AUGUST 3, 2003

DR. ORVILLE BUTLER: We are at Headquarters at Kennedy Space Center, talking with Mike Wetmore, and I think I'd like you to start by telling us a little about your background. Where you grew up, went o school and how you arrived here at KSC?

MR. MIKE WETMORE: I was born in Miami, Florida and reared there, as well. I went to the US Naval Academy and got a degree in mechanical engineering. Bachelor of Science mechanical engineering. I went into Admiral Wickover's (phonetic) nuclear program, including having the Wickover (inaudible). I spent seven (7) years active duty after graduation from the Naval Academy, including a three (3) year period on the USS Woodrow Wilson and then teaching at Nuclear Power School in Orlando, Florida for two (2) years. I taught (inaudible) chemistry material and neurological fundamentals.

In 1987 I got off active duty and came to work for NASA as a Environmental Control Systems engineer. I spent about four (4) years in systems engineering, two (2) in environmental controls and support systems, and about two (2) years in field sales. PRSP, which stands for Power Reactor Storage and Distribution System. So four (4) years in system engineering. In the middle of that four (4) years, I did a six (6) month rotation on assignment to the project control office.

While acting as a engineer I'd gone back and got a Masters in Business Administration, from the Florida Institute of Technology and had become interested in

the business side of this. So I did a six (6) month detail in the project control office, then on back to engineering. In 1991, the Director of Shuttle Processing, at the time, Jay Honeycutt, asked me if I'd come back to the Project Control office as budget lead, and I moved back to take the lead budget responsibility here in 1991.

I worked my way up through the Project Control office, eventually becoming Deputy Director of Shuttle Processing in 1999 and then Director in 2002, and then in July of '03, there was a reassignment of launch integration and (inaudible), at Kennedy Space Center.

DR. ORVILLE BUTLER: Quite a move. I guess I'd like to begin with questions about shuttle processing. You came here in '87, and became immediately involved with shuttle processing. That would have been right after Challenger.

MR. MIKE WETMORE: Actually it was post-Challenger and NASA was staffing back up to get re-involved in the ground support equipment. An area they had stepped out of pre-Challenger, and as a result of the Challenger accident determined that they really needed to get involved in the ground support equipment again. So I was hired on as part of that staffing back up at NASA.

MR. MIKE WETMORE: How did Challenger change the roll in Shuttle processing and NASA contractor relationship?

MR. MIKE WETMORE: Again, cause I came on post-Challenger, I wasn't really here pre-Challenger, it's difficult for me to answer that question, other than by hearsay. Obviously, the shuttle processing contractor, SPC, was held by the

Lockheed Division Operations company, had been the contractor when the accident happened and continued to be afterwards.

NASA had been stepping out and reducing their roll and transitioning more and more work to the contractor and they obviously stepped back in and starting revealing all paper, all processing of ground support equipment included, as a result of the accident. Other than the increase of NASA involvement, I don't really know how much they had stepped out of the more specifics in that case.

DR. ORVILLE BUTLER: When you came here, what did you see as the mood here?

MR. MIKE WETMORE: The mood here, everybody was a little bit conservative because of the accident and the mood was, let's make sure this never happens again. Folks were very conservative in their engineering judgments. A lot of people, even for years afterwards, were risk adverse. If I can use that term. Everybody has always been, in my experience dedicated to insuring the safety of the crew and the mission, and the success of the mission.

We we're in a rapid build-up period when I came back. Pad A was being reactivated. There were many mods. apparently, that had been done in Pad B that have not been accomplished on Pad A. So, as part of return to flight, there were reactivating Pad A. They were activating mobile launch platform Number 3. The same idea. It had not been kept up with the other two (2) mobile launch platforms, and so there was a massive amount of work going on.

We had almost 8,000 shuttle processing contractors at the time and they were running 11 and 12 percent overtime. So, a tremendous effort going on in that time frame. We were going back and re-certifying through a design certification review processor, DCR Processor, re-certifying that our ground support equipment met all the design requirements of the system.

So it was a very busy period. It was not idle even though we were not initially launching. There was major reviews of the launch commit criteria and the orbiter maintenance requirements specification documents had just been completed to make sure we had all the right requirements there. Many of the procedures were being re-written because of those reviews. Making sure we were covering all the requirements and processing was happening at a very rapid pace, as well as the F-1 Pad A re-activation and mobile launch platform. So, it was very busy. Very exciting.

It was a good opportunity to come in from the outside because people we're stepping back and reviewing the basic requirements so everybodys knowledge was really, sort of, refreshed. Going back to the basis of requirements and launch commit criteria and the re-certification of review process, so it was a good opportunity to come on board and review some of those basic assumptions that we made earlier in the program.

DR. ORVILLE BUTLER: And what was, so you recall, what were some of the changes that needed to be done to Pad A and platform Mobile 3?

MR. MIKE WETMORE: I don't remember the specifics, again because I had not been here for post-Challenger (he meant to say, pre-Challenger). To me it

was just a re-activation, so they were doing major correction control and they were making sure the configuration matched the other Pad. I do not have a list of specific Pad A or Mobile Launch for modifications, it was just a large volume of work. It was a piece of equipment that had been set aside for an extended period of time and it was being upgraded and made to match the configuration of the other Pad. I do not the specific list of modifications. I have a resource, Jim,(inaudible), being down in our business office, might be able to answer these questions, cause I know he was project manager for NASA.

DR. ORVILLE BUTLER: Very good. And how did you describe the criteria in the design flaw state?

MR. MIKE WETMORE: The design certification review was a requirement to go back to the program requirements captured in STS7700 to review the requirements there and to verify that the equipment that we were using met those requirements, as well as it was designed in accordance to standards, which was the Suite 2 document. The GSE design standards. In particular, we went out of town, at the time, Rockwell Design Center, where much of the equipment had been built, and we had the design certification review there. where many of the original designers, pulled out their original analysis and drawings and we went through, system by system, to verify that the design was per standards, and it supported all the requirements documents and (inaudible).

Does that answer your question?

DR. ORVILLE BUTLER: In basics, yes.

MR. MIKE WETMORE: Okay.

DR. ORVILLE BUTLER: A lot of what I'm asking is stuff that we already have, but it's good to have somebody telling it to us so that we can put it together, make sure that we're putting it together accurately. During your time in engineering, what did you see as your primary activities, and how did they fit into the shuttle operation at that time?

MR. MIKE WETMORE: It was a little different between the two (2) systems I was in. During the two (2) years I was in environmental life support systems, I was working primarily ground support equipment. Pat Simpkins (phonetic) was essentially was the lead in the group, and he led the orbiter efforts and the launch criteria and the orbiter (inaudible) Minus D studies, and insured orbiter requirements from that.

I was focusing on the ground support equipment and insuring the readiness of the ground systems to process the flight hardware and the readiness of the pad systems to receive and process the vehicle, and the design certification on the ground support equipment.

So, my effort for that first two (2) years was focused on the ground systems and insuring they were ready. Again a great opportunity for me to come in at the bottom and learn that. I did support orbiter processing, as well, but it was more the acception than the norm. Typically, I supported the orbiter and helped to check out if it was a weekend timeframe, and some of the leads could not support. I was two (2) years in environmental control life support systems.

I did a six (6) month detail in the business office and then when I went back, I went back to field sales by (inaudible) storage and distribution groups, and there, I was actually a vehicle lead. So in field sales area, I was working with flight hardware. I was helping to insure that the processing that followed the (inaudible) requirements. I was studying the launch commit criteria. I had the opportunity in that group to support several landings at Dryden where we deserviced the cryogenic tanks, and prepared the vehicle for flight back. I had the opportunity to support several launches from the firing room, which I'd not had the opportunity to do, in environmental control life support.

So again, there my focus was on insuring that my personal understanding of the systems and the basic of launch commit criteria and the performance of the system, making sure my understanding was through enough to support any kind of contingency that we would get during a launch countdown or during a mission. We were trouble shooting what anomalies we saw, and insuring the vehicle was ready to go.

DR. ORVILLE BUTLER: While you weren't here pre-Challenger, one of the things that is clear, is that pre-Challenger, is sometimes they would have 23 day turn arounds. During original design they talked about 160 hour turn arounds and now you have 80 to 90 days flows. What brings about the longer flow?

MR. MIKE WETMORE: In 1991 we had almost 8,000 people, processing here. They were running 10 to 12 percent (10% - 12%) overtime. Now, you have 4,000 contractors running less than 3 percent (3%) overtime doing the same work. Over the years because there was a focus on budget, the focus at Kennedy Space Center has been, and the flight rate, was at seven (7) to eight (8), and planned

to go to 10, back in the '91 time frame. Now the flight rate is about five (5) per year. As we've reduced the flight rate and we've tried to squeeze the budget, the focus has been on allowing the work that spread out to fill the available hours, verses processing at a very high rate for a short period of time and then sitting around and doing nothing.

So the 90 days verses the 50 some odd days, which was more the average. They did have one (1) 28 day flow, but they got there by waiving a large number of requirements, not by doing all the work. In general, the work before and the work now are about the same. The average number of hours are about five hundred thousand hours per flow, and that's what it was historically, although it did go up almost to a million hours per flow post-Challenger. And we got very, very conservative, and did a lot of extra testing for awhile. As we staffed down, we stopped working third shift.

When I was here in 1991 you would have found operations going on seven (7) days a week, three (3) shifts a day, and they even had split shift folks, so that there were people assigned on weekends, not on overtime. Now, nominal coverage is five (5) days a week, two (2) shifts a day, and they work weekends on third shifts only on overtime and it's the exception, rather than the norm.

So, if you look at the total number of work hours and the total number of shifts, they are not as dissimilar as appearing 50 days to 90 days. The work is very similar. It's just stretched out over a longer period of time because the manifest allows us to stretch that work out over a longer period of time and (inaudible) supports that.

DR. ORVILLE BUTLER: So the Dryden factor there is more budget and flight demand rather than (inaudible)?

MR. MIKE WETMORE: There's no reason to do a 50 day flow when you're launching five (5) times per year. There are three (3) vehicles launching five (5) times per year, if you send one (1) of them in, what we call orbiter maintenance down period, or orbiter maintenance in my period, they are both in terms of (inaudible), it's basically a two (2) year overhaul. So, if one (1) vehicle's in overhaul, I and one (1) is only flying five (5) times per year, I only need about two and a half (2½) flights per year out of the other two (2) vehicles. So what does that come to? Almost 150 days available for a flight. There's no reason to do a 50 day flow, if I only have to fly each vehicle about two and a half (2½) times per year.

So we allow the work to stretch out. We minimize third shift, which in is a very inefficient shift anyway. The industry has done a lot of studies to show the effectiveness of workers who are working on third shift verses first or second. We still work some critical path items on second or third shift, or third shift on weekends, if required. We tend to do hazardous operations on weekends, so that they, if I do hazardous operation which shuts down a bay, I'm not making a bunch of workers stand by idle, while I do a hazardous operation. So I do smart, we call it smart overtime, on the weekends to put the hazardous jobs on.

The longer flows are not a product of more work, more inspections. They are a product of not working third shift by allowing the work to stretch out, and we're doing it with about half the numbers of workers. The total workload, the total number of man hours has stayed very similar, and just for you r backup information, I'm doing that from memory. I actually have metrics downstairs if you'd like to look at the history of

the flows and how many man hours. They go all the way back to the beginning of the program.

DR. ORVILLE BUTLER: That might, actually if you could get that, that might.

MR. MIKE WETMORE: That's in my office downstairs. We'll look down there after this is over and I'll show it to you.

DR. ORVILLE BUTLER: What about the role of safety? Where does safety come in and what role does it play, how is it implemented?

MR. MIKE WETMORE: Well my personal experience on safety is - everybody is responsible for safety. When I was in, maintaining ground support equipment, the focus was on insuring that ground support equipment was properly maintained and was designed to protect people on the ground from injuries – to protect us from damaging the orbiter, especially undetected damage which could be a threat to the safety of the flight.

The launch commit criteria, the orbiter maintenance requirement specification documents are all based on insuring that the vehicle is processed in a manner that protects the crew, and that the mission is safely accomplished. So to me, and it's no difference from what I saw in the nuclear Navy, insuring that processing is done properly to protect the safety of the crew, the safety of the vehicle and insuring that it's done properly on the ground, to protect the folks on the ground. A way a life for absolutely everybody.

Now there has been an organization at Kennedy called, Safety, throughout that time period. At one point, early on, that was an external organization. The Quality inspectors, the Safety inspectors, the quote "Safety" engineers were in that organization, but they did not uniquely own responsibility for safety. There were some people that if you asked them who was responsible for safety, might have pointed to that organization. They certainly contributed in engineering support functions to make sure what we designed, was designed for safety. But safety was everybodys responsibility.

Since then, that organization in KSC 2000, which is a reorganization, didn't, obviously in 2000, that organization was split and we left the independent assessment function in that organization. We brought the quality and safety folks that were supporting shuttle into the organization I currently manage. That didn't change what they did. It really didn't change anything for any of them, other than who the division chief reported to. Instead of reporting to someone in the Safety organization, he now reports to the Director of Shuttle Processing. His job is unchanged. His job is gong through that what we do is safe for the people on the ground, and that the quality is such that the crew and the vehicle are protected, as well.

So to me, safety's been everybody's job from the beginning and it continues to be today.

DR. ORVILLE BUTLER: So why did they make that change?

MR. MIKE WETMORE: I think that was original idea, and I would recommend that you talk to the folks, Shannon (inaudible) here at Kennedy Space Center.

DR. ORVILLE BUTLER: I interviewed her.

MR. MIKE WETMORE: Actually was on the team that helped divide that. Some of the reasons and I'm not the best advocate for why it was split. Part of the reason was to actually strengthen the independent assessment functions. When you had both those functions combining in with single organization, then you had the same organization that supposedly was doing safety and quality inspections, and also doing independent assessment.

There's a natural conflict of interest there. They can't really be independent if who their doing inside on is themselves, so part of the reason for splitting was actually to strengthen the independent's of the independent assessment. The other reason was a recognition that the Quality inspectors, who are in the Orbiter Processing Facility, every single day, who inspect when their called, in accordance with the paper, really are doing an inline function. They are verifying quality, they are not external. Their not independent, so I think it was a more logical break down of the workforce.

You put into the shuttle organization those folks that are responsible to insure that quality is proper in the shuttle organization. One of the goals, we have to get out of it, which we haven't been necessarily been greatly successful to this point, was more of a synergy between my Quality inspectors and my Engineering folks. Maybe we can learn from each other. We're still trying to grow that relationship.

I've not gotten wonderful synergies out of having them in the same group, but I improved some communication, and the Quality guys can now raise an issue directly to the systems engineers, who are overseeing the system performance. Hopefully when I write a new procedure I can talk to those Quality guys that are going to have to execute and understand a little bit more about making it more practical and incorporating more human factors into my processes, and insuring the feasibility of executing the paper is written, rather than throwing a piece of paper across the fence that the Quality guys haven't seen in the past, and aren't really sure what that step means because they haven't talked. That's one of my personal goals as Director of Shuttle Processing. I've not gotten a lot of progress in that area, but we're working on that.

DR. ORVILLE BUTLER: We're jumping a little bit here, but I'd like to go back to when you were involved in landing. Many people think that Kennedy is a place, here, and yet we have Kennedy people all over the place. We certainly know there are Kennedy people working at Johnson, at Huntsville. There's a lot of interplay with Headquarters. For awhile we had operations out at Vandenberg before they decided they weren't gonna do defense shuttle.

Can you talk a little bit about what Kennedy's role was, and explain the landing options? What was Kennedy's role out on the west coast for landing, and talk a little bit about the role of the different landing options?

MR. MIKE WETMORE: Okay. I look at us, at not as the Kennedy shuttle, but as the launch and landing project, which is how we are described in the

program documentation. The launch and landing project, which is here at Kennedy primarily, is responsible for all of the landing sites and insuring that the equipment at the landing sites is ready to support a landing there, as well as, insuring that the equipment is ready to support a fairy operation. So our role out at Edwards Air Force Base, or what's the name of that, the NASA center out there, that research center – our role there is once the vehicle lands, we safe the vehicle.

We got up, we helped the crew get out. We help pull the payloads and get the payloads back to the principal investigators. We hook up Freon flow to the vehicle, to cool the electronics when the vehicle is still powered up. We hook up a purge which is pumping conditioned air through to insure no hazardous gases build up that could cause an explosion. We tow the vehicle over to the processing facility, which is really by the demate device, and there by the demate device we prep the vehicle for fairy back to Kennedy Space Center.

Preparing that vehicle means I drain cryogenic fluids so that I'm not blowing off any during fairy flight. Draining some water lubes, cause that way a very limited power supply is coming from the fairy aircraft to the vehicle. You see, you can't have a lot of heaters turned on, so there's a possibility of freezing water, so we turn the water on. So we drain some water off. I'm very familiar with those cause those are things you see on fuel cells, PRSD do, and those are were my systems.

They also do a lot of other inspections and preps of other fluid systems. They put on the (inaudible) that covers the main engine for failure to reduce the aerodynamic drag, and they align the switches and prepare the vehicle.

Then we pick it up, we pull the 747 underneath. We set the vehicle on top of that shuttle carrier aircraft. We make sure the interfaces are correct and then we oversee the fairy back. We actually have folks that go with it as it crosses the country to insure that wherever it lands, it's properly supported.

So, our role is insuring that the landing sites are ready to support landing. We do that before launch. I mean, before we can launch, we got to have landing sites ready to receive the vehicle.

DR. ORVILLE BUTLER: And that?

MR. MIKE WETMORE: And that includes the Kennedy Space Center landing site here, in case you have to return to launch site abort. It includes the landing sites across Europe and Africa, in case we had to abort to that. Those emergency landing sites, includes Dryden and White Sands out in California and New Mexico. We continue in that role today. It has not changed. There for security reasons - there are a couple of African sites that we don't actively bring up every mission. We only bring up one (1) or two (2) each mission.

As an a savings initiative, they tend to be the two (2) Spanish sites as the most convenient, and the most secure safe instruct people to go to. But our role there has not changed. If we ever had a transatlantic landing, Tile site is what they call the sites in Europe and Africa. We would be in charge of going in and figuring out how to get the vehicle back here.

DR. ORVILLE BUTLER: And what choice is it being done by civil service engineers, and or is that being done by contractor?

MR. MIKE WETMORE: The contractor does the majority of all the work. Now as I said, 4,000 ground operations contractors here and I have about 380 civil service. So there 10 of them, for every one of us. Since we went to the space flight operations contract in 1996 which was suppose to be a performance based contract, the contractors are actually leading that effort and NASA role is insight. One exception we made to that was there was a belief, at the time the contract was awarded, that in order to indemnify this contractor, NASA has to be the one to quote "pushed the button on launch". They gave the final Go for launch.

When we get into the final launch countdown. It's called SUE 7, as the abbreviation we use for the procedure, about three (3) days before launch, NASA steps from the back seat, looking over the contractor's shoulder basically into the driver seat. The bus were driving, you know, I may be the bus driver, but the vast majority of the work is still being done by contractor, throughout the firing room, throughout – at the landing sites – at the pad, in the OPF. The contractor will always do the vast majority of the work, but I step into the driver seat for that final three (3) days of countdown and for the landing operations.

Once those landings operations are complete, I turn the leadership back over to the contractor, but for the launch and landing execution itself, NASA is in the leadership role. The vast majority of the work is done by the Space Flight Operations Contractor. They do a great job at it, and I think they are every bit as good and concerned about safety as we are. Does that answer that question?

DR. ORVILLE BUTLER: Yes. Another jump – one of the things that was very interesting during the Apollo era was the variety of cultures that were here at the Center. You had launch vehicle culture. You had a spacecraft culture. We fly different vehicles now and so there's different configurations, and different organizations. To what extent do you see sub-cultures, I guess I would say, to the Kennedy culture?

MR. MIKE WETMORE: I think the roles of the various organizations that Kennedy are different, and therefore, they grow different cultures. The launch vehicle team is very similar to the shuttle team and we're still processing a launch vehicle up there. The fact that it's also a space vehicle and a re-entry vehicle is a tribute to the versatility of the shuttle vehicle itself.

But the Spacecraft operations that used to happen over here at the operations and check out building, are still carried on today by the payloads and Space Station organization, both in the ONC and the Space Station processing facility. They have about the same number of civil servants that we do, almost 400, but only about a 1,000 contractors.

So, the ratio of civil service to contractors is very different there. They are involved with a, almost a different payload every time they process. Whereas I'm involved with in a reoccurring process of turning the shuttle vehicle around. There are differences each flow, but they are minor compared to what payloads experience. Payload folks and station folks are dealing directly with customers and trying to satisfy unique customer needs every flow.

I'm turning around the shuttle, and of course, the shuttle program requirements, and again, is of a reoccurring process.

If they go over to the launch service program or the ELV folks, as you'll frequently heard them being called, they are doing something even different. They have again, a payload customer requirement. So, they are getting requirements from the payload, which they the have to incorporate into a contract to a launch provider, be that Boeing or Lockheed Martin, depending on which vehicle they are flying. They also have the surveillance role, like I do, at looking at how that lift vehicle is processed.

Because it is not a NASA owned vehicle, it is a vehicle that is being purchased on a, I think they're fixed place contracts, with Boeing and Lockheed Martin, they're ability to direct the contractor into getting insight to the contractors is somewhat more limited than mine is, and their processes are even more fixed. What flight Lockheed Martin does to process an Atlas, is a Lockheed, I don't know if I have the vehicle right, is a Lockheed Martin or Boeing procedure. Whereas my NASA owned shuttle vehicle is processed with, of course, with NASA owned processes, and I have the authority to change those.

So they're very distinct cultures between those three (3) groups. We now have an IT organization, but the (inaudible) and the network folks have always had a slightly different role. They are a service provider and our TA organization, a support organization is very much a serious provider to the programs, and they have different cultures because of that.

I don't personally think the cultures have changed that much, probably since the Apollo days. You have got to toy culture that best fits your roles and responsibilities and allows you to do the job in the best fashion possible, and I think that continues to go on today and I hope we stay adaptable as we move to the orbital space program, and the space plane and other future programs.

DR. ORVILLE BUTLER: You're probably right in terms of the goals and purposes of this organization, but I find it interesting that the younger people I've interviewed tend to agree with you. The old timers tend to talk about the change and it seems to be a matter of prospective.

MR. MIKE WETMORE: And I guess that's because I'm fairly new here.

DR. ORVILLE BUTLER: And the old timers tend to get more as one culture now, as opposed to much (inaudible).

MR. MIKE WETMORE: You know another area that I didn't even talk about is our Spaceport Engineering and Technology group. That's what their called now. They used to be Design Engineering. They are a development organization, and now they develop (inaudible). My organization is very much is an operations organization and has not changed.

I came on in '87 and there were culture differences there. Sometimes described as proquelism or sandboxes. In negative terms, I've always found it healthy. I think an OPS guy isn't necessarily the best guy to go design a new piece of equipment. And it's clear to me the design guys aren't the best guys to make operations happen. There's a good check and a balance there. They ask questions that I wouldn't think about and I

think that I ask them questions that make them uncomfortable too, and that teaming of different skills, different cultures, is what brings you your best success.

When we get to much stove piping and not working, back and forth with guys, that's why the cultures are one of the (inaudible).

DR. ORVILLE BUTLER: Can you provide an example of some time when that has happened, or some time when that has been overcome in the (inaudible).

MR. MIKE WETMORE: My personal favorite example of the culture difference causing a problem is a tile inspection robot that the design engineering folks once built. They decided that we really needed to automate the process of waterproofing tiles. The reason why is because it's a hazardous material that we're dealing with. It was difficult work. They technicians are working over their heads continuously, injecting water proof material on to each and every tile on the bottom of the orbiter. I heard numbers like 30,000 for the number of tiles, so you can imagine that it's tedious, boring, difficult work.

So the design engineer folks came up with the concept of, let's automate it. Let's build a robot that can do this for us, and so they went about building a robot. When they were finished they had a robot that was so complex it took more people to maintain than it took me to waterproof the tile. Oh, and by the way, it would only waterproof the tiles that were on the flat surfaces, which is a small percentage. It would not waterproof the tiles that were up around the curves. So I designed a

machine that would do part of a job, and was harder to maintain than doing the job itself. That is that difference in cultures running to its extreme.

That's one ugly example. There are a thousand great examples where we had an operational problem and we pulled in the design guys, and they very quickly told us about a new technology that could fix a problem. I'll just mention a couple.

One of them was, mating the external tank to the solid rocket boosters is an operation where a crane is bringing an external tank in close proximity and then we bolt it on to the side of the rocket boosters. So you have a very heavy object hung from cranes, at great distances, and very close proximity to platforms and we're trying to get it aligned and you know, people are not getting between those two (2) objects because that would be hazardous. They're trying to look great distances and figure out how to align those objects and there used to be a lot of difficulty of aligning and finally, bolting those up.

The prototype guys over here took one look at that and said, you know, if we mount the little laser right on the eternal tank, and we mount the little target on the ISRM, all you got to do is keep the little red dot right in the middle of the target and you can look at that with a set of binoculars and know you're perfectly lined up and do this very quickly. And it was a very simple modification, quickly implemented that has greatly reduced both the safety risk and the time required to do that process.

They continue to come up with great ideas that solve some of our problems. We have tile drying problems. We shine high intensity lamps at the tiles to get the water to evaporate out of them. Works great on the water on the surface, but then you turn the

lamps off, and a couple hours later the tiles are wet again because there's moisture behind them. I know we've developed a vacuum drying process. We haven't gotten it approved by the program yet, but it shows great promise of significantly reducing the time to so that. So, if the requirement folks can successful communicate the requirements to the design guys, and the design guys can understand the operational constraints, you get a tremendous synergy, and you can solve problems greatly.

When those communications and understand break down, you got tile problems and there are ugly examples, but I like to tell the ugly examples. I like telling the success stories.

One more that came out was this, what's it called, a fail safe jack screw. We've had jack screw failures that, once with the Alaskan airlines flying off the west coast a couple years back, was because of the jack screw failure. Jack screws are items that have wear. It happens to the jack screw device, they are difficult to inspect. Its time, labor intensive, and if not inspected properly, they can have catastrophic consequences of failure. We had a couple of jack screw failures here, causing platforms to partially collapse, which could have injured somebody. Obviously, one of them on the Alaskan airline, the jack screw failure caused the loss of the plane and everyone aboard.

The folks here came up with an idea that allows basically to have a follower on the jack screw. It maintains all the strength of the original jack screw and yet does not wear because it had no load on it. So if the jack screw does fail, it's actually the knot riding along the jack screw, the threads wears to a point where that if knot fails, the

load is automatically picked up by the (inaudible), which does not wear because it has no load on it.

A very simple solution, and I understand the airline manufacturers are now looking to commercializing it. So it was an operational problem. Our operational guys took their concept to their concept to the design folks, and they had a concept for repairing it. The design could very quickly fabricate and manufacture this. I understand there were some improvements made to the design because of that partnership. We have a very simple, but not previously available, product that could significantly of our vehicle industry.

DR. ORVILLE BUTLER: You were involved in shuttle landings and you came back to, primarily to Kennedy, when did you finish the?

MR. MIKE WETMORE: On those occasions when the shuttle landed in California, and initially after return to flight, we were landing all of them out there, until we could – they were working on two (2) improvements to the orbiter. I was in the right position to know all the facts behind this, so this is from my perspective out in system engineering.

We landed initially in California for every mission, until they finished installing the parachute - the drag chute, and installing the nose wheel steering. Those were two (2) enhancements that they decided, post-Challenger, they needed to make before they started landing back at Kennedy Space Center. So, for the first shuttle launches, we would, as soon as they launch, or shortly after they launch, we would send a recovery team out to California to safe the vehicle and fairy it back. I was not permanently

located out there. We would go out for a few days, safe the vehicle and come back, so I've never been assigned anywhere except Kennedy Space Center. I did do a one (1) year rotation at NASA Headquarters in '98 – '99, but landing supports was, those were groups of people we could pull at pre-launch, or just before landing out to the remote sites, for support on recovery.

DR. ORVILLE BUTLER: You don't permanent staff out there?

MR. MIKE WETMORE: We do not have permanent staff in California. We actually, I use the term, subcontract, but it's actually Johnson Space Center directly pays the support contractor at Edwards Air Force Base to maintain our equipment out there. If we had an actual landing in California, we would send folks out there to recover the vehicle. At the tile sites, we actually send people overseas prior to each launch to make sure those tile sites are ready to support the launch and they standby throughout the mission, if required.

DR. ORVILLE BUTLER: So when did you move on from your work on that to your next position?

MR. MIKE WETMORE: I was an ECO from '87 to '89, I did about a six (6) month detail in the business office and I went back and I was in field cells PDS, from '89 to '91. In 1991 I moved up to become the budget lead for the Shuttle Program Office, managing about an Eight Hundred and Fifty Million dollar budget for Mr. Honeycutt.

From '91 till '98, I worked my way up through the Project Control office. First doing just the budget as budget Lead, and then doing budget and contracts Lead, and then having the Project Control Office.

Then I actually ran the Project Control Office under one of the line organizations, and I became the Deputy Director of that organization, between '91 and '98. But during most of that time, what I was working was, that prioritization of technical requirements, and figuring out how to live with the budget we were being provided and prioritizing requirements.

That was from 80, sorry I said '81 - '91 to '99. I was in that business, In '98-'99, I did my one (1) year rotation to NASA Headquarters and actually worked the entire Shuttle Program budget at Headquarters, where the Shuttle Program. While I was there, was interviewed and selected to the Deputy Directors job, when I came back home from Washington, D.C. I took over the Deputy Director slot. Does that answer your question?

DR. ORVILLE BUTLER: Uh-hum.

MR. MIKE WETMORE: Okay.

DR. ORVILLE BUTLER: Deputy Director for Shuttle Launch Processing.

MR. MIKE WETMORE: Right. Doug King was the Director throughout those three (3) years and I was Deputy Director.

DR. ORVILLE BUTLER: What do you see as the, how do you see the contractor NASA changing or do you see it changing? You had in '86, the development of USA and the single prime contractor.

MR. MIKE WETMORE: There's been a lot of discussion in the last three (3) years of prioritization taking this program operational and transitioning our responsibility to contractor, and basically all NASA would do is pay for a ride to the Space Station or delivery of a payload into orbit. Because we're the only customer crucial, the Government is, and its an asset that's owned by the taxpayers.

I have never personally thought organization was the right direction to go, and I think that decision was pretty much made before the Columbia accident. It's certainly been reinforced by the results of the Columbia. The Columbia accident investigation is clearly gonna state that they don't believe this is an operational system. This is still a developmental, experimental system and therefore, the Government should stay very involved. So I don't see this vehicle – I don't see NASA changing its role and the processing or preparation of this vehicle.

I think we will continue to have a requirement for a significant number of civil servants to review the work that's been done, and insure that the vehicles had been properly prepared, and I think the contractor will continue to do the majority of that work. I think we will probably staff back up slightly from where we are now.

There will be some requests that we get involved in some additional levels of insight on the contractor and observing what they do. I think that will be healthy. I don't think we were at an unhealthy point before, but I think we had a pretty good feel for the adequacy on the contractor processes and had a good knowledge of what they were doing. Adding folks in will improve that knowledge.

I think you're at a point of diminishing returns, if we add 50 or 60 back on, they won't be as valuable as the 50 or 60 I have now, but they will add value. It will improve the safety of the vehicle, cause every extra sets of eyes increases your possibility of finding something that somebody else missed.

I don't think there's a big risk here. The accident didn't really find any major deficiencies in processing at Kennedy Space Center, which was a testament to the ability of our contractor and of the adequacy of our insight system. But they have recommended several improvements and we'll put those in place.

We had moved to what we call the risk base surveillance program. We, in downsizing of NASA over the years, have backed out of many of the low risk items and we're looking strictly at the high risk type processing activities. They have recommended strongly that we get back into sampling all of the activities so we have a little bit more knowledge. Because those low risk activities, although at process break down isn't likely to cause any significant problem.

Process changes over the years can eventually get to the point where they bite ya. So we're gonna add some sampling of the less hazardous processes to make sure that their stable as well, and that's both on the quality assurance and the engineering side of our organization.

We had, continued to have, some communication problems with the Quality inspectors that need to be improved. They had the impression that there were some areas that I needed more insight on. I've had a communication breakdown there. That clearly came out in the investigation, and so I'm putting some new processes in place to

communicate with my Quality Assurance workforce, so that they understand if they have a suggestion that's it's not being ignored, it's being analyzed.

I'm not committing to always agreeing with them, but in the past, they would make an input, it would be assessed and if it wasn't incorporated, they assumed nobody cared about safety, but them. When in fact, it had been assessed. It was determined that it was not necessarily necessary, and the feedback wasn't doing what it should.

So, I'm gonna improved those communication processes. A – to make sure if they see something, I know about it and make a change if necessary, and B - to insure that if I don't make the change they understand that it's not cause I don't care about safety, there might be other technical reasons why it's not the right thing to do. So, I have some communications improvements to put in place.

I have some increase sampling of the stable processes to put in place and I think those will make the program a little bit safer.

DR. ORVILLE BUTLER: Some people you're working with are short on time with their job, (inaudible) and this is a sort of a futuristic question, some people have wondered if the shuttle is only for Government missions and have been since Challenger, and they question exactly what the purpose of the Space Station is.

Some people have wondered whether we're getting value for what NASA's doing and some people in NASA have been talking about, well, we need to do other things – where do you see, I guess your system of whether we're getting value, and then, 2 –

what directions do you see for the future, particularly as it relates to Kennedy as the Launch Center?

MR. MIKE WETMORE: I'm certainly not an expert in NASA spin-offs. There are people here who are experts and could write a lot, 20 or 30 products that have some out of the space program. I do believe that at the point you stop growing, we start shrinking and I think that the exploration of Space, as a former submariner, the expiration of the deep oceans, the continued search for knowledge is something that mankind has to do if we're going to continue to grow.

I know there are scientists who believe that the money spent on space flight program probably could be more effectively spent in a laboratory somewhere, but those are mostly the guys who science wasn't funded when they applied for grants.

I think there's a lot of good science that's available on the Space Station. I think learning how to live and operate in Space opens up incredible opportunities for the future. I don't know what's on Mars. I don't know what's on another planet. Our concept of mining asteroid belts, I jus think there's an incredible amount of knowledge to be gained by learning to live in this hostile environment and by doing material type sciences in a zero G environment.

By learning to live in a closed environment in Space, what can we learn about environmental control here on earth. As we learn to recycle materials in order to support a Space Station that doesn't have access to our materials. Can we learn more effectively and use what we got here on earth?

I think there's an incredible amount of knowledge to be gained by continuing to push the limits of what our scientific capabilities are. I can't give you the specific list of 20 or 30 spin-offs. I couldn't show you a direct cost pay back, but I do think that research and development is essential to the future of manned spaceflight.

I'm not much of a visionary, and the next vehicle's a long, way away. We spent several million dollars a few years back in a project called Space Transportation Architect Study, and basically, we paid all the aerospace companies for their best ideas, and they came back and said there wasn't anything better than shuttle anywhere in the near future, which is a real testament to the guys that designed this vehicle 20 years ago.

I think an orbital space plan again demonstrates that growth in this area is going to be very slow and incremental. None-the-less, I dream of the day when you can take off from any horizontal field and go into space. Right now we don't have either the materials or the propulsions techniques that will allow that.

I hope some day in the future Kennedy Space Center become obsolete. I don't need a Space Center on the east coast to allow me to take these vary hazardous vehicles off over the ocean for the safety of the public. I hope we become, it's just as easy to hop on a rocket ship someday, as it is on an airplane.

But I also recognize that that's many, many decades away from here. So, I think there's a lot to be gained by continuing to explore and do science in this area. I see Kennedy Space Center's role as secure for decades to come, yet I have a vision of the future when it's no longer necessary to launch just from here. That access to Space

does become convenient. Let's make sure we go there incrementally and slowly and carefully, and don't abandon what we have before we got the step in the chain.

DR. ORVILLE BUTLER: It's been 30 minutes. Well, I thank you for your time and.

MR. MIKE WETMORE: (inaudible). It so happens one of the reasons I'm here is I married a daughter of a NASA engineer out here. His name is Rocco Sanacandra (phonetic), and Rocco is one of the most soft-spoken, kindest, gentlest people you would ever meet in a million years. He is a design engineer who likes nothing more than to work at his drawing board to figure out problems to complex, solutions to complex problems.

Periodically Rocco would call on another organization to ask, and he'd ask for some help, and was always surprised when he got the, Yes Sir, we'll do that right away, response, until it suddenly dawned on to him, on him, that they thought he was Rocco Petrone.

Rocco Petrone, if you get a description of him, was not soft-spoken, was not gentle, was a rather aggressive, tough manager who would (inaudible) brush you at the drop of a hat.

It's a story my father-in law enjoys telling is how, when he said, no, no, no, wait, this is Rocco Sanacandra (phonetic), the response was always, oh, okay and he usually got the support anyway, cause they're too embarrassed after having promised him something to back out of it. So, just an amusing story. I don't know if it's of any

use to you, but Rocco Sanacandra (phonetic) verses Rocco Petrone, got my father-in-law a lot of enjoyment.

DR. ORVILLE BUTLER: I can imagine.

Thereupon the interview ended.