SPACE SHUTTLE PROGRAM STATUS BRIEFING

SPEAKER:

WAYNE HALE, Manager, Space Shuttle Program

4:00 p.m. through 5:00 p.m., EST
Tuesday, March 14, 2006

Johnson Space Center

[TRANSCRIPT PREPARED FROM A WEBCAST RECORDING.]
MODERATOR: Good afternoon, everybody. Welcome to the Johnson Space Center and this update on the progress toward launch of Discovery on the STS-121 mission.

Joining us today is the program manager for the Space Shuttle program. That is Wayne Hale. He will give you all the details and update on the preparations ongoing, and then we will take questions from NASA centers.

We also have a phone bridge, and we will take as many calls as we can, questions from that, as we have time allotted. We do have to finish this briefing by the top of the hour at the latest. So we may not get to everybody, but I can assure you that you will get the information.

And with that, I will turn it over to Wayne.

MR. HALE: Thanks, Kyle.

Good afternoon, everybody. Thank you for being here.

We had an interesting set of names over the last couple of days and have made some decisions just today, about 2:00 this afternoon, that we thought would be good to share with you.

We have been watching a problem, as you know,
with our low-level sensors, what we call our "engine
cut-off sensors," go by the acronym ECO sensors, in the
external tank.

If you will recall from last summer, we had a
couple of problems which caused us a great deal of wonder
about what was going on with the system that tells you when
you are about to run out of fuel and the liquid hydrogen
tank, the external tank.

We kicked off a large investigation after the
events last summer. The NASA Engineering and Safety Center
participated very heavily in this investigation, as did the
external tank project at Marshall Space Flight Center
Engineering, and during the course of this investigation
over the last several months, they found that there may be
a problem in manufacturing some of these sensors. That
problem is in the way the wires are attached to these
low-level sensors.

And you are going to pardon me because I am going
to go low down into the technical here, and we will come
back at the higher level in just a minute.

There is a place that the wires attach to the
sensor. It is called a swage fitting. That swage fitting
in some sensors that have been removed sometime back in the history of the program has been noted to be a little loose, and that has caused intermittent readings of varying resistance in the sensor which, of course, is how the sensor tells you whether it is reading a dry or a wet signal.

Last year, when we prepared to launch STS-114, we had a high degree of confidence that the sensors would only fail, if they were to fail, in the wet reading condition.

After a lot of work, there is now some body of evidence that would indicate it is possible -- [audio break].

[Audio break: 15 seconds.]

MR. HALE: [In progress] -- moderately hard decisions and only bring me the very few decisions that remain. So we had, as you might expect, quite an interesting debate, pros and cons, looked at every possible way around this and finally concluded that it was far smarter for us to be conservative and take the safe route and replace the sensors that are in the tank.

That will take us about 3 weeks of work, and that, of course, will move us out of the May launch window for STS-121. So today, we are proposing that
no-earlier-than launch date, the earliest possible launch date, would be July 1st which is based on lighting.

    We, in fact, will be ready we think with the vehicle before July 1st, but we are dedicated to launching in the daylight so we can watch what happens to the internal tank and the rest of the flight vehicle during the daylight for at least two more flights, STS-121 and the subsequent STS-115. So we are aiming now for July the 1st.

    The team has been working very hard. We have worked folks, particularly those folks at the Michoud Assembly Facility that had been preparing the tank very diligently and very hard to get to potential to launch in May. We wish it had have worked out differently, but it is, of course, first and foremost that we fly safely. We want to have a good attempt when we fly in July or whatever date it is, and so it was prudent to change the sensors out and take the time to do this work.

    We did discover this reading shortly before the tank was shipped from Michoud, and we did have a discussion about whether it would be advisable to replace those sensors at the factory. Due to the fact that those sensors are most easily changed from the tanks in the vertical
position, it was generally agreed at that time that if change-out were required, it would be better to do that at the Kennedy Space Center where the tank is in the vertical position in its check-out cell in the vehicle assembly building rather than to do that at Michoud. Of course, the engineering work was still in debate for sometime until we made the decision today.

The folks that will be doing the work are workers from the factory, Lockheed-Martin's factory at Michoud, coming from New Orleans. They will be traveling to the Kennedy Space Center where they will be entering the tank from the bottom. There is a large manhole cover on the bottom of the tank. They will remove the foam insulation, remove a number of bolts to take the metal parts apart, and then they can enter.

There are plenty of work platforms in the area. The access is quite good, going to the tank, removing the sensors, and replacing them with new and, I would say, much better screen sensors, so that we will not have the potential of having this same problem to the best of our ability on new sensors, newly manufactured sensors, and then backing out of the tank, closing it back up,
reapplying the insulation to the bottom of the tank.

    All standard processes using standard tools will be done by the people that normally do this work at the factory at Michoud.

    We hope to take the four sensors that we will take out of the external tank and put them in extensive tests. We want to see if the one sensor that has got the slightly elevated resistance reading really has this problem that the engineering tests say could potentially have, and then, of course, we will look at the other three sensors which were manufactured about the same time in the same facility.

    We have a number of these sensors and tanks that are still slated to fly. The sensor in question was made 10 years ago in 1996 and passed all its acceptance tests and, in fact, appears to have shifted in its reading not this time when it was transported to the Kennedy Space Center, but when it was transferred last summer before STS-114 to the Kennedy Space Center.

    Let's see. What else can I say?

    We are all very optimistic that we will be able to wrap up the rest of our work. You know we have a number
of other challenges ahead of us that we are going to be
tight on the schedule to get done to support a May window.
This additional 6 weeks that we will now have should
provide us plenty of time to wrap up our work on the
aerodynamics looking at the airflow over the tank after
removing a lot of foam in the protuberance airload ramp
area, and I think we will be in good shape to look forward
to a launch about the 1st of July. The folks are off
evaluating at my direction this afternoon.

Subsequent launches, I really don't have anything
to say about that other than I remain optimistic we will
still be able to get three missions in this year, but I
don't have the details on where we will fly the next two
missions, later in the fall I'm sure, and we will have
those data for you in another week or so, I think.

So, with that, I guess I am ready for questions.

MODERATOR: Okay. Let's limit it to one question
apiece, please, and I will get to as many people as I can.

And I'm not choked up about everything you said,
by the way.

We'll start with Craig.

QUESTIONER: Craig Cavault, Aviation Week.
Wayne, what is the increased process rigor, inspection rigor that will be put in place, and were there any pre-Columbia mission sensors that flew that had this, even the subtle characteristic that documentation has turned up?

MR. HALE: Indeed, we looked at the entire family of sensors that were made in that calendar year. There was, we think, some concerns with the device that makes this electrical swage connection, that have subsequently been corrected.

Out of the about-400 sensors that were manufactured in that calendar year, there were 10 or 11 that were removed during the build-up, after they had been accepted, after the sensors themselves had been accepted, but during the build-up of the tanks that were removed, some of those did show a loose swage connection.

We also flew at least two sensors in that group of family of course, few them a couple of years later in the 1999 time frame, that did, in fact, show small changes in resistance that operated perfectly normally.

So what we have here is an indicator. It is not a guarantee. It is entirely possible we could pull the
sensor out and it will be perfectly fine, but we think we have enough of an indicator that says we ought to go take a really hard look at this and make sure that we have got a really good set of cut-off sensors because, after all that is a critical function, and we want to be safe when we fly.

MODERATOR: Go ahead, Guy.


Is this a design flaw, Wayne, or is this something that happens to particular sensors in a particular lot?

MR. HALE: I would say that it is hard to characterize. I would say that this particular way to make electrical connections is a difficult operation, and so there is some talk of potentially changing the design.

I would also tell you that these sensors, or sensors that are manufactured in the same way by the same folks, are used in a variety of programs. They were used on the Saturn launch vehicles. They were used in the Delta, some of the Delta launch vehicles, some of the other expendable rockets. So this technology is not a really new technology. It has been robust over the years, but again, it shows the level to which we take safety in this program
to make sure that we are going to fly with a good set of sensors.

MODERATOR: Do you have a question, Laura?

QUESTIONER: Yeah. Laura Rotely [ph] from KTLK TV.

Wayne, could you explain why the decision to push back the May launch date -- it is such a painstaking decision -- and why that is so hard for you guys?

MR. HALE: Well, again, the decision that we made today was not based on schedule. Let me make that very clear.

The decision that was difficult for us was because the evidence is not black and white. There are indications in some engineering tests that indicate we have got a concern on the one hand versus the fact that you have to go into the tank. You have to open it up, take the pressure seals apart, take the insulation off, go inside of that tank, change electrical connections, and then back out and button everything up. There are certain risks involved that you could damage the tank and so on and so forth.

So, when you look at it as a risk, what do we know about the sensors and what is the risk there versus
the risk, what do we know about the work to change the
sensors out and what is the risk there, and we made the
decision based on the relative risk, quite frankly, of
those two operations, and then the schedule fell out where
it was. So this was not a discussion about schedule. This
was a discussion about safety, and we came down on the side
of doing what is right to make sure we have a pristine tank
and we will be ready to go fly safely when that tank is
ready to go fly, as we do with all our equipment.

MODERATOR: Irene, and then Mark.

QUESTIONER: Hi. Irene Klotz with Reuters.

Wayne, where do things stand on the wind tunnel
tests with the foam? Have you learned anything yet?

And also, do you know the name of that
manufacturer of the ECO sensors?

MR. HALE: You know, I should have gotten the
name of the manufacturer before I came over here.

We had a discussion last year, and there's a
couple of companies that have the same or similar name, and
I don't want to put the wrong name out. So let us make
sure we get the right name.

I want to also hasten to add that this is not a
shortcoming on the manufacturer's part. This is a
precision part, and in any normal kind of industry, the
failure rate would clearly be well within what consumer
electronics or anything would allow. This is a very
reliable part, and we believe that, if anything, the
manufacturer has improved the process over the years, and
they are making them better now than they were in years
before. So don't take the long message from this
discussion.

MODERATOR: Wind tunnel.

MR. HALE: Wind tunnel tests. Thanks.

Changing gears a little bit, you know, one of the
things that we have done to improve safety with the
external tank is to remove about 40 pounds of foam off the
outside in the protuberance airload ramp area. Those wind
deflectors on the outside of the tank protected the cable
tray and pressurization line that runs up the outside of
the tank.

We have started the wind tunnel tests. We have
got wind tunnel tests running specifically at Ames Research
Center and the Glenn Research Center. The Glenn Research
Center wind tunnel has a 50-percent-scale model of a small
portion of the tank, and the Ames Research Center has got a 3-percent-scale model of the entire Shuttle launch vehicle, and both of those tests are in progress.

The Ames tunnel went supersonic for us just the other day. The results are coming in, and the engineers are poring over them. I would tell you there is one thing certain about wind tunnel tests is that the data have to be interpreted.

The early results, I don't have a very good handle on, but they are proceeding, and the engineers are looking at the data, and I expect to get a report shortly on some of the preliminary data, but the good news is we got the models fabricated. We are in the wind tunnels. The wind tunnels are operating, and we are gathering the data we need to make a good determination of the safety of the new design.

MODERATOR: Mark.

QUESTIONER: Mark Carreau from the Houston Chronicle.

I have a question about how the sensors work in concert with the flight controls. If you could just sort of explain the main mechanism that shuts off the main
engines is not the sensors, as I remember, it is more of a
backup mode, or could you just sort of explain the critical
nature of this hardware?

MR. HALE: Well, just like in your car, you don't
want to run it until it runs out of gas. That's not a good
thing. So you would like to get where you want to go
before the tank is completely empty.

So the normal planning for a mission allows us to
achieve the right orbital conditions -- altitude, speed,
direction of travel -- without running out of propellant.
In fact, we load extra fuel on board to make sure that even
if we have small variations in the performance of the
vehicle during launch, a small reserve is there to make
sure that we get to that point in the sky, without running
out of gas. As a result, when we jettison the tank, we
always throw away some amount of liquid hydrogen and liquid
oxygen which comes in with the tank and is disposed of in
the Indian or Pacific Ocean.

The sensors are there in case we have some kind
of performance problem, which we have had twice in the
history of the program. The first kind of thing that can
happen to you is if you have an inadvertent or a premature
shutdown of one of the main engines, then the other two
gengines have to work longer and use more gas to get where
you want to go.

We had that occur to us way back before -- well, it was in 1985 -- STS-51F. I very clearly remember that flight had some problems with the different -- totally different kind of set of sensors that monitors the performance of the engines and erroneous shut the engines down. It shut one of the engines down based on some erroneous sensor data. The engine was perfectly fine.

We have since gone to a great deal of effort to improve those sensors, by the way, but because of that, we did run out of gas before we reached the orbital altitude that we wanted, and the sensors were there to shut the engines down safely.

The second flight that we had an occurrence on was STS-93, the delivery of the Chandra Space Telescope to orbit, back in 1999. If you will recall, we had a problem where we had a little hydrogen link at the cooling tubes of the engine, plus a couple of other things that happened, the short that caused us to disqualify half-an-engine controller. So we had some shifts in performance and came
up just a little bit short, just a fraction of a second
short of where we wanted to be in terms of engine burn
time.

In both cases, the sensors, through the on-board
computers, correctly told us that the tank was dry, we were
out of fuel, and we should shut the engines down. You like
to shut the engines down with just a little bit of gas left
in the lines to make sure that those pumps that pump the
fuel and that brought the hydrogen and the oxygen into the
engines don't cavitate as they spend down. That is not
good for the engines, and it can lead to a number of
problems.

So we have in place these sensors on both the
fuel side and the oxygen side to let us know before the
engines actually don't have any gas left -- the tank may be
empty, but while there is still gas literally in the line
-- to shut the engines down so that it is a safe shutdown.
That is what they are there for.

And there is quite an elaborate logic scheme to
make sure you do it at the right time and not at the wrong
time, and a quad-redundant, there is four of these sensors,
they vote to get that indication.
MODERATOR: Okay. Let's go to the Kennedy Space Center in Florida for questions there.

QUESTIONER: This is Kevin Oliver from WOTV in Orlando.

Wayne, could you just run through some of the risks you have run by going into the tank while it is here at the space center?

MR. HALE: You know, the principal risk that we run by going into the tank is the risk of hardware damage to the tank that would make a more different kind of repair, say on the seal around the manhole cover, something like that, that would cause a schedule risk.

Whenever you put a person inside the tank, they are in a confined space, and there is clearly a hazard there, and they have got to be provided with breathing air and closely monitored. Folks will be going up on scaffolding. That is also a personnel hazard. It is something they do in the normal course of business both at the Kennedy Space Center and at the Michoud Assembly Facility, but at any time you do that kind of work, you take certain kinds of risk.

The kind of risk that I want to tell you we are
not taking is a flight risk because we think that anything that might not turn out in this repair or wouldn't be detectible by us before we close out the tank. So that when we go to fly, it will be a good tank.

So, really, what we are looking at are two sorts of risks, damage to the hardware that could take us longer to fix than we anticipate -- we think that's very low -- and then the personnel hazards, as I described, which we have a large amount of safety processes in place to keep from hurting anybody.

MODERATOR: Todd.

QUESTIONER: Todd Halverson of Florida Today, for Wayne obviously.

Are the sensors on the 119 tank from the same manufacturing lot as the sensors that were on the ET-120, and is there any reason you guys didn't swap out the sensors in ET-119 after the trouble cropped up on STS-114, or were new sensors not available? I am trying to get a sense of your decision-making process on this.

MR. HALE: Well, the sensors are not made in lots. So we are looking at calendar years at this point of when the sensors were manufactured.
Again, there are some tooling things that were going on in the 1995-6 time frame that have put a little shadow on the sensors that were manufactured then. So the sensors that are in ET-120 that you will recall we tanked twice and sent back to the factory as well as the sensors in ET-121 that we used for the mission last July and the sensors that are in this tank that we now have at the Kennedy Space Center that we are planning to use for the next flight, as well as other tanks, we have those sensors, and they're common in these tanks.

What we have learned in the year -- well, 8 months since we flew is a better understanding of how these sensors work, and the indication that a small shift in resistance could be indicating that we might have a problem with the sensor.

We don't have any of those shifts in resistance indicated on the next tank that we've got. We don't have any shifts in resistance indicated on three of the four sensors in the current tank.

Then, in fact, I should tell you that on ET-120, where we did have some erroneous reading from the system -- now, remember, it's not just the sensor. There's wires and
connectors, and then you get to the orbiter side, there's more wires and connectors, and finally, you get to this electronics box that tries to make sense out of the resistance reading. We still do not have a good and complete resolution to what caused the problem that we saw with ET-120.

Now, I will tell you that we are in planning to go in the ET-120, which is currently back at the Michoud Assembly Facility, and pull out those sensors and look at them. Clearly, something happened during our tanking test with that tank that caused the sensor on the first tanking test to read erroneously, and when I say sensor, I should say sensor system. Again, as we don't know where in that chain the erroneous reading occurred, we want to pull those sensors out of the tank and look at them very closely.

Right now, they don't show any resistance changes from when they were manufactured. So, again, we have a suspicion and some body of evidence, and we would like to get clear of that, but we are going to be removing those sensors and looking at them over the next couple of weeks as well.

MODERATOR: Okay. We are done with KSC.
Now we have the phone bridge, and this is similar to a normal media telecon that we would do if we weren't on NASA TV. So star-6 mutes, and star-6 un-mutes your phone. We will go through as quickly as we can. I doubt we will get to everybody, but we will start with Warren Leary. Hopefully, Warren, you are on the line.


Wayne, other than waiting for the wind tunnel results on the foam, what does the extra time give you in terms of other preparations for this flight, what you will be able to do, let's say, at a more leisurely pace than you would have going from a --

MR. HALE: Well, there are clearly other engineering topics under investigation. They will be in their investigation. Every time we go fly, this will give us a chance to get a little further down the road on some of those topics.

We have been interested in changing out some of the outer window panes on the orbiters. This is going to give us a chance to do some of that work.

As you know, we have been removing and replacing
gap fillers between the tiles on the orbiter. This will allow us time to do even more of those if we determine that is necessary.

There are any number of aging aircraft issues that we have tests in progress that we think are going to turn out in our favor, but we will certainly keep an eye on any of them.

There is always a challenge in the space business trying to keep up with all of the technical things that you would like to do. There are proposed improvements in the system, we will continue to look at. Six weeks is not a long time to make a huge number of improvements, but if one of those comes along that we can make, we certainly will.

MODERATOR: Dan Billow.

[No response.]

MODERATOR: How about Bill Harwood?

[No response.]

MODERATOR: Let's see. Tariq Malik, are you on?

QUESTIONER: Yes, I'm here. Thank you. Tariq Malik, Space.com and Spacenews.

Wayne, I was just, you know, curious. You mentioned that you have plenty of time available towards
having to get these other things out of the way and have the orbiter ready to fly in July. I guess, is there a break then in that time? I mean, will you have an extra week kind of in that schedule to get stuff finished? Is there even 2 weeks, I guess, in that 6-week period? What is your projection there?

MR. HALE: Well, you know, we were racing very hard to get to the mid-May launch period, and this extra 6 weeks, obviously the folks working on the tank will be continuing to work, but I would expect it would allow us to slacken the pace in other areas, perhaps not work overtime that we were intending to work, perhaps allow us to take some weekend days off that we were planning to work. All of that is under assessment at the Kennedy Space Center.

MODERATOR: Let's see. Chad Murray, are you on the line?

[No response.]

MODERATOR: How about Ned Potter?

[No response.]

MODERATOR: How about Mike Cabbage?

QUESTIONER: I'm here.

MODERATOR: Okay.
QUESTIONER: Wayne, I wanted to follow up on one of your earlier answers. Do you see no relationship between the problem that you found here with the manufacturing issue and the anomalies that happened last year during the tanking test and the countdown, or is there some way they could be interrelated?

There is a second part be-real-quick question. What is your latest on what the July window is, from when to when?

MODERATOR: Well, let's see. The July window extends from July the 1st through July the 19th. There may be a day or so on either end of that, depending on the orbital altitude of the Space Station and how that affects lighting, but I think today's calculation is July 1st through the 19th.

You know, the jury is still out. I would not tell you we have conclusively proven that this swage connector issue is what caused the problems last summer. There are a number of potential areas that we identified in the fault tree that could still have caused those problems.

We have been planning a full systems test where we take an end-to-end system and put it on a laboratory
bench -- that is everything, the wires, the connectors, the point sensor box, the sensors themselves -- and subject it to some laboratory testing. We may yet do that.

I think a lot is going to depend on what we see on these sensors that we pull out of the tank that is in Florida now and the tank that we had the problem on last spring and have back at the manufacturer.

We have been concentrating, I might add, on that ET-120 tank that is back at Michoud on the foam applications, and so we have put a lower priority on the engine cut-off sensor, but it has been on the list of things to do. As I said, we always can come up with more tests to run, and we will get to those in due time.

MODERATOR: How about Mike Snyder with the Associated Press?

QUESTIONER: Hi, Wayne.

How does this decision affect what will happen to Discovery's robotic arm? Will it be replaced or repaired?

And then also if you could just talk about the schedule for the rest of the year. I guess the next two opportunities are still going to be August and November?

MR. HALE: Well, let's talk about the arm a
little bit. You know, we had an unfortunate incident that caused some damage to the robot arm that is on Discovery. We have, I think, already pulled that arm off. If not, it will be in the next couple of days, but I believe it is off already and back in the shop there in the VAB to be looked at.

We determined that the best way to fix that arm is to take the graphite epoxy boom section out and replace it with a new one. That process takes a couple to 3 weeks. We have the arm that was taken off Endeavour which is in depot-level maintenance that we can put back on.

The interesting thing about the arm that was damaged was we had special instrumentation for some tests that we wanted to run on Discovery's next flight. They were not mandatory tests, nor is the instrumentation mandatory. They are improvements, nice to have, cut down on the uncertainty of the test results. So, preliminarily, we thought we would use Endeavour's arm and go fly with that arm.

Now, given a few more weeks, we are going to take a look at the schedule, and it may be that the repaired arm that came off Discovery and has the special instrumentation
may, in fact, go back on Discovery, and that work obviously is being thought about right now -- we have got a lot of folks looking at schedules in various areas -- and how best to make use of our time.

MODERATOR: Let's see. Jay Barbree, are you on the line?

[No response.]

MODERATOR: How about Kelly Young

[No response.]

MODERATOR: How about Bruce Nichols?

QUESTIONER: I'm here, but I have no questions.

Thanks.

MODERATOR: Thanks, Bruce.

Jeff Morris with Aerospace Daily, are you on?

[No response.]

MODERATOR: How about Mark Kirkman?

QUESTIONER: Yeah, I'm on. Can you hear me?

MODERATOR: Sure can.


Wayne, some of us were late getting to the phones and have had trouble. Are you going to stick with
four-of-four, the criteria with regard to the sensors, and also, what is the status of the two STS issues we discussed a week or so ago of the pre-valve screen and the seals, to maybe go in and take care of those?

Thanks.

MR. HALE: Thanks.

Well, let's see. There are three or four questions there. The pre-valve screen cleaning is still under discussion. That has not come back to the program management for resolution.

There were a number of tests being run. You know, all these issues, if you find a problem, you go do some testing or some analysis and come back, and we will either do or not do additional work based on that, and I would say that is a very similar kind of discussion, but we will make that based on the risk versus risk of going into the aft end of the vehicle and opening up that complex set of plumbing that we've got for the main engine system versus the risk of whatever small particle impact might cause us there. So that story hasn't come back to us.

The engine seal story is coming together. We have replaced a couple more seals, and we believe we have
got good seals in two out of the three engines. They are still looking at, I think, one or two final seals in the first engine that was installed. It is not leaking, but they didn't measure the seals in exactly the right place. So there is some discussion about going ahead and changing those out to make sure that all our seals meet their dimensional requirements.

We checked those joints at normal ambient temperature, but those pipes carry cryogenic fluid, and it causes considerable thermal expansion and contraction, really contraction in those areas, and so there is quite a bit an art of doing the analysis to make sure that just because it doesn't leak at room temperature, it won't leak at cryogenic temperature. And I think we are about to wrap that up. There may be one or two more seals left, but if we need to, we will change those out, and if not, we will fly with what we've got because they are not leaking right now.

There was another part to your question. I'm not sure I remember what it was.

MODERATOR: Four --

QUESTIONER: Four --
MR. HALE: Oh, the launch commit criteria. You know, we had a long discussion about the requirement for four of four of these sensors.

In the early days of the program, in the design phase actually of the program, there was recognized that you really need three sensors. You need two fault tolerance and a critical piece of avionics. So, if two of them were to fail and you still need to function to work, you have to have three. I mean, that is the basic mathematics of redundancy in the Shuttle world.

And they also at that time recognized that perhaps the system and not just the sensor, but the whole system, might not have the reliability that they really wanted. So they put four in, thinking you only needed three, and in the early days of the program, we had a launch commit criteria that said three of four sensors was good to fly with. In other words, you could have a failure during the countdown and still proceed to launch.

Sometime in the 1986-87 time frame, an analysis was performed that found a commonality in the power, so that you could blow a fuse and lose a particular power circuit in the Space Shuttle orbiter that would take out
two of the sensors, and all of a sudden, you no longer have a quad-redundant, but you have a system that really is not as robust as you would like. So they changed the launch commit criteria requirement in those days to four of four, and it has been there ever since.

During the down time after Columbia, we approved the wiring change to go back and rectify that, so we no longer have a common power circuit that single failure can take out two sensors, and ever since then, we have been in discussions about "Is three of four okay to go back to?"

For STS-114, Discovery's last flight, we agreed to a three-of-four criteria in a very limited set of cases, only the hydrogen sensors, only one of the sensors that we had previously felt we had problems with, and only if it failed in the wet reading direction.

The discussion today with the new engineering data, we think that the sensors might actually have the potential to fail in the dry sensor reading. That puts a whole new framework to the discussion.

We don't think we are quite as tolerant to dry failures as we are to wet failures. So we have instituted that launch commit criteria change on the last flight only
for that flight in only for a very specific small set of cases.

We never instituted a generic, any three out of four, any way, go fly. We don't have any change to the four-of-four launch commit criteria currently in place for the next flight. Based on what we are learning, we are going to go off and talk about that again, so we understand where we should be on launch day, but as of right now, it is still four of four.

That is a long answer to kind of a short question. I'm sorry.

MODERATOR: Let's see. Jeff Morris, did I already call? How about Justin Ray?

[No response.]

MODERATOR: USA Today?

[No response.]

MODERATOR: How about Nancy Holland?

[No response.]

MODERATOR: How about Allen Boyle with MSNBC?

QUESTIONER: Here I am. Can you hear me?

MODERATOR: Yes, sir.

QUESTIONER: Wayne, I wanted to double check on a
couple of questions, if you don't mind. One would be the
procedure, just to recap the procedure for changing out the
sensors. Do you have to take the tank to a horizontal
position inside the VAB?

And then the other, you made a reference to this
mission and the next mission. Now, if both of those
missions might be test missions, does that mean that the
construction mission goal will be changed or delayed?

MR. HALE: Well, okay. Let's start first with
the question. The actual change-out of the sensors will be
done while the tank is in the vertical, hanging up in the
vehicle assembly building as it is now in what we call the
check-out cell. However, in putting the foam back on the
bottom of the tank, it is preferred that that is in a
horizontal position.

So, after we get done with the inside of the tank
and have the new cover bolted back on, they will actually
pick the tank up and put it on the transporter in the
transfer aisle in the middle of the VAB and apply the foam,
and at that point when they are done with the foam work,
the insulation work, they will pick the tank up from the
transporter and take it right over to the integration cell
which is where the solid rocket boosters are waiting for
the tank to arrive, and after that, of course, the orbiter
comes.

Okay. I am having trouble remembering two
questions.

MODERATOR: The second is the mission after this
upcoming one.

MR. HALE: Yes. It's not a test mission, per se.
In fact, STS-115, which will fly later in the fall, will
be a construction mission, but we are going to carry the
next solar array up to the International Space Station as
the current manifested cargo.

But what I did say is we do want to have a
daylight launch to, one more time, look at particularly the
performance of the tank, really the entire vehicle, but
particularly the performance of the tank in the daylight to
make sure we have two good launches with no significant --
and we are going to have some small foam losses, but no
significant foam losses that we should worry about. So we
would really like to get to daylight opportunities.

I am sure we will have a discussion based on what
we see after 121. We have got some new cameras. There are
a large number of folks that believe that it is possible we
could launch after dark because the brilliant light that is
generated by the solid rocket boosters should illuminate
the tank from below, and these new cameras are at a lower
position looking up. That remains to be seen.

Right now, we have said we would like to have
daylight for both STS-121, the next flight, and the flight
following that, STS-115. It is not in any other respect, I
think, a test mission. STS-115 will be an assembly flight.

MODERATOR: Let's see. Pat Duggins with NPR, are
you on?

[No response.]

MODERATOR: I hear somebody breathing. Who is
breathing, since I don't have you on the list? I don't
have a breather.

[Laughter.]

MODERATOR: Let's see. Chris Dolmetsch, are you
on, with Bloomberg?

QUESTIONER: I am, indeed. Can you hear me?

MODERATOR: Yes, sir.

QUESTIONER: Okay. I guess, you know, my only
question, this may have addressed earlier, Wayne, but I was
just wondering do you think with the schedule you have that
the Administrator had thought it was possible to get in
three flights this year, or do you think that is possible
at all?

MR. HALE: Well, I do think it is possible. We
need to go work on the schedule a little bit and see how
quickly we can get the vehicles turned around, but I
definitely would not take that off the table at this point.
I still think it is entirely possible we could get there
Shuttle flights in this calendar year.

MODERATOR: Let's see. Jim Oberg, are you on?
[No response.]

MODERATOR: Okay. I'm running out of people
here. Let's see. Fannie Carter with AFP, are you on?
[No response.]

MODERATOR: Okay. Is there somebody on that I
called on or have not called on?

QUESTIONER: Can you hear me? I'm Nell Boyce
[ph].

MODERATOR: Yes, ma'am. Go ahead.

QUESTIONER: Yeah. Hi. Thanks.

Could you describe a little more the different
type of failure you all now feel that the sensor could
cause? You talked about errors in the wet versus dry
situations, but I am not entirely clear on what this means
in terms of a different type of danger that it could cause
the Shuttle in case of malfunction.

MR. HALE: Well, let's see. There's a couple of
ways I could take that question.

The way these sensors work, it is a ceramic
square, hollow square, that has a platinum sensor wires
zigzagged across it. I think we showed a lot of pictures
last year. I'm sorry I didn't bring a show-and-tell with
me today. We can certainly dig some of those out.

The platinum wire, the very thin hair-like
platinum wire is very sensitive to temperature changes. It
changes the resistance in that wire.

When the wire is dumped in a cryogenic fluid,
liquid hydrogen or liquid oxygen, the resistance in the
wire gets very low.

When the fluid no longer covers that wire and the
temperature starts going up, the resistance starts going
up. So there is an electronics box that looks at
resistance and interprets whether or not the sensor is dry
or wet.

There were very clever when they designed this box sometime ago -- and I think the circuit design actually is an Apollo-Saturn-Heritage circuit design -- that says, however, if we know it is an open circuit, if there is extremely high resistance, it is not just dry, it is an open circuit, we are going to declare that sensor wet because wet failures are more benign.

In other words, we are not likely, as I described to you earlier, to run out of gas. We have put in extra propellant. We have designed our flight, so that we have more hydrogen and oxygen in the tank than we really need to achieve orbit, and so we are unlikely to get to the point that you need to cut off the engine. So, if a sensor is going to fail, if it fails to the wet state, that is probably benign.

If you had multiple sensors fail to the wet state, of course, you would lose the protection that you would like to have because they vote for shutdown.

If they fail to the dry state, that is an indicator to the on-board computer software that we ought to shut the engines down.
So there is less a requirement, I guess you'd say it, in that you could be flying along perfectly fine, and if a number of these sensors failed to the dry state, it would shut the engines off early, prematurely, which is not a good thing in space flight.

So, from the potential to cause problems, obviously you want to shut the engines down if you are running out of gas, but you don't want to shut the engines down early if you are not running out of gas. It's kind of either way, you can get in trouble.

It is more benign to have a wet failure than a dry failure when you do the logic analysis, but neither failure is really what you want. We would like to have four really good sensors, wires that connect the sensors, back to the orbiter, connectors all the way down those wires, a point-sensor box that interprets that.

We would like to have a good system when we go fly, and when you get right down to it, that is why we are going to change these sensors out, as to have the very best shot at having a very good system -- can't say perfect because nothing is ever perfect, but as close to perfect as we can get before we go fly because this is what we call
"Criticality One," life-or-death kind of situation that you want those sensors to work properly, either way. They can prevent bad things from happening if they work properly, and certainly, if they work badly, they can cause bad things to happen. So we need to have a good set.

MODERATOR: Okay. I have time for one more. Is Dave Waters on the line from Channel 13 down in Florida?

[No response.]

MODERATOR: Okay. One last chance. Is there somebody that I called on that wasn't on or that I didn't call on?

[No response.]

MODERATOR: Okay. It sounds like we got everybody in that we needed to. It's all the time we have. So I appreciate everybody coming and participating. Have a nice evening. Thanks.

[End of Space Shuttle Program Status Briefing.]