of what was done following *Challenger*]. Although, after *Challenger*, it was probably one of the more significant periods of learning for a young systems engineer [like myself], because we essentially went back to the beginning and said, "Well, did we get this design right?" And we went back to review every aspect of the design at that time. So that was an initiative that I'm sure was started at the top, I just only saw one end of it. But I'm sure [it was] very similar.

WRIGHT: Do you feel like that's really helped you where you are now, the fact that you've gone through all of those?

ROE: Oh, absolutely. Understanding that it's about relationships and trust, that's critical to the success of the NESC or the success of any program.

WRIGHT: How would you teach these lessons or processes to the next group of upcoming program managers or employees? How do you instill some of the things that you feel are important for success?

ROE: I think it's participating in inter-center projects, projects that get you out of your current role where you may have blinders on to your center's perspective only. Going and spending time at another center. I spent my first 16 years at the Kennedy Space Center and [frankly] didn't

know anything else, and so when I went to the Johnson Space Center, it was quite an education for me to see, from a different perspective, the same Shuttle Program. Getting younger folks that opportunity [is important]. It would have been nice, I think, earlier in my career to have been able to be involved in other inter-center projects or go to another center for some period of time. I think that's critical [to help break down Center-centric thinking].

WRIGHT: That's a good thing to know. What do you feel, of all the lessons that you've learned, what's the hardest one that you've had to learn? Or maybe I should say the one that you take with you no matter where you go?

ROE: [Without question] *Columbia* and *Challenge*r. [Don't be] blinded by the successes that you have, [continue to] think critically about issues. That will stay with me forever.

WRIGHT: Can you teach those types of techniques in a class? And if so, did you have any of those on the job?

ROE: Actually we've spent a lot of time benchmarking and reading literature [on this issue]. When we created the NESC [we wanted] to create an atmosphere where you do think critically about issues. We think it's important that management provide the leadership to establish that atmosphere where it's acceptable to raise issues, and where it's acceptable to think critically aloud about issues—not just in e-mail or in your own mind. Often we see where managers will have a meeting and discuss an issue, and they say, "Well, okay, does anybody have a dissenting

opinion?" That's not how to attack it aggressively. We think the management should lead the way by being the first to ask a critical question or "what if," a worst-case scenario.

Then by doing this in that forum where everybody sees it's okay for the leader to ask, "What if it's worse than this?" or be critical about a particular issue, then I think it becomes more acceptable for everybody else to follow his [/her] example. So that's what we see as the most critical thing, management has to provide the leadership to create the environment that allows critical thinking and raising of issues to be acceptable.

WRIGHT: Can you give us an example how you've used that technique in the last three or four years, or four or five years? An example of one of the issues that you've addressed?

ROE: There have been a lot of issues that the NESC has provided a forum or the infrastructure in which people can feel comfortable raising an issue to a program, especially in a forum like the Flight Readiness Review, which can be very formal and sometimes even [intimidating] to a young engineer. Raising an issue through the NESC, you essentially have the infrastructure of the NESC backing you up, and it isn't a lone ranger saying, "Hey, wait! We've got to stop; we've got to look at this!" I think that's where we've done the most good, in that we have the resources, [money and technical skills] to do testing and analysis that can back up somebody's engineering judgment that something's not right with a particular problem.

WRIGHT: That's great. It seems to be a very neutral forum that they can come to. Can they come with generalities, or are you looking for specific determinations that they need to have investigated?

ROE: I think a lot of times it is just generalities, mainly because it's difficult for one or two people to have the resources to get all the data they need to really investigate a problem. Since we have our own resources, we can investigate a problem, we can run a test, or we can do analysis, and maybe one or two people couldn't do this. I think that's really the difference.

WRIGHT: It sounds very, very interesting. I know you did some preparation work. I was going to give you a second, and I know we didn't specifically talk about the very first question about the best practices or sound practices. I know you alluded to some of them.

ROE: No, I think we covered them. The safety philosophy was I think the sound processes that I wanted to talk about, and the best practice is building of relationships and trust. I think the other thing—we've talked around it a little bit, but I think if I were to offer improvements for planning and implementation of risk mitigation, it would be to include outside experts on your teams investigating difficult issues. Because as we talked [about] earlier, the experts within the program may have been working the issue for years, and they can develop this bias that we were talking about, about not clearly seeing the issues from different perspectives, and so bringing in folks from the outside, whether it's the NESC, or some other Center, or from industry, or the Department of Defense, it doesn't really matter, providing they have the right expertise, and they can often provide you a different perspective on the problem that maybe your own program or project experts just can't see because they've been working it too long.

I think that's the biggest improvement that we could make, if we make that commonplace, that we always bring in folks from the outside to help us. It's often [that] the

program expert has this "can do" attitude about—and "We can do it, we can solve this problem," and it often leads the Program Manager or Project Manager to try to solve his problem with the resources that he [/she] has at hand. Not saying that they're not good resources, but that if you open it up a little bit and take advantage of the resources that the whole Agency has on these critical issues, you'll often come to, I think, a better solution. So, if we can make that common practice, I think we'll be better off.

WRIGHT: It certainly gives another perspective for you to make a determination from. Would there be a process of your internal experts and your external experts who are at different extremes? Would you have to determine how best to move forward?

ROE: Yes, but I think that's exactly what a leader or a project manager wants. He can make a better, more well-informed decision if he hears—whether it's two or three or four different perspectives on the problem. Often we'll hone in on one solution, and we get stuck on that one solution, and we missed the problem altogether. So if you're a leader, to me, you're better off if you can hear two or three different perspectives on the problem, and then you can make a decision on which way to go based on those perspectives. I think that results in better, more well-informed decision making.

WRIGHT: The way that your program is set up, are you in that position to be the person that asks those questions and to bring those in? Or do other people in the group of your experts take that lead in the discussions?

ROE: Sometimes it's me; sometimes we have leads for different tasks. We have multiple people that do that.

WRIGHT: And in your case here, are you making a decision or a recommendation back to the program?

ROE: Hopefully what we're providing, and what our intent is, [is] to provide them an engineering position based on test and analysis, so that it's not just a judgment or somebody's opinion. It's that we went off and did testing or we did analysis, and these were the results to back up our position. In providing a different perspective, it's not just our engineering opinion or judgment; we're supposed to be backed by test and analysis.

WRIGHT: Do you feel that the decision to create your Center will continue on to help solve future issues?

ROE: I don't know. Because we were created actually before the CAIB [*Columbia* Accident Investigation Board] report was written, it was the summer of 2003, there was a lot of support to go do this. As we get further and further away from the accident, I fear that there will be less and less support because as always, funding is an issue, and the less people remember what was happening at the accident, the less people there are to ensure that organizations like this are properly funded. So it'll be a struggle as we get further and further away from an accident, I believe.

WRIGHT: Well maybe some of the lessons learned and the processes you've created will continue.

ROE: And I do think, because we do see now the programs, Constellation, Shuttle [International Space] Station, much more willing to bring in folks from the outside and to bring in folks from Robotic Space Flight Centers. A great example was [when] the Shuttle Program was dealing with an engine cutoff sensor anomaly—it's been two years now. They actually requested one of our folks from [NASA] Goddard [Space Flight Center, Greenbelt, Maryland] to lead the Tiger Team to look into the anomaly. That would have been unheard of five, ten years ago, that they would have brought somebody in from Goddard to lead that. I think we're making headway from that standpoint, and if we can make that happen, and if it was universal, you wouldn't need the NESC. The goal would be to make everybody think that way, and then you don't need the NESC.

WRIGHT: How many issues have you addressed since you've been in formation?

ROE: In four years, it's a little over 250 issues. All different, all Mission Directorates, so not just human space flight.

WRIGHT: Are these any of the ones that you've seen or ones that you encountered when you were sitting in the midst of the program?

ROE: Yes. So I recuse myself from those.

WRIGHT: What advice would you share with somebody joining a similar program or wanting to join NASA at this point?

ROE: I think it's what we've already talked about, how important it is to build those relationships and trust. Often as engineers, we're trained in the discipline and the physics of a problem, or math, or engineering solutions, and knowing how to and knowing how important it is to build trust and relationships is not what we get trained in. You have to see some examples, like I mentioned Ron, Bill and Tommy, of how important it is to go do that. If somebody's starting a new program, I'd spend a whole lot of time, as much time on those relationships as I do on the technical aspect of it.

WRIGHT: You have any suggestions on how to teach that or how to train people in that?

ROE: Well, I think you have to see it and participate in it to appreciate it.

WRIGHT: A hands-on type of affair, isn't it? What else would you recommend to equip the next generation of Space Agency employees? What are those attributes that people are looking for, that you can train to have that trust and that relationship building?

ROE: A lot of times, we see [what] really inhibits that is when people become really defensive about their technical position. They're not open to other people's suggestions or criticisms, and they get way too defensive, and then they really, again, become blind to seeing that there might

be a different way of accomplishing it or a different solution. So trying to be able to resist that temptation to be defensive about your own particular technical position, and to be open about somebody else's perspective, and to listen to other people's perspective—I can't tell you how much I've learned in the last four years. After working in the Agency for 25 years, I've probably learned more in the last four because I'm working with such a diverse group with diverse experience. So if I take the time to listen to them, I can do a whole lot better than if I just stick to my own personal technical position that I've developed only by working in human space flight. So you really have to be able to open up your mind to other perspectives, and it's difficult sometimes.

WRIGHT: That's a great point, thanks for bringing that up because I think everybody gets comfortable.

ROE: Oh, absolutely. When I was at the Kennedy Space Center, it was a frame of reference that was purely processing of the Shuttle. When I went to the Johnson Space Center, I said, "Oh!" It was a totally different perspective. Now I've been working with folks from Research Centers and Robotic Space Flight Centers for the past four years, and it's two and three different perspectives. There's something we can learn from all of them, and if we can keep open to that, we'll do much better.

WRIGHT: Very good information. I think I've kind of worked through all those. If you want to look through some other thoughts.

ROE: I think we hit everything.

WRIGHT: I think one of the areas that we might have, that you might want to talk about a little bit more, is that when we ask for an example of a successful risk mitigation activity.

ROE: Yes, the STS-93 electrical short. The ascent of STS-93 we had an electrical short in a circuit that affected the main engine controllers, and following that, the program stood down, I believe it was about four months, if I remember correctly. We inspected all the wiring, or a majority of the wiring, on all the ships. To me, it took a lot of courage on the Program Manager's part to say, "No, we're going to stop. We're not going to fly until we investigate this anomaly."

It's hard to maybe remember, but there was a lot of pressure there, before *Columbia*, to complete the Space Station. I think it takes a strong leader to be able to recognize when we need to stop and truly investigate a problem without flying. Often we get in this position where, "Oh, we'll continue to fly while we'll investigate the problem." Because from a schedule pressure standpoint, that seems to be the easiest thing to go do. So it takes a lot of courage to stop and truly investigate a problem while the fleet's on the ground.

WRIGHT: One of the comments that you made through our visit today was about a strong leader, and you mentioned that you worked with Tommy Holloway and Ron Dittemore. Are there others?

ROE: Bill [William H.] Gerstenmaier and Bob [Robert B.] Sieck. Those are folks that do represent strong leaders in my mind.

WRIGHT: You mentioned some of the attributes that you find in leadership. Were there other attributes with the gentlemen that you mentioned, like openness and good communication? Were there other things that they did that you admired, that you feel really helped the success of the program? Maybe you could share with us how they deal with failures? When things didn't work out the way they were supposed to, when they had to start over again. What were some of the leadership things that you felt that they did to help carry the program through?

ROE: I'm trying to think of good examples. I think the whole aspect of building up the team; as opposed to sometimes you get a leader who has a tendency to tear down the team when things don't go right. But those gentlemen, Tommy and Ron, [and] Bill, they have a tendency to build up the team and build up the morale. That's probably it.

WRIGHT: That's a good thought. Is there anything else that you can think you'd like to add?

ROE: I think we covered most of it.

WRIGHT: All right. I can give you a minute. I don't want to rush you.

ROE: I think we talked about a little bit, the creation of those councils in the Shuttle Program. Earlier in the Shuttle Program, there was certainly a lot of friction between the Centers, Marshall

[Space Flight Center, Huntsville, Alabama], Kennedy, and Johnson. The relationships, I thought, were horrible in some cases. The creation of those councils really went a long way to improve those relationships and got the Centers working together much better. I thought that was critical, too. I think that's it. I think we talked about all my key points.

WRIGHT: All right. I thank you, and I wish you the best of luck in taking care of those issues before they become problems.

ROE: Thank you.

[End of interview.]