AUGUST 21, 2003

DR. ORVILLE BUTLER: We are at the Kennedy Space Center, Headquarters building again. I'm Dr. Orville Butler and we chatting with Warren Wiley. Last time we gotten you up to about 1992, and then you jumped ahead for a little bit on S33, S34.

Why don't we go back and try and fill in that gap from the period in between – in '92 you were the manager of the Space Shuttle Integration office, which again, is a new program. Can you tell us a little bit about why their bringing about, why their developing this new program?

MR. WARREN WILEY: Well, this was a move that was to try and centralize and bring the Space Shuttle Operations and consolidate it here at KSC. And their talking about taking the program itself and moving the Program office and a series of the Program functions to the Center. In other words, they just decided to do -- that thinking that that would be more centralized, the Shuttle Operations and so forth.

When they started that transition, but in the middle of that, and I'm not exactly sure what participated it, they stopped it. So, the Program Manager at the time was Leonard Nicholson (phonetic), who was actually gonna move to Florida and most of his staff was supposed move to Florida. He even had a house that he was getting about ready to go rent, I think at the time.

DR. ORVILLE BUTLER: Move to – this is from Houston?

MR. WARREN WILEY: From Houston to Florida.

DR. ORVILLE BUTLER: And Houston, that previously, or had up until this time, controlled the contract from the Shuttle?

MR. WARREN WILEY: Well, at the time, the contracts were, sort of a split. Okay, the KSC had the Operations contract. So all of that was done at KSC. JSC had the Integration and the program and the Orbiter contract. Marshall had the ET – SSNB and SRB contracts, so this is before they consolidated into the, what we call today, I guess the Space Flight Operations Contractor. At that time it was still the, what they call, the SFOC, Space Flight Operations Contractor. At that time, it was still what they call Shuttle Processing Contractor, mainly made up on Lockheed employees – were mainly doing the work.

So, I knew an associated administrator here, a guy named Jeff Pierson (phonetic). He, for some reason, wanted to go back and look at whether this was something that needed to be done, or should be done, or not -which was to move the focus of the program from Houston to Florida. The Orbiter Project and the astronauts and everything would still remain in Houston. The Marshall contract – but the program office that had the integration functions were gonna move to Florida.

He went back and I guess, spent some time looking at it – decided that he did not want to make that move, but they did want to move some functions that were launch oriented or launch, landing and processing oriented, to Florida. So at the time,

Brewster Shaw (phonetic) was the Deputy Launch Integration Manager, or was appointed the Deputy. I guess he was the Deputy Program Manager, at KSC.

They decided to move a number of these functions from Houston to Florida. They asked me to help set that up and lead that effort. So we ended bringing down a number of the functions. Things like launch (inaudible) criteria, which were previously down in Houston. All the OMRS, which is the Orbiter Maintenance Requirement Specifications document that deals with things that Florida, how you test and how you check the vehicle out. That was moved to KSC.

Construction of facilities for the program. The focal point of that was moved here. There was some software things that were moved, and integrated logistics was another function that was moved. So those – we ended up setting up an office with (inaudible). We had two (2) sections and I was the, sort of, the Deputy Program Manager, or Deputy Manager of Launch Integrations here at KSC, so it was tried out to be somewhat of an efficiency move and to give the – as far as moving the program down here – get it closer to where the actual activity took place. I mean, the actual launches and so forth. Launches and landings.

By moving just these functions, they still moved the things that are important in the program that deal with activity of launch and landing here, but they maintain the rest of it in Houston. So, at the time, it was gonna be a big move and then it turned into kind of a small move. We ended up bringing in several people from Houston that were doing some of those jobs and they we ended up filling those positions with other people here that had the capabilities of performing those jobs.

At the time we ended up having kind of a dual role, where Houston had part of it and we had part of it down here.

DR. ORVILLE BUTLER: How did that work out, because I know when you finally integrated the contract, there's quite a bit of competition or possible even tension between Johnson and KSC. So during this time, you had part of it and Johnson had part of it, how did the two of you interact to work out?

MR. WARREN WILEY: Oh, we worked very – I think it worked very well between us and Johnson. The, I guess functionally, I reported probably to, at the time I think, Brewster Shaw (phonetic), but my real direction or whatever, came from Houston, so their the ones who did my performance appraisal and stuff like that.

So, we ended up working fairly good together. Whenever we had, typically monthly meetings of some kind with the contractor, which was Rockwell International at that time, was the integration contractor. We would meet with them on a regular basis. We would meet in Houston or Houston would come here and meet on a regular basis and we talked daily on the phone.

There's a Board called a SIR, System Integration Review, that is a Board that is run under the level, what we called the Level Two Function, that was run by the system integration contract. I co-chaired the part of the Board that dealt with the things that I had here, and then Larry Williams, who's a manager at Houston, co-chaired the things that were handled at Houston. We had that Board kind of broken apart into two (2) pieces.

We would essentially review the items and make recommendations that would eventually go to, what we call, a Program Requirement Exchange Board, which was a meeting that was held weekly looking at the what changes needed to be done to the program and we would then report to that Board what our results and finding were from the System Integration Review. So in the early part, when we had the (inaudible), I think it worked very well.

There were some start up problems and things of that nature, which you would guess, but I think we got most of those worked out. Essentially that's the way the office is working today. It's still there. It's been consolidated considerably from what it was at the time, but today there's still the, Program Integration effort is handled in the (inaudible) office down the hall.

DR. ORVILLE BUTLER: You mentioned that you had smaller contracts – divided contracts, and that that eventually was consolidated?

MR. WARREN WILEY: Correct.

DR. ORVILLE BUTLER: Can you talk about that consolidation process and what were some of the factors that brought it about and how did that affect KSC?

MR. WARREN WILEY: I think the factors that were brought about was that we were trying to find efficiencies within the program, because at the time, budgets were getting smaller, operating costs were still high, is there a way, trying to find a way that we could maybe, reduce these costs. We're under a lot of

pressure, in this time frame, as well. What the general feeling was, was that if you could consolidate all the contracts into one (1), one (1) group.

In other words, rather than have lots of (inaudible) of peice which is at KSC, and orbital peice and others – if you could consolidate all those under one (1) organization, one (1) contractor, one (1) company, you would be able to gain a lot of efficiencies and people, and not having various waive mechanism of reporting. You all kind of bring it together.]

This was actually precipitated, I think very heavily, by the contractor itself. He kept saying that, you know, if you let us do this job, we can save you a considerable amount of money. So there was a lot of pressure to go make this happen.

So, I think a contract was written and I'm not exactly sure of the exact time of when that was written. I'm sure you can find out or you got some people that will talk to you about it, to kind of pull of this together under what they call the Space Flight Operations Contract. It was actually a marriage to some extent between Rockwell and Lockheed Martin.

In the past, Lockheed Martin had the contract here at KSC, and Rockwell still held the orbiter and the Shuttle integration contract, so we were dealing with two (2) independent companies in this. They got the idea of marrying this to try, you know, you'd only have one (1) level of overhead, if you might, would say that you would not have to pay for now, because it's all under this joint corporation type thing. So that's how they thought they could get the costs reduced down.

So a contract was written and Lockheed Martina and Rockwell got together and formed this company called SPC, or USA, I'm sorry. To propose, or I guess, or to not really propose, because it was - it wasn't over competition, because it was felt it was the only – these companies independently might have been able to get (inaudible), but jointly there was nobody else who could really, really, do the job.

We had them come back and give us a proposal for how they would perform this function and how they would manage and so forth. What that did – what had really affected KSC was that since it was a joint proposal, it took the funding line that KSC had control of and moved it to Houston. So now all of the control of the operations here at the Center and the operation elsewhere are controlled out at Houston, as opposed to here, from a funding standpoint.

There was a little bit of money that would come to KSC that would be used for launch site equipment, new designs, maintenance of the systems, but most of the effort still was being controlled at Houston. That took the program manager here at KSC, who was a Shuttle management, where they had a contractor who reported to that, now they didn't have a contractor reporting directly to them. They had to kind of go through JSC to get contract direction and so forth to the contractor here that was performing the operations.

I think that created some issues and some problems and that was probably about the time that I moved on to another job.

DR. ORVILLE BUTLER: It's interesting to look at that because a lot of things happened after Apollo 1, I believe it was, the shifting of contracts and the processing contracts were handling directly out at KSC, rather than at Marshall and.

MR. WARREN WILEY: Yeah, here we were just kind of doing the opposite. Angelo spoke about it one time that things are centralized and then they become decentralized and then it would become more centralized, and I think. Also at that time, or close to that time, the program was controlled in Washington and then they became, they delegated the program back to the field Center, to JSC.

Now there was a change I think after the Challenger accident, where they said Washington ought to be in control as opposed to the field Center and then so Washington had control of the Program. Then somewheres in that time frame it was back to JSC and now after this accident, its coming back to Washington again.

DR. ORVILLE BUTLER: So you think after Columbia it's?

MR. WARREN WILEY: Actually I think was starting to shift before Columbia happened. With a new administrator, he's was pulling more of the control functions, or the program functions, back into the headquarters arena as opposed to leaving them in - with the lead center concept which was what it was in the previous administration.

DR. ORVILLE BUTLER: Okay. Anyway, you had moved on, and in '95 to become Deputy Manager of Launch Integration as opposed to?

MR. WARREN WILEY: Right. That was a consolidation function where we consolidated a lot of the, when one of the guy's retired. When the

substitutes retired, we consolidated some of those functions into one (1) organization, so no longer did I have, you know, it was like one (1) organization, so they moved me, at that time, to become the Deputy of Launch Integration. I believe at that time Lawrence Shriver (phonetic) was here. Had taken over that function and I moved over with Lawrence and became sort of, his Deputy.

DR. ORVILLE BUTLER: So now we've made it up to the S33 – S34 time period, but one (1) of the things you mentioned before that we really hadn't talked about in our pervious interview, but you thought we ought to, was the issue of launch and abort. Why don't you tell me about KSC's role in the launch and managing the various work sites?

MR. WARREN WILEY: Well, KSC has the responsibility for actually executing the launch. Once the vehicle's in the air, the transition moves over to JSC to handle the vehicle when it's in the air. JSC controls the vehicle until it lands and that wheel stops, and that wheel stops, and that's when the transition goes from JSC back to KSC. One of the things, of course we have to concern ourselves with, is aborts. I know that during the Challenger time, or after that particular accident, there was a lot of attention put on abort windows and aborts gaps.

These are areas that the vehicle could fly to or an area that if certain failures were to happen that the vehicle would have to ditch. It could not get to an abort site. We tried to make sure that we had those areas and gaps pretty much covered and we did, I guess with the return to launch site and the three (3) sites that we had overseas at the time. We could cover all the gaps.

In case an engine went out that we could not get to orbit, where would you go, and we had the, early in the phase you had the return to launch site, where the vehicle would actually do a pitch (inaudible) maneuver and try to fly back, actually to the launch site. You know, dropping the tank out over the ocean and then coming in and landing back here.

And then there's the transatlantic abort sites which if it was at a point where you'd just jump over the ocean, if you will, we had several sites over there, I think we had Saragossa, Spain, Marone (phonetic), (inaudible) and there were several others.

DR. ORVILLE BUTLER: Décor? (phonetic)

MR. WARREN WILEY: Yep, Décor (phonetic). Marone I think is in Morocco. Saragossa is in Spain, I guess. We also had sites up the East coast in case they could not get someplace or they could actually divert and fly into an exit like Cherry Point, and another ocean site, I think (inaudible) going up the coast. We always staffed the ones overseas - and staff the ones overseas in case there was a launch or abort into one of those areas.

What we would do is we would send over what we call, GOM's, Ground Operations Managers and send over contractors and people that could man our engines and we actually purchased fire equipment, I think, to put at some of these sites. They go over several weeks before launch and make sure that everything was in readiness before the launch occurred so that if they were called up they would be ready to handle the vehicle.

DR. ORVILLE BUTLER: Now are the sites exclusive for Shuttle use, or were they, at other times, used for other purposes?

MR. WARREN WILEY: There were other times they were used for other purposes. Yeah, I think Saragossa is actually an Air Force Base. I'm not sure about the others, but I think they all are used in sort of, military type aircraft functions. The one in Décor (phonetic) I'm not so sure out there, because that one (1) was in a small country on the east coast of Africa and it didn't appear, I've never been over there, it didn't appear like there was a lot of activity into that area, but probably if that was the only airport into that country it was used for some planes coming in and out.

I don't think the Décor (phonetic) had much of a military force, because it was such a small country. So they were all up and staffed and we ended up before our flight, we would have weather flights over there. They would send astronauts over in some type of aircraft and they would fly profiles and you know, and report back on what the weather conditions were.

That's why we had more than one (1) site, cause we required one (1) site to be it – and if all the sites were bad, we would not fly that day. So we required one (1) of those flights to be good, so we had to have weather operations and weather aircraft over there to certify that the site was acceptable for landing. So they were over there.

That was the same thing we did here. There was always a weather pilot, weather aircraft, that would come in and report on what the winds were, what the conditions were, what the turbulence was. When clouds were out there, he'd go out

and check the clouds out and so forth before we would go out and fly. Make sure that everything was acceptable to proceed in launch.

DR. ORVILLE BUTLER: Were there any times when you came close to an abort?

MR. WARREN WILEY: Once. I guess, and I was actually – for our bridges flight. He flew – they were going uphill and one of the engines indicated a failure and checked out, and he got to a point where - they were at a point where they could make orbit on two (2) engines. Had it shut down earlier they probably would have been in a transatlantic abort, or an abort back to the base, but it had shut down.

They had gotten enough velocity, enough height to where, when the engine shut down, they were able to get to orbit and actually the call was, abort to orbit. I believe went up the line. That inhibited any other engine shut down so they could continue to go fly, until they got to an area that there were very safe and they re-enabled the limits on the engine. I think that was really the only case where we got close.

That was the only (inaudible) shut down that we had on an SSME. It turned out to be an instrumentation problem and not really a problem with the engine.

Just the way the instrumentation logic worked, it resulted in that engine shutting down automatically on its own thinking that the (inaudible) temperatures are too high and actually it was instrumentation failure and the engine was working okay. Be that was it may, it did shut down and that was the only one (1) we've had in flight. The only time we really come close, but I was ready.

I guess we had several aborts before we flew. Okay, these were where the engine would start, and we had a series of logic in the engine that detected – or checked everything to make sure that we lifted off with full (inaudible). I guess for some reason we ended up with a failure before lift off, the engine would shut down. The engine would go into a shut down, before we lit the solid rocket motors. So those used to get pretty interesting.

The engine would actually shut down and now you're sitting there with a hot area beneath the engines, and the tank loaded full of fuel and you really don't know why they shut down, usually right away. I mean it takes a few minutes to get through the data and figure out what had really happened.

There was one (1) and I believe it was on 103, I could have been mistaken, it may have been Challenger. In fact, it might have been Challenger. I think we had the flight on – on one (1) of those flights anyway, and I thought I had a history of when all these aborts occurred and I could identify them, but what I found didn't have that on it. But I'm sure you can find out.

We actually, when I shut the engine down, I remember sitting in the firing room when the engine was shutting down. Kind of watching things, making sure things were working okay, and I remember over the headset, one (1) guy called me and he says, you need to look at your fire detectors, look at the fire detectors. So I called up my supervisor and manager at the time, (inaudible), who I reported to, and then he reported to the other firing room. I was in the back-up firing room.

Asked him if the fire detectors were on and gave him the certain numbers, I think were 34 -35, or 34-37 and I forget what they were now, and he called back to the console in the back they came back and said the fire detectors were on and I said, well, the report came back to me. Did that mean that the fire detectors were on, or are they indicating that they had an alarm condition.

And they came back and said that their indicating that they had an alarm condition and that's when we needed to initiate the (inaudible) to tract through the area because there's obviously a fire underneath the engines. Hydrazine burns are invisible so you can't see it on a screen. You have to go by either fires detectors and so forth.

I remember at the time, we initiated water and the big detectors went off and then we turned the water off and it came back on and we initiated the water for awhile longer. I think we did this two (2) or three (3) times, before it finally got indication that there was no fire left underneath the engines.

We worked to get the pressure off the engines because we thought, because when the engine shut down, you end up locked up the (inaudible) hydrazine and that hydrazine is heating up, and its expanding and we think that's what possibly fed the fire. It turned out to be a main fuel value that leaked. We were just leaking that, and as soon as we got the pressure off, the driving force went away.

So we – this too a number of changes after that, I guess. I think we found that we did not damage the vehicle with water and that was one of the things we were concerned about. We did dampen some heat shields and some pockets that had to be

pulled out and dried. And things we were able to dry out very quickly, so after that when we ever had an abort, water would come out automatically.

We also instituted procedures to get the pressure off automatically, as well. The sequence such as that we would pressure off the vehicle so if there was any leaks it wouldn't dry the leaks, so as to isolate the system. At the same time, we looked at some of the other data and found that there was actually a pretty hot flame going up the side of the vehicle. Somewhere in the neighborhood of a thousand degrees, I believe.

I'm not exactly sure how high it went up, but of course if the astronauts stayed in the vehicle, which is probably the safest place they could have been, but if they had walked out, at the time, I don't know if they would have gotten hurt or not – or injured or not, because we, at the time, we just had sort of an open grading swing arm that went to the through access arm.

After that incident, we went into a number of modifications to the path where we actually decked in and put steel plating down along the egress path and put some water spray along the egress path so that if anything were to happen similar to that again, they would be able to get through that path and be safer than they possibly would have been at that time, had they had to come out of the spacecraft or out of the protective compartment, rapidly. Probably the safest place for 'em was sitting inside that protective group (inaudible).

DR. ORVILLE BUTLER: So what would they do, what would be the procedure of the crew on the pad to abort?

MR. WARREN WILEY: We would keep them there and we would safe the system. Unless there was some reason that the system was degrading, we'd want to keep them inside until we got everything safe'd. Everybody is monitoring their systems very well, and in multiple locations to make sure that there was no danger to them staying in the cabin. Then we would safe the system. We would get into what we call the (inaudible) off load.

I believe we start draining back one (1) of the propellants and then we would ask the crew, give the crew the okay to leave the vehicle and there was people who'd have to go up there, you know, to open the door and hurriedly take them out. The close-out crew would go back up and bring them, get them out and then they would leave the pad and by the time they left the pad, then we could go into the other propellant drain and start draining back the hydrogen.

As long as you had one (1) propellant into a stable flow it was safe to go up there. We would not want to put two (2) propellants into a flow because in case, you could get leaks that could cross mingle and create some more hazards while the crew was there.

If there was a major incident, I guess where things were degrading, the launch conductor could ask them to bail out of their crew and they would go out, across that arm into the baskets and then slide down the baskets through the emergency egress system out into the proximity – out near the pad (inaudible) and there was a bunker in there that they could seek shelter in or they could seek shelter in an armored personnel carrier and drive out in that.

Before every launch we had, what we called, a sort of a count down or terminal countdown demonstration test, and they would practice that procedure.

DR. ORVILLE BUTLER: Very good. Okay, why don't you tell us a little bit about where you are now and what your projects are?

MR. WARREN WILEY: Well, Right now of course, I'm the Associate Director, for what they call Advanced Space Transportation Projects, here at the Center and it was sort of a follow-on from the work that I did on S33 and S34. The Advanced Space Transportation systems are looking at what type technologies and what type systems would be needed sometime in the future that we should kind of, go and develop.

Actually S34, and S33 going on, a new program called Space Launch Initiative, was initiated. It was a large funded program to actually put together a plan for how we might either replace or augment the Shuttle in the future with a new transportation system – fully reusable transportation system.

We went through a number of what we call, STAS studies, or Space Transportation Architecture Studies, where we had in the neighborhood of, I think, five (5) to six (6) contractors that would – were putting together concepts and some cross-figures and, you know and operation models for how they might develop a vehicle. That was weeded down somewheres in the neighborhood of about four (4). We maintained – or five (5), I guess it was five (5). We maintained those for a little while and then we ended going down to three (3) companies. T

Then we opened up a proposal, and we initiated what we call the NASA Research Announcement. The NASA Research Announcement went and solicitated technologies and architectures and then we got proposals in and we evaluated them and ended up selecting a series of projects and programs, I guess, architectures to do further work on. Some of the technology is not there today, so some of these projects were to initiate some new technology about programs.

KSC was given the - delegated essentially, the authority from Marshall to evaluate the operations projects that came in from the companies and select the ones that were the most promising. All those went to a Board, and the Board essentially selected a series of projects. Out of those, we ended up with some propellant specifications contracts. That seemed to be a technology that had promise.

We also did some umbilical, automated umbilical type work, which was a technology that also had some promise. Now that was done primarily in-house with NASA people. We had a couple of range contract – range functions. One (1) was a program called STARSS, which is Space Telemetry And Range Safety System, and NASA (inaudible) Locator was another range project that we had, and then we had some work to do in automated check out.

We had contracts with several companies. We had some in-house things. My job was to essentially manage those contracts as they proceeded, dividing cost schedule and performance information back to the program and making sure that the contractors and our in-house efforts met up to those metrics.

We have since taken some of them to completion. We terminated one (1) for non-performance. The others have now been taken to completion and one (1) project that we still have in the works is the called the STARSS, we actually built hardware and flight demonstrated on a F-15 at Dryden earlier this year. So we had a flight demonstration test that verified that the technology would work, and now we're looking at how we would take that to the next step.

The Propellant Specification Contracts that we had, we took them to completion but they didn't show us as much promise as we thought they would. The task was fairly difficult that they were trying to accomplish. In most of the architectures as we were, that were being followed, didn't require propellant specifications, so therefore, those did not go on into further options.

So we started looking at – and then we did a lot of the work in evaluating the various architectures. We did not have a specific in mind. We were trying to identify requirements, such that the companies would have sort of, a clean sheet and an open sheet to do as an innovative design as they could. This effort was going on and went on really until last Fall. Last Fall there was a change in the SLI contract, where we went and split the SLI program into two (2) programs. One (1) is called the Orbiter Space Plane and the other is called Next Generation Launch Technology.

We put together some plans for how you would implement and (inaudible) a space place, when the program was first getting started. Decided to split that off into a different organization, so there's a new organization that's out there that's run by Shannon Bartel (phonetic) and Rosal Hansen (phonetic), that are doing (inaudible)

space plane and the Next Generation Launch Technologies is actually the program that I certainly have.

What we're looking at today is what technologies do we need to invest in that will get us to the, what may be, the next generation of the launch vehicle. Now that may not be until 2015, or maybe 2020. You know, we're trying to get something that probably will be flyable in 2015, but today we have to invest in some of those technologies, such that we can get the cost and turn around time and some of the other issues that we currently live with today with the Shuttle. See if we can't reduce those life cycle costs and recurrence costs and get it such, that it can fly faster – not fly faster- but fly quicker.

To be more available than the Shuttle is today, so that's sort of, the effort we're in. We've got some reference technologies, reference architectures that we're looking at that we're evaluating the technologies against So, we're looking at developing the concept of operations for those eight (8) or so reference architectures. They vary from vertical take off, horizontal landing, like the Shuttle is today to maybe even a horizontal take off and horizontal landing.

Some use rocket propulsion. Some use, what we call, rocket base – or turbine base cycle propulsion, where you would actually use an air-breather to get started and then would convert over – and so you could use the atmosphere – oxygen in the atmosphere to get your initial thrust, and with that I'd have to carry that (inaudible) and then once you'd get to a point, you'd have to convert over to rocket and then you'd use the oxidizer fuel in the vehicle.

So we're gonna- how those might work – we're looking at several operations technologies. There's thermo protection systems, structures, propulsions, integrated vehicle help monitoring. Trying to pull all those together to come up with some concepts and then look at how we would invest in – with the money that is available – in some of those technologies to bring them to a level that we can put them into a vehicle.

We're also working very closely with the Air Force. The Air Force has established a need for an operationally responsive space lift capability. What their looking at is how you might get replacement of sensors in orbit or replacement of satellites to how you might do recognizance, to how you might even do conventional weapons with our system. There what the Air Force terms, analysis of alternatives, gong on now, which is a fairly large study, where they look at all the alternatives in order to meet this particular mission.

We're providing some effort in looking at the technologies that they would do because their looking at very, very fast response times where NASA is not so interested in response times. They need to get systems up fairly quickly. So we have some effort going on in that area and then there's also a initiative that was run out of the Department of Defense on National Aerospace Initiative.

It had three (3) pillars. One (1) pillar is earth to orbit access. One (1) is in space – propulsion or hyper-sonic propulsion, and then the third one (1) is in space. The hyper-sonic propulsion was funded at a fairly high level.

We are working with the Air Force to try to combine some of the NASA and Air Force activities together because one (1) of us can't go it alone in todays fiscal environment. But is there a way that we can combine and have the Air Force lead some things, and have NASA lead some things and actually combine (inaudible) to lead other things.

Maybe there's a way that we can leverage each others strengths. There is a – we put together a group that looked at kind of a lot of the technologies that would be needed for this, and had a combined meeting with senior Air Force and some senior NASA officials that look at all these technologies, prioritize these technologies and earlier this year we actually came up with a technology plan.

A national technology plan, which is being looked at by leadership, and seeing how they could possibly augment some funding, or if you had some funding this is sort it how it ought to go through and these are some of the higher priority items. We're in the process of maybe revising that effort now and that essentially, pretty much, bring you up to date as to where I am.

Some other functions that I do – there's space architecture effort going on – a space architect, led by Gary Martin. There's an earth orbit arm of – a working group of that. I participate and I invite people to participate in looking at the technologies to actually go do heavy lift vehicles.

So we're starting to look at far off futures, and how you might do exploration and some things of that nature. We're looking at some things that may be further out in the future. That's something, you know, that we're trying to come up

with in space plan. I guess the space architect which, I said is Gary Martin, out at NASA headquarters, will put together based upon the input he gets from several of these teams.

The other thing I sort of do is, I have a senior launch advisor, I guess for the expendable launch vehicle launches. Expendable launch vehicle has a process that they go through where they have several senior -- actually it's the LV Program Manager, the KSC Center Director, NASA headquarters, and they have a guy that's been around for awhile that's seen a lot of launches that can observe the process and make sure that there's no issues being worked, or should be worked, during that process. I support most of the ELV launches in that capacity, as well.

MR. WARREN WILEY: Very good. I'd like to go back and ask, relatively briefly about one of the issues you brought up on Shuttle.

MR. WARREN WILEY: Okay.

DR. ORVILLE BUTLER: And the processing with the Shuttle as it gets older. Can you tell me a little bit about how the processing of the Shuttle has changed because it's an aging craft?

MR. WARREN WILEY: Well, I'm not as close to it as I used to be. I think the processing level has changed. There's a lot more attention that has to be spent to the detail of the parts. These parts in the Shuttle, you know, there are in a very, very, severe environment, and so even though it's designed for a hundred mission life, or whatever, some special inspections, I think, have to be in place looking for things like cracks, wear points, things of that nature.

Also the Shuttle is very difficult to work on. It requires essentially intrusive activities in order to perform the functions getting ready for flight, which means, a lot of people on it, and in it. Walking around on the wiring and you know, we've had problems with wiring, and we're now in the process of doing some special wiring inspections throughout the vehicle.

The tile is aging. I know there's an issue with the reinforced (inaudible) leading edge following the last accident, where they've got to find ways of doing some inspections of those things because the materials may not be as well (inaudible), as we would like to have it. So as it gets older, things are gonna, going to be found, like the cracks that we found in the feed lines, the (inaudible), that were not inspected.

There will be other things that just require some real special attention to looking at the vehicle and doing inspections and the older it gets. I know one (1) time there was a (inaudible) that was called the aging aircraft program that where, that was right out of Langley, maybe we ought to be bringing up some of those lessons into the Shuttle , as well. We may, because the new Langley Safety Center, or the new Safety Center is going to be right on Langley, so that could bring some effort into creating more, I think, efforts.

I believe a lot of the – especially after this accident – where's there's gonna be a lot more attention to the requirements, and there will probably be a lot more requirements that come out of this that require us to go and actually do more work and that being slowing down the processing and to some extent, (inaudible) more to flight as we process with this.

DR. ORVILLE BUTLER: As I see it, the Columbia accident – there wasn't a problem when it was on the ground – the problem was after it was launched.

MR. WARREN WILEY: Right.

DR. ORVILLE BUTLER: So it wasn't something that necessarily processing could have?

MR. WARREN WILEY: No, I don't think processing, in this case, could have saved it. It was some other – it was a design issue that wasn't fully understood. That essentially led to the accident.

DR. ORVILLE BUTLER: Do you think they will develop a capacity to do in-flight repair?

MR. WARREN WILEY: Yes. I think they will. Actually I attended a briefing yesterday where their talking about how they would do this. Because especially on the bottom of the vehicle, it has to be very, very smooth. There's a step and gap measurement that's made between each tile corner to make sure that they fit in there just right. The reason for that, is that you got a laminated flow of boundary layer that the Shuttle when it's entering the atmosphere, as long as that laminated flow boundary layer's there it keeps it, to some extent, cool, relatively speaking.

If you end up, what they call, tripping that boundary layer, then you get a turbulent flow rather than a smooth flow, it gets turbulent and that overheats things. We've had problems in the past with a tile that may have been not installed just right

and tripping, what we call, the boundary layer and has created some hot areas on the wing of the lower surface of the Shuttle. Whenever they go out and do this repair, in the limited capacity that they have, in those EVA suits, they have to find a way to get a smooth repair in the system. There's looking at how they meet (inaudible).

How they're to do the RCC, I'm not sure. If there is a problem with the RCC, we're gonna be very careful on looking at how things might come off it with the (inaudible). I've got a dry throat all of a sudden.

DR. ORVILLE BUTLER: Since last time when we talked, I was skipping along and you were said, hey, there's a significant piece of history that you missed. Are there any other big pieces of history that we haven't covered that you think we ought to?

MR. WARREN WILEY: Well, I can't think of anything right now. We talked about the leak issues. Yeah, that was a piece I think we missed. The aborts and I think there was four (4) or five (5) of them that we had earlier in the program and you know, that has created a lot of new requirements and how you go fix to prevent those things. I remember going up talking to the administrator, who was Jeff (inaudible) at the time. I was asked – I talked to him about engine check-out and engine aborts and I remember him saying that aborts weren't very good for his heart condition.

We have pretty much, I think, resolved those issues, cause we haven't had an abort for some time, there's always that prospect out there lurking. The other is, I thought a little bit about, and you asked very early in the interview last time, was

about the difference between the launch vehicle and the Spacecraft side during Apollo and Skylab and then the Shuttle. I'm not sure I answered that question really well.

I was thinking a little bit about it, but one of the things I found when I was thinking about it, was that in the launch vehicle side, it was sort of, I think I mentioned, was run by the break off of Marshall. It had sort of the German rigor in that style and reporting and movement was through, pretty much, direct lines. You know, an engineer would report to a lead engineer. Lead engineer would report to a section chief and then go up along those lines.

In the spacecraft style, they worked more in teams and where they had a team of people that would kind of work together and they were more matrix, if you will. They would have a – where on the launch vehicle side they was a mechanical section, an electrical section or whatever – and you worked those systems and the spacecraft side had an electrical system, but they would have a project engineer and maybe an electrical guy would work for the project engineer on that particular system.

When we merged, we ended up going with that more matrixed function. I remember some of the launch vehicle people could not accept that. They had a really rough time accepting that philosophy where if I, as a lead engineer, would report to a project engineer, that had responsibility for maybe that particular vehicle as opposed to reporting directly to him – and have him do the reporting back up – if you follow what I'm.

Sort of the chain of command type thing. They had a real tough time, some of them had a real tough time adjusting to that. Others of us, and especially because I was fairly young, and I didn't have a tough time adjusting in that area.

I found it very interesting that when we did make the change and move into the Shuttle that a lot of the people that were working with JSC and Rockwell at Apollo, manned service module, were the leadership essentially, and a lot of those people came over and worked in the Shuttle area.

A lot of the launch vehicle people, you would think would be more involved in getting the vehicle ready to launch went over to the payload processing organization. There is not a lot of people that ended up staying – or moving from one (1) group to another. I was one and there were a couple other people that ended up going into this organization, but it was just kind of a culture change. A culture difference and how the two (2) organizations worked and (inaudible) to overcome. When they merged and some people could not overcome the culture differences.

Just a little piece of trivia.

DR. ORVILLE BUTLER: Are there any other people you really think we really ought to talk to?

MR. WARREN WILEY: Yeah – have you talked with Oris Lambert (phonetic)?

DR. ORVILLE BUTLER: I don't think we have.

MR. WARREN WILEY: He's a retired guy that would have a wealth of history on Apollo and would have a fairly extensive history also on Shuttle.

He's retired, but even though he's retired, he still stays involved. He ended up retiring from NASA and going to Lockheed, but he just has a very large knowledge on all the systems. He retired maybe 10 / 15 years ago. About 10 years ago, I guess. If you could get a hold of him and he would want to talk to you, you'd probably find it pretty interesting talking with him.

I'm trying to think of who else has been here for quite awhile. I thought of some people but I don't know if you talked to them or not. But not many of us, what we call, Apollo leftovers, left.

DR. ORVILLE BUTLER: Well again, we thank you very much for your time, and I appreciate your giving that extra time to us so we can collect your story.

MR. WARREN WILEY: You're very welcome. One guy, I don't if you talked to him – Jim England?

DR. ORVILLE BUTLER: I don't recognize that name.

MR. WARREN WILEY: Jim England is – he's in an office back here. He's been here before my time and is still here. Ray Evans is another one that's been here a long time. He's been here about 40 years and Jim's been here about 40 years or so. Those might be some people to talk with. Larry Schultz (phonetic) is also one that's been here for years. He had come in during the Apollo program, as well. So there's some people.

DR. ORVILLE BUTLER: You mentioned Brewster Shaw, is he still around?

MR. WARREN WILEY: Brewster Shaw was a commander. He flew STS9 with John Young as his - Brewster Shaw was his pilot. He was the commander of, I think two (2) missions after that, and then he came down and took over the launch integration office here when Captain Crippin left the Center, he did work the launch integration manager at the time. And so Brewster took it over, and then when the program was starting to move, I worked with Brewster and with – in that capacity.

Then he went on to become the Program Manager out in Houston and took over the program and then eventually he retired and is working for Boeing now. He is, well, he's vice president – he did have Space Station, but I think the SPC, or USA, they report to him now. I'm not sure, but he's another one – he's a contractor now and I'm not sure you could get a hold of him or not.

DR. ORVILLE BUTLER: I see.

MR. WARREN WILEY: Yeah.

DR. ORVILLE BUTLER: Very good. Well, thanks a lot.

MR. WARREN WILEY: All right, you're welcome.

Thereupon the interview ended.