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"Space Shuttle Program Update on STS-121"

SPEAKERS:

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MIKE LEINBACH, NASA Launch Director

[Moderated by Bruce Buckingham, NASA Public Affairs]

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P R O C E E D I N G S

MR. BUCKINGHAM: Welcome to the Kennedy Space Center for our next Space Shuttle Program Update. We have with us today Wayne Hale, who is the Space Shuttle Program Manager, and Mike Leinbach, who is the NASA Launch Director, and will begin with opening comments from each of these.

Wayne?

MR. HALE: Well, good afternoon. It's always good to be in Florida, and it's a great day when we can come down to the Kennedy Space Center and see the Space Shuttle sitting on a launch pad.

You know, the preparation for a Shuttle launch is an intensely technological thing, but it's also a supremely human thing. We have had so many people work so very long, many long hours to get to this point to have Discovery on the launch pad, thinking about the folks at the Michoud Assembly Facility who have worked extremely hard in very difficult circumstances to provide the external tank and all the folks here in Florida that have assembled the stack, the solid rocket boosters, and on and on and on. Through the mating and the low lap that we had about a week

ago, it has just been a great period of time.

Today, we gathered at the Kennedy Space Center with a large team from all around the agency of folks supporting the Shuttle Program to do another one of what sometimes seems to be an interminable round of reviews to make sure we're ready to go fly. Today's review was a Debris Verification Review. This review is something which is new with Return to Flight, following the Columbia accident. We feel a very strong need to review how well we have done in eliminating the potential for debris to come off the external tank or any other part of the launch vehicle and cause a hazard during the accident phase of flight.

I am pleased to announce that we have gone through that review, and we have found no show-stoppers. We believe we have made significant improvements since last year in the elimination of many of the hazards from foam, but one of the things I don't want to hear when I go home and turn on my TV tonight is that we fixed the tank and no foam is going to come off because that is not the case, and you are going to hear me say this over and over again as we go down to flight. There will continue to be foam come off

the external tank.

What we have done in a very systematic manner is eliminate the largest hazards. Today, we have a tank on the pad that has lost 34 pounds, the largest amount of foam off the tank that we have ever taken off the tank to reduce the hazard. We have put on a special set of sensors, both accelerometers and force measurements on that tank as well as a suite of six new cameras on the solid rocket boosters that will be monitoring the performance of the vehicle during ascent to ensure that we have done our job properly in the removal of that protuberance airload ramp, the reduction of foam, but we do expect to see foam come off, and particularly as we look today, the next largest source of hazard, the 34 brackets on the outside of the tank that hold the piping on the outside of the tank on are covered with a pound and a half to 2 pounds of foam each for another 30 or so pounds of foam.

We know that next on our agenda for following tanks will be the elimination of that foam. We have a team in full court press in the design centers, both back at Marshall Space Flight Center as well as the Michoud, the external tank facility, working toward a design of that

bracketry that will allow it to be flown without foam on it, will keep the ice from forming as well, but without that foam, and subsequent to that, we will work on the next area of concern and eliminate systematically, as we go forward in time, the sources of foam coming off the tank. So that the very last tank we fly, I think will be the very safest tank that we will ever fly, one causing the least source of debris.

Today in our review, we did come to the conclusion that we have an acceptable risk posture to go fly from the debris standpoint. That is a major milestone.

Next week, we will be going to the external tank design certification review, and at that time, we will find out from the structural analysis whether all of the aerodynamic changes have resulted in a situation where the structure will still hold together, as I told you about a week and a half ago. Our preliminary words are good, but we are going to find out the final story next Wednesday at that Design Certification Review, and then in about another 10 days following that, back down here on the 16th and 17th of June, we will have the Flight Readiness Review of the final management review of the preparations for the flight

of STS-121.

We are looking forward to a good flight at the opening of the window on July 1st, and with that, I will hand it over to Mike.

MR. LEINBACH: Okay. Thanks, Wayne.

Well, as Wayne and his senior managers are going through their interminable reviews, we had to process the hardware here at the Kennedy Space Center, and I can tell you, the hardware processing is going extremely well with the vehicle at the launch pad.

Between now and launch on July the 1st, we have almost 2 weeks of contingency in the schedule. As long as I have been in this business, we have never had that amount of contingency, and we built in quite a bit this flow. We were protecting for a tanking test, which we thought we might have to do. It turned out we do not have to do that tanking test. So that fell off our plate and saved us about 5 days or so.

So it is an unusual pad flow with the amount of contingency we have. It is an understood pad flow, and so far everything is going really, really well.

The crew will be here in about 2 weeks for their

terminal countdown demonstration test. That is where we get the crew here, and we get them into the orbiter. It's especially important for them to be here and go through the final preparations for launch. They get suited up and get into the vehicle. It's especially important for the rookies on the team. So we will do that in about 2 weeks, and then we will be ready for picking up launch countdown on the 28th of June.

Meanwhile over in the OPF, Orbiter Processing Facility, the Atlantis' processing is going extremely well also, looking for a roll-out of Atlantis on July the 25th. That is on schedule. That would be for the STS-115 mission or the Launch on Need should a rescue mission become necessary.

So right now, we are in great shape on both vehicles and looking forward to a launch on the 1st.

MR. BUCKINGHAM: Okay. Thanks, Mike.

Okay. Let's take some questions from Kennedy. Then we will go to other centers that I understand also have questions.

So, Bill, you had your hand up, right here, second row.

QUESTIONER: Bill Harwood, CBS.

For Wayne, I remember last year when you had the DVR, there was this risk matrix and where the foam fell out in terms of probable or unlikely. How did that work out in this one? I heard there was a little bit of discussion about how to characterize ice frost ramp foam. Can you maybe give us a sense of how that stands?

MR. HALE: We did go through the review today. We did not baseline the hazard report, which is where you see these little 3-by-4 matrix with the red, yellow, green squares in it.

You know, we had a discussion about 2 weeks ago -- it's been longer than that -- 3 weeks ago that we talked about ice frost ramps. We included the Administrator and the Chief Engineer of the agency, Chief Safety Officer of the agency, and went through all the pros and cons. At the final analysis, the agency concurred with my recommendation, which is that we not change those ice frost ramps.

We think they are a hazard. I want to make that very clear. They are an area of foam insulation that we very definitely need to deal with. The principle that we

have to remember, however, is that in a flight test, you want to make one major change at a time, instrument it, fly it, and see how that performs before you make another major change.

So we are going to fly this flight with a major improvement, the elimination of the PAL ramp, but we know that we have another hazard that we also need to eliminate, and that will be the elimination of the ice frost ramps as quickly as we can come up with a good design option that will eliminate that hazard.

So we put them right at the top of our risk matrix. That's the number-one thing that we have to work on next. We have a whole list. I wish I had a count of a lower risk, but still areas on the tank that we want to continue work on, and we tried to characterize all of those things over the last 2 days and put them in the right place in the hazard matrix.

QUESTIONER: It is not a probability?

MR. HALE: Well, you know, it's an interesting thing. We had -- I wish I had of taken probability in college.

We have discussed probability more in the last 48

hours than I ever really wanted to, and the bottom thing that you come to with probabilities, what were your assumptions.

We looked at the flight history, and if you look at the flight history, we probably don't have much risk. We looked at the causes for the so-called thermal crack cause for foam loss, which caused that big piece of foam to come off the PAL ramp on STS-114, and we tried to apply that to the ice frost ramps. We don't see nearly as many losses of the ice frost ramps from our flight history as the empirical or physics-based model would indicate.

So you run all these things together. You try to decide how many releases there may be on a flight, and you come up with different numbers based on different assumptions.

Basically, this vehicle -- and you can take this to the bank -- is about a one-in-a-hundred vehicle. Okay? That's not a scientific number. If you want a scientific number, it's probably a little different than that, but, you know, it is a risky vehicle to fly, and nobody should mistake that. There are a number of things that can cause bad outcomes on this vehicle.

What we have tried to do is take a very serious look at every one of the areas that we think are high risk and do our best to mitigate those and reduce the risk.

So did that answer your question, or did I just --

QUESTIONER: You totally converted it.

MR. HALE: Okay.

[Laughter.]

MR. BUCKINGHAM: All right. Let's go to Mike Cabbage.

QUESTIONER: Mike Cabbage with the Orlando Sentinel for Wayne.

Is the DVR going to be a standard thing from every Shuttle launch from here on out, and when did you come up with the idea of doing a DVR for this mission? Was it after the shedding that you saw on Discovery last July, or is this something new? Is this going to happen from here on out?

MR. HALE: You know, I think we are probably going to have Debris Verification Reviews periodically. I don't know whether we will do them on a per-mission basis.

Obviously, following the loss of Columbia from

debris, we needed to have a review before STS-114 on how well we had done.

Since on our first flight, the STS-114, we had another unexpected foam loss, we felt the compelling need to have another review to see if we had improved ourselves adequately to launch this time.

We have a number of things that we want to improve in the future. Based on what performance we see out of STS-121, we may or may not have a Debris Verification Review before the next flight, which after all comes only about 8 weeks, a little less, later, but we certainly will have a Debris Verification Review when we make the next big change, which will be the ice frost ramps.

So we will have them periodically, but probably not every flight.

QUESTIONER: I have a follow-up question to that. Looking at the schedule and the way it is unfolding right now, what is your best guess on when you guys might be ready to fly modified ice frost ramp?

MR. HALE: I'm going to hear a story on that in the next few days. The next tank that is coming out from

the factory from Michoud is also coming with unmodified ice frost ramps because currently we don't have a good redesign. The folks are working on that. Whether we can get that on the third tank or the fourth tank is probably the real question, and we are looking very hard to getting a design into the wind tunnels that we can verify will not shed additional pieces or cause other problems.

We have got a series of thermal tests to show that whatever modifications we do will not grow ice which, by the way, is why they have that foam insulation on them.

We probably are going to have an interim solution based on what I have seen with some insulators in between the upper and lower parts of the bracketry followed by a final solution, we think, and again, this is the early thoughts of the design team. A final solution may be in making an entire bracket out of a very low conductivity material. Titanium is a high-strength, low thermal conductivity material. It has been identified.

That final solution probably won't come along for several more tanks, maybe six or eight tanks. So we are probably going to see an interim reduction in most of the foam with a final solution of complete elimination of the

foam around these brackets coming six or eight tanks down the road.

MR. BUCKINGHAM: Let's bring the microphone back over here and go to Jay Barbree, down the aisle, third row.

QUESTIONER: Jay Barbree with NBC.

Wayne, I asked you about this the other day at the roll-out. You're talking about the ice frost ramps, and you get better pictures, I understand, the 2nd, 3rd, or 4th. You are going to visit that on the status 2-week meeting.

How are you leaning? Are you leaning toward going ahead and find -- if everything is ready, if you have no problems, weather is good all on the 1st, are you leaning to go with what you have at that time, or do you feel that the lighting that you will get on the ice frost ramps, it will be more important to take a chance to go farther into the window?

MR. HALE: Good question, Jay. We have had our photo analyst folks looking at the lighting on a day-by-day basis.

One of the big inputs to that analysis is the exact orientation of the tank, and as you know, when we

separate the Shuttle from the external tank, the tank is uncontrolled at that point, and it generally has what we call small tip-off rates or a little bit of roll, a little bit of pitch rate, and the lighting can vary quite a lot based on those very small angular rates that occur right after separation.

Based on what we know today, there is no reason not to launch on July the 1st. That is not an absolute guarantee on any day, quite frankly, in the window, but you might not have some shadows due to these tip-off rates. But we think that the lighting is adequate on July 1st.

We are going to continue to review that data because the exact position you are in depends on where the International Space Station is, and as we get closer to launch, we will get a better prediction of where the International Space Station is and exactly how that affects the launch window and the lighting.

So it is possible we might move a day or so, but right now, I don't think that is going to happen.

QUESTIONER: If everything is ready, weather and all of that, your inclination is to launch?

MR. HALE: Yes.

QUESTIONER: Thank you.

MR. BUCKINGHAM: Okay. Todd, right here, second row.

QUESTIONER: Todd Halberson of Florida Today with two, if I could.

Wayne, how many other areas of the tank still could shed critical debris, and what are they?

MR. HALE: Oh, gosh. I should have brought the whole list. We had a long list.

You know, part of the probability gain is we looked at every piece of foam on the tank, and there are some -- more than 300 -- manually applied areas of foam on the external tank in addition to the robotically applied acreage foam.

We tend to concentrate on those manual applications, but there also was a considerable discussion about that robotically applied acreage foam.

In a lot of these areas, we have never seen foam come off in flight. So one might say, well, you shouldn't worry about it or you don't need to worry about it. However, that was the position that we had earlier on in the program about concerning some of the releases that we

now are very concerned about. So we don't take that as just because we haven't seen it before, you're never going to see it as a good way to fly.

So, when we did probabilities for a lot of these areas which we have never seen foam come off, the statistical guys assumed a foam release, and they assumed a foam release with a mass estimate that came from the external tank team, and they put it at the worst possible time and looked to see if you could transport down. When you do that kind of probability analysis, again, make some of these very severe assumptions, there are many areas on the tank that potentially could cause critical damage.

Then you weight the whole analysis with do we have an understanding of how foam comes off the tank. Yes, we think we know four different potential mechanisms for foam to come off the tank. They have different physical applications. Do any of these apply to one of the areas that could cause potentially bad things to happen if they come off? Well, if so, then we are more worried about it. Does the flight history say that we have ever seen a piece come off in that area? Well, yes, then we're more worried about it. So, if you rack all these things together and

you come up with a prioritized list of, I think, areas of potential improvement to eliminate the potential for debris release, that is going to keep us busy for a long time, and that is why I say that we are on a road for continuous improvement. We are trying to take those in a priority order, eliminate the biggest hazards, and work our way on down.

Let me give you an example. The foam that came off that brought down Columbia was about 1.6 pounds, over a pound and a half of foam. The foam that came off STS-114 that made us stand down these many months to eliminate that hazard was about a 1-pound piece of foam. The largest piece of foam that we've ever seen come off an ice frost ramp is .09 pounds of foam.

Since potentially that is not the biggest piece that could come off, the statistical boys did an analysis for us, and they said you ought to consider that an ice frost ramp could lose up to .2 pounds of foam. So that is what, two or three times bigger? So, if you think about it, .2 pounds is 3 ounces. Okay? It costs you less than a buck to mail that letter down at the post office.

So we are working our way down the list of

potential debris sources to smaller and smaller releases, and we are also looking at the areas where we think they are more likely to release and working our way down the list to the areas where they are least likely to release. So, over time, we will continue to see foam come off, but they will be smaller and smaller pieces, and they will be less and less frequent, and, therefore, the risk and the hazard goes down, and that's the approach we've got to take.

QUESTIONER: A quick follow. I was curious about your rationale for flying with the ice frost ramps. I thin it was STS-112 where you had a foam loss from the bipod that was fairly significant, and the approach at that time was to incrementally and serially attack the problem before you actually had a fix in place, and, of course, STS-107 came along.

What is different now that makes you feel comfortable with the philosophical approach you are taking now with fixing it down the line instead of now?

MR. HALE: Okay. Well, you know, if we had not -- all right. Okay. Let me go one more time. If we had not had to address the PAL ramp, which was a much larger

hazard, then we probably would be working on the ice frost ramp, but, again, the principle here is in a flight test vehicle where you make a major aerodynamic change, the removal of the PAL ramp is the largest aerodynamic change we have made to the Shuttle stack since we started flying it. The principle is to make one change at a time.

We have addressed our biggest hazard. We have removed it. We have provided instrumentation in the cable tray to look at the aerodynamic forces in the brackets after we removed the PAL ramp. We have added cameras to look at how the tank is going to perform. We put all of this instrumentation on it. We need to fly this vehicle to make sure that we did the first change right, the PAL ramp change, and then we can go address subsequent changes.

The other difference I think between now and then is then we had no idea why foam was coming off the tank, and now we have several years of very hard work in the laboratory and with the tank that we brought down here and tank twice, took back to the factory, and have literally dissected the foam on that tank to understand the mechanisms for foam to come off the tank. We have a much better understanding of the mechanisms for foam release.

We were in the dark then. We may not be perfectly in the light now, but we certainly know a whole lot more than we did and can make a much better educated estimate of a risk than we did then.

MR. BUCKINGHAM: Okay. Let's take a couple more questions here. Then we are going to go to some of the other centers.

Stefano?

QUESTIONER: Stefano Coledan, Time Magazine and Popular Science.

I have two quick questions. I heard that there are potential electrical problems in one or both boosters. So this is a question for, I assume, Mr. Leinbach.

And for Mr. Hale, what is the material that the conduit, the electrical conduit coming down the tank is made of? What is the material?

MR. HALE: The actual electrical conductor?

QUESTIONER: The cable tray.

MR. HALE: The cable tray. Okay. I'm sorry. You switched gears. I was about to give you the cable tray on the solid rocket boosters, which is aluminum.

The cable tray on the external tank is aluminum,

but it is covered with what they call "super lightweight ablator," SLA insulation to keep it from overheating and hold it together during the reentry of the tank at certain altitude.

MR. LEINBACH: Okay. And on the electrical problem of the solid rocket booster, it is only on the left-hand side. I would characterize it as a minor problem at this point in time. It is a standard problem report that we pick up during processing.

What we saw was a switch from one of our three main buses, the power feeds to the booster itself. Friday night switched from Bus B to Bus C, and internal to the integrated electronics assembly, there is logic that protects against faults, and so the box worked exactly as it should, switched to the back-up bus, and we are out there troubleshooting right now. The guys literally are at the pad right now troubleshooting the problem. I don't see this as a big issue at all. It is a problem report. We will have it resolved as soon as we can.

We are holding as a constraint the booster power-up because we don't want to power-up the solid rocket booster with an unknown electrical problem. So, to me, it

is a standard processing issue that we will work our way through. It is no big deal.

MR. BUCKINGHAM: Okay. Thank you.

Let's take one more question from Mike, and then we will go to Headquarters for some questions there.

QUESTIONER: Hi. Mike Schneider, Associated Press.

I was just wondering if you could go into a few more details about the debris verification review, meetings like how many people, talk, how many presentations there were, and were there any dissenting voices who disagreed that the risk was acceptable?

MR. HALE: Well, I am pleased to report that we have a lot of dissenting voices.

[Laughter.]

MR. HALE: We had a very -- "contentious" is not the right word -- "spirited" may be the right word -- discussion.

I think that Ralph Roe of the NASA Engineering and Safety Center provided us a lot of very good thoughts.

We had a number of folks that were interested in making sure we had good rationale at every step along the

way.

This review, I am trying to think. It is in our new building over here, the OSB II, a beautiful place to have a meeting. We probably had over a hundred engineers from around the agency here today that had been working in a variety of areas from the Kennedy Space Center, Marshall Space Flight Center, Johnson Space Center, folks from Langley, and other places around the agency. I know we had some Headquarters folks. So we had a quite eclectic group that was very interested in getting down to the nitty gritty details of the engineering.

It is interesting to me, the engineers, as averse to the English language as they are, were very concerned about the exact words that we put in the report to make sure we captured our concerns and testing and results properly. So it was quite an exciting time for the last 2 days.

MR. BUCKINGHAM: Okay. Thank you, and I do understand we have questions at Headquarters. So, at this time, let's transition to Headquarters and take your questions, please.

QUESTIONER: Warren Leary, New York Times, for

Wayne.

You mentioned the continued work on modifications for the ice frost ramp. Does this mean you are going to have a lot more wind tunnel testing, how much more, and where will it be done?

MR. HALE: Good question. Yes, we will be testing new proposed changes to ice frost ramp brackets and any residual foam that is needed around those brackets. I would expect that work will take place in probably the Glenn Research Center tunnels as well as probably the Arnold Engineering Tunnels up at Tullahoma. There is a potential we may do some of that work at the Ames Research Center as well.

The wind tunnels around the agency have been used quite extensively in this pursuit of improving the external tank. I expect we will continue to use them extensively, and there will probably be multiple tunnels looking at different aspects of the design.

There are even a couple of small tunnels -- well, not small tunnels, but a couple of tunnels at Langley as well as what they call a "hot gas facility" at Marshall that will be involved in doing testing. That is in

addition to what we call the "cryogenic testing," which is not a w individual tunnel, but it demonstrates how well our design does in not forming ice, in other words, insulating from the cryogenic fluid inside the tank to this metal bracketry that hangs out in this nice warm humid Florida air that we have down here.

QUESTIONER: Tracy Watson, USA Today, and forgive me if you covered this in the first few minutes. I was a little bit late.

Can you remind me which part of the TPS is of concern for foam from the ice frost ramp? Is it RCC? Is it tile?

And also, Mr. Hale, if you wouldn't mind, I would love to get the range of estimates of probable damage from those ice frost ramps. You said that the numbers depend on the assumptions, and if you could tell me what kind of range you came up with, that would be great.

Thanks.

MR. HALE: Okay. Let me see. The principal area of concern is with tile damage. We looked at the size of the releases that come off the ice frost ramp and the debris transport, that is to say, the aerodynamics, and

they don't pose much of a threat, if any, to the reinforced carbon wing leading edge.

The tile, however, further back on the vehicle and depending on which ice frost ramp you are concerned about can be damaged in ways that might require repair or certainly would not allow it to have a full capability for entry. Again, we are very conservative on that. If you get a certain size damage for the purposes of this review, we call it "unacceptable." Whether or not, in fact, we could fly home with that is the subject of a really intense set of analysis that would have to be done.

In terms of numbers, I have been through so many numbers in the last day and a half. I'm having trouble remembering. The number that sticks in my head, there are a couple of numbers that stick in my head, and I hope I've got these for the right case. With the very worst-case assumptions, there were some numbers down as low as 1 in 75, and for some of the better case assumptions, we are talking about numbers on the order of 1 in 400 for ice frost ramp foam losses potential, but I think all of those -- and I hope I am not saying this wrong because, again, we have been through so many numbers, and I didn't bring the

whole package with me. Some of those assumed we had a release, which is not always the case, as you know.

So, again, I hate to quote probability numbers without the context because it depends so much on what the assumptions were and how conservative or how fine the calculations were that went into the case, but we are talking, you know, basically -- I don't want to throw out a whole bunch of numbers, but we are talking basically something on the order of 1 in a few hundred or 1 in 100, which is consistent with the entire overall risk we fly with the Space Shuttle.

MR. BUCKINGHAM: Okay. Thank you.

I understand we have got questions now from Johnson Space Center. So let's take those questions at this time.

QUESTIONER: Thanks. Mark Carreau from the Houston Chronicle. I have a couple of questions, and they are both for Wayne Hale, and I will go one at a time.

Tell us what you expect to see in terms of launch debris. I mean, if you could sort of spin this into a positive -- well, an affirmative description, do you expect to see less debris overall than you saw in 114 or simply

smaller pieces, but the same amount of debris?

MR. HALE: Well, we expect absolutely to see less debris than we saw in 114. In terms of the debris, we have eliminated the PAL ramp. So I don't expect to see any 1-pound pieces of foam coming off.

I would expect to see foam losses in the less-than-a-tenth-pound range, several of those. We saw about four on the feed-line camera that we saw at STS-114. Given that we will have now seven cameras instead of the one, I expect we might see seven times as many in that small range.

When we look at the photography that is taken post external tank separation -- and that is kind of the final analysis, how did that tank do all the way through the launch phase -- we can see hundreds, and I am not off base here. It is hundreds of little white splotches, and whether that means what we call "popcorn" or a little bit of foam that eroded away that is clearly not a hazard or whether it is something that we would call a "debris release," you know, we are going to see a lot more of that on these cameras.

That doesn't mean that our hazard is worse. That

just means we are going to have a better view of it.

So I expect that we will see, you know, on the order of a dozen -- I will go out on a limb here -- small, less-than-a-tenth-of-a-pound pieces of foam come off. Those will probably be very visible in the cameras that we will get.

We will still get the one live camera view from the liquid oxygen line camera. The other six cameras on the solid rocket boosters, they have to get the boosters back in port, and we pull the recorder out, and we will release those about 4 days after launch, 3 or 4 days after launch.

So I expect we will see quite a lot, and no one should go home saying that we are not going to see any foam come off the tank. We have seen popcorn come off the inner-tank region quite a bit, and that we have done -- we expect that will continue to happen, and we do expect to see small pieces come off the ice frost ramp.

I would be very surprised to see a large piece, and that is kind of the purpose of this test flight is to see what we've got.

QUESTIONER: I had a follow-up question. Is

there a point in terms of mission elapse time into the lift-off where you are really in a vacuum, you are out of the impact sort of danger point? At what point do you calculate that to be, if you have that?

MR. HALE: Well, you know, interestingly enough, Mark, we had a long discussion about that today.

Going into STS-114, we had said that 2 minutes and 15 minutes, 135 seconds into flight, was the end of the period at which we were concerned about aerodynamic transport. The air pressure at that stage is -- you're up about 200,000 feet. There isn't much air up there.

Our analysis folks went off and said, "Well, if you released a 1-pound piece of foam, when would you no longer have enough air to worry about it causing a collision hazard with the orbiter?," and they came up with 166 seconds.

My discussion with them or the discussion that occurred today is we really don't expect to see a 1-pound piece of foam come off. If we did, I would be worried about it anytime. So I am still stuck on 135 seconds, although the engineering analysts are trying to talk us into 166 seconds, and I don't remember the exact air

pressure at 166 seconds, but I do remember saying it was four times lower than the almost nothing that you've got at 200,000 feet. So that is considerably lower air pressure than you probably have in Houston today, Mark.

QUESTIONER: Gina Sunseri, ABC News, for Wayne.

Wayne, you said there are no show-stoppers, but what are the hurdles that are still ahead before we reach July 1st?

MR. HALE: Well, let's see. We've got a number of processing things, and I'm sure Mike could give you a long list. We are going to load the hypergolic propellants for the reaction control system. There's still a number of electrical checks and vehicle check-outs to do. So, I mean, there's a list. There is a standard list of those kind of things that all have to work properly before we go to launch.

In terms of the management reviews, again, I would say the big items is the -- what we call the "Design Certification Review" for the external tank that we are going to have next Wednesday. Actually, that is the final management summary next Wednesday. It has already started, and the important step there is to verify that the

structural analysis folks can demonstrate with the new aerodynamic loads that the structure of the tank still maintains its safety margins and is safe to fly. That is a must-pass thing.

There may be there are other items at the Design Certification Review that we are going to look at very carefully that could cause problems if the analysis and engineering review is not as we expect it to be. Then we have the Flight Readiness Review where we go over all of the things that have transported, all of the anomalies that have been open since last week, including those that occurred during flight, to make sure that we have done all of our work properly, the design testing, the construction of the particular piece parts on this vehicle, the new things we have done on the orbiter, the changes we have made there, everything from windows on down. All of those reviews have to go properly.

Again, I foresee no show-stoppers, but there is a lot of work that has got to be done in the next month to make sure that we are safe to go fly.

MR. BUCKINGHAM: Okay. Thank you.

We do have some questions from Marshall. So

let's go there next, and we will wrap them up.

[No response.]

MR. BUCKINGHAM: Okay. Not hearing anything from Marshall. All right. Shall we go to questions from Headquarters then? I think we have a couple of extra questions there, and then we will come back here to Kennedy.

[No response.]

MR. BUCKINGHAM: All right. Well, I'll tell you what we'll --

QUESTIONER: Guy Gugliotta from The Washington Post for either Wayne or Mike.

I see you have 2 weeks of contingency. Have you or could you reconsider having a tanking test, and if not, why not?

MR. HALE: Do you want to take that?

MR. LEINBACH: I will be glad to take that one.

We decided over a month ago, probably 6 weeks or so ago, not to do a tanking test, and so at that time, we stopped all activities leading toward the tanking test. We put the procedure development on hold. The team is not preparing for a tanking test. We have no requirements for

one. So to do one now before launch is impossible, I would say. So we are not planning on a tanking test anymore. There is no reason to do one.

MR. HALE: Filling up the shuttle tank is not like running to your local gas station and hooking up the hose. It's a little more complicated.

QUESTIONER: I am the U.S. correspondent of the German [inaudible].

I am interested in the time table for the launch of the Columbus Space Lab which is the European part for the ISS. The Columbus launch is scheduled as the seventh or eighth flight from now for autumn 2007, and I would be interested in how opportunistic you are that you can keep to the time table because I understand that every setback in the Space Shuttle Program would also affect the launch of the Columbus Space Lab and this 880 million European taxpayers' euros.

MR. HALE: I was extremely pleased to see the arrival of the carrier aircraft yesterday with the Columbus module. I think there is going to be a ceremony here Friday welcoming it into the Space Shuttle -- Space Station Processing Facility. We are anxious to come to the day

when we launch that magnificent laboratory to become part of the International Space Station.

I personally am very optimistic we will launch the Columbus module on the date that you mentioned. We have looked out into the future of our production schedule, for external tanks, and other things that we need, like solid rocket motors, and barring any huge unforeseen problem, I see no reason why we would not be able to launch that exactly as we have scheduled. There seems to be plenty of time to allow for the normal -- I call them "normal" -- the minor day-to-day kind of things that we run into. We have plenty of contingency. So I think that launch will proceed exactly as we have scheduled it.

MR. BUCKINGHAM: Okay. Thank you.

I do think we are going to go back and try at Marshall one more time. So let's take the questions from Marshall, and then we will come back to Kennedy.

QUESTIONER: Good afternoon, gentlemen. Liz Hurley, WASS in Huntsville.

This question is for Mike. Mike, tell us. You said you've got guys out there on the launch pad trying to troubleshoot the booster problem right now. Give us a

timeline on when you expect them to come to some resolution. Will it impact your timeline at all?

And, Wayne, tell us about your redesign on the ice pods as far as the Marshall Space Flight engineers. You said you haven't gotten a good design yet. How far along are they with that redesign?

MR. LEINBACH: Okay. I'll go first.

The guys are out there right now. Our plan says we will give them tonight to troubleshoot. They have some, what we call, "break-out boxes" on the electrical system to send very, very small-current message signals through the system to try to isolate the fault, wherever it may be. So we will give them a couple more shifts, maybe a day to do that.

We do want to get into our hypergolic loading for the orbiter side, and that is planned to pick up tomorrow. So, if we can't isolate the problem tonight, we are going to probably decide to go into a hypergolic loading tomorrow on the orbiter. That is about a 2-day job, and during those 2 days, then, the electrical guys from the booster side would be able to look at their data in more detail and try to come up with the follow-on troubleshooting plan that

we would enact over the weekend, and so with the contingency we have, I really don't see this as an issue for us. We may rearrange a little bit of our schedule.

As I said, it is a constraint, the booster power-up, that is our B power-up, and, therefore, we don't want to load the hypergolics on board the booster, but we have plenty of time to get into that later in the pad flow.

So we may rearrange a little it. I can't give you a timeline, not knowing what the problem is. I can't tell you how long it is going to take to fix, but trust me, the guys are out there, and we have got the best in the world working on it right now.

MR. HALE: Let me talk about the redesign of the ice frost bracketry or, I should say, the protuberance bracketry that are covered with the ice frost ramps for just a second.

We have a really excellent team at the Marshall Space Flight Center who is working very diligently on that.

We had a preliminary design which we took in the wind tunnel about a month, 6 weeks ago. Unfortunately, that design did not stand up to the aerodynamic forces that those foam areas would see during launch, and they

continued, despite repeated modifications to shed small pieces of foam, exactly what we don't want to have happen in the wind tunnel.

We have now shifted gears to designs that eliminate foam wherever possible by using other kinds of insulating materials in them, in between the metal parts, and the folks there at Marshall have been working with their cryogenic facility to ensure that we can build a design that won't grow ice. When we have that design finalized -- and I think they are very close -- we will go back into the wind tunnels.

Wind tunnels are difficult to schedule because there are a lot of competing folks that like to do their work or need to do their work in the few wind tunnels that this Nation has. We are talking about supersonic wind tunnels, and so we are working our way back into that queue, and we expect to be back in the tunnels, testing those new improved designs, in the next 6 to 8 weeks, and following that, we will have a good -- I presume we will have a good series of outcomes and have a good design that we can then go implement in the factory.

So I am very pleased with the hard work that has

gone on in Huntsville, Alabama.

MR. BUCKINGHAM: Do we have more questions from Marshall?

QUESTIONER: Yes. Patricia McCarter with the Huntsville Times.

Assuming all goes well with STS-121, do you still expect to have three Shuttle launches this year?

MR. HALE: I've got a very, very good answer to that: Yes.

MR. BUCKINGHAM: All right. Well, that is last question from Marshall. So let's bring it back here to Kennedy, and we will take a handful more questions here.

Irene, you haven't had a question yet. Let's go with you.

QUESTIONER: Thanks.

Wayne, I'd like to know if you have some ball-park, current Return to Flight cost?

MR. HALE: You know, that's one I didn't come with.

You know, there is Return to Flight Part One, and now we've got Return to Flight Part Two. Most of our Return to Flight Part Two, which is STS-114 to the present,

has been concentrated with the external tank, and as a matter of fact, we have had quite a large expenditure down in New Orleans with the factory from hurricane damage, and we would have to split all of that out.

So the short answer is I don't have a good cost estimate for you on all this redesign work because it is wrapped up in the hurricane response as well, but we will go do some research and see if we can.

That's a good question, and I should have had an answer for you, Irene.

QUESTIONER: Also related to that, what kind of flexibility do you have in budget and in schedule if you need a third test flight or something doesn't go exactly as planned on this mission?

MR. HALE: In terms of a third test flight, we have already said we would like to get a third flight in daylight conditions to make sure we still know what's going on with the foam.

There really isn't a cost delta associated with a third test flight, and the only schedule constraint is really the lighting.

If we get ourselves off in August, September, or

even into October, we have good lighting windows for that. So I really don't see much problem making -- I hesitate to call it a "third test flight," although that's effectively what it will be, to see how well we've done on the foam.

One of the things that we have yet ahead of us to talk about is when we roll out the new bracket design for the first time, the improvements to the ice frost ramp, do we need to see those in daylight, and we haven't had that discussion yet to see how they perform. That is a discussion that we will have ahead of us, and I think that may wind up being next spring.

MR. BUCKINGHAM: Let's see. Let's take it to the front row, right here, try to get it around to folks who haven't had a question yet, and then we will go around to others.

QUESTIONER: Yes. Just wondering, foam work aside, ice work aside, how would you characterize the work that has happened on the in-flight repair techniques, and how comfortable would you be in the event of -- obviously, it would have to be fairly minor damage, but being able to use what is going to be flying on this mission and be able to fly home on it?

MR. HALE: You know, we've had really a full court press on in-flight repair.

If you think about what the heat shield does, first of all, it has got to way almost nothing because it is big, and every tile weighs a quarter pound, something like that. It is a very light, very lightweight material. Mostly, it's nothing. It's got a little bit of fiber and mostly nothing in between as an insulator, and it stands up to 2,500, 2,800 degrees for half an hour. There are not many materials in the world that can do that. So it is 2,800 degrees on one side and cool to the touch on the other side. You know, my oven doesn't even do that.

[Laughter.]

MR. HALE: So, to say that we are going to now go out in the vacuum of space where it alternates between 250 degrees above zero to 250 degrees below zero every 90 minutes and there is no gravity to kind of get stuff into a depression or something, you know, it is almost impossible to think about repairing that material.

I am pleased to report that we have four repair techniques that have not certification-level capability, but some good engineering basis in thinking that they will

work, and we are putting forward work for improvements as well. So it's not a great capability. We have had people working on it very hard for the past 3-1/2 years, and they have really beaten the bushes and worked very, very, very hard to give us the maximum capability that you can get.

We are going to continue to work on repair capability for the life of the Shuttle program, and, you know, in a way, it's a little sad because this reusable surface insulation that we use in the orbiter, fabulous stuff, does not have a home in the future program. Some day, no doubt, we will come back to reusable thermal protection systems, and the work we are doing today will pay off for that generation as well, but right now we are just working to get ourselves as much capability as we can have for the life of the Shuttle Program, and perhaps it will lead to greater things later on as well.

MR. BUCKINGHAM: Thank you.

Jay?

QUESTIONER: Mike, the way things are right now, you are expecting to roll out Atlantis on July 25th, have it ready for an August 28th launch. If you had to use it on a rescue mission, where you are now in the flow -- say

anything, if you had to go to the Station or not to the Station, you lose propulsion, any need -- how fast could you get it off the ground on an emergency, on a rescue mission, if something goes wrong with this launch?

MR. LEINBACH: That's a good question.

Our processing flow in the OPF is really based on mission processing, and it turns out that the capability the International Space Station has to support our crew in the event of a rescue says that we can stay on that processing schedule in the OPF. We can roll out on July the 25th, whether it's for STS-115 or for a rescue mission. So our plan in the OPF on paper right now doesn't change.

If we did run into a problem with launch of STS-121, we would very much look at our processing flow in the OPT and see if we could speed it up.

The capability on the International Space Station says we don't have to do that. So we would probably stay on the same schedule, get out to the launch pad per plan on August the 1st, but then our pad flow changes. We would launch in about 18 days for the rescue mission as opposed to 28 days for the STS-115 mission itself. So we get off the pad about 10 days earlier for the rescue than we do for

the mission.

QUESTIONER: [Inaudible.]

MR. LEINBACH: We can probably get out the OPF faster than July 25th, but that is a very unusual case you are proposing. I can't even go down that road.

MR. HALE: If you are talking about a crew needing to be rescued that is not at the International Space Station, that would be a very dire circumstance indeed, and I don't think we have the capability to launch a rescue mission within the lifetime of a crippled Shuttle independent of the International Space Station.

QUESTIONER: [Inaudible.]

MR. HALE: Yes.

MR. LEINBACH: Yes.

MR. BUCKINGHAM: We are running a little short of time. Let's take one more question. Then we will have to wrap it up.

QUESTIONER: For Wayne, with two quick ones I'll try to squeeze in before you wrap.

Can you look ahead to the Flight 116 and how the tank stands for getting 115 off the ground with the Launch on Need mission? You said earlier, I guess, you had to

take a week out of that flow or something to make that happen.

And to go back to the probability, I'm not trying to beat that to death because I don't understand probabilities either, but did you guys do that this time and that's not something you want to present to us, or did you not make one of those matrixes that categorizes where these threat levels are?

MR. HALE: Well, okay. Let me be real quick. We did not baseline. As a matter of fact, we went the guys back to do quite a bit of work on the matrix. So it is not ready for us to sign off, much less release, today.

We did come to a really good understanding, but there are a number of things that they needed to do. One of the things that we wanted them to do was to show the worst case on this threat. They had broken every potential hazard into how does it affect the wing leading edge, RCC, how does it affect average or acreage tile, how does it affect the special tile that we have around the door seals, and we said, okay, we don't need three different X's, if you want to think about it on this matrix. We want one at the worst, you know, what the worst affect is.

So they've got to go do that. We have had three or four other, I would call, smaller organizational kind of things that we want to do differently. So it is not ready for sign-off. They are going to come back in about 2 weeks to our program control board for what we call "baselining" of that hazard report. At that time, it is in the public venue, and we say this is what we got.

And your other question?

QUESTIONER: 116 and the tank.

MR. HALE: Oh, 116 and the tank. Yes. We do -- you know, before the accident, tank production was never a pacing factor in Shuttle flights. I mean, the tank -- tanks were growing out of the assembly line in plenty of time. We were always more concerned about getting the orbiters turned around or other things, as pacing item and the launch rate.

Following the accident and a better understanding of how critical the foam is and the amount of hand-touch labor that has got to go into making that foam right, so that it stays on that tank as best as possible, has made the external tank the pacing item, quite frankly, in our launch rate.

So we are continuing to look at the processes down at Michoud to see how we might streamline them. Clearly, the pendulum has gone all the way over to taking the maximum amount of care on every little thing. Some of the questions we have to ask, are there some areas on the tank, perhaps on the side away from the Orbiter, where we don't have to take quite so much care, not that you want to do a sloppy job by any stretch of the imagination, but perhaps does not require the length of time that we are putting in on the side that faces the orbiter.

So we are right now pressed to get that third tank delivered to the schedule. We have about a week that we need to take out of their proposed delivery schedule, and the folks are looking very hard at what they can do either by reviewing some of the processes, reviewing some of the facility work that has gone on around the tanks, or bringing in more people to help. So there is a number of ways to get back that week or so before December, and we've got a good management challenge in place to try to make that happen, but if there is going to be a management challenge -- and quite frankly, tank production is going to be the pacing item for Shuttle launches through the end of

the program. So we are going to continue to give a lot.

They went from being the -- probably "operating in obscurity" is not the right word, but close to that, to being in the limelight every day, and I think most of the external tank people would tell you, they prefer the obscurity. But they are definitely in the spotlight, and we visit with them very frequently.

You know, I am very proud of what they are doing because they are working with materials that were never intended to be structurally sound for six times the speed of sound, and they are making it work, and that is just an amazing thing.

MR. BUCKINGHAM: Okay. We will have to make that the last question, and as always, thank you for your participation. Thanks.

[End of Space Shuttle Program Update on STS-121.]

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