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Interviews of Gulfstream Personnel (June 2011)

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UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*	
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AIRPLANE ACCIDENT	*	
ROSWELL, NEW MEXICO	*	Docket No.: CEN11MA258
N652GD	*	
	*	

Interview of: SHELLEY BRIMMEIER

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Thursday,
June 16, 2011

The above-captioned matter convened, pursuant to notice, at 8:20 a.m.

BEFORE: MITCHELL GALLO
Accident Investigator

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I N D E X

I N T E R V I E W

(8:20 a.m.)

MR. GALLO: On the record.

INTERVIEW OF SHELLEY BRIMMEIER

BY MR. GALLO:

Q. Well, Shelley, thank you for joining us. The purpose of the investigation that we have today is just for safety purposes. There's no regulatory action that we're pursuing. And I just want to start out by getting your title within the organization, what your responsibilities are.

A. My name is Shelley Bremmeier. And I am an aircraft performance group head. My role on the G650 program was the performance focal, so the lead performance engineer on the project.

Q. How long have you been working at Gulfstream?

A. Ten years now.

Q. What other projects have you worked on?

A. I have worked on various projects throughout the Gulfstream fleet, including the 550 certification program, the 450 and special missions aircraft.

Q. Do you work on specific areas such as avionics or stall qualities?

A. Specifically aircraft performance, which includes the takeoff climb, cruise, descent and landing and some additional phases of flight, emergency descent, analysis, things like that.

Basically, how the aircraft flies.

Q. When did you become assigned to the 650 program; was it when the takeoff performance test plan was developed or were you working on some other aspect of the 650 program?

A. I've been working on the 650 program since the early development phase right after the project came out of preliminary design. So since January of 2006.

Q. And within the test team, did you have a certain title for the takeoff performance, like coordinator? I know there are different titles but was there one that was assigned to you?

A. No, as far as the test goes, we were support. Essentially, we will receive the data at the end of the test.

Q. And going to Flight 153, the people that you had in a briefing, did they have certain titles, like coordinator, and who was the conductor?

A. I'm not sure that it was --

MR. REMICK: So there's two briefings, so do you want to start with the afternoon or the evening?

MR. GALLO: We're going to go with the preflight briefing on 153.

MS. BRIMMEIER: Where we reviewed the test cards?

BY MR. GALLO:

Q. Correct. Can you just go by who attended that briefing?

A. Okay. To be honest, I'm not sure that there are specific titles for each of those persons but their roles are

clearly defined. The people that attended were: Reece Ollenberg, flight test engineer, and he was the lead for that test; Dave McCollum, who was a support flight test engineer; Cynthia Townsend, who is also a flight test engineer; Kent Crenshaw, pilot, and he was the pilot-in-command; and Vivan Ragusa, also flight test pilot; and then myself as a performance engineer; and Eric Upton as a performance engineer.

Q. There's an engineering brief and there's a preflight brief. So those were the participants in the preflight brief?

A. Correct.

Q. I'm trying to get to understand whose role, what everybody's role was. So who was the test conductor then?

A. Reece Ollenberg was the test conductor on the aircraft. I guess you would say that there was another test conductor. That would have been Cynthia Townsend, who was the test conductor for the telemetry trailer.

Q. And then would it be Reece that headed off the preflight briefing?

A. Yes, he ran through and led the brief.

Q. And then did Reece also lead the brief for the engineering brief then?

A. He did but that ended up being essentially more of a discussion so it became a back and forth of the entire participants.

Q. Okay. Can you tell me what was discussed in the brief

during the engineering brief?

A. During the engineering brief, we were proposing some slight changes to our continuous takeoff technique. Specifically, the engine-out takeoffs. Those are what we were targeting. But essentially laying out one technique to apply for all engine takeoffs and single engine takeoffs.

And that consisted of talking about the different kind of pull forces that we would request the pilots to pull. Before, we were requesting, you know, a very strong 75-pound pull force and we decided to change the rate to more of a ramping to 60 pounds, 65 pounds of column force versus a strong pull immediately to 75 pounds.

We had also talked about wanting to target different pitch attitudes. So instead of targeting 10 degrees for a flaps 10 -- it was 10 degrees for a flaps 20; and 10 degrees -- 11 degrees for flaps --

Q. You can refer to your notes if you want.

A. I can't remember exactly what that was. But we essentially wanted one target pitch attitude which would be 9 to 10 degrees basically because of accuracy. We knew that the pilots couldn't go straight to only 9 degrees, so we said, you know, a 9- to 10-degree pitch, I believe.

Let me see if I can find that. Yeah, a 9-degree pitch attitude with an overshoot of .01 degree essentially up to 10 degrees. And that was for consistency across both flap settings

because prior to that we were targeting, you know, different increments.

Q. And as far as the amount of pull force that was set, why did you choose that value?

A. Well, essentially that was -- I believe that came out of the testing that the pilots -- I should say Vivan Ragusa and Reece had done in the ITF, the Integrated Test Facility, which is an aircraft simulator, on the ground aircraft simulation. It's a nonmoving simulator.

Basically, it was pilot feedback that I'm interpreting where that came from. And then when we were testing that day, there were comments about, did that feel good? Yes, it felt okay. You know, Kent replied, yes, it felt okay.

Q. And then the establishment of the target pitch, how was that established?

A. Again, I was not involved in those conversations. I basically, you know, heard it in the brief that we had, the afternoon brief prior to the 153 preflight brief.

But that basically came about because we didn't want to overshoot our pitch angles and in basically laying out a repeatable test technique, that's what a couple of the performance engineers, including Pat Connor, Reece Ollenberg, flight test engineer, and then I think Ken Obenchain (ph.) was also involved in this discussion. He was also a flight test engineer as well.

DR. BRAMBLE: Can I ask real quick, that was for

establishing the 75 pound and the 60 pound?

MR. GALLO: Actually both. The initial 70 and 75 pound and also the 60 and 65 pounds. I just wanted to get clarification how those values were stated.

BY MR. GALLO:

Q. I'll ask you. Both the initial values were based on the flight simulations that were done?

A. No, the initial 75-pound full force was a target that was basically a similar technique that was used when we did G550 testing, continuous takeoff testing.

Q. And you have this test team, who is responsible for reducing the data and analyzing the data?

A. For this test specifically, it was a combined effort between the flight test engineers and the aircraft performance engineers. And that was something that we had agreed upon prior to going out to test.

Q. But as far as the takeoff pull performances, there is somebody that comes in and takes the data and goes through the data and says, well, the test was okay but you need to modify it in such a manner, and then it comes back to the flight test? I'm just trying to understand the dynamics and the relationship between everybody.

A. So the process, if I had to guess at the process, it would be that the flight test engineers would reduce the data and provide results. The performance engineering group, you know,

would review the results and before we would publish anything as far as a flight test report, you know, we would have those conversations on it, do we think these fairings are in the right way through the data, and discussions like that. There's a collaborative effort before the report would be finalized.

Q. And you were actually also -- you were also on Flight 88 and 132. Was there any --

A. Before you continue, I would like to clarify. I was not on the flights. I attended the briefings.

Q. Correct. I know previously as far as a reduction on those flights, did you have discussions regarding the de-speeds and stall angle of attacks with Reece?

A. In general, not just concerning just those flights, yes, we did. We had talked about where the flight tests did stall angles, you know, for following how much margin we would like to keep to stay away from that stall margin, you know, stall angle. And in general, that is why we worked out the speeds, takeoff target speeds, you know, the way we did. We were careful of staying away from ground effects stall and trying to keep it margined for in ground effects stall.

Q. When you do the data analysis, are there any reports that are generated?

A. I think the report that would document that, you know, the speeds, takeoff speeds, would be, you know, the flight manual substantiating data report, which is at the end of the flight test

program.

We don't have a document that lays out the process of how we move from stall speeds to takeoff speeds until the substantiating data report is written up after the flight test data is collected.

Q. Following a specific flight, is there any report that's written by flight test engineering or flight sciences regarding that specific flight?

A. Yes. The reports, each flight report, is written by a flight test engineer for that flight.

Q. And are there any reports written by the air crew of that flight, either as a separate report or are included as an attachment to the flight test report for a specific flight?

A. I'm not sure of the answer to that question.

MR. REMICK: By air crew, do you mean the pilot and co-pilot?

MR. GALLO: Yes.

That's all the questions I have. I'll pass it off t John O'Callaghan.

MR. O'CALLAGHAN: I have it?

MR. GALLO: Yeah, for now.

BY MR. O'CALLAGHAN:

Q. Let me just get some disclaimers here. I've actually never interviewed anybody in my career here because I'm a nautical engineer and I mainly deal with data. So if this comes across

clumsy, I apologize in advance.

And also let me pass on my condolences to you. I know this is probably very hard for you in that you've lost friends and co-workers and that's on our minds and hearts here. So I just want to express my condolences, our condolences.

Just following up immediately on Mitch's last question there, I think he asked do any reports get generated following specific flights and I think the answer was, yes, the flight test engineer might generate something. So were such reports generated for Flights 88 and 132?

A. I'm not sure.

Q. Okay. So then I'll go to my actually prepared questions. A lot of these are kind of more of the technical ones but these two start off kind of in a more general way.

I have seen your statement, the written one. Not sure we need to go through or over all that in detail but can you maybe perhaps give a brief overview and description of the sequence of events on Flight 88 and 132 and 153 starting with, say, the run prior to the roll events on 88 and 132 and the runs including the 88 roll events, and then run 7A1 just prior to the accident run, just as you recall, how did things transpire, if you can recall?

A. Okay. I'll start with Flight 88. Flight 88 was -- essentially the first point of the day was to go and perform a V_{MU} test point and the Flight -- well, let me not say that because I don't know for sure that it was Flight 87. It was one of the

prior flights, maybe 86 or 87, that we were doing V_{MU} testing.

And the first point of the day was the V_{MU} test point that we had the roll-off event. Post flight briefs, we really discussed how Kent Crenshaw who was flying that test point had not done a buildup in approaching the lower thrust ratios to do the V_{MU} test point.

So, you know, we revised -- and when I say we, Reece Ollenberg and I think Jake Howard also signed off on it and revised the TSHA to include a statement that says that the pilot flying the maneuver should perform a buildup, something to the effect of those words.

MR. REMICK: Shelley, before you go on, are you saying that the roll-off, the takeoff event that ended up with a roll-off in 88 was the first and only takeoff of Flight 88? Was it the first takeoff of Flight 88?

MS. BRIMMEIER: Do you want me look at my test cards?

MR. REMICK:. Yeah.

MS. BRIMMEIER: I believe it was the first one. We were intending to do kind of no wind so we would have started with the first run of the day --

MR. REMICK: Okay. Just clarify that point.

MS. BRIMMEIER: Okay.

MR. REMICK: Because, John, I understood your question to ask about what was the flight just before it and there may not have -- or what was it, the takeoff, just before the Flight 88

roll-off event and there may not have been one.

MR. O'CALLAGHAN: Yes, thank you for clarifying that.

DR. BRAMBLE: Can we go off the record for just a minute?

(Off the record.)

(On the record.)

DR. BRAMBLE: Let's go back on the record.

MR. O'CALLAGHAN: After our discussion, I think we need to clarify on the record we have a log, and it will become clear anyway, for the flight.

BY MR. O'CALLAGHAN:

Q. Thank you, Shelley. Let me just recap what I think I heard you say, that following the event on 88, there was some discussion and the conclusion was that likely a buildup progression towards that was not done, had something to do with it, so the lesson learned was that you should do a buildup to the test point and subsequent flights; is that fair?

A. Yes.

Q. Okay. Thank you. So go ahead and proceed to Flight 132, please.

A. So Flight 132 there was an IFR for the day to not have the yaw damper active, and it was not just for that day, but particularly let's just talk about that day.

The Flight 132 was a lightweight takeoff demonstration and it was continuous takeoff testing when the roll-off event

occurred on that run. And I'd actually like to refer to my test cards to give comments on how that run -- basically, what I heard over the microphone, the hot mic of the aircraft.

So for Flight 132, we did have the yaw damper inactive, and the run where the roll-off event occurred -- let me find it now -- was 3-Bravo-1. And it was a single engine continuous takeoff test run.

The previous run, Vivan Ragusa was flying all of these cards, this whole card. And the previous run he had rotated too late, so rotated 4 knots late. So we kind of contacted them and said, you were a little late on the rotation. They kind of knew it at the time so they said, okay, we just want to redo that, that test point. That was 3-Bravo.

So 3-Bravo-1, I think he anticipated a little bit and pulled a little earlier than the target rotation speed and basically that was when the roll-off occurred.

Post-flight, the crew had discussions. I mean, I was there but not a participant in these discussions, that the yaw damper being inactive may have contributed to that, that besides that event, the aircraft seemed to be, and I'm going to use the word that I will interpret from what they were saying because I don't know a good word to use, but the aircraft seemed to be wiggling, you know, kind of through the air.

And so then after the post-flight brief, we called back to Savannah and said, you know, we don't want to do any more

continuous takeoff testing until the yaw damper can be active. And so that seemed -- that was kind of the resolution from the crew. And we didn't do any continuous takeoff testing post that flight for a few flights.

Does that cover your questions on 132?

DR. BRAMBLE: John, are you there? John O'Callaghan, are you on the line?

MR. O'CALLAGHAN: Oh, that silly mute button and I'm here talking to you and you can't hear me. Now I'm off mute. Yeah, I have just a couple more questions on 132.

BY MR. O'CALLAGHAN:

Q. Do you know why the yaw damper was IFR to begin with?

A. I can't talk to the specifics but it was basically something that had happened back in Savannah on one of the other aircraft that --

MR. HORNE: I can answer that if you want me to jump in.

DR. BRAMBLE: That's okay.

MS. BRIMMEIER: You can ask somebody else.

DR. BRAMBLE: If she doesn't know, we can ask later.

MS. BRIMMEIER: I don't know the specifics but I do know that it was through the flight test fleet that that IFR was enacted.

BY MR. O'CALLAGHAN:

Q. Okay. Thank you. And then immediately following the roll event on 132, do you recall any of the discussion in the

cockpit and how the subsequent runs went by that?

A. The note that I have, which is what I'm going to off of from my memory because I can't remember the conversation specifically, but the note that I have was, I think, a comment from the pilots at the time, and it might have been from Gary Freeman who was also the copilot I guess at the time. He said at lighter weights this needs to be done slower. I don't know if that means that the pitch rate was a little high or just that the thrust-to-weight ratio, you know, basically popped the aircraft up in the air. I'm not sure.

Q. Okay. Thanks. Did the tests proceed as scheduled for the cards following that or were there other things done, if you recall that?

A. I'm looking back through my notes.

I think that was the only card of the day. No, wait. Let me see what else I have down here. Nope. That was the only card of the day.

Q. Okay. And just for my own understanding of how these things work and the telemetry trailer and all that, I imagine that you folks have your duties in there so when -- is everybody kind of tuned in to the conversation that's going on in the cockpit or are they kind of having their conversations and the people in the telemetry trailer are doing their own things because they have duties as well? I guess, can you just describe that? I mean, is everybody kind of together in a conversation or is everybody doing

more of their own duties? How does that work?

A. The way that the telemetry -- what we hear in the telemetry trailer is a hot mic from the aircraft. And anything that's said on board, we can hear in the trailer.

For us to talk to the trailer, we have to basically hit a button to get the signal to go up there and talk to them. So we have to make a radio call to talk to them.

Also, in the telemetry trailer, our computers that have the data screens up so that we can watch time histories of the data that's being recorded real time.

So our roles there were really to watch the time histories and watch things, the perimeters pertinent to the takeoff, essentially the takeoff speeds, when the engine failure occurs, you know, what kind of pull forces and rotation rates and pitch attitudes we were seeing throughout the takeoff run.

So my job was to do was to watch the data, the telemetry data and see how well they were able to match our predictions and our targets.

Q. And what happens in between runs in the telemetry trailer, let's say?

A. We sit and wait for the crew to set up for the next card, next test card. They would, you know, sometimes -- they had the same target speeds on board. Reece Ollenberg, the flight test engineer, would have those as a reference. So he was able to, you know, basically say these are the target speeds we're going to use

and, you know, pretty often he would call back to the flight test telemetry trailer and say, do you guys confirm those speeds? We would call back and say, yes, or we got a different speed or hold on, we're checking something, you know, between runs.

But then once the runs started, essentially, there was no radio contact from the TM trailer to the aircraft just because of conducting a test.

Q. Okay. Thank you. I think I'm going to shift gears a little bit here. I'm going back to something Mitch was asking about the rotation technique. I understand sort of the differences in the absolute pull force, you know, going from 70 to 60, but there's also sort of the rate at which you pull back.

A. Uh-huh.

Q. Can you just perhaps describe various rotation techniques in terms of, you know, pulling back and the rate and why one would maybe favor one over the other and different requirements in that regard?

A. Okay. I guess to start out with the 75-pound pull technique, that 75 pounds is the maximum allowable pull to demonstrate during takeoff testing allowed by the force. So basically 75 was the limit. We couldn't go beyond. So 70- to 75-pound pull force was, you know, the best rotation we thought we could get.

And the rate that was accompanying those early technique tests was a very abrupt rate. Basically, almost a step function

rate, you know, column force. Nothing pulled to 75 pounds almost as instantaneously as the pilots could do.

We had gotten pilot feedback that that was hard to target one pull force very quickly, very abruptly, and so, you know, if we could go to reduce that pull force so that we don't overshoot or also reduce the rate, you know, that might be something that's easier to repeat over and over again.

And I think the following discussions to that effect also included, you know, just making it a little bit safer, making it something that's easy to repeat, making it something that not only our flight test pilots would be comfortable doing but, you know, fleet pilots as well.

Q. Okay. Oh, I'm sorry. Go ahead.

A. You mentioned, you know, what other kind of rotation rates would be expected. I guess in the performance world we talk about performance takeoffs versus corporate takeoffs. So this was intended to be a performance takeoff to get a quick rate of rotation out of the aircraft, not a don't spill the martini in the back of the aircraft.

So we've had discussions aside from 132 and 88, you know, just about how performance takeoffs and the rotation rates are slightly different than a corporate style takeoff.

Q. Okay. You anticipated my question there because it sounded like there's some incentive to the step function and the high force and imagine it's to get as high of a rotation rate as

possible or something. And so does that go to eventually minimizing field length or something? I guess what would be the incentive for the step function input?

A. Yes, it would be to demonstrate, you know, the shortest field lengths that are possible in the aircraft.

Q. Okay. Thank you. This is kind of another aside detail. I notice that 88,000 pounds was used. And in looking through some of the test plans, it looks like that's something between a medium and a heavyweight. And I also thought maybe that the intention was to test as a heavyweight. Am I confused there or can you explain why 88,000 pounds or how 88,000 pounds came to be used for the takeoff weight?

A. For which flight are you talking about?

Q. For the accident flight, Flight 153.

A. Flight 153? We intended to start Flight 153 as heavy as we could. There are limitations that are predicted limitations from our database that the aircraft would be gradient limited at heavy weights on a hot day in a flaps 20 configuration. So, we didn't then start out at 104,000 pounds, you know, that we could have because the gradient limitation would not have given us enough climb performance.

But we started the day intending to test flaps 20 first. And so that brought the weight down from something close to a max takeoff weight of anywhere between 104 to, I guess, 99,000 pounds. Let me see what the flight weight, what we actually took off with.

Well, we started the day intending to test a lot of flaps 10 and 20 CTO points. So by the time that the Flight 153, you know, card 7, by the time we had gotten to that point, the aircraft just had burned fuel. And we were okay with that because it was company testing that we intended to collect the data, lay on curves and see how well it had matched up with other data that we had collected. If it had been a certification test or something like that, the weight would have been very critical.

Q. Okay. Thank you. That explains that. Now, shifting gears once again, kind of getting into the weeds a little bit here, but I'm trying to learn as much as I can about the plan and obviously it's very sophisticated and I'm not sure I follow everything about what I've read so far.

So can you please explain or describe the differences between the normal flight control logs and the first flight mode and what configuration was intended for field performance and what was actually being done on the accident flight?

A. Yeah. Unfortunately, I am not a control loss expert and so the things that I know about the control loss systems are very limited. I don't know that I could accurately answer your question.

Q. Okay. Well, if there is somebody that might be better for that we could ask, do you know who that might be? That was on your FEMA because we're going to be interviewing like eight folks today.

A. Yeah. I have some ideas but I'm not sure who is on the list that would be the person.

Q. Do we have a list?

A. I guess I would probably refer to Jake Howard, who is our chief -- or he's our flight test pilot.

Q. Okay. Thank you. This might be the same answer, but differences in the alpha limiter system and this intended production configuration versus the test configuration, would questions along those lines be better for Jake?

A. Yes. I can talk a little more to the alpha limiter system but still I am not an expert. If you want to go ahead, I'll try to answer.

Q. The other question I wrote for myself here is, please describe the alpha limiter system and the differences in the system between the test configuration and the intended production configuration.

A. Okay. I can't speak to the details but I can give a kind of general overview. The alpha limiter system in first flight mode can operate -- we can shift the shaker onset to somewhere where we would like to be. And so for the CTO test, we were shifting that to basically alpha. That would be equivalent to the Vsr with some margin to account for tolerances.

And I can't speak to how that margin was derived, but I do know that's where we basically put shaker so that if we had encountered it throughout any of the CTO testing, you know, we

would know that basically we shouldn't have encountered it. So that is different from the production system in that you -- shaker would be beyond the alpha for Vsr from what I understand.

Q. Okay. A few more of the details on the margins that were set, but maybe those I'll defer to somebody else since we're getting a little more into the weeds.

I guess I'll ask, along those lines, can you recall any events in which the stick shaker activated unexpectedly or unintentionally during any tests prior to the accident or any events that you would have expected it to activate but it didn't? That's kind of like two sides to the same coin there.

A. You know, I can't think of any specific times that the shaker -- that I knew that the shaker had activated. You know, I was not watching for that either.

Q. Do you recall if it activated on 88 or 132?

A. No. I don't recall.

Q. Okay. I'm just about done here. There are three questions kind of related here. One is please describe any hard limits or boundaries on the airplane's state or performance established for flight testing and how these are determined. So basically are there any thou shalt not's or any kind of hard limitations sort of like when the airplane is in production, is there a limitation section that the pilot is not supposed to violate those things? Is there an analogous for flight testing?

A. Yes. There is some limitations that we lay out in

developing a precertification flight manual. So there are limitations laid out there.

There are also limitations in the IFRs, which are interim flight restrictions, that are instituted throughout the flight test -- well, instituted or relieved through the flight test program basically to keep the aircraft safe from an issue if an issue is known.

So in those ways, the IFRs are listed on each of the flight test cards for each flight or on the flight test cards' cover page for each flight, and then just the general aircraft envelope and other types of flap exceed speeds and stuff like that are listed in the flight manual, the draft flight manual I guess is what you would call it.

Q. Thank you. So those limitations, do they get pulled into the test procedure when it says, you know, pull back the throttle at such and such a speed and da-da-da-da-da, do those procedures reflect the limitations or are there any things in those procedures that constitute limitations in themselves, I guess?

A. I can't speak to that as far as the procedures being a limitation, but I would say that if a procedure is called out that would go against an IFR or a flight manual limitation, then that test would not have been conducted that day.

Q. And sort of related to this, what is the process for altering a test procedure? I know there are these cards and they

kind of specify the steps, A, B, C, D, about how to conduct a test. But once that's on the card, how can it be altered or modified?

A. Occasionally, when we go through the preflight brief, we do talk though the procedures on every card that we're going to test. Occasionally, we will talk through if we do want to modify a procedure and give additional guidance, we will provide it during that preflight brief and everyone attending would mark up their cards and agree that that would be the procedural change for that flight card.

As far as -- I don't know, formally if you're saying would we propose a brand new technique, how does that get approved? I don't know the answer to that.

Q. Well, I guess I'm thinking more, you know, imagine for purposes of testing and as you test things out and as you're learning in the field there, there may be tweaks required to the way things are done. And I'm trying to understand if somebody wants to alter the procedure, that is, on the fly while in the middle of a test, whether the pilot-in-command can do that on his own authority or if there is more of a committee approach to it or how that evolves, I guess, if the question makes sense.

A. Yeah. I think prior to each run, you know, for the most part, the crew, the pilot and test flight engineers will kind of go through these are your target speeds and talk through the procedure; not very detailed, but they will kind of go through,

okay, I'm going to pull V_R at let's say 112 knots or whatever. They'll go through sort of a breakdown right before the takeoff roll.

I don't recall any situation where we were like sitting on the end of the runway and the pilot or flight test engineer suggested a change.

Q. How about between run 78-1 and 78-2 on 153, was there any discussion of altering the technique then, that you recall?

A. Not that I recall.

Q. And my final and I'll be done here, the question is, can you describe anything that would prompt the cancellation or postponement of a test, aside from obviously like an accident event, or if any such cancellations or postponements occurred during the program?

A. You know, I've been most familiar with the field performance testing so I can only really speak to that part of our testing out in Roswell. But as far as that would go, the things that would cancel or postpone a test would be if the winds were out of limits according to the TSHAs laid out for the testing that we were planning on doing that day.

You know, if there was essentially a new IFR that was proposed during the flight test program either from Savannah or I guess we could have proposed something from Roswell and then, you know, there would have been a kind of a halt to discussions about what was limitation and how does it impact us and things like

that.

But for the most part when we were in Roswell, the things that would hold us up would be either an aircraft part or system that had an issue and then we had to repair it or weather being out of limits so that we couldn't proceed beyond the wind limits or something like that.

Q. Fantastic, and actually, I lied, I do have one more question looking at my notes here.

MR. REMICK: I thought you said you weren't a lawyer.

MR. O'CALLAGHAN: I get a professional courtesy, I guess.

BY MR. O'CALLAGHAN:

Q. Last question here. Please describe any post-flight engineering analysis performed after the roll events on Flight 88 and 132 and the timeline of that.

A. Performed by myself specifically?

Q. Well, I guess you can correct my understanding here if I'm wrong, but what I understand is there is flight test organization and then there is flight sciences and I think maybe flight sciences is the customer for flight test. I mean, is it that kind of a relationship? You can maybe clarify that as well. But if weather -- I know after the accident event when we were down there last week, we got some presentations from a bunch of folks in flight sciences with their CFD analysis and so forth and I'm just wondering if flight sciences folks and aerodynamics folks

took up an analysis of Flights 88 and 132 after those events or not?

A. Okay. So first of all, I'll address the question about the relationship with flight tests. Flight sciences is a customer for flight tests and I am a part of the flight sciences organization. So we are the customer receiving the data that is being collected.

For the field performance testing, Flight 88 and Flight 132, as far as I know, there was no data analysis centered on the roll-off event until after Flight 153.

Q. Okay. Great.

MR. O'CALLAGHAN: I think that's it. I have probably hogged my share of the time. So thank you very much for your time and energy. I appreciate it.

MS. BRIMMEIER: Okay.

MR. O'CALLAGHAN: Mitch, it's all yours I guess.

MR. GALLO: Bill is next.

DR. BRAMBLE: Thanks, John and Mitch.

BY DR. BRAMBLE:

Q. Shelley, one of the things that was provided to us was organizational charts for flight sciences and flight tests. I was wondering, is there a separate organizational chart for the G650 flight test program that cuts across those?

A. I guess within engineering, there are sort of several silos of work charts. So one being the core engineering; one is

650 engineering, and the other is aircraft development program.

Flight tests, the entire flight tests organization lives in the core engineering group and I guess have dotted line reporting to the 650 program. I'm just going to use that as a kind of a term.

The 650 engineering org chart does have a flight sciences group in 650 engineering. And so in that we have a flight sciences' director for 650 and I fall under him.

Q. And who is that?

A. That is Tom Lavrisa.

Q. Is there actually like a one-pager that shows the relationship among the 650 team members?

A. Yeah, I think there is.

Q. We needed to ask for that at some point. I just wanted to know if there was one.

A. Uh-huh.

Q. Do you know if there was a written approved flight -- I should say, was there a written flight test data reduction plan?

A. Yes.

Q. And can you give us sort of a general outline of how that data reduction was supposed to proceed?

A. Specifically for the field performance testing?

Q. Yeah. We could say specifically about continuous takeoff testing.

A. Continuous takeoff, okay.

Q. Or the VME. Let's start with VME.

A. Okay.

Q. Just generally, how is the data supposed to move and who is supposed to do what with it?

A. Yeah, there's not a clear black and white with the way that the data reduction was going to happen for all the field performance testing. It was kind of shared responsibilities between flight test engineering and aircraft performance engineering. For the most part, it's flight test engineering's responsibility to reduce the data and provide us the results. However, there's been a collaborative effort between the two groups to understand the data and the results that we're getting from it.

So the data analysis methods report is really a report that outlines the kinds of equations that we're going to use to reduce the data, what kind of process and how we're going to lay it out to prepare the flight test reports that will summarize all of that data. That document was written by flight test engineering, reviewed by, including myself, but other, I think, engineering organizations as well.

Q. So does the plan specify that for only flight test has the data until they've done certain things with it and then it moves on or does the data sort of go in parallel out to the --

A. I don't know that it specifies that. The way the process that we've been following throughout the flight test

program has been that the data is in parallel.

So the subset that we request, as far as flight test goes, we are able to receive that soon after the flight is complete. And when we were in Roswell, we were receiving the data as flight test engineering was receiving the data to help with the data reductions efforts.

Q. Okay. So do you know what kind of analyses have been performed already on the VME test, specifically, the Flight 88 data?

A. The only analyses that I am aware of is the data that's included in a draft report that Reece Ollenberg prepared.

Q. And did you ever see that report?

A. I have seen parts of it but I do not have a copy of it and am not completely familiar with it.

Q. And do you know if Reece had shared that report with anyone before the accident?

A. I do know basically from conversations with Pat Connor that he and Reece had had conversations about it but I don't know that Pat had seen the data until the accident, until after the accident.

Q. And was it normal for the analysis to have been confined to Reece for that type of information and for that period of time?

A. I guess. I don't know. I mean, I think for the V_{MU} tests, it's a subset that I think that Reece and Pat and I had all agreed that Reece would look at and review and put together. So,

I think that was what we expected, you know.

Q. Okay. And had he made any comments to you about what his preliminary findings had been?

A. Not directly to me.

Q. Have you heard indirectly prior to the accident?

A. Not prior to the accident. The only thing, the conversation that I referred to between Pat and Reece had happened, like, literally a few days before Reece came out to Roswell, which was Friday before the day of the accident on Saturday.

Q. Okay. I notice in the test plan that it says that efforts will be made to minimize the number of crew aboard the aircraft and that for initial test flights and flutter tests, it's kept to two, just two pilots. And we've been wondering with the telemetry capability, what's the need for the two flight test engineers aboard the aircraft for continuous takeoff testing?

A. You know, I don't know that I can speak directly to that other than I know that the flight test engineers on board the aircraft have access to a lot more of the data. The systems and parameters that are recorded on the aircraft are not all streamed to the telemetry trailer. So, I would suppose that, you know, part of debugging an issue in-flight would be to be on board, to understand what the on board parameters are saying.

Q. So what you are saying is basically it's only a subset of the parameters that are being measured and collected aboard the

aircraft and streamed to the trailer?

A. Yes, exactly.

Q. So in --

A. And it's very limited. We have to make sure that for the flight test that is being telemetered, that we have all the parameters that we need. If we had just tacked onto the last test that was being produced, you know, we wouldn't have had the right target parameters that we needed for continuous takeoff testing. So essentially we had to lay out which parameters we wanted to be telemetered to the trailer.

Q. And so one of Reece's responsibilities was to monitor these additional parameters that you guys couldn't see?

A. I would assume so, yes. That is some discussion that I have not been involved in.

Q. Okay. What was Dave's role?

A. The way that I kind of interpret what the breakdown was is that there was essentially one flight test engineer watching systems and kind of how everything was working, making sure there wasn't some flight control system failure or alarm or anything, you know.

And then the other was to basically, you know, check the data that we had just collected for the tests. So then the CTO testing would be to basically do a quick review, did we meet our target speeds, what was the pitch rate, pitch angles, essentially was it a quality test point, and, you know, did it need a quick

look at, does it need a re-do on the spot.

So the way that I interpret that responsibility was that Reece was watching the flight controls and systems and Dave was doing the quick look back through the test targets.

Q. Okay. What test flights, and we can probably get the cards, but in general, what test flights were flown on Friday after everybody arrived?

A. There were no tests after everybody arrived on Friday.

Q. Okay. And then the tests on the morning of the accident, we have the video from the tests but we haven't had a chance to review all of those, but in general, were they continuous takeoff tests or were there other types of tests that morning?

A. We only conducted continuous takeoff tests. It was in the plan to do rejected takeoff testing as well. We did only continuous takeoffs.

Q. Okay. Do you recall -- on the test card there is a note saying there was a bobble on card 2C3. Do you recall what that was about? Did you make these notes on the cards that we have or was that something --

A. These are my cards, yes. Well, most likely.

(Off the record.)

(On the record.)

DR. BRAMBLE: Let's go back on the record.

BY DR. BRAMBLE:

Q. I'm just interested in having you tell us about that note on card 2C3.

A. Right here?

Q. Right.

A. Yeah. It says, "Kent", quote, "bobble on that one." Essentially, you know, what I would do while I was listening to the hot mic, if a flight test engineer or a pilot had a comment, I tried to make a note, basically, so that we could talk about it during the debrief, and it was not my responsibility to capture those kinds of things but that's where that came from. As I was listening, I heard him say, oh, we had a bobble on that one, and I wrote it down.

Essentially what I interpret that to mean is that the pitch came up -- with column force the pitch increased and he probably pushed a little to arrest the pitch increasing and in pushing, you know, pushed so that the pitch would decrease and then kind of pulled to pull it back up. So we had to use that term bobble to describe that kind of a maneuver where the pitch may be increased, decreased below, and then they had to pull to correct again.

Q. Okay. That's helpful. And was this something that was sort of like a point of concern or was this sort of a routine, just a description of that?

A. From what I can recall, it was just kind of a post-run comment: Oh, I had a bobble on that one. I don't recall that it

was a concern.

Q. And then on 3A1, you wrote lot of depth pressure for run 36. Do you recall?

A. That again was probably a comment that I had heard over the hot mic from the aircraft.

Q. What was your --

A. I mean, I guess I'm not sure what my interpretation of that is. Let me take a second to look at the parameters here. It looks like I didn't write the actuals down.

If I had to guess, I would say that that's in reference to meeting the V_2, which the target V_2 was 136 and then in the effort of Kent trying to pull to meet a 136 speed, that maybe it was hard to pull to meet that maneuver, to meet that speed.

Q. And did the aircraft have to be airborne to follow the test procedure? Did the aircraft have to be airborne by V_2, before V_2, you could say? That was a tortured sentence. Was it the intent of the test that the aircraft should be airborne prior to V_2?

A. Yes.

Q. Would it be an acceptable test if the aircraft was not yet airborne prior to V_2?

A. I guess let me describe how I interpret V_2 and then address the acceptable/not acceptable test point criteria.

So the definition of V_2 is that speed which you hit at 35 feet above the end of the runway or above the ground level, I

should say. So V_2 on a single engine takeoff should specifically, that speed that you're at 35 feet. Now, we had given target V_2s and that was the target speed for them to meet post-liftoff at 35 feet.

To talk to the test acceptability criteria, the test plan calls out an acceptability of plus or minus 2 knots. So if the crew was within 2 knots, we would say that was an acceptable test.

To speak specifically to this day's Flight 153's testing, we were not concerned specifically on accepting or rejecting test points. We were concerned on collecting several test points to lay in to get a feeling for where the data was going to fall. So after each of these runs, we did not necessarily deem it accepted or rejected.

Q. I see. So eventually there would be a certification test run where you would expect to hit V_2 plus or minus 2 knots at 35 feet AGL, above the ground surface, I should say?

A. Yes.

Q. Okay. But that was not necessary during these tests?

A. No. The intent of these tests was to develop what our speed schedules going forward would be. So the intent was to take this data and lay it alongside all the other CTO test data that we had collected and determine what those target speeds were going to be. Even though we had given targets, you know, basically, those were not the final -- they were not the final speeds that we would

use for certification.

Q. Okay. On the test card one of the notes that's printed on the card is -- actually all the cards, but seven in particular, is that shaker would be at 90 percent NAOA. Do you know what that means?

A. Yes. Ninety percent NAOA means 90 percent of the normalized aircraft angle of attack. And so 90 percent of normalized aircraft angle of attack means 90 percent between -- well, the normalized AOA goes from an angle of attack -- actually, I'm not even sure what sets the lower boundary. I guess the lower angle of attack on it occurred.

And then the 100 percent normalized AOA is equal to the alpha for Vsr. So the alpha where we were using for our reference to all speeds for our takeoff, yeah, reference to all speeds. So being at 90 percent means you're, you know, 10 percent down from that alpha that's defined by Vsr. I believe that's the way it goes.

Q. Okay. So it's 90 percent of the reference alpha at which point?

A. For whatever flap setting that you are using for that configuration and then, I'm sorry, I cut you off before you asked the rest of your question.

Q. The second half of my question wasn't going to make sense so that's okay.

A. Okay.

Q. I was going to say for which speed, but it doesn't matter.

A. Yeah. It's essentially for the flap configuration.

Q. So it was adjusted so that it would not -- I guess you did have some margin in there?

A. Yeah. The intent was that shaker would occur prior to the crew getting into a warning area. It was the first warning before you hit a limit.

Q. Do you know how many degrees of protection that would provide?

A. I do not know. I probably could find references and get that information but I don't have it right here.

Q. And do you happen to know what the Vsr alpha was?

A. Yes. I think I have it in one of these binders but I'll just kind of make a -- from what I remember, for flaps 20 it was about 15 degrees and for flaps 10, I believe it was about 15 degrees as well. I could find those numbers. Usually, when I need them, I dig them out.

Q. Okay. All right. Well, we can submit a request later for a researched answer. Do you know how the stall AOA and the maximum takeoff pitch -- well, let's see. Do you know how the stall AOA was determined?

A. It was determined from the company stall testing that was completed probably late 2010. And I was not involved in that data reduction.

Q. Okay. And how did Reece decide upon the 9-degree pitch target for the CTO for 153, the rotation pitch?

A. From what I understand, we basically just wanted a constant one level across both flap settings and prior to that we were seeing, you know, 9 degrees. Let me see, let me go back to my notes. I think they were targeting, you know, 9 to 10 degrees for flaps 20; 10 to 11 degrees for flaps 10 and just wanted to make it a consistent target for whatever flap setting you're doing continuous takeoff for.

Q. And what about the prior incidents, did they have any bearing on that, on the lowering of the pitch target?

A. You know, I do believe that the previous roll-off events, especially the Flight 88 event, had kind of put it in peoples mind, and when I say people, I mean the crews that were there on site, that 12 degrees was a kind of a stay away from attitude.

And so I had heard a couple of times, you know, Reece and Kent both saying, yeah, we don't want to go beyond 12 degrees; 12 degrees, we've been there, we don't want to see that again.

Essentially, the intent was to lower pitch attitude to be at 9 degrees so that there was still margin to overshoot by about a degree, because it is just human nature to not be able to be exact and it was intended to reduce instead of going consistently higher, to reduce by one degree the flaps, to tend to be consistently a little bit lower.

Q. Yeah. In the earlier roll-off events, were those considered to be like incipient stalls or stalls or were they considered to be something else?

A. You know, I had not heard anything from the crews saying that they thought it was a stall and I didn't come to that conclusion either. Like I said, I don't have a feeling that it was ruled during Flight 88 or 153 -- I mean, sorry, Flight 88 or 132 that it was a stall characteristic that happened.

Q. All right. During one engine operative CTO tests, when should a pilot transition from the rotation target pitch, by reference to airspeed, in particular, V_2? When should they transition from target pitch 9 degrees to speed by reference to V_2, at what point during the takeoff?

A. That's not something I can speak to that is black and white. Essentially, we had discussions with the crew that once you lift off, start targeting that V_2 speed, but there was not a clear set of actions, I guess, defined by us. It was upon the -- essentially upon the pilots to use their judgment as far as I know.

Q. What was the role of a Safety Review Board with respect to Flight 153?

A. The post-accident Safety Review Board?

Q. My understanding isn't clear on this. Does the Safety Review Board review the test safety hazard analysis prior to a test or only after?

(Off the record.)

(On the record.)

DR. BRAMBLE: Let's go back on the record.

(Mr. O'Callaghan no longer on the telephone.)

BY DR. BRAMBLE:

Q. So getting back to my earlier question, what was the role of the flight test Safety Review Board with establishing the conditions for card 7 or for the continuous takeoff testing? Like, what role did they play in identifying -- well, I'll just leave it at that. I'll let you elaborate on that.

A. The flight test Safety Review Board for field performance included all of the tests that we were going to be conducting for field performance, including CTOs, continuing takeoffs, rejected takeoffs, you know, single engine and twin engine landings. There's probably a couple of others in there, too, some thrust reverser testing, some brake test points, you know, things like that.

So the Safety Review Board really to was determine if it was the avenue to present what state the aircraft was in as far as the maturity of the systems and to present the types of testing that we were going to be doing. So, to lay out not necessarily in detail the procedures but to lay out that these are the tests that will be performed.

And it is an avenue for anyone involved to be able to, you know, express concerns, to, you know, bring up any issues.

And then also, you know, basically, if there are any issues that need to be looked at, actions are taken and then the Safety Review Board would then convene, you know, again to follow up with those actions and determine, you know, whether we are ready to go and do that test.

Q. And who is on the SRB, the flight test SRB?

A. There's actually quite a few in attendance. It includes flight test, flight test engineering, core engineering representatives, so people, you know, from the flight sciences, flight controls, mechanical systems, electrical systems, flight test pilots.

Q. And so with respect to card 7, the continuous takeoffs with one engine inoperative, were there any particular guidelines developed or hazards identified as part of the SRB, communication strategies?

A. Yes. I guess I probably should add that the flight test SRB does review all the TSHAs for the testing that would be performed. So that is reviewed in that meeting.

In regards to how the procedures are laid out, that is more specifically laid out in the flight test plan for field performance than in the Safety Review Board.

Q. Okay. And if a safety issue or if a safety related event were to occur during the testing, then would the Safety Review Board become involved? What would be the procedure for reporting or dealing with a safety significant event?

A. I guess I can't really directly answer that question since I am more support for the flight test organization than a part of that process. So I really can't answer that.

Q. Was the flight test SOP that was effective for these tests, that 1998 flight test standard operating procedure?

A. I am aware of the document that you're talking about. I had not seen it until after the Flight 153 accident.

Q. So do you know whether that was the current version, 1998?

A. I don't know. That is the version that I saw.

Q. Before?

A. After the accident.

Q. All right. And how about the test hazard or test safety hazard analysis for the continuous takeoff tests? Do you know what were the contents of that?

A. Yes, I am familiar with the contents of the test safety hazard analysis sheets for each of the field performance. They were included in the field performance flight test plan. They are included in every field performance flight test set of cards. And they are reviewed in the preflight brief prior to every field performance test. So depending on which test we were testing that day, we would, you know, we would use the appropriate TSHAs in the deck of cards.

Q. And who creates the TSHA for a particular -- let's say, for card 7, I mean, to be specific?

A. Yeah, I mean, I can't say specific people because I'm not completely sure, but essentially they are written, you know, by flight test engineering and approved by -- well, written and comments are provided by I guess both flight test engineering, flight test pilots, our chief G650 engineer -- I think that's the three signatures on the TSHAs.

Q. So on card 7, for example, are the TSHAs the -- are they in the notes?

A. The TSHAs are on the back of the packet. They're in the back pages of the packet.

Q. All right. That helps. So the TSHA contains risk alleviation statements, these numbered items; is that correct?

A. Yes.

Q. And those numbered items are things that are supposed to be adhered to during the test? Is that the idea or some sort of guidelines?

A. Yeah, for the most part, they're laying out elements of safety that need to be adhered to. So runway-X having a long runway length or having, you know, the service done to the aircraft or what kind of -- it basically, it will lay out just any kind of things that are good practices and should be adhered to before starting any of the test points. The preventative actions and minimizing procedures essentially are, you know, pretest and during test procedures to follow.

Q. Okay. All right. And, getting back to something that

Mitch asked earlier, if you want to change the printed material on a test card, is there any form that has to be submitted or any kind of formal --

A. No, not that I'm aware of. There have been revisions to a test card that I am aware of and those have happened in the preflight brief. They have not been major changes, slight changes, and the crew basically all has to agree that that's what they want to proceed with, with that procedure.

Q. Okay. So it's considered fairly routine or -- I don't mean to characterize it for you, but --

A. Yeah. I mean, field performance there are a few instances that I can think of essentially just targeting one degree different or changing a pull force here or there, maybe targeting if you're going to fail an engine by a throttle chop, you know, depending on weight changing, how early before V_R that you fail that engine. Things like that basically, so that we're conducting the test and getting the results out of the tests.

Q. Okay. And on the earlier topic about the V_{MU} testing and Reece Ollenberg's analysis, did you know anything about the report or its contents that he had written prior to the accident?

A. No, the only thing that I knew was that he was working on reducing the data.

Q. On Flight 88, when you said after Flight 88 that it was decided that that would be done with a buildup, do you know -- given that that was classified as high risk, do you know why there

wasn't a buildup prior to that?

A. Essentially, we had done the buildup test points on the previous day. The thing that we had overlooked was that the pilot-in-command was Jake Howard that day. And going out the following day, you know, we had Kent at the controls and we were basically going for that one last point. Basically, the discussions post-flight, we did acknowledge that, oh, yeah, we didn't think about having two separate pilots performing the buildup the day before and then end point the second day. So that's why the TSHA was revised.

Q. Were there any procedures in place for notifying management about safety-related events that might occur during testing?

A. Nothing formal that I'm aware of.

Q. And did pilots practice CTO maneuvers, test maneuvers, CTO test maneuvers in the simulator before the actual flight test?

A. Possibly. I guess I'm not aware that we took a specific pilot saying that you're going to be doing CTO testing, you know, this next round, go and practice. I'm not aware that that had happened.

In the case of Flight 153, I do know that Reece and Vivan went to the ITF simulator to basically work on, you know, the technique and kind of evaluate it prior to going out to Roswell. That's the only situation that I'm aware that there was practice, practice runs performed.

Q. In the simulator?

A. In the simulator, yes.

Q. All right. How was the tone of the interaction among the crew members on the day of the accident?

A. I think that, you know, we kind of had a little bit of a refresh. We had Reece come out and David come out. Vivan also came out and Kent had been there the week prior and I had been there the week prior.

So, you know, we were kind of, okay, new faces, new people, a little bit of a reenergize. We had not been doing CTO testing that week prior so I was looking forward to getting back to doing CTO testing to collect that data. And I know Reece was, you know, in the same -- of the same mindset, you know, looking forward to getting some data and looking at it, see how it laid out.

You know, we did have, you know, the CTO brief and the preflight brief to get -- you know, to prepare for the new set of tests and talk about the technique and really go over, you know, since we were changing gears on the testing that we were doing. Basically, prepare for that.

But the morning of, we basically showed up early in the morning and were, you know, trying to get the aircraft out first thing in the morning.

Q. Had there been any talk that the tests might be cancelled for that week or postponed?

A. Not that I know of.

Q. All right. Did you participate in a conference call with Reece and others about the upcoming tests the Wednesday prior to their going out to Roswell?

A. No, I did not.

Q. How well did you know Kent Crenshaw?

A. I've actually known Kent for almost 10 years.

Q. How about Vivan?

A. Vivan I had just met when he had done his testing in Roswell.

Q. Not prior to that?

A. So it was probably early March when I first met him.

Q. And how about Reece?

A. Basically, as soon as Reece started working at Gulfstream, he started interacting with us in the performance group. He was, you know, as soon as he got here kind of designated as the engineer that would be doing the performance testing. So we interacted quite often over past probably 2 years.

Q. And how about Dave?

A. Dave is the guy that I knew the least. I knew Dave just, you know, from personally meeting him a couple of times and that he was working on a lot of the air data system stuff. So I had interacted with him a couple of times, just talking to him about how that was going. But I had never interacted with him during a flight test until Flight 153.

Q. Okay. And could you give us maybe sort of a thumbnail sketch of the personality of each of those folks?

A. Yeah. Kent was always really -- had a good sense of humor and was really upbeat. The one thing that I -- the one impression that I got of him was that he was very concerned about safety and that probably came from my first interaction with him when I was participating in 550 field performance flight testing. But he was, you know, very conscientious that we were doing the right procedure, that we were being safe, but he was also very interested in how the data looked also. I mean, he wanted to see how he was flying and how it affected the data.

Q. And how about Vivan?

A. Vivan, since he and I still had a kind of new working relationship, I didn't know that much about his background so I would talk to him about what did he fly before and, you know, what did he like. He was very good natured, always very positive, and in the case of Flight 132, you know, he really wanted to understand what happened during the roll-offs so that he didn't -- he felt like he wanted to know and understand so that he could correct his technique. But it seemed to me that he was, you know, there for a lot of the field performance testing and there to get experience to kind of be one of the people that are involved in the testing as a primary pilot. That's what I interpreted.

Q. And did you have enough of a sense of Vivan to feel like you knew whether he would feel comfortable being assertive as a

pilot not flying, as a right-seater when necessary?

A. I mean, I guess I don't know or have a feel for that.

Q. And how about the competency of the two pilots, do you feel like -- how would you assess their competency?

A. I mean, my experiences with Kent I would say he was top notch and he was one of the best pilots, you know, in my mind. Just interacting with him, he took into consideration and wanted to talk about procedures and safety. And I really felt that, you know, being a DER, had very much experience on field performance. I mean, he was one of the go to guys if I had a question about takeoffs and technique.

You know, both he and Jake Howard were the two people that I would call just in my normal working day to get advice on, what do you think about this, how do you -- you know, what would you do in this situation. He was one of the -- he was an expert in my opinion.

Q. And then how about Reece and Dave in terms of their personalities and competency?

A. Yeah, Reece was always very good natured as well. He was very collaborative, which was nice from my end to have, you know, a very good working relationship between flight test engineering and flight sciences. I know he was, you know, very willing to call us -- when I say us, myself and Pat Connor, you know, to talk about test procedures and test data, show us what he had looked at. We would share what we'd looked at. Working with

him was very pleasant. He was, you know, very communicative about what he was working on.

I also really felt that he was very experienced even though he was new to Gulfstream. I had the feeling that, you know, he had a lot of really good performance experience and I was really actually very happy to have him join our team.

Q. And how about Dave?

A. And Dave, I didn't know very well but I knew him to say, hi and, you know, pass him in the halls and ask a technical question once in a while. He was always very nice, very pleasant. I can't comment too much on interactions because I just didn't have much with him.

Q. Okay. That's fine. And how about Reece's ability to be assertive; did you have a feel for that?

A. You know, I really feel that he would not allow procedures that he felt were unsafe. You know, he was one of the people that was saying, you know, I was there on a roll-off event. We got to a high angle, pitch angle, and that was his feeling of why we had the roll-off. And he said, I just don't want to be there again. And, you know, there was actually -- he didn't have to be too assertive because there was sort of a, I don't know, agreement at that point but he -- I really believe that, you know, he was conscientious of being safe and was able to communicate that.

Q. Okay. One of the other things we'd like to do to the

extent possible is find out what you know about the recent activities and possibly sleep of each crew member. I realize you may have limited information, but with respect to Kent Crenshaw, when did you first see him on the morning of the accident?

A. Well, I'm sure we all kind of set an arrival time to be about the same time and I'm going to assume it was like 6:30 a.m. or something like that. I can't even remember what time we had set but essentially the whole team was targeting, you know, to be there right before dawn so that they could get on the airplane and get out basically on the runway just, you know, right as the sun was coming up.

Q. How long did it take to get from the hotel to being on the runway?

A. Oh, it was, you know, a 15-minute drive to the airport and then to being on the runway I would say maybe it takes half an hour.

Q. Another half an hour?

A. Yeah, to get the airplane and powered up and checked out. They do their preflight checks and everything and get ready to go.

Q. So that would have meant departing the hotel by like a quarter to 6:00?

A. Yeah, I can't talk to a specific time.

Q. But 45 minutes earlier, right?

A. Yeah, something like that.

Q. So did you first see the flight crew at the hotel or at the airport?

A. I can't say for that day but I do know, you know, we were staying in the same hotel so usually we would all just congregate, have a little bit of breakfast in the break area and each car would kind of fill up and go to the airport as, you know, as our teams were -- everybody showed up and was ready to go. I kind of think that I did see Kent and Vivan there during breakfast, but that may be because I saw them almost every day for -- I mean, I saw the crews, you know, doing that almost every day for a couple of months.

Q. So you don't really have a specific recollection of that morning but you do certainly have a general recollection of seeing them in the mornings?

A. Yes.

Q. I see. And do you have a specific recollection of the first time you saw Reece or Dave that morning?

A. I would say similarly. I know I think that they showed up in the break room about the time when everybody was getting ready to go. But I kind of think that they were all there that morning.

Q. And then how about the night before, do you remember when you last saw them the night before?

A. When we all went to dinner together after our preflight brief meeting. We all went to dinner across the street, so we

stayed at dinner and then came back to the hotel.

Q. Do you know what time everybody got back?

A. I would say around 8:00.

Q. Okay.

A. It didn't strike me as being a very long dinner or anything like that.

Q. Okay. So Dave and Vivan arrived that afternoon and that evening you all went to dinner?

A. And Reece arrived that day as well.

Q. And Reece, okay. Did anybody drink alcohol at the dinner?

A. I don't remember.

Q. How about after the dinner? Do you know if anybody consumed any alcohol after the dinner?

A. I don't know.

Q. And how was the -- how would you describe the health, mood and alertness of the crew on the morning of the accident of all four crew members?

A. I mean, I think everybody was, you know, ready to test. You know, I didn't notice that anybody was really dragging. You know, we had discussions, "Good morning, how are you?" You know, everybody was kind of awake.

Q. Everybody seemed like themselves?

A. Interacting. Yeah, everybody seemed to be themselves.

Q. And had anyone in the days before the accident exhibit

any signs of illness?

A. Not that I know of.

Q. And so you had been out at Roswell for a few days already, right?

A. Yes.

Q. So you didn't have any interactions with those folks back in the days, 2 or 3 days prior?

A. No, I did not.

Q. With the new folks? And did you have any communications with Reece or Dave or Vivan on Wednesday or Thursday on the phone?

A. Nothing on the phone. I was trying to think, you know, if Reece had sent e-mails or anything but mostly I think he was, you know, the only interaction I really remember is, you know, when they showed up and we had the big brief after they arrived.

Q. Do you recall if either of -- either Vivan or Kent were wearing corrective lenses during the tests that morning, the morning of the accident?

A. I mean, I guess I can't say yes or no. I mean, I think individually, Kent did use reading glasses, I think, but I could be mistaken on that.

Q. And did anyone report taking any medications in the 24 hours before the accident?

A. Not that I know of.

Q. All right. Compared to other -- have you worked at other aerospace companies prior to Gulfstream?

A. Only as an intern I worked at a space company.

Q. To your knowledge, how does pay at Gulfstream compare to other manufactures, aircraft manufactures for people in your position?

A. I mean, I think it's pretty comparable.

Q. And how about leave?

A. Again, I would say pretty comparable.

Q. How about the amount of overtime worked by flight test engineers?

A. I guess I can't say how that works at other companies with not being experienced with that.

Q. Okay. How about the size of the workforce for a certification flight test program?

A. I guess the only impression that I have is what I know of large companies, which are large companies, much larger than ours anyway. I can't talk to a specific flight test program but I just in general have a feeling that the larger companies have more people doing the same type of work than we do in our organizations at Gulfstream.

Q. Did you feel that staffing was sufficient to meet the targeted deadlines for the flight test program?

A. You know, I'm not usually involved in discussions as far as staffing and how many people we would like to hire and how many people we have hired. You know, I believe that a lot of people knew what their roles were and what deadlines they had and I guess

that's all I can really talk to.

Q. Did you feel that the time frame for completing the certification in the flight test program was realistic?

A. I felt that it was a little aggressive.

Q. What made you think that?

A. There just seemed to be pressure to continue tests, to continue flying, and the schedules from being developed 5 years ago looked a little different than the schedule developed 6 months ago. The time frames were being compressed.

Q. By how much?

A. I guess I can't talk specifically to that.

Q. And do you know why they were compressed?

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY DR. BRAMBLE:

Q. So getting back to what you said about there seemed to be pressure to continue testing and flying and the schedules had been compressed in the last 6 months compared to the original schedules 5 years ago. Why were the schedules compressed; do you know?

A. I think there was, you know, software development, levels of maturity, you know, maybe a couple more levels than we had expected. The calendar or schedule, I guess, as it was laid out, you know, basically in this last past year had been very

success oriented, so if there was a change required, you know, it added additional time into the development program.

Q. And, so, was there an effort to avoid changes?

A. Not that I know of, an effort to avoid changes; it was really to understand why a change was required. And I guess I would say it has to do with hardware and software.

Q. And can you give me any specific examples of things that came up or might have been discussions in deciding they needed to justify why changes were required?

A. I mean, I guess one example that is kind of specific to field performance is the brake software. We did have to revise the brake software loads because we were seeing skidding during performance braking stops. And so there was really discussion of show the data that shows the skidding and propose changes to the suppliers, have the supplier basically revise their software and give us a new load. And in that whole process, you know, that delayed us collecting the data that we're going to use for certification knowing that we had to have a revised software load.

Q. Who set the flight test schedules; who was responsible for laying out the long-range schedule?

A. I guess I don't know specifically. I know that my director attends meetings at flight test with, I assume, other directors of the G650 program and other key personnel and they have weekly meetings from what I understand.

Q. You mentioned pressure to continue testing and flying.

I understand what that means is keep the program moving. So whose job was it to sort of keep things moving in a forward direction? Where did the pressure come from?

A. I mean, I would use the general management.

Q. Do you know --

A. I mean, I believe that, you know, Kurt Erbacher the program manager, you know, was one of the people who was focused on the schedule.

Brian Durrence, as the chief engineer, you know, would want to understand how changes are going to impact the schedule.

And in the flight test world, there was an effort to understand how much of the testing that we had done is going to be used to generate final data towards a certification effort, just the tracking of accepted/rejected test points and that kind of a thing.

Q. Can you give me examples of communications that you perceived as pressure?

A. I guess in preparing to go back to Roswell in March, one of the items that was limited was the nose wheel steering. Nose wheel steering was limited above a certain speed. That was okay for testing other than field performance testing, up and away testing. That was probably an okay limitation, but it was in place when we first went out to Roswell so we were focused on making that; we rearranged the test sequence in order to accommodate that limitation being in place.

At the time, I had said that, well, since the nose wheel steering, you know, shouldn't be active above a certain speed that we weren't ready to go to field performance testing and basically the feedback to me was we'll figure out a way to rearrange the testing to make it useful for us to go a little earlier.

Q. So as a result you rearranged the field performance testing schedule? Was there any kind of implicit message sent by that communication? I mean, how did the test team perceive that message?

A. I mean, I think the -- in general, not just that message, in general, we felt that we had to pay attention to what test we were sequencing and our sequencing them, which is important in the test program anyway, but it would have been more comfortable to do that without limitations being placed on the aircraft configuration as well.

Q. Okay. Did the compression and the pressure to keep things moving give you any concerns with respect to safety?

A. I would say my concerns were more focused on having time to look at the data once we collected it, you know, looking ahead to where we were looking, what we were testing.

After the November testing and during the March testing, you know, we, being the people on site in Roswell, had a couple of discussions between flight test engineering and flight sciences that we didn't quite have enough time to reduce the data, that we were getting to fly the next day without really understanding, you

know, the data we had collected the day before. And that's kind of a general feeling. In some cases, I don't know that that affected the safety at all. But that was my feeling.

Q. You said in some cases you don't know that it affected safety at all. Do you feel like in other cases it did?

A. I guess knowing some of the results that we have looked at after the accident, I would feel that it was an issue.

Q. Specifically with respect to which data?

A. I think specifically the V_{MU} data.

Q. Do you think that the compressed time frames had anything to do with the fact that those data -- that Reece did not finish analyzing and assimilating those data prior to the test and going back into the test program?

A. I think that our focus was not on the V_{MU} data and so that's why it had -- the results have not really been finalized and published. I guess, in general, I feel that there was a certain amount of expertise that certain individuals had and that they were the ones reducing the data and they were the experts in that field. And so when testing was continuing, it may have drawn, for example, Reece and myself away from reducing data and back to focusing on collecting data.

Q. Specifically with respect to the V_{MU} data?

A. I mean, I was not intending to be involved in the V_{MU} data reduction. I was intending to be involved in the field performance data reduction and I guess -- the V_{MU} is one of the

tests that I'm concerned that we didn't have the data prior to doing the testing in March but I'm only more concerned about that now that I know it would have been in limitation on the aircraft. Previously in Gulfstream aircraft models, it was not a limitation so we were not as focused on that data this time around.

Q. The people who were responsible for reducing the data were Reece and Pat?

A. There's really teams of people, but for the most part the leads were Reece, Pat, myself.

Q. At what point would you have gotten involved in analyzing it?

A. In analyzing?

Q. The V_{MU} test?

A. The V_{MU} test? To be honest, I think I would have reviewed the report and basically decided if I, you know, found similar results. I don't know that I would have done my own individual data reduction. I would probably have just validated that the method he used was a method I would have agreed with.

Q. Can you think of any other factors other than time pressure that might have delayed the analysis and dissemination of that information?

A. No.

DR. BRAMBLE: Okay. That's all I have for this round. I might have one or two more in follow up depending on what else comes up.

BY MR. PROVEN:

Q. Now, comes the fun part because I have to back to the -- since I'm not allowed to talk in the middle, and go all the way back to where you started and see where I made highlights. It will be a slow and tedious process and I apologize.

A. Okay.

Q. What I do is make a little note in the middle of your conversations to come back to. Emergency brief of proposed changes created a single plan, pull forces were changed, changed pitch from 9 to 10, and my question was, when did you have that briefing that was, I think, was the night before, right?

A. It was actually in the early afternoon.

Q. Okay. I'm sorry. On the Friday before --

A. On Friday before the Saturday flight.

MR. REMICK: There were two briefings. There was a 2:00 briefing and a 6:00 briefing. The 6:00 is a preflight briefing and the 2:00 is an engineering briefing.

BY MR. PROVEN:

Q. So 2:00 in the afternoon on Friday and 6:00 in the morning?

A. 6:00 in the evening on Friday.

Q. So what was covered on the 2:00?

A. The 2:00 was essentially a discussion about continuous takeoff technique and the technique that we wanted to use on Saturday.

Q. And that's where you came up with the 9 degrees?

A. Yeah, it was a slight change from the previous technique and then a slight reduction in the pull force as well.

And it was basically for Reece and Vivan to go over the technique that they have employed in the practice and share it with us, share with us the discussions that they had had back in Savannah. And basically familiarize the crew that we were changing the test procedure that had been done before and re-familiarize everybody with the fact that we hadn't been doing CTO testing for, I don't know, a week or two up till that point.

Q. And then at 6:00?

A. And at 6:00 was the preflight brief where we briefed the flight test cards and TSHAs and, you know, discussed the procedures.

Q. So one's the general and one is more specific for the flight crew?

A. Yes.

Q. That makes perfect sense. Now, the other part is to read my handwriting. I think it was 132 but they had the in-flight restriction that said yaw damper off, I believe.

A. Yes.

Q. Why did they decide to leave the yaw damper on; what motivated that decision?

A. The restriction was in place from what I understand from an event that happened here in Savannah on one of the other

aircraft and it was disseminated through the fleet. So, you know, I don't have specifics on that flight.

Q. That's fine. "I don't know" is always the right answer. But on the basis of another event somewhere else, they said let's turn the yaw damper on?

A. Throughout the 650 fleet, the flight test fleet.

Q. I have another one on the next page that I remembered. Is the yaw damper dual; are there two yaw dampers or can one rudder to the yaw damper work in separate sections of the rudder?

A. I'm not familiar with the system enough to answer that.

Q. That's always the right answer because I use that a lot. And we have others. I'm sure everybody but me knows, but what was the date of the V_{MU} testing that -- a month is fine, I'm not looking for the date.

A. It was in November of 2010.

Q. November of 2010. Okay. So just to get my sequence in mind, the accident, the time between November and so forth, the data had not been reduced by that accident date?

A. It had been reduced by Reece and put into a draft report but had not -- I mean, I had not seen it until after the accident.

Q. By going from a 10-degree to a 9-degree pitch attitude, does this affect the takeoff performance number that you'll be able to publish in the AFM and so forth and, if it does, what does it do?

A. It would affect the distances of the flaps 10 if we

hadn't stayed with targeting a little bit higher pitch attitude. We might get a little bit of benefit in the takeoff, the field length. We were not so concerned about increasing the field length just a little bit for flaps 10 since it's not a guaranteed point for a customer when we sell the aircraft. We don't use flaps 10 as a selling point but flaps 20. So reducing by about a degree we thought would be minimal effect on the increase in the distance, but I would expect some small increase in the distance from that.

Q. I now remember having heard that but I had forgotten. The question was what were the roll-offs thought to be but you didn't hear that they were considered stalls. What were they, what was your understanding for why these roll-offs prior to the accident? And if you didn't hear anything, that's fine.

A. I mean, I didn't hear anything that would have said this is what we caused the roll-off other than, you know, we pointed to the fact that we had overshot the target attitude and that, you know, that may have impacted it. So the discussion was more focused on we blew beyond the target pitch attitude.

Q. I can see that.

We talked about the flight test guidance from '98 -- you said back in 1998, the flight test book?

A. Oh, the standard operating procedures, flight test standard operating procedures.

Q. I'm sorry. I apologize, I didn't memorize the name of

it.

A. Okay.

Q. But you said that you were familiar with that one but not another document that I've seen. What were you using for the testing?

A. The flight test standard operating procedures document that you're thinking is the 1998 document. That document I had not seen until after the accident.

Q. So since you hadn't seen that, what were you using as your guidance?

A. Not being in the flight test organization, my references were the flight test plan, previous test reports from, you know, 550, 450. You know, using previous fleet experience as a reference.

Q. Thanks. I'm sorry. I put you in a different group in my head.

A. That's okay.

Q. You guys had decided at the 2:00 meeting to go to 9 degrees. When the new crew came in a week or two later, how would they know that 9 degrees is what they wanted to go to from now on? How does that process move the information from one crew to another?

A. I think each organization kind of had a similar rotation schedule setup where we would have, you know, at least one person stay behind when a new person came in so there was a week overlap

of a person who had been there before to, you know, at least a week. I think the pilots were doing a 2-week -- each pilot was there for 2 weeks and they alternated by a week so that there was a week overlap.

Q. Okay. That makes sense.

A. Yeah, flight test engineering, I think, had a similar layout in the, you know, the test that was being conducted for Flight 153. I'd have to think -- Cynthia had already been there. I think she was there the previous week and then Dave and Reece showed up. So she was the person that had the previous experience.

Q. Corporate knowledge?

A. Yeah, and then with the performance engineers, we were doing the same thing, rotating people every week.

Q. That all makes sense. That sounds like a lot of verbosity, verbal pass downs. Was there any report written that would have done that in a more formal manner?

A. I mean, I think the flight test cards, which, you know, there is a master flight test card binder that we keep in the office.

Q. Would have captured that.

A. And so that would have been the record of what procedures we had briefed when we were testing and any notes.

Q. So the incoming after Captain Vivan would have seen, a-ha, everybody is going to 9 degrees because it's in the flight

test card plan?

A. It would have been a reference that they could have used. I wouldn't say the procedure was for them to review all of the previous testing prior to that flight.

Q. Great. You made a comment about the size of the workforce seemed to be smaller at Gulfstream than at others. My question was is that because the scope of the work is larger or because they just had more people but the scope of the work is the same?

A. I think my interpretation is that the larger companies just have a lot more programs going on at one time and so the support staff needed to --

Q. So the scope of the work is larger so the workforce is larger; if the scope of their work were smaller, the scope of their workforce would be smaller?

A. I would have to guess.

Q. Just what you were saying. It was in my mind, Boeing is a --

A. Yeah, they're huge.

Q. So they have more people.

DR. BRAMBLE: But the question earlier was specifically about for a flight test certification program.

MS. BRIMMEIER: And I can't speak specifically because I do not have experience interacting with other manufactures on the size of their programs.

BY MR. PROVEN:

Q. That's why there was a question in my mind was what you were answering. And I think you actually answered but let me make sure I understand it. Because of the previous experience with the other aircraft that were not V_{MU} limited, it hadn't come up as a, wow, this is the more important thing we're going to do because of previous experience so you put into a priority chain and it wasn't as high as we now suspect it might have been and I'm not trying to put words in your mouth. I'm just trying to understand.

A. No. Yes, I would agree with that statement.

Q. That's what I thought I heard you say. What was the nose wheel steering limitation and how did they fix it?

A. It was actually a limitation of going beyond a set speed and I don't remember if it was 60 knots or what the speed was. And it was fixed with -- I believe it was a software change and maybe a slight hardware change. But that came out to Roswell and was delivered to us after the aircraft had already arrived there.

Q. So, obviously, you can't take an airplane off at 60 knots, it wouldn't work.

A. No.

Q. So were they allowed to go beyond 60 knots with some techniques applied?

A. Yeah. The nose wheel steering had to be turned off.

Q. There we go.

A. As part of the procedure.

Q. So they would make all of their takeoffs while this problem had been identified but was the nose wheel steering wheel off; is that right?

A. Correct. And there were discussions about what testing would we do with the nose wheel steering off and whatnot. So we were focused on what that impact would be.

Q. You need the nose wheel steering for the LBIs because it provides a lot of stability?

A. Exactly, and that was one of the tests that we deferred until we knew that that was in place.

Q. Okay. I got it now. So you made the takeoffs without nose wheel steering or the ground ones without nose wheel steering. And it was fixed with the software and the hardware and perhaps a hardware but maybe not.

MR. PROVEN: Thank you.

MR. GALLO: Ready to go?

MR. REMICK: Just going to get the last questions of every speaker.

BY MR. REMICK:

Q. The takeoff speed development, I know it's reiterative, I'm just curious, when the takeoff speed table that you were using for the targets, how long had that been stable, that you'd been using those speeds, the V_Rs, the V_1s the V_2s, consistently or had they been modified for this trip to Roswell?

A. They had been modified for this trip to Roswell.

Essentially, we were using the same V/Vsrs speed ratios for quite a while and the database change was mostly because of the stalls speed update, a stall speed update.

So changing the Vsr that we used to ratio to get to V_R to V_{LO} even though it's a fallout of the testing, we still provided targets in V_2.

Q. The stall speed updates came from more of your testing or just a change in the assumption that you wanted the ratio --

A. You know, I'm not sure the difference between the -- I believe that the testing had been completed and there were small adjustments made to the fairing of the data reduction.

Q. More data reduction maybe. As much as you know, could you talk about the progression in the techniques, how target rates, rates or attitudes, had been modified through the program? We know where we ended up that day with a 9 and the control force had been reduced from the 75 limit down to 60. Was there a progression in pull forces, rates or attitudes through the program as you had been working on it?

A. Well, essentially the progression in using the CTO technique basically went from what we talked about, 75 pounds and the input to 60 to 65 pounds input, slightly more ramped input. As far as testing a rate, pitch rates, and things like that, we did some dedicated pitch rate testing and target pitch testing. But those were not intended to be the CTO technique.

Q. And one other, and you may be the wrong person for this

question, but it came up, modifying the test cards during the briefs. As best you know, the TSHAs are company approved. We're talking company, not cert test here, because obviously we would have done the approval if it had been cert test. The company approves the TSHAs after the SRV. The company approves the test flight and the flight as planned. Are the test cards approved?

A. The only way I know to answer that, I don't know that the test cards necessarily are approved prior to them being briefed. The procedures are laid out in our test plan and then small modifications that may have been made during a brief, that's where I know the modifications would have been made.

Q. I have seen that both ways in test programs. My understanding is the test plan, a Gulfstream flight test plan, basically, allows -- has variances or tolerances. So if you are modifying a test card, you are still never exceeding a limit that was approved within a TSHA or a flight test plan; you were just operating within the allowances?

A. Yes, to my understanding, small changes were not intended to go beyond other limits.

Q. I think that's typical of test card philosophy that I've seen, as long as you don't violate what's inside the preflight test plan, you have some allowances to make adjustments.

MR. REMICK: That's all I've got.

BY MR. HORNE:

Q. My first question is based on some stuff you had in your

notes but there was some discussion about what the flight instrument they used, per se, in the first attitude and monitoring speeds, whether to use the VFE, whether to use the revision, or whether to use the HUD. So what's your impression of what instrument was Kent using to set the pitch attitude?

A. I would have to look back at my notes since I'm not super familiar with each of those systems. I was just trying to take notes as they were talking about them, and it was mostly just my scribbles that I didn't think I'd have to replay. Let me see if I can find my notes. I don't know where mine went. Oh, the primary flight display.

Q. So the regular PFD?

A. The regular PFD.

Q. What about airspeed? Did they discuss whether to monitor airspeed at all?

A. No. I assume off the tape, but I don't know.

Q. How about the pitch limit indicator?

A. Well, we did have discussion about the pitch limit indicator, that it would come up and kind of show that you're -- I don't know how the system actually works but Kent was describing, you know, that it came up and showed that you were in a warning area essentially while doing the takeoff, the pitches.

And we did have discussion about that that was set at an arbitrary point and that it was not -- the pitch limit indicator was not set yet for what the production aircraft would be set at.

Q. That was another question I was going to ask you about. But before we get to that, do you know whether he was using the pitch limit indicator and the HUD or the pitch limit indicator and the PFD as a reference?

A. I guess I don't know. I remember Vivan saying that you could look at it in the HUD, making a comment about that, but I guess I don't know what they were doing in the cockpit.

Q. I saw that note there so that's why I was asking. Okay. So let's go back to the part you raised again.

A. Okay.

Q. There was discussion about the PLI and arbitrary limit, telemeter sets an arbitrary limit and it would -- pushed out of the way for production so that customer pilots would not see it repeating this technique. Was there any discussion of the use of the PLI and how it was set or how it differed from the legacy G550s or G450s?

A. You know, I'm kind of looking at my notes and I have, you know, delta -- actually, I was dyslexic and wrote LPI instead of PLI. I have the delta was .15 normalized airway on legacy aircraft and that must have been a comment that somebody had made and I wrote it down.

Q. Yeah, traditionally the shaker came on at .85 versus 1.0 was the limit, so that would be .15 delta. I read that.

A. So that, sorry, we did have a discussion about where it was and that it was coming up during the CTO testing, that, you

know, Kent didn't want to see that come up, you know, during the technique and that we did talk about how it's coming up at kind of at a point where we'd have to push it out of the way to do a continuous takeoff.

Q. Can you expand on what you mean by that?

A. I was a listener to this discussion so I wasn't really participating in giving any feedback or guidance but they were discussing how, you know, basically, the pitch limit indicator might need to be pushed up to a higher normalized AOA is what I would interpret that.

Q. So it was too close to where you were trying to target?

A. But it was close to where we were targeting and that, you know, it would be a nuisance if it came up during every takeoff. And there was discussion about was it finalized and, you know, responses were, no, it wasn't. That was my understanding.

Q. Did they ask any -- was there any discussion of what the PLI really meant to the pilots? How was it set; what was it?

A. You know, I don't remember any discussion about where it set relative to normalized AOA for 650 and how that relates to the legacy aircraft. I just don't remember discussion saying this is what it represents on the 650 and where it is on the 650.

Q. Okay. And then was the PLI a limit? If they hit the PLI, was it a limit?

A. Not that I know of.

MR. HORNE: That's all I have.

MR. GALLO: I have several questions. Some of these may be redundant.

BY MR. GALLO:

Q. I apologize, we've been going through a lot of questions. But the first one I know you have an answer. Are you a DER?

A. Yes.

Q. Who do you report to on that?

A. Grant Eaton.

Q. Did you work in any way on any of the previous stall tests on the 650 program?

A. Nothing other than being a witness to the TM data collection.

Q. But you were involved in all the VME testing?

A. Yes.

Q. In one of the TSHAs, and this is the one that was stapled onto Flight 088, it talks about maintaining a ground effect AOA margin similar to the pre-error AOA limiter margin of 1.5 degrees. Was that margin in itself changed throughout the subsequent testing where you have target IGE, in ground effect, AOA limit; was that margin ever changed throughout the testing?

A. No.

Q. And going back to Flight 088 and 132, is there any data analysis, or I don't know what terminology you want to use, but was there any data reduction and analysis after 088 and 132?

A. There was data reduction and data analysis. Can you clarify what particularly you were expecting us to analyze?

Q. That's probably the next question because I really don't know what you look -- how you do your data analysis and what you're looking for, what all is involved, and I know you mentioned that Reece would be involved in something like that. But I'm -- from the macro level, I would just like to know -- and you answered, I believe, that there was data analysis and reduction after 088 and 132. Do you know how soon after those flights that data reduction and analysis was done?

A. We started looking at the data as far as laying it with CTO scattered data and basically laying it in with the other data that we had collected probably within a week or two of collecting the data.

Q. So then I have a follow-up question just to understand the process, because some of the questions I have to ask is something that other people would ask of me, so I want to understand your process a little bit better. Once the airplane lands, you have recorded data on board the airplane and then you have TM data?

A. Uh-huh.

Q. Is it fair to say that an instrumentation group comes out and retrieves that data or how does that data get collected and then disseminated and then who reduces it and who analyzes it in a group sort of context?

A. Okay. Yeah, the data that's recorded on the aircraft is regarded as the master data set. So the TM data that had been recorded has been saved but it is not the data set that we use to reduce data for, you know, final data reduction.

The data when the aircraft lands, the data is retrieved off the aircraft from a flight instrumentation, you know, group perspective and then downloaded onto, when we were in Roswell, onto the server out in Roswell.

At that point, flight test engineering and performance engineering have access to the data and can start looking at it. Probably within a couple of hours after the aircraft lands, that process is done and the data is out there.

As far as reducing the data between Reece and me and our group, we had kind of talked about how we would all run a script that we had all kind of approved and were using to get the key elements of the data out that we were looking for and start basically using the same process between he and us to just get the data plotted up and then do detailed analysis on those points and where stick-outs occurred or something like that, you know, after the fact.

Q. Okay. And the data that you are looking for in context of the takeoff performance test plan is -- well, you're trying to meet the objectives in the test plan so you're looking for any out layers that are coming up from the data reduction analysis and also the data reduction analysis that you're looking for is also

based upon the data reduction plan for the test program?

A. Yes. The data that we collect -- you know, we have defined parameters in the flight test plan, field performance flight test plan, of what are the key parameters that were reduced, and the data analysis methods report documents how to use those to lay into a, you know, speed schedule, brake, V_{MU}, whatever parameter you are trying to derive from that test data.

Q. And if somebody has a passing interest, let's say, a curiosity, how would they get access to that data? And the example I have when I worked in flight tests, the insurance would say, oh, did you hear what happened on that flight and then how does somebody get access to that data? I don't know who would ask that question that you opened. Is it a common area or would they go to a person?

A. I guess the flight test data in flight test engineering, they have a drive that they keep that data on and then for passing data to flight sciences, there's a separate drive. So we get a subset of the data and depending on what the flight number is depends on what parameters you receive in that data set.

So for field performance testing, there's sub-parameters that would be delivered to us, you know, always for field performance testing. That's on a network drive that you have to be granted access to.

Now, how do you get access is really just an approval process and as far as I know, it's not a very limited process. If

you have a reason to work on the 650 program from the flight sciences perspective, you have reason to access the flight sciences flight test drive where that data is stored.

Q. And you mentioned that there -- well, let me just go back. For example, let's just use Flight 088 or any subsequent flights in takeoff performance, how many meetings as a group would you have? When would you have opportunity to meet with the people that are making decisions on how the flight went and what we should do on the next flight? Is that just limited to the test team itself or does it go beyond that?

A. I think while we were in Roswell, kind of day to day, then it was limited to the test team. The, you know, planning up to that point, there were meetings that would involve, you know, people that we thought were key feedback providers, I guess. So there were meetings to have discussions and basically anyone who was somebody who needed to contribute, you know, would be invited. As we were in Roswell day to day, I would say that it was mostly the test team that was on site having those meetings and discussions.

Q. And you mentioned that there were stall speed updates which led to changes in the speed schedule. Who provided the stall speed updates and in what format?

A. Those come from our aerodynamics group, specifically, Bob Mills, and the update that we had gotten most recently, and that's the stuff that we used in Roswell, was an Excel spreadsheet

to be followed by a memo, but we didn't have the memo at that time.

Q. Do you remember when you received that update?

A. It was early March. We had just prepared a new set of speed tables when we went out there.

Q. We talked a little bit about the flight test Safety Review Board, the SRB. Can you name its members?

A. I probably can't name all the members because I'm not sure, you know, who was there and, to be honest, I know that there is a specific must attend list and then there's a greater would have interest in the test list. And I do know that Barry McCarthy is part of the must attend list and I would, you know, say there's a flight ops, flight test pilot person on that list also. And I'm just not familiar with those lists.

Q. When was the last time you worked on a certificate program, aircraft cert program with field performance?

A. I guess I would have two instances to provide. The last time that I was on site witnessing field performance testing was during the G550 program.

During the 450 program, I supported the certification effort in building the flight manual, analyzing the reduced data, but I was not on site to witness that test.

Q. My next question pertains to Eric Upton and Adam Hart. Why did they get assigned to 088 and then Flight 153 Eric Upton joined in? Did you assign them there?

A. Yes. It actually goes to this was more of this was an educational effort since we don't do field performance testing very often at the company. We had made rotation schedules, I think that I had already talked about, where people would rotate, you know, in and out, and as part of our department's training, we wanted to have one DER on site the whole time throughout the testing but rotate all the other engineers through so that they could witness the testing and how things happen and things like that.

In the case of Eric and Adam for Flight 88, that was a 2-week test in November. We were there for about 2 weeks. Everybody got 2 weeks in the rotational schedule. And actually, they were in November and then they also both got a repeat chance to go in the March schedule.

So the reason people were there or not there really was based on the rotational teaching schedule. Adam and Eric both got repeat visits because they experienced the first one and had seen how things were happening and were able to be there sort of to do some cross-training with another newer member of the group.

Q. How is it decided if a test point is complete or when you are finished testing, how is that determined and you're ready to move on to certification?

A. Yeah, I think that --

Q. And, I mean, this is a good test point or this is a good test and we don't need to repeat it, how is that decided?

A. I guess I can't speak to a specific process. My understanding is that, you know, basically we'll lay out all that data and look at what kind of pull forces they had, what kind of rotation rates and basically say that, you know, most of the data falls in these parameters, all being very similar and being close to the same speed target. I don't want to say targets, the speeds all reduced to a similar speed for rotation liftoff, 35 feet.

All that data kind of gets plotted on a big scatter plot so you get it, you know, kind of a shotgun blast of all the data and see where the averages fall. At that point, that's when we lay those lines and the averages for, or maybe not an average. In some cases, you'd want to go to a high side or a low side of the data to be conservative. That's where we would use that data to develop a certification set of targets and that's when, you know, the certification testing would happen.

So that data is used to support the certification testing, but as far as it being ruled out prior to that data collection are we going to put together on one spot, as far as I know it doesn't happen unless you're early or late on a rotation speed or something that's just way outside the targets.

Q. Is there a group of people or one individual that says the test plan is complete and now we move on to something else?

A. You know, this program is my first time being this involved in that process so I guess I can't speak to that process as we haven't gotten to that yet.

Q. And regarding your office location, where are you located in relation to experimental test pilots and flight test engineers?

A. I'm in the RDC2 building, which is, I don't know, what is that, a mile and a half or 2 miles away from this main plant.

Q. And then the experimental test pilots are here?

A. Oh, yeah. They are here.

Q. And the flight test engineers are here?

A. The flight test engineers are here.

MR. HORNE: That's all the questions I have.

MR. GALLO: John?

BY MR. O'CALLAGHAN:

Q. Thanks. I just had one follow-up regarding the V_2 speeds and how those have evolved following the V_{MU} reductions. We got a presentation on this last week and I think I heard you say similar things that, again, the 9 degrees offers a lower alpha so you would get a higher unstick that was 60 and that would translate into a higher V_2 speed if you did the 1. where the -- higher rotation speed anyway, if you did the 1.05 V_{MU}. The V_2 speed schedule, if I recall right, it was set based on 1.13 Vsr; is that correct so far?

A. That's correct.

Q. And that 1.13 Vsr for V_2 that wouldn't really be affected by the V_{MU} testing. So regardless, and you can just tell me if I'm thinking through this correctly, even if the speeds for

V_R, that would just translate into -- I guess, one would presume then that you would be well above 1.13 Vsr at the new V_2 speed. So basically, there would be a lot of conservatism over the stall speed, right? I'm not making myself clear.

A. I understand your question and I'll give you an answer and you can ask a following question, how about that?

Q. Okay.

A. The data analysis methods report, which lays out how we reduce the data, does lay out that if you are adjusting speeds schedules, basically because of maybe a V_{MU} limitation or something like that, that you keep the same increments between your V/Vsr speed schedules.

So for final speed schedules, we would have, and probably will be, shifting all of the data that we've collected, you know, basically, up to meet a V_{MU} limit so that the increments between V_R, V_{LO}, V_2 or V_{35}, you know, would stay the same.

Q. Okay. I think I understand that, but without the hindsight of all the work that's being done, has been done, with the PFD and ground effect and flight tests and all that kind of stuff, at the time, based on -- I mean, there was no -- I guess, there was no reason to believe that the V_2s that existed then didn't represent a 13 percent margin to stall. So even if all these speeds were bumped up, that would mean that you would have even more margin to stall, right?

A. Correct.

Q. Let me explain it this way, what would have led anyone to question the Vsrs that were being used based on V_{MU} tests, if anything, that Vsr may or may not be right?

A. Well, the Vsr that we used as the reference stall speed was really a clean air out of ground effect stall, stall speed, you know, reference stall speed, I should say. So there was really -- I mean, we thought that we were accounting for the margins that we needed from the free air stall.

Q. And the V_{MU} test, I mean, I haven't Reece's draft report yet. I keep reminding myself that we have to look at it. But absent a stall and ground effect during V_{MU} testing, what in the V_{MU} test would have shed any -- led you to think that V/Vsr should be any different or that there would be a ground effect increment?

A. I guess I don't know that there would be anything other than that it would drive our speeds to be defined differently.

Q. Yeah, okay. So, I guess what I'm taking away is that, yeah, it would drive the schedules up, so I could either add margin there, but in and of itself, it wouldn't indicate that the Vsrs that were presumed previously based on free air were not correct; is that fair? Am I thinking that through correctly?

A. Yeah, I think that's fair.

MR. O'CALLAGHAN: Thank you. That's all I have.

MS. BRIMMEIER: Okay. I'd like to request -- I have an appointment at 12:00, so I'd like to request to take a break just to make a phone call to let them know I'm not going to make it.

(Off the record.)

(On the record.)

BY MR. GALLO:

Q. One more question, do you have anything else that you want to say before we conclude the meeting?

A. No.

Q. Or that you think might be useful in understanding the nature of the accident that we haven't already asked you about?

A. No, I don't think so. I know that you have heard a lot of the data that's been looked at after the accident and I've only been on the outskirts of looking at that data. I have not been super involved in that process.

MR. GALLO: Well that concludes our interview and we're off the record now.

(Whereupon, at 11:47 a.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD
INTERVIEW OF:	Shelley Brimmeier
DOCKET NUMBER:	CEN11MA258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 16, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha Wheeler
Official Reporter

_____

Lourie J. Brown
Transcriber

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*
	*
AIRPLANE ACCIDENT	*
ROSWELL, NEW MEXICO	* Docket No.: CEN11MA258
N652GD	*
	*

Interview of: PAT CONNOR

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Thursday,
June 16, 2011

The above-captioned matter convened, pursuant to notice, at 5:50 p.m.

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Accident Investigator

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I N D E X

I N T E R V I E W

(5:50 p.m.)

MR. GALLO: This is the interview of Pat Connor.

Pat, thank you for joining us today. The purpose of this interview is for safety reasons. It has nothing to do with regulatory or enforcement actions. We just want to get your story on what you know. And I think John O'Callaghan from our performance group is going to start off the questions today.

John?

INTERVIEW OF PAT CONNOR

BY MR. O'CALLAGHAN:

Q. Pat, it's good talking to you again. I'm sorry we can't be down there in person. Thanks again for your presentation last week. It was very helpful.

And the form of my questions are going to be basically, now that I have a copy of your presentation and been able to go over it again and understand it a little better, I think maybe what I'll just do is maybe make some statements about it or things that I think are true and bounce them off you and see if you agree or you can correct me. So it should be very short compared to the previous questions I had.

So starting off with the development of the V speeds, I'm looking at the plot of V/V_{SR} and the line that's V_{LO} or V_{SR}, I guess the first thing that occurred to me in reference to the rest of the presentation is that I guess that line would correspond to

one particular pitch, wouldn't it? I mean, if you changed the pitch, that line would have to move up or down?

A. Yeah, if you are at a constant V/V_{SR}, that would tend to correspond to a constant pitch generally.

Q. So the line that's drawn there, I guess it was based on the G650 -- or, I'm sorry, the plot, the derivative of, I guess, the genesis of the data underlining that plot stems previous programs; is that correct?

A. Correct. That was a G550 V/V stall that got shifted down to our target G650 V_2 limit of 1.13 V_{SR}.

Q. And then the V_{LO}, the liftoff speed for the 550 program, as we discussed, it probably applied to a particular pitch attitude because at a lower pitch attitude then it would require a higher liftoff speed for a higher pitch attitude and lower liftoff speed; is that correct?

A. Generally, I'm just trying to recall, for that data is presented as a function of thrust away and it varies the liftoff -- V/V stall varies a little bit as a function of thrust away. So I would expect a little bit of variation in pitch attitudes depending the thrust away that you're at.

Let me take just a second and turn to that presentation so that I'm looking at the same stuff you are.

Q. Sure. Take your time. I'm looking at Flight 9 of 22.

A. Okay. I'm up to date with you.

Q. V_{SR} line is relatively constant about 1.105, somewhere

around there, at the higher thrust away at 1.1 but it's approximately constant?

A. Yeah, that is fairly constant and so it would expect by virtue of that a fairly constant liftoff angle.

Q. Right. Now, so -- and there's a specific liftoff angle or pitch attitude that corresponds to that. If I were to increase the pitch attitude, it would lower the V_{LO} and so the line would drop down maybe below 1.1 or so, and if I were to lower the pitch attitude, it would increase the V_{LO} and so it would raise that line, shift it upwards?

A. Exactly.

Q. So, now, my question is do you know what approximately the pitch attitude that corresponds with that's -- particular drawn, what that is? Is it 10 degrees or 11 or 9?

A. In hindsight, it is probably somewhere between 9 and 10 degrees.

Q. All right. And then I note the rest of this presentation it goes as a result of the V_{MU} testing, you know, the V_Rs or the V_{LO}s would be closer to what was being assumed for the V_2s. But I asked this question of Shelley as well but the V_2/V_{SR} that's shown in this plot on Flight 9, that's not affected by liftoff speeds; that should be valid no matter what, if following the analogy to 550; is that correct?

A. Well, on the 550, that was at a much higher level because we didn't have the capability to rotate the airplane in

order to get to a V_2/V_{SR} of 1.13. So it was up around 1.2 even a little bit higher than 1.2 on the G5.

Q. Okay. But the 135 knots, that was quoted as the V_2 for the G550 at flaps 10 and our weight?

A. That's exactly right. That would have been represented 1.13 V_{SR} for those conditions.

Q. All right. So regardless of what the V_{MU} testing was hitting, this is my understanding and you can correct me if I'm wrong, there's nothing that would have come out of the V_{MU} testing that would have led you to suggest that at 135 knots you didn't have a 13 percent margin to V_{SR}?

A. Exactly.

Q. Is that right? Okay. So now I'm trying to understand, you know, why the V_2s would be bumped up as a result of the V_{MU} testing and Shelley explained that, well, it's because you are always looking -- that you want to preserve the same deltas from V_R to V_{LO} to V_2. And so if the V_{LO} goes up and the V_R goes up, then you would bump up the V_2?

A. Yeah, typically we do a one-for-one bump. For instance, the U.S. Air Force has with increased rotation speeds, we bump all the speeds up one-for-one. If we bump up the rotation speed by 5 knots, we bump up the V_2 and the liftoff speeds by 5 knots.

Q. But the V_{MU} testing doesn't say anything about proximity to the stall?

A. No.

Q. Okay. I think I understand that then. Now, a question that we were talking about with Paul a little bit is the performance of the takeoff and, you know, the target pitch and then transitioning to V_2. I was trying to think how that would be conducted, and as I understand it, you rotate to the target pitch attitude of 9 degrees, wait till you get to V_2 and then rotate some more to stabilize at V_2.

And my question was that given that you are accelerating when you hit V_2 and you can't change pitches continuously, doesn't that imply that of necessity you're going to have to overshoot V_2 a little bit? Either that or pitch above the target before you get to V_2 in order to stabilize the V_2?

A. Yeah. My understanding was that we needed to adhere to a pitch attitude at liftoff to make sure we met our V_{MU} limits but then after liftoff, we needed -- and the instructions to the pilot community was to start increasing the angle of attack so as to achieve V_2 by 35 feet.

Q. Okay. So the maintain pitch, your understanding is maintain pitch to liftoff or maintain pitch to V_2?

A. Let's see. You pitch-up to a certain attitude for liftoff but after liftoff, then you increase that attitude as you climb out. If we held a constant pitch attitude as we found out during Roswell 1 in November testing, we were overshooting our speeds by a considerable margin. So it was in February, we went to Birmingham, did some additional testing and during that, after

they lifted off, they then started targeting higher pitch attitudes, which in turn cut down the acceleration during the climbout to 35 feet so as to get closer to our V_2 targets.

So we were not holding a constant pitch attitude during the latter stages of our testing in order to get closer to our target V_2 speeds.

Q. I see. Okay. And I'm trying to recall now if that change is reflected in the test card procedure or not. I don't have that in front of me. Do you recall?

A. I'm trying to recall, too. Let me see if I have it, okay?

No, the card here is saying maintain the pitch attitude until -- a target pitch attitude until V_2 is achieved. But I think that did not get -- did not reflect the slight change in technique that we determined in February as a result of the Birmingham testing.

Q. Okay. I'm hesitating because I guess that's a little bit new. I guess what I'm hearing is that flight sciences had specified a new technique, meaning maintain pitch to liftoff and then between liftoff and V_2 rotate to a higher pitch so as to maintain V_2 when you get there. But the test card says maintain the pitch until you achieve V_2?

A. Correct. But -- go ahead.

Q. Then you run into the problem I outlined that you can't instantaneously go from 9 degrees or whatever it is to whatever

higher pitch angle you'll need to be stable at V_2 and so you're going to overshoot as a matter of course.

A. Yeah, you are exactly right.

Q. Do you happen to know what the trim pitch attitude would be for 135 knots -- let me just put it this way, what the expected trim pitch attitude would have been for 135 knots?

A. Not offhand. I think it's probably getting up to 14 or 15 degrees, in that realm, because you probably have an angle of attack of about 10 degrees and then, let's see, another 4 degrees on top of that for the climb angle. Let's see, we're getting -- yeah, somewhere in that range, I think, is probably about right.

Q. So, in other words, you would have to increase the pitch angle by 5 or 6 degrees in order to stabilize it at V_2?

A. Yes.

Q. So you don't initiate that maneuver until till you get there?

A. Now, that's where even though the cards say maintain pitch attitude to V_2, we were increasing the pitch attitude as we climbed out to minimize the overshoot in speed just as you are saying. If you maintain your pitch attitude, we were getting entirely too much acceleration and our speeds were going up and our distances were going up.

So we did instruct the pilots to once they lifted off to then start pulling back to chase the V_2 before they got to 35 feet rather than hold that pitch attitude until they got to 35 feet

because otherwise they were overshooting the target speed by quite a bit higher increments than we were looking for.

Q. And this morning, folks were describing -- additionally, I guess the word they were using was sort of -- somebody described it as being hammered into it during the briefings that you didn't want to exceed 11 degrees presumably as a result of the experience during Flight 88 and 132; does that ring a bell with you as well?

A. Yes. I was aware that they had had a couple prior roll-off instances when they went above 11 degrees at the liftoff point.

That's why we were targeting -- we had pitch attitudes targeted below that for liftoff, but above that, the feeling was we were safe to pull back as long as we were below the stall barrier system, the shaker onset point. We felt that it was a safe maneuver to continue the pitch-up after that.

Q. After what, again, after --

A. After liftoff.

Q. Up to 11 degrees or beyond 11 degrees?

A. Beyond 11 degrees.

Q. So to you, what did the 11-degree limit that flight test was talking about, what did that mean or how was that to be implemented?

A. That was a target not to exceed at liftoff.

Q. At liftoff?

A. Correct.

Q. And then once liftoff occurs, the pitch limits are no longer in play; is that right?

A. Yes. That was my understanding that they were then free to increase the pitch attitude to hit the target V_2 speed.

Q. Okay. All right. Now, I can see how the thing comes together then.

Do you know if whether these maneuvers worked in the simulator, you know, lifting off and doing this and achieving V_2, do you know if it was tried in the simulator and if it was successful?

A. No, we never -- to the best of my knowledge, we never attempted to demonstrate these maneuvers in the simulator prior to flight testing.

Q. Just hold on one second, let me look over these -- that might be all I have for you. Yeah, I think that's it. I think I'm all clear. So, thank you, Pat. I appreciate it.

A. Okay. You are welcome, John.

MR. GALLO: John, do you have any additional questions?

MR. O'CALLAGHAN: No, that's it for me. Thanks.

MR. GALLO: Okay, Bill will go next.

BY DR. BRAMBLE:

Q. So when was it that you first learned that they were overshooting the V_2 that led to the work in Birmingham?

A. I first became aware of that probably in January of this year. We went out to Roswell in November, conducted our first

round of performance testing. That data did not get reduced until during December and I didn't see the first results until January.

At that time, it was very clear that we were missing our targets by a fairly significant margin and because of that our takeoff distances were going to be much greater than we had expected.

Q. And who was involved in the work at Birmingham on the airplane?

A. Reece Ollenberg had organized that. Jake Howard was flying it. Do you recall, Tom, who the flight test -- who the copilot might have been on the Birmingham?

MR. HORNE: It was Vivan.

MR. CONNOR: Okay. Vivan Ragusa.

BY DR. BRAMBLE:

Q. We can look it up if you want.

And, so, what was the point of that effort, again?

A. The point of the Birmingham test was to refine our technique to get the target V_2 speed closer to what we were hoping to achieve.

And during that technique, as I was explaining to John, we did -- after they hit a target pitch attitude for liftoff, they then pulled back further and increased the pitch attitude typically from 10 degrees up to 14 or 15 degrees during the climbout to 35 feet and we were able to achieve much lower V_2 speeds, probably only a few knots above our target as opposed to

significantly more than that.

Q. Okay. And during those tests were there any roll-offs?

A. None that I'm aware of. There were approximately six runs conducted at Birmingham in mid-February and no roll-offs that I am aware of.

MR. O'CALLAGHAN: Bill, can I interrupt real quick?

DR. BRAMBLE: Sure.

BY MR. O'CALLAGHAN:

Q. Were those Birmingham runs done flaps 20 or 10 and what was the goal of the pitch target for that, 9 or 10?

A. Right. They were done flaps 20. That's our guaranteed condition. They were all simulated engine-out CTO runs and because they were flaps 20, the target pitch attitude for liftoff was 9 degrees.

Q. Okay. But no flaps 10s were attempted then, I guess?

A. No. We were primarily interested in refining the technique on our main primary takeoff configuration at flaps 20.

MR. O'CALLAGHAN: Understood. Okay, Bill.

DR. BRAMBLE: Okay, thanks, John. Considering you are going to disappear at any minute, if you have another comment or question, please, just interrupt.

BY DR. BRAMBLE:

Q. Was Kent Crenshaw involved in those tests at all?

A. I don't recall who the other pilot was at Birmingham.

MR. REMICK: We can tell you if you'd like to know.

DR. BRAMBLE: That's okay.

BY DR. BRAMBLE:

Q. Was the information from that -- was the outcome of that testing a refinement of that technique conveyed to the other test pilots in some fashion?

A. I'm pretty sure it was and apparently, though, it did not get reflected in the final flight test guidelines. That card was indicating hold constant pitch attitude and that's what was resulting in excessive speed overshoot.

Q. Okay. A little bit about your background. How long have you been with Gulfstream?

A. Twenty-three years now.

Q. Your current position title?

A. Let's see, principle engineer in charge of aircraft performance, also acting group head of the performance group.

Q. How long have you been principle engineer in charge of aircraft performance?

A. I've been a principal engineer now for about 5 years now.

Q. And have you worked at other manufactures prior?

A. Thirteen years as an aircraft performance engineer at Lockheed in Marietta, Georgia, before coming to Gulfstream.

Q. During the presentation last week, you mentioned that you had spoken with Reece about the speeds in the days before the accident, I think.

A. Yes.

Q. Can you describe that conversation?

A. Yeah. I think it was Monday the 27th of March, Reece and I met. I showed him some of the reduced V/V stalls. We looked to see how -- I was concerned about whether our liftoff speeds met the necessary V_{MU} margins: 5 percent above the single engine V_{MU}; 10 percent above the twin engine V_{MU}. So we took a look at that and, quite frankly, marginal. We were just on the ragged edge of meeting those V_{MU} limits.

The other thing that we discussed of significance at that point in hindsight was Reece asked me if I would -- prior to that, and as I reported a week and a half ago at our meeting, we were using a 10-degree target for the flaps 10 configuration. Reece had asked me if it was okay to use a 9-degree pitch attitude for the flaps 10 configuration. Because flaps 10 is not as important from a takeoff distance standpoint, I anticipated there may be a small performance penalty but I didn't consider that that significant for that configuration.

So I mentioned to him that I personally had no problem with reducing the flaps 10 pitch attitude for liftoff from 10 degrees down to 9 degrees.

Q. Okay. What was the outcome of the discussion about the liftoff speeds being on the ragged edge just above the V_{MU} margins?

A. We didn't reach a firm conclusion. It was just noted

that they were right on the ragged edge. The normal liftoff speeds were right on the ragged edge of meeting the margins relative to the V_{MU} speeds. So we didn't have a conclusion. It was noted that we may possibly have to shift things up to meet those V_{MU} limits. So that was just something we were going to monitor as we went forward.

Q. Why do you think that they weren't shifted up before the next week's testing?

A. Let's see, up to that point, we had not reduced the V_{MU} data. And, so, as far as V_{MU} was concerned, if anything, by going to the 9-degree pitch attitude now at liftoff, we were going to be lifting off at higher speeds and have more margin. So that wasn't an issue.

What became an issue was the target speeds that we were using once we went to the 9-degree pitch attitude now put our liftoff speeds at essentially our target V_2 speeds and we were providing the flight crew with an almost impossible task to then pull back immediately after liftoff to hit the V_2 speed.

Q. So -- and Reece was aware of that issue or was Reece aware of that issue?

A. No. Reece was not and we did not become aware of that until, as I explained a week and a half ago, until the beginning of May. We finally got a copy of the draft V_{MU} report that Reece had been working on and once we got that report, we were able to go into the data had been reduced and determine that once the

decision was made to reduce the pitch attitude for flaps 10 to 9 degrees, we should have gone back and adjusted our target speeds upward by approximately 4 knots, as I recall.

Q. All the speeds or just V_2?

A. No, all of the speeds.

MR. O'CALLAGHAN: Bill, if I can jump in real quick?

DR. BRAMBLE: Sure.

BY MR. O'CALLAGHAN:

Q. If that had been done, the resulting V_2 by what was known then would provide an even greater than 13-percent margin to V_{SR}?

A. That's correct.

Q. So, if anything, betting even more conservative, because at 135, as we discussed previously, the thought was that there was still a 13-percent margin, right?

A. Exactly. As you recall on the previous run, 7A1, the target liftoff speed, I think, the target V_2 speed was 136 and it got to 144.5. So about 8 to 9 knots higher.

Had the speeds been bumped up by 4 knots, there still probably would have been about a 4- to 5-knot overshoot but not a 9-knot overshoot.

MR. O'CALLAGHAN: All right, Bill. Thanks.

DR. BRAMBLE: Okay.

BY DR. BRAMBLE:

Q. So essentially, the bumping up of the speeds would have

affected the pilots ability to hit the speeds of the designated target against either rotation at 35 feet, but as far as the proximity to stall or stall margin goes, this information had no bearing?

A. What information is that?

Q. The information that V_{MU} was, basically, approximately at V_2 for a 9-degree turning pitch for the OEI CTO test?

A. Right. I think that just meant that he was just going to miss his V_2 target by a greater margin than he did for the flaps 20 configuration.

Q. So adjusting the speeds upwards just made the test more feasible to sort of hit the speeds at the desired pace?

A. Exactly. It would have provided a more realistic target for the flight crew to hit instead of a very unrealistic target.

Q. But from a safety standpoint, based on what was known, is that negligible or no impact on the safety margin; the change didn't matter from a safety standpoint based on what was known at the time?

A. Correct. The only thing that I'm sure you have heard is that because he was missing his V_2 target speeds by so much, I think the pilot had it in his mind that he was going to attempt to pull back a little bit higher, even though the guidance was clear, no more than 9 degrees during rotation.

Q. But, correct me if I'm wrong, but he didn't exceed 9 degrees until after main gear lifted off?

A. No. I think he, on 7A2, was seeing 11 to 11.5 degrees at liftoff.

Q. Main gear liftoff?

A. Correct.

Q. Okay.

A. On 7A1, he was right at 9 degrees, the target, but on 7A2, he was lifting off according to the data at about 11 to 11.5 degrees.

Q. At main gear liftoff. So even if he had followed the revised prescribed procedure for rotation that was developed at Birmingham and followed it to the letter, which involved continuing to pitch-up after rotation, or, I'm sorry, continuing to pitch-up after liftoff --

A. Yes.

Q. Then this would -- he would not have reached a pitch attitude above 9 degrees until after main gear liftoff?

A. That's exactly right. He was supposed to pitch-up to no more than 9 degrees till liftoff and then continue the pitch-up after liftoff.

Q. Okay. Did Reece have any other discussions with you that week leading up to the accident about how the test would be performed that dealt with target pitch or speed, or just that one discussion on Monday?

A. No, that was our only contact that week prior to him going back to Roswell.

Q. And in recent months, had Reece expressed any concerns to you about the schedule, the flight test schedule, pushing things too fast or raising -- well, let me leave it at that, did he express any concerns about the schedule being pushed too fast in recent months?

A. Not that I recall.

Q. Had he expressed any concerns to you about the safety of the test program in recent months?

A. No, none that I recall.

Q. And was there any requirement to report safety-related events to any person or group within the organization?

A. I'm not aware of a requirement, but I think, in general, if anybody recognizes an unsafe situation, they're -- I would feel obligated to report that condition. I can't speak for other people.

Q. All right. Was there any kind of committee where flight test related safety incidents were to be reported and collected or something like that?

A. After the SRB, no. You know, if during pre-brief, post-brief of any flight a safety issue came up, that would seemingly be one of the key places to mention that.

DR. BRAMBLE: Okay. That's all I have for right now, thanks.

MR. GALLO: I have some questions.

BY MR. GALLO:

Q. Are you a DER?

A. Yes.

Q. Who do you report to, to the FAA?

A. Grant Heaton, who is my advisor at the FAA.

Q. What prompted your concern for the liftoff speeds in March?

A. We were asked -- oh, in March?

Q. I believe when you went to Reece and you started talking about the liftoff speeds.

A. I was just showing him that we had -- I had just been out to Roswell from the 15th to the 25th of March. During the time that I was there, we were not conducting flight performance testing. Instead, they were doing engine flaps rate testing and some other things. But while I was there, we had reduced a lot of the CTO data that had been collected just previously. So the reason for talking to Reece was to show him where we stood based upon the reduced data. I had returned on the 25th. My meeting with Reece was on the 27th. So it was mainly just to show him where I thought we were at relative to our target V-stall conditions.

Q. And typically after a flight lands, how soon is it that you get to the data to analyze?

A. We are, of course, monitoring the data in the TM trailer. Actually, after the airplane lands, frequently it can be days and weeks before we get a chance to go back into the data to

analyze it in conjunction with all of the other data that we've collected. While we were testing in the TM trailer, we are seeing -- looking at a couple of key points on where the final V_2 speed was and a few other critical points but typically, we don't see the final reduced data for days or even weeks after that.

Q. And you mentioned --

MR. GALLO: Oh, go ahead, John.

MR. O'CALLAGHAN: I'm going to ask my last question here and then have to bail.

BY MR. O'CALLAGHAN:

Q. In that regard, did you ever have the opportunity or were you ever asked to take a look at the data from Flight 88 and 132 prior to the accident?

A. No, not prior to the accident.

MR. O'CALLAGHAN: Thank you. I'm going to bail folks so I guess I'll talk to you tomorrow then.

MR. GALLO: Okay. Thank you, John.

BY MR. GALLO:

Q. Regarding Reece's V_{MU} report, how did you become aware of its existence?

A. During that meeting on the 27th. Apparently he had been working on it after he returned from Roswell during a brief respite from the field performance testing. When he pulled out a copy of that report or pulled it up on the screen and when we started to look to see whether we had the sufficient V_{MU} margins,

he was referencing this report. So that was the first time I became aware that Reece had finalized V_{MU} data that was actually collected back in November.

Q. But then during the aero presentation we had, I think it was last week, you mentioned that you looked at the V_{MU} report and that was the basis for adjusting the speed schedule?

A. Yeah. You are exactly right. After the accident, I was asked to look into the derivation of our target speeds that we were using. I subsequently determined that our target speeds seemed to have been developed correctly based upon the V/V stalls schedules we were using.

But it later occurred to me that I needed to take a look at this V_{MU} report after the Roswell accident to see what information it might have relative to our target speeds. I requested a copy of that the middle of April and received it the beginning of May, and within about a week, I determined that once we shifted the flaps 10 target attitude from 10 degrees to 9 degrees, the target speeds that we were providing were no longer valid. They should have been increased by approximately 4 knots.

Q. When Reece asked you if it was okay to use a 9-degree pitch target for flaps 10, did he tell you why he was asking for that?

A. Two reasons. There's an all engine abuse over rotation test that's required. And I guess the other issue that I've already mentioned is the flaps 10 data is not as limiting or is

not as critical as the flaps 20, our primary takeoff consideration.

So I think it was primarily the all engine operating 2-degree over rotation abuse case that he was concerned about. And the other thing was just consistency. We had already adopted the 9 degrees for flaps 20 and so what's the harm of using 9 degrees for flaps 10 as well. I think it was actually those two reasons.

Q. Were you aware of any stall speed updates in March?

A. Let's see. I'm trying to recall. We did step up to an LC version of stall speeds but I was thinking that was prior to March. I believe it was the LC speeds that Shelley had used to develop all of the final V/V stalls that we were using at Roswell 2. So those tables were developed at the latest the beginning of March and possibly late February. I'm not sure exactly.

Q. Were there any changes after the V_{MU} testing to the speed schedule?

A. No, because after the V_{MU} testing, it didn't get reduced until the middle of March. So the V_{MU} test results basically all that told us is that here's a safe attitude, basically 10 degrees for flaps 20; 11 degrees for flaps 10, that you can go to and safely liftoff the airplane.

MR. GALLO: Thank you.

BY MR. PROVEN:

Q. I'm going to focus on theirs. What's LC speeds?

A. That's just a way we designate the tables that we've

developed with certain prefixes. And so back when we were doing our initial testing at Roswell in November, we were then using a K1 table. The K is just a sequential letter to refer to the stall speed variation. The 1, in that case, referred to a 1-degree margin relative to aero stall.

The LC tables were a subsequent derivation where we only had a half degree difference between the reference stall speed and the aerodynamic stall speed.

Q. And the reference in this case is? What is the reference?

A. The reference is the speed that -- when I talked about being at 1.13 V_{SR}?

Q. Right.

A. That V_{SR} is the reference stall speed.

Q. Okay.

A. And that's relative to this margin from aero stall. If the airplane stalls at 15 degrees and we use our reference stall speed then is 14.5 at which we base our V_{SR} speeds.

Q. So you had actually come closer to the stall between the K and the L?

A. Exactly.

Q. One degree to a half of a degree. And I do remember hearing that earlier. It really only referred -- I was thinking V_{LO} and V_S.

A. No, this is just the nomenclature we use in the

performance group to keep track.

Q. Which one is the latest?

A. I believe Shelley Brimmeier covered some of that. She and I work together.

Q. Sure. When you talked about the 14-degree pitch attitude as being approximate, that's through the two -- I presume that's two engines?

A. No, we were seeing up to 14 degrees pitch attitude single engine.

Q. Okay. And 14 degrees would give you V_2 plus something, which would be --

A. Yeah, even at 14 degrees, we were still seeing a slight overshoot relative to our target of 1.13. We were getting to about 1.15 V_{SR} flaps 20.

Q. With two motors or one motor?

A. One motor.

Q. One motor?

A. One motor basically.

Q. That's not what I expected the answer to be so I'm glad I asked it. All right. And actually, John asked this question. My understanding, just to review it, Birmingham, you did flaps setting 20 and you did EIO with continuous takeoff, right?

A. Correct.

Q. And didn't do 10 because it was not your concern. I mean, it's not --

A. It wasn't our primary concern.

Q. It wasn't your primary focus. Had there been any testing at flaps 10 prior to Flight 153?

A. Yes. We did have a fair amount of other data at flaps 10. We had done after --

Q. After the Birmingham sequential?

A. I'm pretty certain in early March, Birmingham was done the middle of February. The middle of -- in early March, we had done some additional CTO testing with flaps 20 and 10.

Q. Okay. With single engine?

A. Uh-huh.

Q. Then my really non-test pilot background shows up right around here. If you -- the way I understood you to say, we're going to move everything up 4 knots. So V_1 is going to move up 4 knots; V_R is going to move up and V_2 is going to move up. I think that's what you said.

A. Well, we should have done.

Q. Well, that's where we would be today based on the --

A. Hindsight, we should have bumped the speeds up by at least 4 knots.

Q. Okay. What I am having trouble getting my head around is if you delay rotation by 4 knots and you rotate at the same rate, you're still going to be shooting above V_2 and there's something I'm missing in that.

A. No, I suspect you're right that we would have bumped the

speeds up by 4 knots, my expectation is that we would still overshoot our V_2 target maybe by 3 or 4 knots as opposed to 8 --

Q. Eight?

A. -- 8 or 9 knots.

Q. Even so, with the airplane accelerated about the same rate, you rotate to the same pitch attitude, you're 4 knots late in the rotation.

A. Uh-huh.

Q. And you bump the other 4 knots up. But it would appear to the uneducated, that's me, that the acceleration rate is going to be the same --

A. Uh-huh.

Q. And I think you are going to have to make that adjustment to your pitch attitude to capture or attempt to capture V_2. Well, and I guess you could do that because you have that margin now. Now, you could be a little more aggressive in your pitch attitude adjustment to capture V_2 and you might -- okay. I talked myself into it. Initially, I didn't see how you could do that but you would just have to be a little bit more aggressive in your pitch attitude adjustment.

A. Yeah. I would -- my expectation if we bumped up the speeds by 4 knots or so, we would pitched up to 9 degrees, lifted off and then we would have still wanted to continue to pitch-up to about 14 degrees in order to get our V_{M2} speed as low as possible.

Q. Right, but there might be a bump up. But I see how you

could capture it now. Initially, I was thinking with the same technique, you'd have the same result but you would adjust the technique slightly to capture.

Okay. You mentioned that there is a two engine abuse requirement on the pitch attitude of 2 degrees. Is there an OEI abuse requirement or do you have to be spot-on for that?

A. The OEI abuse requirement is that you rotate at 5 knots below your normal rotation speed. But you just pitch-up, I think, to your normal attitude and then climb out.

Q. I see heads nodding up and down. It looks like it's the right answer. So, all right, it's just a slightly different abuse then?

A. Uh-huh.

MR. PROVEN: That's about all the questions, so thank you.

MR. REMICK: I thought I had no questions, but now I do.

MR. PROVEN: I keep doing that to you.

MR. REMICK: You do.

MR. PROVEN: That's what happens when an uneducated test pilot comes in here.

BY MR. REMICK:

Q. So my question is, Pat, were you -- the second segment climb gradient, were you close, did you have margin on the gradient at the V_2 speed?

A. Yes. We were testing -- this was a full thrust on the

operative engine and the inoperative engine was really just the engine in idle. At that condition, we were taking off at about 88,000 pounds. First segment, I computed, which is with climb gradient -- with the gear down, we should have had a 4.8 percent climb gradient.

Typically, with gear up, that increases the climb gradient by another percent and a half or two. So we should have been second segment climb gradient, should have been approximately 6 percent, whereas the minimum climb gradient at that point is 2.4 percent. So we should have been, as far as climb gradient, had quite a bit of margin in that particular case.

Q. So my thought was, so in theory, knowing what we know now, it would be possible to give up the V_2 speed to be more relaxed at least from a climb gradient perspective. Obviously, there's several things going on here and one of them is field length, obviously. But from a climb gradient perspective, hitting that V_2 speed doesn't appear to be the most critical factor for you.

A. Right.

MR. REMICK: It struck me. Over to you.

MR. HORNE: Okay. Thanks.

BY MR. HORNE:

Q. Pat, I had an opportunity to go back and look at the G550 takeoff techniques on my iPad and it said that V_R pull 75 pounds in 1 second. Then from liftoff, rotate to a recommended

target pitch attitude and then it had recommended target pitch attitudes to achieve V_2 at 35 feet.

So I was wondering, did we have these for the crew and, if not, is that something we could have provided them or why didn't we provide that to them?

A. For the G5 or the G650?

Q. For the G650.

A. You know, after liftoff we did provide the target for liftoff that we wanted to stay below, but there was not a -- we had not yet established a target pitch attitude that we wanted to be at by 35 feet, which would correspond with the V_2 speed that we were looking for. So that's why, I guess, that the guidance was just pulled back and trying in attempt to get to V_2 speed.

Q. Were you going to factor those angles out of the V_2 and see what attitude you got to and then give that to the customer to recommend?

A. Yeah, that's pretty much what happened in the case of the G5. I was very involved in the G5. And really it was what we finally put in the flight manual, which was just going back and looking at what sort of pitch attitudes we had typically gotten from our flight test data. But I'm not sure when we were actually testing that we had established a good set of criteria. Did your search indicate anything?

Q. No, I was just looking at what's in the manual to see if it would give us something on that.

A. I think what's in the manual came out after the fact. We just looked at what sort of pitch attitudes we were typically hitting on the climbout to 35 feet.

Q. Okay. Do you know what the PLI was set at for Flight 153?

A. Yeah, I think it was set at .9, if I'm not --

Q. And that was .9 of --

A. And then the normalized angle of attack being --

Q. Do you happen to know what angle of attack that was?

A. No, not without the -- I guess we'd have to find the stall angle and the alpha 0 lift and then find out what .9 of that difference is.

Q. Okay. Was the PLI a limit for the crew? If they hit the PLI, was that a flight test limit?

A. That was my understanding that, yeah, it's unacceptable during normal CTOs to have any shaker onset.

Q. Okay. And then I'll just try to jump to this question. Do you know why the PLI was changed from 85 percent to 90 percent?

A. What I heard was they got a few nuisance trips when it was set at 85 percent. So I think this was an attempt to get rid of those nuisance trips.

Q. Okay. And then the following question to that was this change from 85 to 90 percent, was that at the same time that we changed our tables from the K1 to the LC tables, from 1-degree margin to a half-degree margin?

A. I'm not certain. I think I'm just not clear on the time frame. You know, both of those happened between November and March.

Q. I'm just wondering if we had two things happen at the same time that took away more margin.

A. Yeah, you know, for the Birmingham testing, I can't recall if that PLI was set at the .85 or the .9 at that point.

Q. Okay. You know, since what you've said is maintain a pitch attitude until liftoff. I've got a little bit of a follow up to that but how were they determining liftoff?

A. That was being debated whether liftoff -- well, in the crew compartment, I think that's a very uncertain thing. From a flight analyst standpoint, we were having our own debate whether it's the weight on the wheel indicator or whether it's -- if you look at wheel speed, where it peaks out and then starts to decay, I think the general feeling is that that's probably a better indicator of liftoff than the weight on wheel.

Q. I'm more concerned about the crew compartment because you've got a limit until a certain point. But how is that point announced to the pilot? Was there any discussion about, for example, a flight engineer calling liftoff or looking at radar altimeter or looking at vertical speed? Was there any of that discussed in the briefings?

A. To be perfectly honest, I don't know. I wasn't aware of how the flight crew would identify the liftoff point.

Q. Okay. That's fine. And just a couple more here. You said that we instructed the pilots to increase pitch after liftoff. I know you're one of we. Can you tell us who else was involved in the we of, this is the technique we are going to use?

A. I think Shelley was involved, Reece, Ken Oberchain (ph.). We had a meeting in early January to review the Roswell 1 results and it was evident there when we held a constant pitch attitude during our climbout that we were getting very high speeds and needed to reduce those speeds and the thing to do would be to, after liftoff, pull back farther to get those speeds down and convert that excessive speed into climb, get to 35 feet at a shorter time at a lower speed.

Q. Were you there when Kent was getting ready to fly Flight 153? Were you in the briefing, the preflight briefing?

A. No. I had left the week before.

Q. Okay. Then this question doesn't apply.

MR. HORNE: That's all I have. Thanks.

MR. GALLO: I don't have any other questions.

BY DR. BRAMBLE:

Q. Do you have any kind of a sense about how much the revised stall AOA was going to impact the minimum field lengths for V_{SR}?

A. That reduction from half to degree -- from a 1 degree to a half degree was going to have?

Q. No, there was presentation during the performance group

meeting about the CFD and other data suggesting that stall was -- I thought it was more than half of a degree. Maybe it was 1 degree. By I don't know, I should ask you because I have to look at the notes.

A. Well, let's see, you know, during that briefing I guess what the big thing that I took away from it was we had estimated previously that the in ground effect stall angle would be reduced by about one and a half degrees relative to the out of ground effect stall angle.

Since the accident, our analysis has indicated basically twice that amount and that's with no crosswind. With crosswind, it suggested an even further reduction in alpha.

And what it means is that we did not -- when we set up our target alphas for V_{MU} testing, we did not have the margin for those that we thought we had relative to the in ground effect stall, that the original estimates were too optimistic. The later more refined data is showing us being much, much closer to the alpha stall condition.

Q. Just so we have some sort of a rough sense of this, I mean, did these changes from the beginning of 2011 until to now, in terms of the refined stall angles, are we talking about an increase in a minimum field length for takeoff on the order of thousands of feet? I mean, I know it varies by condition, but I have no idea what kind of magnitude of effect this is on the performance test.

A. Are you asking me based upon what I know now?

Q. Yeah.

A. We were basically targeting a 6,000-foot takeoff distance at takeoff, gross weight, sea level, standard day. As of February, when we did the testing at Birmingham, that data was showing just right on the ragged edge of meeting that requirement. We were showing that we were hitting a V_2 speed of about 1.15 VSR instead of 1.13 and it was showing us being right on the ragged edge of meeting that requirement.

Since then, looking at the V_{MU}s that we tested, it was apparent that we did not have our full 5-percent margin and that we would probably have to bump up the speeds in the final flight manual based upon our test data further, and as your speeds go up, so do your distances. And that's what we're currently assessing as we speak, where do we think we're likely to be after all is said and done. And right now, it's very uncertain.

Q. You don't have an answer?

A. It's probably going to be in excess of 6,000 feet, but to say it's going to be 63-, 65-, 6800 feet -- until we determine the new technique that satisfies all of the margins, it's very uncertain where we'll wind up.

DR. BRAMBLE: That's all I have.

BY MR. GALLO:

Q. What is the latest in ground effect stall angle?

A. For flaps 20, it's -- let me get my numbers right, 10.8

degrees. For flaps 10, it's 11.8 degrees. That's symmetric estimated stall based upon the CFD work that Bob Mills has done.

Q. And what's your free air stall angle effect?

A. It's on the order of, let's see, 15 degrees flaps 10, and probably 14 degrees flaps 20.

Q. And then you had mentioned the latest procedure captured V_2 at 14 degrees pitch angle?

A. Pitch attitude.

Q. How does that translate into AOA?

A. Typically, what we would -- the way it was coming out, the pilots were holding a fairly constant alpha, and by holding a constant -- so you pitch-up to your target alpha and then they were holding fairly constant alphas.

So in the case of flaps 20, 9 degrees, and then letting the pitch attitude build up -- the pitch attitude is a combination of the angle of attack plus the gamma, the flight path angle. So as the gamma built up, that was the increase. The angle of attack was remaining fairly constant.

MR. GALLO: Okay. Do you have anything that you'd like to add?

DR. BRAMBLE: Just one more.

BY DR. BRAMBLE:

Q. And just to clarify because you said it was bumped, the stall angle of attack for 10 degrees, I think it was 10 degrees, bumped up about a degree in January and then it bumped up another

degree after the accident?

A. No, let's see. The stall angle, we did sometime in January, we went from the relative to the aero stall where we're using a 1-degree margin prior to January for our reference stall. And then somewhere in the February time frame, we cut that back to just a half degree relative to the aero stall. Is that --

Q. I guess what I was after was what was the evolution of the understanding of the stall angle at 10 degrees over time?

MR. PROVEN: Ten degrees of flap or 10 degrees of pitch?

BY DR. BRAMBLE:

Q. Ten degrees of flaps, because currently it's estimated at an 11.8 based on the computational dynamics.

A. Right. That's the in ground effect stall. So it was probably the -- out of ground effect was right at 15 degrees, so that's a 3.25 degree difference. Prior to the latest estimation, I think our aero stall estimate was probably exactly in between the two. So it would have been, let's see, 15 minus a degree and a half, probably about 13.5 -- 13 to 13.5, when we did our Flight 153, was the best guess of where in ground effect aero stall would occur.

DR. BRAMBLE: Okay. That's all I have.

MR. GALLO: Quick one?

BY MR. REMICK:

Q. You had said when you looked at the data for the reduction from 10 degrees to 9 degrees pitch attitude on the 10

flaps takeoffs, that the bump in speeds, all of the V_1, V_R, V_2, was really for fly-ability -- I'm calling it this, that's my word -- fly-ability, to make it easier for the pilot to fly. Was there a need to bump the V_R, V_1 speeds? Were there any other requirements that were pushing those speeds? I think you mentioned it was common to move all at once, but is it possible to keep V_R, V_1 the same for field length and bump V_2 for, again, my word, fly-ability?

A. From a performance standpoint, generally, what you want to do is bump all your speeds -- and when I say all the speeds, we can leave V_1 out of it for the time being -- V_R, V-liftoff and V_2. If you just bump the V_2 speed, what will happen is now you're beginning to rotate to a higher drag configuration much earlier and so your acceleration isn't nearly as good as if you keep the airplane in a low 3. attitude where you have minimum drag, accelerate in that configuration, and then when you feel you can comfortably rotate and hit your pitch attitude, you want to do that as late in the game as possible. From a performance standpoint, distance standpoint, if you begin to rotate earlier into this high drag configuration, then your acceleration slows down considerably and you pay a performance penalty. So generally, we prefer to rotate as late in the game as can and still just hit our V_2 speed.

Q. Yeah, the reason I asked, really, I guess because it sounds like the issue that you were trying to solve was

overshooting V_2s by a lot, by, you know, 8 to 10 knots, but otherwise, the original set of speeds were okay, were fairly comfortable. The rotation speed was comfortable but the V_2 speed wasn't achievable. So I was just kind of curious how to balance that.

A. Yeah, and actually one of the key points, remember, we only changed to the 9-degree attitude, flaps 10 just prior to Flight 153. Up until then, we had the 10-degree attitude and that was because, once again, flaps 10 has a higher stall angle by about a degree than the flaps 20 configuration. So when we originally setup our target pitch attitudes for liftoff for Roswell 2, it was 9 degrees, flaps 20; 10 degrees, flaps 10.

Under that basis, the original target speeds that we worked up for testing at Roswell were on a sound basis. Our liftoff speeds were slightly above the minimum liftoff speeds that would go with a 10-degree pitch attitude. But when we lowered our pitch attitude just prior to Flight 153 to 9 degrees, the minimum liftoff speed that you could reach at a 9-degree attitude was now, in essence, what our target V_2 speed was and there was no way the pilot was going to --

Q. To get there from here?

A. Yeah.

MR. REMICK: Great, thanks.

MR. GALLO: Do you have anything else that you'd like to add or comment on?

MR. CONNOR: No, I think that's as much as I know about it.

MR. GALLO: Make sure.

(Whereupon, at 7:10 p.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD
INTERVIEW OF:	Pat Connor
DOCKET NUMBER:	CEN11MA258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 16, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha Wheeler
Official Reporter

_____

Lourie J. Brown
Transcriber

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*
	*
AIRPLANE ACCIDENT	*
ROSWELL, NEW MEXICO	* Docket No.: CEN11MA258
N652GD	*
	*

Interview of: PAUL DONOVAN

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Thursday,
June 16, 2011

The above-captioned matter convened, pursuant to notice, at 3:05 p.m.

BEFORE: MITCHELL GALLO
Accident Investigator

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I N D E X

I N T E R V I E W

(3:05 p.m.)

MR. GALLO: On the record.

This is an interview with Paul Donovan.

Paul, I thank you for coming today. The purpose of the interview is for safety purposes and nothing to do with enforcement or regulatory action. I just want to make sure you understand that.

INTERVIEW OF PAUL DONOVAN

BY MR. GALLO:

Q. Why don't we just start out by describing, you know, your title and what your responsibilities are within Gulfstream?

A. I am the group head for flight test engineering, so all of the flight test engineers technically report through me. But in addition to do that I am also responsible for conducting some of the testing as required field performance flying qualities mainly. And I am also an FAA DER.

Q. Who do you report to as a DER in the FAA?

A. My advisor is Grant Eaton.

Q. How long have you been in this position?

A. The group head role?

Q. Yes.

A. Approximately 2 years. Maybe a little bit longer than that. I don't remember exactly.

Q. What did you do prior to that?

A. Flight test engineer here at Gulfstream.

Q. The total amount of time in Gulfstream has been how much?

A. About 9 years and 9 months.

Q. What other programs have you worked on within Gulfstream?

A. When I first came in I worked the G5SP program. I did the field performance there with Kent. I did the G4X program field performance and flying qualities. And I have worked on just about every special mission program the company has: the Japan Coast Guard, SEMA program, CAEW, Swedish fin cap. All sorts of little modifications, mostly flying qualities but some field performance.

Q. And as group head, how is that different from the other two people within that org line, Phil Burton and Bill Osborne? What's the difference between group head or how is that defined versus --

A. Well, Phil is also a group head. He just has different people reporting to him and different tasks that he is responsible for.

Bill is just sort of, even though he is in that same line, he is not a group head. He is sort of like -- even though the tech specialist is a title in engineering he is sort of like a super tech specialist.

Q. We talked to Shelley earlier in the day and she had

mentioned that Reece was working on a draft report.

A. Correct.

Q. And I haven't seen the report so I don't know what the particulars are. Was that a report that Reece took upon himself to work on or is it part of the normal company process in reporting flight test results in data analysis and reduction?

A. It's a normal process, and the way we operate is when you write the test plan you are also responsible for conducting the test, doing the flight cards, being on board, doing the debriefs, writing the report, analyzing the data and finishing up. So it is -- you do it from the start, you go all the way through. So, if Reece was assigned the field performance, which is everything underneath it, and it was up to him to, if he needed help he would ask me for other people to help, but he had some other people working in field performance also.

Q. Now, this draft report did it relate to a specific test point or flight within the test point?

A. All the V_{mu} testing that we had done for the program.

Q. Looking at his duties, it seemed like, and he was managing the flight test but then he was also doing data reduction and analysis.

A. How do you mean managing the flight test?

Q. I guess --

A. He was responsible for the field performance flight test plan. He was responsible for writing the cards. But that's just

a normal duty. When you have a test plan and especially when we go off site, the FTE in charge, he is responsible for looking for what needs done, figuring out when it needs done, coordinating with flight ops and then doing all the briefs to make sure that we have everything done. So, yeah, he -- it was -- if you want to use manage in that term, he was managing it.

Q. Yeah, and I guess I don't know for lack of a better word. But with all those duties does he really have time to do data reduction analysis? I know he had other people helping him with that but I don't understand your processes as well within Gulfstream because I haven't worked for Gulfstream. So is that too much for one person to do all that?

A. No. And certainly not for him because that's the reason that he came to the company was to be able to do that. He wanted -- his previous job when I worked with him before was doing data analysis and doing the similar tests up at Lockheed where we did the same thing. We'd fly the test points, write the plans, and do the reports. So when that was available here he wanted to do the same thing again.

Q. And the draft report, who else was working with Reece on the draft report?

A. I'm not sure who else was working on it. I imagine he was probably doing most of it. I don't know who all he had sent it out to review, but he was probably working on most of that himself. I do have a copy that he sent me just before we swapped

places in Roswell, though.

Q. Let's take for example Flight 088. After that flight finishes, it's on the ground, does the FTE then create a report?

A. There is supposed to be a sort of a after the flight flight test engineer report, which is a brief summary that includes takeoff and landing times, because people are interested in that. And a very brief summary of what was completed in the flight, if there were any engineering issue, any maintenance issues and instrumentation issues, and then a general plan for the next day.

Q. Does it also cover -- well, let's say successes and failures or it didn't meet its test point criteria?

A. It may. It depends on the FTE and the amount of time they spend on them. Some people write them very detailed. Some of them don't. Typically it's not intended to be a data results review. It's supposed to just say these are the points we have completed.

Q. And is there also a separate report by the air crew putting their experiences down in some report separate from the FTE or are they combined?

A. I don't know for this one if we have seen pilot reports. Sometimes on previous programs there have been pilot reports that I have been working on and Kent was a good one to do that. And I don't know that we have been doing them, at least I don't think I have been seeing them on the 650.

Q. And I believe Shelley had mentioned that there was an update on the speed scheduling that was presented to her in March that was from the aerodynamics group. I've forgot the aero person's name.

A. Pat Connor?

Q. No, it was Bill; I'll come back if I need to look at the name.

A. Because I thought she was the aerodynamics group.

MR. O'CALLAGHAN: Bob Mills.

MR. GALLO: Bob Mills, that's correct.

MR. DONOVAN: oh, okay.

BY MR. GALLO:

Q. So he, I guess, presented her with an Excel spreadsheet of updated speeds in March --

MR. RAMEE: Can we go off the record for a second?

MR. GALLO: Let's go off the record.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY MR. GALLO:

Q. Let me just back track then. It wasn't Shelley that received the updated speed schedule. That came from Bob Mills. He had some product developed.

A. Well, he doesn't generate the speed schedules. That comes out of the performance group that Shelley, I believe, is the

group head for. Bob works mostly with wind tunnel data, design, things like that. So he looks at seal alpha data and I think he's pretty heavily involved in the, I guess it's high incidence protection feature function on the airplane. So where the settings are going to be at for the stall system.

Q. Okay. And there's an Excel format, the spreadsheet format that this is all presented in, the stall, update stall speed.

MR. RAMEE: I think the V speeds, the updated V speeds were presented to Cynthia in an Excel spreadsheet, is the way I recall the testimony.

DR. BRAMBLE: Let's go off the record.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY MR. GALLO:

Q. All right. Paul, what do you know about any stall speed updates that occurred in March?

A. I know they have been working on the stall speeds and trying to provide updates. I'm not sure what the official latest versions were that were used before the --

Q. All right. Because it's Shelley that had mentioned that there were stall speed updates and they were in an Excel spreadsheet format, and then I started looking at placards 153 and 153 on limitation instructions and there is item number 4 -- its

Aero-10-033 Revision A, and it says "GVI stall speeds revision A.xls." I'm wondering if that's, that was the most up-to-date stall speed prior to 153 or that was what Shelley received?

A. Don't know. I wasn't there for that flight.

MR. GALLO: That's all the questions I have for now. John, you are up.

MR. O'CALLAGHAN: Thank you.

BY MR. O'CALLAGHAN:

Q. Thank you, Mr. Donovan, for taking our questions. Sorry I'm over the phone, can't be there in person, but I appreciate your taking the time to be with us.

The same questions we went over Shelley and Cynthia. Can you describe from your point of view the relationship between the flight test organization and the flight sciences organization and the flight ops organization and what they do, what their responsibilities are and the relationship to each other, in particular, regarding the sort of test, sort of field performance testing?

A. Man that's a tough one to answer. So the relationship between flight test, flight sciences and flight ops in regards to the field performance; is that correct?

Q. That's correct, yeah.

A. I'm not sure I even know where to start. I really don't know where to start. How far back do you want to go?

Q. Well, maybe it will help if I give you my background so

maybe you can see where I am coming from. Way back in the day I used to work at Boeing in stability and control and left the company before I actually got to participate in any actual flight tests, but I was a very heavy consumer of flight test data and updating simulator databases and things like this.

So when I was there I kind of saw our group as a customer for flight test where basically we would tell flight test we need these sorts of data, these measurements, these conditions so we can get the data for our simulator database or for cert or whatever else there may be --

A. Okay. I think I know where you are at now.

Q. Yeah. The flight testing data you have to kind of figure out how to get that data and make sure that the instrumentation was right and then do some preliminary cleaning on it and filtering of noise, you know, cleaning up the data. Then they would put it on a big server where we would go grab it and do our analysis. So I saw it as sort of a customer supplier relationship.

A. Okay. Just in my experience in all the places I have worked, it's really kind of two ways that flight test organizations are set up. One of them is just like that where they are sort of a customer support based where they go gather data and then they do some preliminary data quality checks and then they hand it over to engineering and that's all they do. Then there are other companies that do it like Gulfstream does

where the flight test engineering group will take more of a responsibility of the data and do more with it.

So in general, at the beginning of the program the engineering disciplines, like flight sciences, were supposed to identify certification requirements in a document and then it was up to the flight test department to take those documents, make sure they were right, fix them and then write test plans based off of those requirements to gather the data to be able to show compliance at the end of the program. Flight test is responsible for writing the reports that will show compliance with all of the FAR regulations.

Is that kind of what you are looking for?

Q. Yes. But then also, you know, I mean Shelley was present on site at Roswell and I think a couple of engineers from her group were also there.

A. Correct.

Q. So they were all participating in some way. Can you elaborate on that? What their role as you would see it at the test site would be?

A. Yeah. In the past programs, at least since I have been here at Gulfstream, there has always been some need for some engineering support and they always come out on the field performance sometimes to provide some specific numbers, because we don't have access to all of the engine decks so they run specific things to give us test conditions. They also are responsible for

all the field performance predictions. So we don't have access to all those numbers. They come out and support that way. But there's always differences; when we reduce data it doesn't match the prediction in previous programs. So what we have been trying to do on this one specifically is have a more integrated team between the flight sciences performance people specifically and the flight test engineers responsible for the performance.

So there has been a lot of work done to coordinate data reduction and analysis methods, how we were going to look at the data, what we were going to consider, how we were going to choose different parameters, what the right ones were that needed to be looked at so that we wouldn't have a long data review at the end to try to resolve differences. So the intent was to have one group of performance people, half flight test, half flight sciences, looking at all the data.

Q. I see. And from our earlier conversations in the morning I got the sense anyway that there's sort of two things to do with data. One is to collect it and be satisfied that what you have collected is what you want. And then the second is to actually reduce it and analyze it and draw some more elaborate conclusions from it. And given time pressures and the busyness of things there's a lag between those two. So, I guess the question is do you agree with that assessment and, if so, what's time lag between data collection and data analysis as you see it?

A. There is a lag. However, I would think that what we

were doing I'm fairly sure, and this is my own opinion, that nobody would have gone on the airplane had they thought that we had been going too fast or we were doing something that was unsafe. I mean, I have known Reece for a long time and he was a good engineer, knew what he was doing. So if he had any concerns of doing it -- we talked all the time and he wouldn't have gone on the airplane if he wasn't ready to go. Same with Kent. So I don't think that they felt a direct pressure to go fly, although I'm sure there was some subtle pressure somewhere.

Q. Thank you. Changing gears a little bit. There was some discussion this morning about the yaw damper, IFR and the reasons for that and I don't know if we heard exactly what the reasons for the IFR was; perhaps you might know.

A. I'm trying to think back when we had it. We had the yaw damper IFR, oh, yeah, there was a -- yeah. There was an incident at one point when we brought the FAA down for a week of demonstration flying and it seemed every time they went on a flight something unexpected occurred. One of the incidents was -- I can't remember if it was out of a landing. I think what we were doing was multiple takeoffs. We had done a landing, came in, taxied around, made a 180, got back on the runway and started another maneuver and apparently the yaw damper was incorrectly coded so it was -- it had a yaw rate input that was not giving us the correct rudder command for pilot input.

MR. REMICK: For clarification, I was the pilot at the

controls of that flight. I mean we didn't explore this, but I probably know as much about that one as many --

MR. O'CALLAGHAN: If you care enough to elaborate, please do.

DR. BRAMBLE: Let's go off the record for just one minute.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

MR. O'CALLAGHAN: What's the outcome of all that?

MR. DONOVAN: Ask your question again.

MR. GALLO: Ask your question and you can get an answer.

BY MR. O'CALLAGHAN:

Q. I guess the question was what was the yaw damper, the reason for the yaw damper IFR and did the reason eventually get cleared up and, if it did, when?

A. The reason for the yaw damper IFR was an incident during an FAA flight that we found that the yaw damper was incorrectly coded or operation on the ground gave -- it had a yaw rate term applied in the wrong spot that countermanded the pilot input on correct. It was written up after the flight as a PR. I don't know the exact date that it was closed, but we had been operating in subsequent flights with the yaw damper off.

Q. Okay. Thank you. And on a different topic kind of going to stall and free air, I'll ask two questions in one. When

you do free air stall testing what sort of things identify the stall and then how do you identify Vsr based on that?

A. When we did the aero stalls -- they haven't done any aero stalls here. All the other airplanes have had a stick pusher, so previous aircraft are the stalls identified by the pusher and then the shaker is at a certain increment prior to that. But the aero stalls are either identified by a G break, a pitch-up or a roll-off. That's just the typical aero stall, how it happens. But I don't know, I have not finished -- started reviewing the aero stall report or the stall speeds report for the G650 yet.

Q. And would the Vsr be the 1G speed at the alpha which that G break pitch-up or roll occurred?

A. I believe that number is selectable by the applicant. And I'm still not sure exactly where that's being set. It seems to, there have been some changes to it so I'm not currently aware where it is at.

Q. Okay. So were you aware of the roll events on 088 and 132 when they happened or shortly after they happened?

A. Yes. I was in Roswell when the Flight 088 occurred. Once we came back from Roswell there were two briefings: one that Kent Crenshaw did that was done for pilots, and Reece had done one, actually on the 29th of November, that kind of went through all the testing we were doing in Roswell, but he did spend some time on that incident.

Q. And what were the conclusions; what was said about it?

A. I believe the conclusion was that it was an over-rotation. I don't remember anybody mentioning anything about stall. It was -- I think it was an 8-degree roll and then a 3-degree roll, if I'm getting them straight, was recovered easily. And the -- I believe the action that came out of that was we had to change one of our safety test safety hazard analysis documents, because even though it said make sure you do all the appropriate buildup maneuvers, what we had done is -- as the pilots are out there they alternate flights left seat; each guy on the next flight subsequently moves. We had that, I believe, that V_{MU} card was from a previous flight that didn't get conducted. So we kept trying to fly it.

Just so happened it was on the flight where Kent was in left seat and he had not done any previous V_{mu} maneuvers. So it was essentially his first V_{mu} point on the 650, although he's done the V_{mu}s with me on G5SP, G4X, special mission airplanes before. So it wasn't his first one ever. So I believe that was partly what the conclusion was, because the TSHA was revised to say, make sure that the -- roughly, make sure that the pilot has done buildup maneuvers also not just all of the buildup maneuvers identified in the test plan.

Q. Okay. Was an explanation of the physics for why it rolled delved into or was it just assumed that there -- low separation going on or --

A. It wasn't stated in anything that I have seen. I don't know that anybody stated anything related to that, no, not that I know of.

Q. How about now -- recall if the stick shaker activated on any of those flights?

A. I'm trying to remember. I can't say for sure. I know they -- no, I can't say for sure.

Q. But in a normal program would the intent of the shaker be, well, let's presume that the roll event was due to full separation or an amphibian stall, the intent of the design that it would alert before those rolls occurred or is there some additional tolerance allowed because it's a test program, or can you speak to that general topic? What would be expectations in terms of stick shaker and a roll event?

A. On previous models we have had the stick shaker activate well ahead of any kind of roll or anything even considered close to stall. There is significant margin on previous models of Gulfstream airplanes. On this aircraft there is not so much margin allowed -- well, not allowed, but not so much margin being taken advantage of for various reasons. And I haven't followed the latest setup of where the stick shaker is going, but I don't know that it is being used as a stall warning at this point but I am not sure of that.

Q. When you say there's plenty of margin on the previous program, are you talking in the production version or even during

testing?

A. I'm talking about like G4X, G5, G5SP.

Q. Right, but the production, great number of airplanes or even their flight test configuration?

A. Yeah, in production. In production and in flight test.

Q. Flight test. And so you said there were several reasons for the difference with this airplane. Can you briefly elaborate on what some of those reasons might be to change the --

A. They were trying to get as much available alpha out of the airplane because that's one of the things that was sacrificed on previous models. There was performance that we weren't taking advantage of because we did have such a large margin between the aero stall and where the stick pusher was set. So the belief was they could gain some additional performance by being a little bit more aggressive with where the new settings were on the 650.

Q. And I'll just read between the lines. I guess there's a demand for that increased performance on this airplane because it's heavier or --

A. I don't know if it's a demand but there is a performance guarantee that the company was trying to meet, whether they needed to set the stick pusher or the high instance protection feature and the alpha SR to meet that, I don't know. I can only assume that that's part of the reason.

Q. Okay. Thanks. I got some questions about the stall warning logic, but I'm almost -- and I have a presentation that

outlines it and has all these flow diagrams and things. I'm almost thinking it might be more efficient to maybe send that as a question in writing than to try to delve into it in this format because it's looking at diagrams and these sorts of things.

But I will ask about the flight control system logic, and I know there's a normal mode in our first flight mode and then our alternate law and direct law and -- sounds a lot like an A320 and I guess Poly is the vendor behind it so maybe that's not surprising. But can you briefly run through what the flight control modes are and, you know, normal direction and alternate and, in particular, describe any differences between the first flight mode and the normal mode and what was intended for the field performance?

A. For the field we intend and have to certify it using the normal mode because that's the final TC configuration. First flight mode was only actually intended to be used for first flight, but with all of the outstanding work that needs to be done on the flight control system we typically fly in first flight mode for most flights and we were doing that for all of the field performance, I believe, to date.

I'm not very familiar with all the flight control differences, but I believe that the big difference from normal mode to first flight mode was an NZU control law and I think the first flight mode was designed more of just a simple cable replacement logic. I'm trying to remember now ultimate mode and

direct mode. One of those modes has just two gains, fixed gains that you operate the system in and I can't remember the difference between them. Those aren't modes that we typically do any of the testing in.

And I think in first flight mode a lot of the protections are not available, which I don't -- in first flight mode the high incidence protection, stall protection system isn't active. But what's available is an interface from Telis that let's us go in and set values in the system. So we can go in and set a shaker value at some normalized alpha so that we can use it as a stall warning.

Q. All right. And, again, the -- so even in flight testing the first flight mode the hesitation would be that you would get stick shake before any indication of stall; is that correct?

A. Yes. The way we were using the system, I believe is the way, that way. We were setting a normal alpha to give us a warning prior to getting into any stall condition.

Q. Okay. And you mentioned on the yaw damper flight when they got back they wrote up a PR; I think that's like a problem report?

A. Yes.

Q. But was a PR written after 088 or 132?

A. No. Not that I'm aware of because it was not identified as -- at the end of the day or probably in the debrief if it was identified as an aircraft problem that's one that would be written

up. So my assumption is that since they didn't identify it as an aircraft problem they didn't write anything up. I'm not aware of any PRs written up for those two specific incidents.

Q. But would a stall that occurred prior to a warning, would that be considered an aircraft problem?

A. It would be identified probably as an engineering issue. I don't know if it would be a problem report though.

Q. Not necessarily a system malfunctioning so much as --

A. Right. It may have been an issue for further review and it might have drawn attention and further discussion with engineering groups, but I don't think a problem report would have been written for that.

Q. I am going to ask just a couple more questions here along the same lines I asked the other folks. I'd like everybody's opinion on how -- if there's an analogous thing to the limitation section of an AFM for airplanes that are in operation production, if there's an analogous set of limitations for flight testing, and if there are, are those transmitted to the pilot via the procedures in the test cards or by some other means, and then how much -- and then -- you can answer that, then I'll follow-up -- I'll give you a heads up about what the second question is going to be -- how much flexibility the pilots have to alter the procedures spelled out in the test cards, and if they choose to do so is there some kind of a buy-in required from the team or can they kind of decide to do that on their own?

DR. BRAMBLE: I can't even follow all the parts in your question, John.

MR. O'CALLAGHAN: All right. As I explained to Shelley in the very beginning, this is the first day I have ever interviewed anybody. I am usually looking at data, so I apologize for my clumsiness.

BY MR. O'CALLAGHAN:

Q. The question is in terms of the, you know, in production aircraft in the AFM there is a limitation section, things that the product cannot exceed. And I'm wondering if in the flight test, while they are doing flight testing if there is a similar set of limitations that even the flight test pilot should not exceed and how those are transmitted to him?

A. Well, there is a preliminary AFM that's used during the test program. So we do have that document available.

Now, as far as when we are doing test are there specific limits and where are they defined, a lot of times those will be defined and identified in the flight test plan. Some of the other places would be in the safety review board that's always held, and mostly it would be in the test safety hazard analysis documents, TSHAs. So, those are the ones that will say you have a certain crosswind limit, it's got to be day BMC, limitations like that.

Now, if there's -- as you go through the tests if something comes up where you find something doesn't work or you identify a limit, then anything like that gets done in the brief.

And as I'm thinking there are a lot of places where these limits come in. Every time we brief we go through the list of interim flight restrictions, which has been started since the first flight of the program. So anything still active on that aircraft those are reviewed for applicability for the test aircraft that you are on. So if there is any limitation those are gone over and then they are tracked.

Q. Okay. And so, for example, the maneuver we are talking about where continuous takeoff, you rotate, or you accelerate, you cut the engine at a certain speed, you rotate at a certain speed, you go for a pitch angle and then target a V_2 speed. And the implication there is that you would maintain the pitch limit until you got your V_2 speed. So does that step-by-step procedure does that constitute sort of a limitation on how the maneuver should be executed or does the crew have the liberty to sort of vary it as they go along depending on how things are going?

A. I'm not sure what you are getting at about varying. But the test procedure that's in the plan gets put onto the test cards, gets briefed to the pilots. If there's anything that's not clear or anything that needs changed it's identified in the pre-flight briefing. And if everybody agrees to it, including the engineering support who is there, the flight test engineers who are on the flight and the pilots, then the card gets redlined and flown to that.

Major changes to procedures are not done. If there's --

for example, we did a pitch limit of 10 degrees on one of the cards. It was decided in an engineering meeting prior to that to change it to 9. Well, the card wasn't correct so we changed it to 9. So everybody marked that up. I mean that's typically where it's done. But the procedures, in general, if it is a large deviation from what is already planned, it's not usually revised and done as a different way of doing the test on the fly in the brief.

Q. Would omitting the pitch target from the procedure be a major change? Say, well, we are going to rotate and go for V_2 right away, would that be a major change?

A. That would probably be a major change because it's identified in the plan as having a pitch target and I think all of the AFM procedures have a pitch target and then once you get to that pitch you go to V_2 at 35 feet.

Q. Okay. Thank you. I think I'm running out of ideas. So thank you very much.

A. You are welcome.

DR. BRAMBLE: Okay. I think I'm up next.

BY DR. BRAMBLE:

Q. Well, you mentioned that Reece had some other people that had been assigned to assist him in the field performance work and that he could request others as-needed. Who were the other people that had been assigned to him, to assist him?

A. I believe Valerie Thurston was doing field performance,

Cynthia Townsend; those were the prime ones. And then I was also helping. And that was in addition to the three people from flight sciences, or actually, I think there may have been more.

Q. Which portion of the flight test plan was he responsible for executing, or was it all of it?

A. The field performance plan, the whole thing.

Q. The whole thing?

A. Right.

Q. Okay. All right. And backing up a little bit, I'm not sure, did we get your date of hire or how long you have been with Gulfstream?

A. Yeah, 9 years.

Q. Who did you work for in the past in the aerospace industry?

A. Grumman Aerospace; Northrup; Northrup-Grumman; D. Howard Corporation; Lockheed Martin.

Q. How many other aircraft certification test program do you think you might have worked on over the years cross all those companies?

A. It would take a while to count them all up. I don't know.

Q. Could be in the dozens?

A. Easily. Now, half of those were military, but there were military requirements to be met, too.

Q. All right. What was your understanding of Reece and

Dave's role on Flight 153 in terms of what they were supposed to be doing during each test flight or during each card that they flew?

A. What we had been trying to do is typically would have been using one flight test engineer on board early in the program mainly to monitor the flight controls and then he was also being a test conductor. We were finding that that role was just too much for one person to do. So we were trying to, after we were comfortable with the airplane we were trying to get more people experienced on the airplane and familiar with the flight controls, what to monitor, how to watch it and just get everybody more experienced on the airplane. So we were having two people on board where we would have one primarily watching the flight controls and then one functioning as sort of the test director in those roles. So then we could have a better review of the data during the flight and when we got on the ground.

Q. Okay. Which of them was doing which?

A. I couldn't tell you that.

Q. And you said you knew Kent from prior flight test work?

A. Yes.

Q. How long had known Kent? How well did you know him?

A. I flew with him. He was probably the pilot I flew with the most here. So 10 years worth.

Q. What kind of a guy was he? What was his personality like?

A. Don't get any better than that.

Q. Was he an extroverted or introverted kind of guy?

A. He wasn't introverted. He was very friendly, willing to talk, liked to tell you about his experiences, very knowledgeable. I think he taught at the Air Force Academy so he understood not only how to fly the airplane but why they flew.

Q. And how about his -- what was your impression of his competency as a test pilot?

A. He was probably the safest pilot in the company. He was -- in more times than not he was more conservative, and on some programs we had points that went out exceeding the envelope because that's what the requirements would do and he always argued that he didn't want to do that because it wasn't required, don't need to do it, and it was easier to just write the report and explain why we don't need to do it and that everything is fine. So he was -- he always erred on the conservative side.

Q. Did you feel like he was capable of being assertive if he felt that he had a concern, a safety-related concern?

A. Absolutely. We had lots of discussions about safety issues, crew makeup and who needs to be on and who doesn't need to be on it.

Q. How about Vivan, how well did you know him and can you describe him a little bit?

A. I didn't know him very well. I think I have only -- I only flew with him once. I think he just recently came over onto

the test side from product support so I didn't really know him very well.

Q. From your limited experience did you form any impressions about his personality or interaction style?

A. No.

Q. How about Reece, I understand you guys knew each other well. How many years?

A. Can I have a minute?

DR. BRAMBLE: Sure. Let's go off the record.

(Off the record.)

(On the record.)

DR. BRAMBLE: Let's go back on the record.

BY DR. BRAMBLE:

Q. I know this is difficult and I apologize for having to ask you about this stuff. I know it's difficult to rehash. I do want to document how long you knew Reece and how well you knew him.

A. I knew him well. I knew him since probably the late '80s when I ran into him through a mutual friend out in California. I ended up working with him. So I knew him not through work at first. We ended up working together at Lockheed on the C130 for a while there. And then typically everyone shuffles around different companies. We kept in touch and knew where everyone was and when I had the opportunity to bring him in here I did.

Q. Okay. And how would you describe Reece's personality?

A. He was very easy going, non-confrontational and he was very technically adept. He knew what he was doing. That's why we hired him because he could handle the job of doing all the field performance.

Q. How assertive was he if he had some type of concern or had a conflict?

A. If he had a concern about something on the flight he would voice it. He wouldn't have allowed himself to be steamrolled into doing something he felt unsure of. He wasn't as outgoing as maybe the typical flight test engineer, but he certainly had no -- I don't know what the right word is. He would not have allowed himself to be talked into something he didn't feel was right.

Q. How about Dave, what kind of a guy was Dave and how well did you know him?

A. I knew him probably for about since I think early '90s when I met him at Lockheed. So I met him at work and, same thing, kind of kept track of what he was doing all along. He was more of an outgoing type person. Again, he technically knew what he was doing. Same thing, when we had the chance to bring him up here from the Dallas flight ops department to help out for a while we took that opportunity because he was an expert in air data systems and he was always willing to do whatever it took to help get the job done.

Q. All right. And, to the extent possible I'd like to find out about any interactions that you might have had with these four guys in the 72 hours before the accident. That would have been from Wednesday through Saturday morning. Maybe we should start with the easy ones first. Crenshaw and Ragusa, did you interact with them much in the days before?

A. Well, the way it was set up I was out in Roswell for those previous 2 weeks. Don't know the exact dates.

Q. Prior to when Reece went out?

A. Right. Reece, Dave and Vivan came out on the 1st. So for the previous 2 weeks I was out in Roswell and I flew with Kent and Chip King and Gary Freeman. So I don't know if anyone explained, we had a rotation going on. So the previous week within those 72 hours it was Kent, Chip King, myself and another flight test engineer were on the aircraft flying. So the only interactions with -- I had none with Vivan. With Dave and Reece it was by e-mail. And then the day that they came out and the rest of the crew went back we passed in the lobby of the building, had lunch, had about a 1-hour turnover of what we had done, what they were going to do, what the plans were, when the team was going to come back in the following week. We discussed some FAA letters that were sent in about our program and schedules. Then we got on the airplane and came home.

Q. Okay. What were you guys working on the 2 weeks before the turnover?

A. Well, the intent of the whole trip starting in March was to complete all the company testing for field performance. There were also some thrust laps ray testing that we had to do at various elevations. One of them at Roswell, one at Telluride, had some simulator test conditions we were flying on days when we couldn't do field performance. So there were various other maneuvers but the prime mission was all the field performance, takeoffs, landings, RTOs and general. The V_{MU} testing had already been completed in November.

So the first 2 weeks out there it was primarily continuous takeoffs when I went out. The plan that I discussed with Reece was since he had been doing all of the takeoff developments and understood the takeoffs and none of the RTOs or landings had been done that I would work on primarily landings, RTOs, the thrust laps tests and then anything else that came up so he could focus primarily on just takeoffs. So the day, April 1st when he came out I gave him a run down of what I had done, what was remaining and what we thought the schedule was for when we would be complete and bring the airplane back.

Q. So the plan was to get all the field performance testing done by the end of March or the end of April?

A. The plan was to get it done when we got it done. The schedules have always been a sore subject in the flight test group especially. Pretty much we disregard them and we feel that we will do the tests when we are ready to do them and get them done

when we can get them regardless of what the schedule says.

So when we got to Roswell no matter how long -- if it said 1 week and you will be done, we were going to take as long as we needed to get it done. So I think we had initially planned to be there maybe until mid-April for the company tests, but because we had -- some of the tests couldn't be completed because of various configuration problems in the airplane they were deferred until a later time. So I think we were looking at maybe returning on the 5th of April. The middle of the next week.

Q. Okay. So, you mentioned that there were some FAA letters that you had to discuss.

A. We didn't have to, but we did because they sort of impacted the way we were -- the way the program was going or potential impact anyway.

Q. What were the letters about?

A. I can't remember specific. I have got copies of them all on my computer. But they were -- a lot of them dealt with the request for realistic schedules from Gulfstream. And there was one specific one. I can't remember what it was now, that we had. I think they were dated the 31st of March. I think there were two of them sent in.

Q. Who were sending letters?

A. I believe they came -- I could tell you for sure if I went and looked at them.

Q. Okay. You can't recall?

A. Came from the certificate, ACO up in Atlanta.

Q. Okay. Why was the schedule a sore subject?

A. Because the -- boy, that can take a long time to answer.

Q. For flight test. I should be specific, a sore subject for flight test?

A. Yes. For flight test. Well, the goal was to get the airplane certified by a certain date, which I believe was end of June. So we had to have all of the testing and the reports done by the end of May. So that date never changed even though the airplane came to us late, incomplete, not ready to fly. And then we had issues on the very first flight that took months to actually get into a test configuration that we could -- it wasn't the optimum, but we could fly with multiple restrictions and IFRs.

So essentially, the schedule that we were told to meet was an unrealistic schedule in our opinion. It caused us to be working 7 days a week, through holidays, and gave us no allowances for when we said we couldn't do a test on one airplane, things would get shuffled around. So we were always reacting to what management was doing with the schedule rather than listening to the people saying we need to do things in a certain order or be able to plan them in a certain order. We were just sort of surprised when things got changed at the last minute. So that's why we kind of disregarded the schedules because it didn't matter what was on paper; it would change at the next turnover meeting or the next morning you'd come in and everything would be different

than what you planned.

Q. So by you planned, you mean the flight test would make a plan and then management would have a different plan?

A. Yes. Well, and in general, each of the airplanes were instrumented for different tests. So the first aircraft was instrumented to go through the flight controls test, the aero stall. So it had a nose boom, a stall shoot, and special instrumentation and egress procedures for that airplane. The second airplane was mainly a powerplant. So it had a lot of -- it had instrumented engines. It had a lot more instrumentation to meet those test requirements, and so on, through the rest of the fleet.

So when some of the tasks would be moved from airplane to airplane just because the end date of the test on that aircraft poked out past the date, then you would have to take that test, move it to a different airplane; all the associated instrumentation not planned for it. So now there's different versions of software on different airplanes, different flight control software, FMS software, potentially hardware, just a whole different layout introduced a whole lot more complication.

Q. And how did that impact the organization of the flight test program?

A. It was very frustrating. And I think it had a big impact on the morale and -- now what was the second one, on the organization. Yeah, the morale was terrible just because nobody

really knew what to expect, and I think not only in the flight test engineers but in the maintenance side too because they could be planning on doing some mods on an airplane and some one would come up and say, well, we have to go fly this airplane just because we had to go fly because, you know, the war room charts show progress by flight hours not by what you are actually getting done.

Q. Where was that; where was the impetus emanating from to do that even if it didn't fit with the flight test organization plan?

A. It would have had to come from the flight test director, but I'm sure it came from his bosses, which were the program director at least, if not the senior VP. I know they were heavily involved in directing what needed to be done in our organization.

Q. I forgot the middle person. You said the flight test director and who is the middle person?

A. Program director and then their boss, the senior VP for test.

Q. For flight test?

A. For engineering and test.

Q. Okay. And was that because of a certification application window that was closing or --

A. Yes. I believe that was actually in one of the FAA letters strongly recommending that we consider applying for an extension.

Q. What was the discussion that ensued as a result of that letter and how was a decision made about how to respond?

A. You mean as far as the company's response?

Q. Uh-huh.

A. I don't know what the company's response was. I believe that they just continued to provide schedules that showed that we would be able to complete meeting the goal.

Q. Okay. So, Reece's wife said during our interview with her that as of Wednesday before he went to Roswell that he wasn't sure whether the test was going to continue, and there was a meeting to discuss what was going to happen. Do you know anything about that?

A. Well, that -- while we were in Roswell we were looking at the remaining tests and we were trying to decide if we needed to continue or if we needed to come back to Savannah to get some upgrade to the airplane. There was consideration of just keeping the existing crew out there instead of bringing those guys out, which we didn't do.

Q. And what were the upgrades that were considered that would have occurred if it had been brought back?

A. I can't remember all of the changes that needed done. I know we had an issue with the HUD being misaligned, which we had some test points that we had to do in the field performance plan for landings using the HUD. So that was one of the issues. I think we had an issue with the flap control unit. We were getting

flaps that wouldn't go from flaps 20 to 39 when they were selected. There were various issues that we were just going to get fixed when we came back.

Q. And why was the decision made to postpone those changes or what was -- I mean, that option was considered and then it was decided to continue?

A. I'm not sure.

Q. Did the meeting about whether the tests were going to continue on the Wednesday prior to the accident have anything to do with the FAA letters?

A. I don't believe so. I think they were after that meeting.

Q. All right. Did Reece express any opinions to you about how he thought the test program was being, how effectively he thought the test program was being managed?

A. I don't think I'm allowed to use those words.

Everybody talks about how we feel the program is being managed; in general just categorize it as poor and reactionary to management, senior management direction not really taking in the requirements of the flight test engineer or the people doing the work on the airplanes not taking their concerns to heart and actually listening to what needs to be done there.

Q. So he made -- did Reece make comments to that effect?

A. I can't cite specific ones, but we all talked about that at times.

Q. So you can't recall Reece making any specific comments about the management of the flight test program?

A. I couldn't quote what he said, no. But I couldn't quote what anybody said. I don't even think I can quote exactly what I said, no. It's just general discussions.

Q. All right. Did Reece ever express any safety-related concerns that might result from mismanagement, the ineffective, the poor management, I think you said you categorized it?

A. No, not due to that because I think we did a good job as far as having the flight test engineers. We have -- we went through and improved from previous programs what we had done. We now wear flight suits and flight boots, and on certain risk missions there are parachutes, helmets as required. We made sure everybody has third-class medical. All the flight test engineers go through the 1-day flight safety crew training course. I don't know what the official title is. But it goes through a briefing on hypoxia, emergency egress. They put you in the swimming pool so you get a full day's worth of training on safety concerns. And then we made sure that everybody who goes on the airplane is familiar with all the equipment on board: where the emergency equipment pallet is, fire extinguishers, crash ax. Everyone has to be able to open the main entry door, the baggage door, emergency exit doors. So I think we did everything we could to have all the flight test engineers trained as best we could.

Now, the one thing that Reece and I had been talking

about were some things that we had seen in some other flight test safety working committee presentations. One of them was a fire suppression system in the cabin. But, you know, we talked about that and we watched some of the videos but we didn't think it was something that we could get installed on the aircraft in the middle of the test program now, but we were considering it for future programs.

Q. Was there ever any concern that the pressure and the jumping around with the tests and the reconfigurations of the airplanes might cause something to be overlooked expressed on the part of Reece, expressed by Reece?

A. Not that I remember him saying. But, obviously, there's always that potential.

Q. Did you have any concerns about that?

A. Of missing something?

Q. Yeah.

A. Always concerned I'm going to miss something.

Q. All right. And getting back to the recent activities of the four folks aboard the airplane. You saw them in passing in the lobby in the hotel; is that what you said or at the airplane?

A. At the airfield, yeah. We had lunch brought in. We kind of met over lunch. Talked over the plans.

Q. That was about lunchtime on Friday?

A. Yep.

Q. Okay. Did you have any more conversations by telephone

number with Reece after that?

A. Not after that. But the one thing I do remember telling him was specifically I told him don't do repeat test maneuvers because the airplane does not have the performance. It's not doing; it's just not there. And I told him the flight sciences guys are going to ask for it; don't do it. And that was based on the landing performance that we had been doing where we couldn't meet the expectations as far as speeds. And we had just decided in the airplane that we couldn't fly the maneuvers as they wanted them.

Q. Which speeds were you having difficulty hitting?

A. Well, just the flying at the rev speed and meeting their speed that they expected at touch down. We couldn't meet the requirements or their expectations.

Q. Okay. And how was the decision made not to continue to attempt that test when were doing that one?

A. You mean --

Q. Who was --

A. I was on the plane.

Q. Who was involved in talking about, okay, we are going to call this off and not try it again?

A. That was the flight crew on the airplane: Kent, myself, Chip King and Chris Booth, the other flight test engineer. And we just talked about it while we were doing the maneuver. We couldn't slow down as fast as they expected. And we just said

that's it; that's the last one we can do that way. So we flew the maneuver as best we could and that was going to be the answer.

Q. Do you remember how many times you might have repeated the same maneuver?

A. Not offhand, but I do have all the flight cards for those so I can find that out.

Q. All right. What was Kent's role in that decision making?

A. He was the pilot-in-command. He had the final decision. But as always, it's everybody on the airplane has an equal vote, so we all agreed we didn't need to continue repeating test points that we weren't able to do any differently than we had already done.

Q. Okay.

A. And everybody agreed with that decision, too.

Q. All right. When you saw everybody on Friday, how did everyone's health, mood and alertness seem as far as the incoming crew and Kent?

A. Excellent. Kent was -- being out there with them for the previous week we had gone to dinner most of the nights. I would see him at the hotel working out. He always gave me a hard time about running too fast on the treadmill next to him. He was in excellent health. He would tell me how many pushups he did that night. So he was not a concern there.

Vivan, Reece and Dave had just been back here so I don't

know exactly what they had done previously, but when they came in they seemed happy, no obvious problems. They didn't come in scowling or swearing. They were happy to be there.

Q. All right. Do you know if Kent, since he was the only one you had been around for the last few days, but do you know if Kent took any medications in the 72 hours before the accident, even nonprescription?

A. I don't know that he did.

Q. How about alcohol, did you see him consume any alcohol?

A. Maybe one of the nights when we were at dinner he had a beer, but I don't think it was ever more than one.

Q. Okay. Switching gears. Why is it necessary to have the two engineers aboard for the high risk -- why can't you just do it all by telemetry?

A. It's possible that you could, but part of the reason we put people on board is we don't consider telemetry to be the prime area for the test conduct. First of all, you can't get every parameter that you can see on the airplane through telemetry. So most of the flight control monitor can't be done in telemetry so you need to have at least one person on board for any game changes, for any flight control monitoring that's required. So there had to be one person on board.

As far as having the second person on board, could we have done without a second one, in hindsight, sure. I wish we would have. But as we were talking about it we felt we were far

enough along in the program that the airplane was reliable enough that we could put a second person on to help and divide the tasks: one to do the flight control monitoring; one to do the test conducting. Because trying to run the data system and record data, make sure all of that information is done while you are trying to do the flight control monitoring is too much.

Q. All right. Was there a written or a formal flight test data reduction form?

A. Yes.

Q. Was that primarily something that was utilized by flight test or by flight sciences?

A. Flight test.

Q. All right. And --

A. I believe we also sent a copy up to the FAA, not that it was required but just sort of for their information.

Q. All right. Was there a system in place to track who had which data from which runs and who was analyzing them?

A. No. The data that -- on this program it's been different than previous programs. Typically on previous ones a data request comes in from engineering that says for this maneuver I want this number of parameters and then the flight test engineer responsible for that would process the data, validate it and send that out. So there was more capability to track the data and where it went.

On this program the engineering guys insisted that we

give them -- we were taking too long getting them the data. So they wanted data instantly after the flight. With the data processing, the data system IABS that we use it's very easy to create your own parameter. So anyone in the telemetry room or on the airplane can create a parameter and there's little database management, validation of any user-created parameters. So you could create a parameter, call it gross weight, and it could be the sum of airspeed and altitude, and no matter -- it would calculate that. So unless the parameter was in the flight test database where it gets validated and checked, then everything else could be user-defined. So there is a more lack of control of data especially once it goes out from flight test control anyway.

Flight sciences gets 3- or 4,000 parameters each flight. So where it goes, what they do with it, I don't know.

Q. One moment I am just sorting through some things here.

All right. What's the function of the Safety Review Board? The Flight Test Safety Review Board, I'm sorry.

A. Right. I knew which one you meant. The Flight Test Safety Review Board, anytime we write a test plan if the person writing the test plan and the people signing it feel that there is a test based on past Gulfstream experience and the FAA Order 404026A, we get our guidance -- if it comes out to be a medium or high risk test then that's identified in the test plan. A TSHA, a test safety hazard analysis, is written and included preliminarily in the test plan, the one that gets signed.

Prior to going to do the testing with a medium or high risk, a note is sent, or e-mail or some way the flight test director is notified that we have medium or high risk test so we need an SRB and it's up to him to call the board members together and set up meeting. So the function of the SRB is to review the test maneuvers, agree or disagree with the risk assessment, with the mitigating procedures, corrective techniques and then agree and sign off on those.

Q. Do you know who sits on the SRB?

A. It's chaired jointly by the director of flight test and the director of flight ops. There is a management representative, I believe the director of engineering. The chief test pilot. I think the chief flight test engineer. Maybe program manager. I can't remember specifically.

Q. Did you feel the members of the SRB; do you feel it was an appropriate composition of personnel?

A. Yes.

Q. All right. Are you familiar with the 1998 version of the flight test standard operating policy?

A. Yes.

Q. Is that a document that was a living document that was in use or is that sort of like a -- document or was there a new one?

A. It was in use. It probably wasn't widely distributed as it should have been. There was another version of it that was in

work or had been revised but not signed, and probably about maybe 2 years ago, roughly in that time frame, the previous engineer, a flight test, previous flight test manager had decided that it would be better if we divided that up and each of the departments in flight test wrote their own standard operating procedure, which I had written an initial one based off of that document for just the flight test engineers. That has been continually revised although not signed.

Q. What's the title of that document?

A. I don't know. Flight Standard Operating Procedure; I don't know, might have been Department 343 SOP.

Q. Who created the TSHAs that applied to the CTO test?

A. Reece did; based off of probably the past testing that we had done at Gulfstream based off of his experience at other companies.

Q. Do you know if it's required to fill out any forms to change a test card?

A. No. There's no form to change a test card.

Q. Is there a formal procedure for notifying management about safety-related events during testing?

A. There is no formal process, although as we have seen in the Flight 088/132, when an issue like that comes up it was reviewed and identified and discussed. But, I think, depending on what the outcome was determined, if it would have been something other than potential maybe we flew the maneuver wrong, if it was

something else, then maybe it would have gone up the management chain, but I don't know.

Q. All right. And how high up did it go, the information about the events on Flight 088 and 132?

A. I'm not sure how far. I know that Reece had asked me who do we need to tell. And I said, well, you need to go tell Barry. So the director of flight test was told about it and, I don't know, I know Kent gave a briefing to the pilots but I don't know who was there.

Q. Do you know anything about the work that Reece performed in the simulator with the flight test pilots prior to the accident trip?

A. No. I was in Roswell.

Q. How about during, you know, prior work he might have done in the ITF or in the other simulators to help prepare pilots for takeoff maneuvers?

A. Not that I know.

Q. He hadn't done any that you know of or you don't know what he did?

A. I only heard after the fact that he had been in the ITF. I don't know that there was anything else done.

Q. How about the pilots, do you know anything about their practicing of takeoff maneuvers in the ITF?

A. I don't know.

Q. All right. You said morale was poor before the

accident. Was that just in flight test or do you feel it extended to the other departments that were associated with the G650 program?

A. I don't know. I don't get out much.

Q. All right. What did you think about the size of the workforce for the certification flight test program, was the size of the workforce appropriate?

A. It would have been appropriate had the schedule not been compressed. I think the initial budget was reduced when we put in the bid the beginning of the program. So I don't think we had the budget to go hire as many people as we had planned to and then as the scheduling requirements went from, I think we had initially planned a 5-day flight schedule, went to a 7-day flight schedule then, obviously, you don't have enough people.

Q. You mean 7 days a week?

A. Yes.

Q. How long had it been a 7-day schedule?

A. Most of 2010. I know there were people in our group that were working over a 50-percent overtime rate. And the majority of the group was probably 25 to 35, 30 percent overtime for the year.

Q. Twenty-five to 35?

A. Thirty.

Q. For the year 2010?

A. Correct.

Q. And has that continued into 2011?
A. Yes.
Q. Has it gotten any worse or been about the same?
A. It's been about the same.
Q. How about pay and leave, were those compensation and benefits was it comparable to other aerospace companies?
A. Company pays very well. There are no complaints there. Benefits are probably one of the best that I have seen. I have no complaints about that and there has never been an issue about overtime pay either.
Q. As far as getting compensated?
A. Correct.
DR. BRAMBLE: All right. I'm going to leave some additional questions about the testing numbers to you guys or actually we are going to move down the row, I guess.
MR. PROVEN: I didn't have many.
BY MR. PROVEN:
Q. I wanted to understand the proper terminology. Could the HUD be used for takeoffs but just not landings?
A. It could be used for either. There was a note on the flight card that said it was misaligned so pay attention.
Q. So it could be used?
A. It could be used; it was just misaligned.
Q. But the expectation would it be misaligned in the takeoff mode because it only mentions the landing mode?

A. I don't know.

Q. What does that mean, misaligned; the runway is going to be over here but the actual runway is over here?

A. I think it was misaligned in pitch.

Q. Pitch, okay.

A. And that was one of the tests we couldn't do that we were going to come back and I was going to do a re-shot.

Q. And my education periodically shows up for lacking. So you are at VREF at a certain, obviously, airspeed VREF and they couldn't get from VREF to the touchdown speed? They are supposed to accelerate in the process?

A. Yeah, the expectation from flight sciences was there was a certain decrease in speed from VREF to touchdown.

Q. Okay. On the order of whatever that number is --

A. Whatever that number was.

Q. -- maybe 10 knots or so?

A. Eight to 10 knots, right, somewhere in there.

Q. Yeah, that's what you normally try to do. They were unable even with -- I presume it would go all the way to a throttle --

A. Right. At flight idle 3-degree approach to touchdown.

Q. He couldn't make it slow down?

A. Couldn't meet the performance maneuver, correct.

Q. Yeah, they couldn't get to the -- they are always landing fast?

A. Well, faster than what the --
Q. The target was?
A. Correct.
Q. What flight number was -- do you recall what flight number that landing performance was?
A. Not specifically, but it was probably within maybe 140 to 152. I could go find it if you want.
Q. I was just curious as to where to look to read about it.
A. I don't know that I specifically wrote that on the card, but since we record audio I'm sure the comments are in there.
Q. Now, perhaps a little off the subject, but what could you possibly do about that? I mean you are at flat idle, what are you going to do next?
A. Nothing. It is what it is.
Q. It is what it is. You are going to have to adjust the performance numbers --
A. Well, the only way to do it is you have to increase VREF but still that doesn't really do anything for your number. The bottom line number is you are going to touch down at that speed.
Q. Okay. All right. Great.
MR. PROVEN: Thank you.
MR. REMICK: Mine will really be quick. You got me curious anyway.
BY MR. REMICK:
Q. So it's the air distance numbers you guys were having

trouble from 50 feet to touchdown, couldn't get the delta V to work out, yeah?

A. Correct.

Q. I was going to ask you, I hadn't even thought to ask you about that, but then I got curious. The takeoffs it sounds like you were -- Reece was mostly working the takeoffs and you were mostly working the landings. Pretty consistently what we have heard was they are having a heck of a time, they are really having a very difficult time nailing the V_2s on the takeoffs.

A. Yes.

Q. And so in some discussion about the maneuver or the characteristic of the airplane trying to get there, do you recall any discussions or participate in any of that testing so you could describe what the airplane characteristic was as the pilot was trying to wrestle it to V_2?

A. I was not on any of those flights. But the takeoffs, I think it was Reece and Valerie were on most of those. So I don't have any firsthand knowledge of it.

I do think I have some e-mails from Reece where he talked about the only one who was able to fly the maneuver as -- to meet the performance was Jake because he was a machine. Everybody else had trouble. That's all I remember about that.

I know there was -- initially we started off with certain pitch targets, and force targets and then the discussion was, well, it's not -- it's too hard to do; we can't do it. So

either reduce -- I think at some point we reduced the pitch angle and then reduce the force and the -- even on the last few flights out there, you know, from 75, it was 60 to 65 and they were actually flying with 50 to 55 pounds.

So, yeah, the performance of that maneuver was much more difficult. And from what I have experienced on previous Gulfstream airplanes this is not the same as the G5 or G4X, so assuming the same technique is going to work doesn't appear to be valid.

MR. REMICK: All right. Thanks. That's it for me.

BY MR. HORNE:

Q. I think you answered one of my questions. You did not perform any CTO tests?

A. I did not on the 650.

Q. Do you know what angle of attack the PLI was set to, the pitch limit indicator?

A. Only after looking at the data after the flight. I think it was -- that's the same as the shaker, right?

Q. Right.

A. I think it was changed to -- I can't say for sure, no. It was adjusted to either .9 or .93, I think.

Q. Do you know why it was adjusted?

A. Not off the top of my head. I think there's an e-mail and a discussion about that.

Q. Do you know if the shaker or PLI was a hard limit?

A. It was not identified as a hard limit as far as I know. It may have been discussed but I don't remember it being written down anywhere as knock it off at shaker. It was probably an implied limit that that's what we were using it for.

Q. I don't know if you read this, but step 7 on the card basically says maintain a target pitch attitude until V_2 is achieved then transition to speed.

A. Correct.

Q. Can you give us your interpretation of what that means?

A. Yeah, it would be the target pitch attitude for that maneuver, which I think in step 6, it was redlined out as 9 degrees. So the maneuver would be flown at the target rotate speed. He would pitch up until pitch attitude of 9 degrees and then as soon as he hit V_2, he would adjust pitch, maintain V_2 and fly the maneuver.

Q. So he would wait until V_2 and then adjust pitch?

A. Yeah.

Q. I was interested in your comment about the schedule. You think that the number of schedule changes and the timing of the schedule changes impacted the safety of the flight those guys were on, flight 153?

A. I don't think it impacted the safety of that flight directly. I can't say that changing the schedule had affected that, no, because I know when I had gone out there the previous few weeks and even when Reece was out there, like I said, we sort

of disregard the schedule. We did what we felt was needed to be done. Whatever time it took. Probably not the best for my career here, but that's the way we felt. You know, we were going to do what we needed to do regardless of how long it took. And that was sort of a common theme for the people in flight test.

Q. Okay. And then the other question I had, you talked about the pressure of flight sciences to get the performance for landings. Can you describe in a little more detail what level was that pressure coming from? Was it one individual? Was it from management? Where was that --

A. Well, I don't think there's any landing guarantee. I know they had targets that they are trying to meet. The only performance guarantee I know was the takeoff distance and I know there was some discussion between Reece and Pat Connor about meeting 6,000-foot guarantee. And initially there was a meeting because we had calculated one number -- flight sciences came up with one that was significant and larger by thousands of feet. So that's, I think, what was generating the change in takeoff technique, so a different pitch attitudes, different control forces and things like that.

But as far as the landing specifically, I don't know. You know, it was just a -- they had targets for braking use on the landings and RTOs because they were trying to get the best performance out of the airplane. So what goals they had and who set them, I don't know. All I know is they had run their

predictions and come up with distances and they had a target that they were looking for. So they were trying to get that same number from the flight test data.

Q. So it was pressure to meet their predictions?

A. Yes, I would say that's probably it.

MR. HORNE: Okay. That's all I have.

MR. GALLO: I have some additional questions.

MR. DONOVAN: Okay.

BY MR. GALLO:

Q. Just looking at the field performance certification flight test plan, I just want to get an idea of how much had been completed at the time the accident occurred. Evidently you completed the V_{MU} speed portion of it.

A. Yes.

Q. The takeoff performance, obviously, that didn't get completed as well as the abuse takeoff or how about the rejected takeoffs?

A. The majority of those were completed.

Q. Okay. How about the thrust reverser effectiveness?

A. Those, there may have been one or two test points that were remaining. So the majority of those were done too.

Q. And then how about the landing performance?

A. Most of those were completed.

Q. Why did you get involved with the landing performance aspect of it?

A. I think probably in the past 10 years the only field performance that's been done has been, I have been doing it. So when we were doing our rotations between Reece and I we decided that we needed to have one experienced FTE out there full time. So we would split the tasks and it just so happened that he had been doing all of the V_{MU} and the takeoffs back in November while I was doing the other fill-in flights and then he had been more involved in that. So I didn't want to try to get in the middle of what he was doing. There was plenty in that plan for everyone to do. So when he went back the first 2 weeks he was trying to complete the takeoffs. So it just seemed like a logical place for me to go out and pick up the next part of the tests. There was no previous plan. That's the way it happened when I went out there. I looked at was remaining and decided that's what I would do.

Q. Did you participate, in that, is it more due to your knowledge or you're actually trying to alleviate some of the workload?

MR. RAMEE: I don't think you all are understanding each other.

BY MR. GALLO:

Q. I'd like to know, first of all, why he was participating in the landing performance and he did. So the -- and I understand, you know, he answered the question, but then I want to further add --

A. Why I did the landings?

Q. Yeah. Was it --
A. Specifically?
Q. Yeah.
A. It wasn't intended that way. We didn't have a previous plan saying that. We had just -- the only plan we had was we would alternate every 2 weeks between Reece and I for the duration of the testing and whatever testing we decided during our time out there would be done that's what we were going to do. It was sort of a day-to-day plan. Whatever we could get done.
Q. But to add, your participation was more voluntary, it wasn't --
A. Yes.
Q. You didn't need to do it; you were kind of --
A. Well, yeah, it was voluntary going out there but we, Reece and I had talked about it and we decided that it wasn't the right thing to do to put one person out there for the duration of the testing. So it seemed sensible to alternate people. So between Reece and I we had the most experience doing the field performance from the flight test side. So me going out there doing part of the testing was what we thought was a good plan.
Q. I assumed since your title is group head you would have some kind of supervisory or managerial duties to do --
A. Yes.
Q. -- aside from doing actual work, for lack of better words?

A. True. Doesn't mean I like doing the managerial work.

Q. We mentioned about Reece's draft report and there was a draft regarding the V_{MU} testing. And Flight 088 was completed in November of 2010 --

A. Right.

Q. -- why was Reece's report still a work in progress? It hadn't been completed because this is some period of time after the V_{MU} testing has been done.

A. Right. He had -- he was working on that. Of course, then you have the holidays. And then there were also tests. I mean, there were, I think, a few days where they were discussing the takeoff techniques and I think we even did a few days or one trip out to Birmingham to try a revised takeoff technique. So there was -- not only was he doing that report, he did have other things he was looking at for the field performance to get ready for the return to Roswell, which was in the beginning of March.

So I'm trying to remember when we came. We came back just before Thanksgiving. So, yeah, it seems like a long time, but in actual fact you had the Thanksgiving holiday, then you had the Christmas holidays. So maybe a couple of weeks in December, then getting ready for some additional takeoff performance in mid-February, trying to reduce that, trying to coordinate with the flight sciences guys on what they were analyzing with the rest of the flight test people and what they are analyzing. Yeah, it seems on paper to be an extremely long time, but when you are

actually doing it, it is not that long a time.

Q. Okay. Excuse if I ask the very basic questions, but I'm trying to ask questions that would be anticipated of me from somebody that doesn't understand flight test. The flight test plan mentions a buildup approach to establishing a target pitch attitude for the takeoff performance. And V_{MU}, correct me if I'm wrong, come into play in some manner.

Now, the report that Reece was working on is dependent on his reduction analysis of data and anybody else is helping him with that aspect. So is the buildup essentially done prior to the subsequent flights after V_{MU} testing, without a completed report showing that the data has been reduced to analyze in quality control?

A. Well, the V_{MU} test points were planned at different pitch attitudes, which gives you that CL that you need for your target pitch for takeoff. So the buildup in the V_{MU} points was something that's in the plan that you have to conduct at different pitch attitudes and thrust weight ratio. So there are some quick review of the data to make sure it's what you expect but you don't need to write a report to the V_{MU} to continue doing the V_{MU} or even to go to the field performance takeoffs. As long as you can look at the data, you can make a couple of plots, you can see where, you know, what CL, what pitch attitude, and then what speed you are going to need.

Q. So completion of a report is not defining as the end

step to some portion of the buildup; you don't need a completed report to say we have done buildup?

A. You don't need to have the report completed. You do have to have enough of the analysis completed to know that you have the speeds that are required for the next phase of the test.

Q. When is the data reduced and analyzed typically after a flight comes down? What period of time?

A. When we are in Roswell usually we do it as soon as we get the data downloaded from the aircraft. When we have the TM there is an ability to do a quick look in there. On the airplane we have the ability to look at the data on there too. So there is review done almost real-time.

Q. Do you recall what the angle of attack and ground effect was prior to the takeoff performance portion of the test plan?

A. No. Well, and I don't think I understand your question totally.

Q. I'm looking at, and let me just go reference the Field Performance Certification Flight Test Plan. Towards the end it says the pitch attitude buildup is based upon the maximum angle of attack obtained during development aerodynamics stalls adjusted for ground effect based on low speed wind tunnel tests. The maximum pitch attitude used for the actual test will be based on the results of the stall testing and the buildup results. Lift coefficient versus pitch attitude at liftoff will be plotted to determine the target pitch attitude/angle of attack at liftoff. A

safety margin from stall similar to the free air -- the high incidents protection function will be used.

So at some point there had to be when you began all this there is some in ground effect stall AOA.

A. Right. And that comes from the wind tunnel data which comes from, I think it's the applied aero and --

Q. Do you know what that value was before they started?

A. Now, I do. When they did the test I didn't.

Q. And you know now because you -- well, let me go back. When you didn't know about it, did you actually really know about it and forgot about it and you just look now to refresh your memory or is it something you just learned of now?

A. No. I knew there was an in ground effect number. I didn't know what it was for this airplane. But seeing the data, looking at it now, seeing some of Reece's notes and how he was doing it, I know what the number is and what further reviews and CFD analysis has told us.

Q. And I know Reece was working with flight sciences and aero is in that group, and Bob Mills, did he ever interface with Reece at all?

A. Yes.

Q. Going to the -- regarding not being able to maintain V_2, were there any discussions or meetings held regarding that with flight test, engineering, flight sciences and Bob Mills?

A. I don't know if Bob was in there but I know there were

meetings between Reece and the aero performance group.

Q. Any pilots involved in that?

A. Couldn't tell you for sure but I wouldn't -- it would be uncommon not to have one of them at least aware of what was going on.

Q. And while they are studying the inability to maintain V_2, was there any work done in the ITF regarding this issue?

A. I don't know.

Q. During any flight test where Kent was the pilot, did he ever express any frustration over to being able to do a maneuver or complete a maneuver just because he couldn't get the test point down?

A. (No response.)

Q. Did he become frustrated easily?

A. I'm not sure how you mean frustrated. Like where he would be slamming the cockpit or just yelling about something, no. He would always look at it analytically and try to figure out what was going on and maybe what was he doing or what needed to be, what the whole reason was that he couldn't get the test. That would be the only test point that would be the only frustrating point for him.

Q. And I believe you have already answered this question, but I just need to clarify. For Flight 153, card 7, step 7 says maintain targeted pitch attitude until V_2 is achieved, then transition the speed.

A. Right.

Q. Number 8, retry gear after positive rate of climb is established. Number 9, adjust pitch attitude to maintain V_2 to the lesser of gear retraction complete or 400 feet AGL. So what is the -- the question is how long are you supposed to maintain V_2; is it just kind of transient condition to get the gear up or are you supposed to fly out at V_2?

A. Can I see that?

Q. Yeah. Kind of explain to me your understanding of that.

A. I mean, step 7 says maintain the target pitch attitude, which was 9 degrees, until V_2 is achieved then transition to speed. So when you get to V_2 you hold the V_2 speed and adjust the pitch as required. There's no other way to do it.

Q. Okay. And you mentioned some of the people that are on the Flight Test Safety Review Board, are those people also the ones that create the flight test schedule for the organization?

A. Yes, some of them are involved in that.

Q. When I mean create doesn't mean duplication--

A. Direct changes to it?

Q. -- it means you are authoring this is what's going to happen this week?

A. Yes.

Q. How many test plans were being worked on during the week of the accident?

A. On that aircraft?

Q. On that aircraft and as a whole with all the other aircraft.

A. I can't tell you specifically how many. Whatever -- we can go back and look at the schedule and see what was being done. But it's routine when we go out to Roswell to have additional tests planned in case the winds go out of limit; you don't want to be sitting around with nothing to do. So we always take additional tests to be able to go fly.

Q. And the next question is more of an if you could define what the terminology means. For example, you -- if you are in the V_{MU} speed testing, you have development, certification and assurance.

A. Uh-huh.

Q. Can you combine all those together?

A. No. The V_{MU} assurance tests we determined were not required to be completed.

Q. Okay. How and when is it decided that a test plan is complete, that you have now finished the GBI field performance certification flight test plan?

A. For the company portion of the tests we would determine that we have either flown all the test points required and gotten the data that we can write a report that would support compliance and then we would write the report and send it in. Then, and that's possibly also determining that we don't need to fly every test point in the company section, and then if there is a section

in there for certification, then that would be after the FAA sends us the TIA that says go do these test points per this test plan. We would go fly the points as required and once they were completed and the report written then we would say we were done.

Q. When you say we, because I'm trying to get an idea, that's kind of at the micro level, the team maybe comes to you. I don't know, the team goes somewhere and, says, oh, guess what, we are done with this packet. Who is the person that signs off and says this is done now, we can go to the FAA? Is there one person or is it the Safety Review Board that does it?

A. No, the Safety Review Board doesn't have any say in whether we are complete or not. All they do, their function is just to review the safety and the TSHAs. Usually it would be the person responsible for whatever test plan. He would know what test points are completed or not completed. Then they would say, okay, we are done with this test; I'm going to go write the report.

Q. Okay.

A. So I guess to say the test plan gets closed out officially when the report is signed and released.

Q. Why was Roswell chosen as one of the airports for field performance testing?

A. Roswell is used because in the advisory circular 257A there is an allowance for extrapolating your field performance, so you are allowed to extrapolate 6,000 feet without penalty. So

Roswell's elevation at 3,667 feet allows us to extrapolate out to 10,000, which covers the majority of the airfields that most of the airplanes operate at. It's a typical place for companies to go out and use.

MR. GALLO: Okay. That's all the questions I have.

John, do you have any questions?

MR. O'CALLAGHAN: Just a couple.

BY MR. O'CALLAGHAN:

Q. Back to the V_2 technique. I'm thinking of -- I'm trying to visual that in my head and the difficulty is -- let me just step through the scenario and you can tell me where I am going wrong or if I am on the right track here in terms of what I think happened. So when you rotate up to your target at 9 degrees, but at that pitch attitude presumably the airplane is still accelerating?

A. Correct.

Q. When you get to V_2 you are still going to be accelerating and if you want to stabilize at V_2 you are going to have to pitch to a higher attitude but you can't do that instantaneously.

A. Correct.

Q. So you are either going to have to increase the pitch attitude before you get to V_2 or accept some higher speed after you get to V_2 during the climbout.

A. Well, when you rotate you are not at V_2 so there is some

speed that you are able to accelerate.

Q. Right. Right. So you rotate at Vr --

A. Right.

Q. -- you are at 9 degrees, presumably you get to 9 degrees before you get to V_2 --

A. Correct.

Q. -- so you are still -- so now you wait, you accelerate, you get to V_2 --

A. Right.

Q. -- so now it's going to take some finite time to rotate the airplane up to the trim pitch to maintain a steady speed. So you are going to -- of necessity, you are going to have to overshoot V_2 and then maybe come back to it or something but you can't just instantaneously level off at V_2 unless you anticipate the pitch a little bit; is that correct?

A. I can't say that's right or wrong. That's more of a pilot technique and how they would do it.

Q. Okay. All right. We are going to have to be talking with them too so I will ask them.

And you mentioned -- it was very interesting what you mentioned about the VREF and the V touchdown. Are those speeds on the G6, are they before testing started, were they derived based on similarity ratios to previous programs like the takeoff speeds were? You know where you look at V_O or Vsr, the takeoff speeds they look like they are built up from V_O or Vsr ratios based on

earlier programs.

A. That's correct. They do have those speeds but they don't look anything like the ratios for G5SP. The ratios are much larger. The speeds are a lot higher.

Q. For the takeoff you talking about or the --

A. Yeah. For the G5SP takeoff speeds, and that's all the function of where the stall protection system is set on that aircraft compared to the 650.

Q. But looking at the rate applying the same or similar ratios, so you start with a higher Vsr so you apply the same ratio and then you get to your higher speeds for the G6, if I remember Pat's presentation correctly.

A. Yes.

Q. Is there a similar sort of thing for the VREF and V touchdown; is it a similar starting point?

A. No. I don't believe so. The VREF is just 1.23 Vsr and then the touchdown. I think there's some guidance material in one of the ACs but I don't think it's a requirement.

Q. And I'm kind of bouncing around. Back to the takeoff again, the technique where you pitch to a target, hold it till you get to V_2 and then transition, was that technique done similar for the G5 test programs or earlier test programs or is this new to the G6?

A. No, it's similar to previous, and I think that information is actually even in the AFMs in the section 5 in the

takeoff or field performance section.

MR. O'CALLAGHAN: I think that's it for me then. Thank you.

BY DR. BRAMBLE:

Q. Just to clarify on the touchdown speeds, the speeds were coming out too high at touchdown; is that correct?

A. Yes.

Q. So, what are your options if you rotate at the rotation speed and you pitch to the target pitch and you don't hit V_2 until after and -- I'm sorry, you hit V_2 at the same time when you rotate or maybe --

A. Well, if you follow that maneuver, the option -- well, assuming on this one was an engine-out case. You can't pull power back. So the only thing you have left is to pitch up if you want to fly the maneuver as it was written.

Q. All right. And would that be an acceptable modification?

A. It's the way the card was written. So if we are looking at comparing two maneuvers, 7A1 and 7A2, 7A1 was flown incorrectly because the speed was too high.

Q. So, to interpret, that interpretation of the card would mean that as long as you have achieved main gear liftoff you can exceed the target pitch and go for a pitch that will capture V_2?

A. I'm not sure I agree with that totally. So you are saying -- ask that again, please.

Q. Okay. So if you are having a difficulty where you are hitting V_2 as you are rotating, the only way to not exceed V_2 would be to continue to increase pitch --

A. Increase the pitch, correct.

Q. -- as you are rotating?

A. Yes.

Q. Would that be considered acceptable as long as the -- when would it be considered acceptable to exceed the target pitch; what is the earliest point at which it would be acceptable to exceed the target pitch?

A. I don't know. I don't know how to answer that one.

Q. All right.

A. And that may be more of a judgment call for the pilot.

Q. Have you had a chance to review Reece's reports or his figures prior to the accident from the V_{MU} testing?

A. No. He was working on it while he was back here for the 2 weeks. So he had sent it to me -- I think I either received it the 31st, so the day before. So I hadn't had a chance to review it then.

Q. And then where did you -- oh, he e-mailed it to you or --

A. He had sent me a location on a common drive on our network.

Q. Okay. When did you first review it?

A. I don't remember exactly.

Q. It was after the accident at some point?
A. Most likely, but I can't say for sure.
Q. Were you aware that Reece had expressed concern about the former 10-degree target pitch angle?
A. I don't know if I'd use the word concern. There was some discussion about the pitch target that was going to be needed. I know he did say that. I can't remember exactly if it was 11 degrees or whatever. But he did say that there was a pitch angle that they just didn't want to go there again. So that may have been in relation to one of the two other maneuvers, the Flight 088 or 132. I can't remember.
Q. And my apologies if this has already been covered, but the shaker on test card 7, it said the shaker would be set to 90 percent NAOA threshold. What was the normalized AOA based on? What was 100 percent of the NAOA?
A. 100 percent I believe is where the alpha limiter would stop you from going beyond.
Q. Okay.
A. Are you asking what the ratio is, what the --
Q. No, no, no. I just was wondering sort of what that peak value is, that 100 percent. It's where the alpha protection would kick in --
A. Well, on pusher airplanes that's where the pusher activates. So it's what your actual alpha is versus the scheduled activation alpha. So that's what it would be here when the two

alphas equal ratio to equal 1, that's where it activated.

Q. Pusher activates at 100?

A. The same with, I believe with the alpha limiter the same. But it's a lot more complicated system.

DR. BRAMBLE: That's it for me on the second round.

BY MR. PROVEN:

Q. The test card very clearly says what you said about the gear and the 400 feet, and you may know the answer and I'm sure these guys do. Normally on a real live engine failure you hold V_2 to 1,000 or 1,500 feet. This is just a test card program to stop at 400 feet?

A. Uh-huh.

Q. Okay. We are not saying that that's not ultimately the certification is going to continue on out?

A. All we were doing was trying to gather data to build the AFL.

Q. Right. Okay. Just wanted to make sure; my test card is very limited. Do other Gulfstream use an initial higher pitch attitude and initial pitch attitude of higher than 9 degrees?

A. Yes. Actually, I had gone back and looked at what I had done with Kent on the G5SP and we had much higher targets.

Q. So I have asked this question of others and my understanding is that, stop me if I go wrong, if I pitch to the attitude that's given in another Gulfstream I'll wind up at V_2?

A. Eventually, yes.

Q. With -- I mean, it would be the perfect roll if I pitch to exactly right and I lose an inch at exactly the right time I'm going to get V_2. And if I pitch to that attitude and I have both engines running, I'm going to get V_2 plus 10 or 15?

A. 10 probably, right.

Q. Okay. So this is what I have characterized, because I used to fly DC8s as a two-step rotation, which we had to do in the DC8.

A. Yes.

Q. You got to see Reece's production of the V_{MU} data. Ultimately does that change or would it have changed if you had seen it at any of the V speeds, and, if so, by how much?

A. No. I don't believe it would have.

MR. PROVEN: Thank you.

MR. REMICK: No more questions from me.

MR. HORNE: No.

DR. BRAMBLE: Give me a moment because I got one more.

BY DR. BRAMBLE:

Q. So the way I understand it from the briefing you got performance is that the V_{MU} data indicated that the airplane couldn't lift off until about a knot after the V speed that was given to these guys for the card 7. So --

A. This was during their recent review of the data.

Q. Yeah, but in consideration looking at the data points Reece had collected. So knowing that, do you still feel the V

speeds would not have changed?

A. (No response.)

Q. If that was, in fact, the case. I don't have it here to present to you. But if the V_{MU} testing showed that liftoff was occurring a knot higher than the V speeds provided to the crew for test 7, do you think that that data would have resulted in the revision of V speeds?

A. If we would have had that table that Pat showed -- I believe he's the one who showed that table that had different -- or showed that the V_{MU} speed was -- that we couldn't lift off at the V_2 speed, which the airplane obviously demonstrated that on those two maneuvers, yeah, then they would have had to change the V speeds.

Q. So the original answer that you gave was that because you didn't see that table or --

A. Well, that table wasn't generated until recently.

Q. Oh, I was under the impression that it was one that Reece made.

A. Maybe if I saw the table I could tell you for sure. But if I think if it's, if it's the one I'm thinking about, there was a table that showed 10-degree pitch, 9-degree pitch and the V speeds that were being used and what the V_{MU} speed was. If that's the table, then it was one that's recently done.

Q. Okay. Well, these things will be clarified when we have had a chance to actually see what Reece put together.

A. Well, Reece didn't put that table together.

Q. Right. Right. But we have asked for a copy of his draft report so it will be easier for us to distinguish what's new and what's not. Sorry for the confusion.

A. Sure. No problem.

DR. BRAMBLE: That's all I have.

MR. GALLO: I don't have any other questions. Is there anything else you would like to mention that we have forgotten or we didn't cover or a concern that we should be addressing?

MR. DONOVAN: Not that I can think of right now, but there may be something that comes up. Is there anything that I need to go back and look at to provide?

MR. GALLO: No, not at this time.

DR. BRAMBLE: I think we may want to put together some requests but we should probably do those through Rick.

MR. GALLO: That's all I have then. Thank you.

(Whereupon, at 5:35 p.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD
INTERVIEW OF:	Paul Donovan
DOCKET NUMBER:	CEN11MA258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 16, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha J. Wheeler
Official Reporter

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*
	*
AIRPLANE ACCIDENT	*
ROSWELL, NEW MEXICO	* Docket No.: CEN11MA258
N652GD	*
	*

Interview of: GARY FREEMAN

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Friday,
June 17, 2011

The above-captioned matter convened, pursuant to notice, at 1:00 p.m.

BEFORE: MITCHELL GALLO
Accident Investigator

APPEARANCES:

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I N D E X

I N T E R V I E W

(Time noted: 1:00 p.m.)

MR. GALLO: This is an interview with Gary Freeman.

INTERVIEW OF GARY FREEMAN

BY MR. GALLO:

Q. Thank you for joining us today. Let me just start off, if you could tell us what your position is and how long you have been with Gulfstream and describe your professional experiences?

A. I have been at Gulfstream 22½ years. I am a senior experimental test pilot. I started in the Navy. Naval Academy graduate and aerospace engineer. Fighter pilot, Navy fighter pilot, F-4s, F-14s, did a lot of test work in F-18s. F-14s at Patuxent River. I went back to the Navy, did another operational tour in F-14s. And then came to Gulfstream in October of 1988 and I've been here since.

Q. Have you worked on previous takeoff development tests within Gulfstream?

A. I don't think so. Takeoff development, I don't think I've done the takeoff portions. For a specific takeoff performance, I've done a lot of engine cuts and single engine work and things that we were handling, qualities related, but performance related, I have some experience there but it's been in the landing areas, not takeoff.

Q. How much have you flown with Vivan?

A. Not very much. I flew at Roswell and I can't recall if

I've flown with him before that. I think, yes, I have flown with him at least once before that.

Q. What did you think of his abilities to conduct test points?

A. He did fine. He is the new guy here, new to the large cabin, been here a couple of years, doing fine. He needed some, you know, experience in there.

Q. Have you been involved in any training of the other pilots at all?

A. No, not specific training.

Q. Going back to Flight 88, there was a roll-off event, can you describe the maneuver itself that led to the roll-off event?

A. I wasn't involved with that. It was a V_{MU} maneuver but that's about all I know. Kent Crenshaw and Jake Howard did that flight.

Q. Was there any discussion about Flight 88's roll-off event when the crew got back to Savannah?

A. Yes.

Q. What was discussed?

A. Kent gave a brief on the whole event, the whole roll-off event. I wasn't there. I was out of the office.

Q. So you didn't talk to him directly when they got back?

A. No.

Q. Going to Flight 132, there was a roll-off event there. Was there any discussion about technique again on that roll-off

event?

A. Yes, there was. We talked about not necessarily -- yeah, we talked about that event.

Q. And the roll-off event was it a result of technique or some other factors?

A. It was the result of the technique and other factors.

Q. And as far as the technique, can you describe how did technique differ from what the ideal technique was to be?

A. Well, were in the developmental, we were developing the technique. So we didn't have an ideal technique. We were in the process of developing it and as per our flight test guidance, we were going to apply not-to-exceed 75 pounds force quickly, achieve a pitch attitude and intercept V_2. And that was the stated technique we were attempting to develop.

Q. Was there any concern that this now became the second roll-off event during testing?

A. There was concern about that event. I don't remember if it was because it was the second one or not but there was concert of that event, yes.

Q. After Flight 132, did you perform any additional takeoff performance flights after 132?

A. I did not.

MR. GALLO: That's all the questions I have for now.

John?

MR. O'CALLHAN: Yes, thank you.

BY MR. O'CALLAGHAN:

Q. Some of the questions we have are repetitive of things we've heard, we've asked other folks, but at least I'm interested in getting everybody's opinion and what they have to say about it. So I'll ask some of the same questions I asked.

Regarding the engine-out continuous takeoff, can you just step us through the procedures from the pilots point of you, what you're doing with the flight controls and so forth through the takeoff roll through, say, 100 feet?

A. We would add full power on both engines, or add the appropriate power. Some of these were done at less than full power for degraded thrust or less thrust than normal. And we'd apply the specified power and at the rotate speed minus 20 knots, and the speed was not -- the speed that we pulled the engine was not necessarily important. The important part was that the engine had reached the idle thrust before we rotated. We'd pull the test engine, the right engine in this case to idle, rotate the airplane to a pitch attitude and from that, intercept V_2 and climb out at V_2.

Q. Can you go into some detail about the intercept of that whole transition, basically, the pitch to the target and then the intercepting of V_2 and how that works?

A. Well, at the rotate or at the rotate speed, the pilot was going to apply a maximum 75 pounds of force to intercept 9 degrees at that time at flaps 20 and 10 degrees at flaps 10 pitch

attitude, and then monitor airspeed to accelerate and then pitch the nose up as necessary to intercept the V_2 speed to climbout not-to-exceed shaker airspeed, stick shaker airspeed. They had a PLI, a low speed awareness cue that would tell us the highest angle of attack we were allowed to achieve.

Q. Okay. Thank you. And we have heard talk about an 11-degree limit. Can you describe what that is and its relationship to PLI, if any?

A. I don't know about the 11-degree limit. We had an angle of attack limit and we had a PLI. The target was 9 degrees, 13 degrees was supposed to be the stall. And there were on occasion where we went to 11 ½ degrees because the target was exceeded.

Q. To be clear then, one would choose initially for 9 degrees but then as you approached V_2, you would draw above that as required enough to go into the V_2 and not overshoot it?

A. Correct. The pitch attitude was an initial pitch attitude to rotate the airplane to and then as the airplane accelerated the pitch was as required to intercept and maintain V_2 airspeed.

Q. Did the moment of liftoff play any role in the attitude would be targeted or when you could go above them?

A. I didn't understand. Say that again.

Q. Did the moment the airplane lifted off the ground, was that relevant in deciding when one could exceed 9 degrees or --

A. No.

Q. Was it just not part of the equation conscientiously?

A. It wasn't really part of the equation.

Q. Now, on Flight 132 at the roll event, can you step us through what happened there and what you think produced the roll?

A. What I think now or what I thought then?

Q. Why not both?

A. Okay. We added the power, I think it was less than full power for takeoff. I'm not sure exactly. I haven't really reviewed it since that event. And at some V_R or V_1 minus 20-ish speed, I pulled the right engine to idle. We accelerated and about the time that I was getting ready to say, rotate, Vivan rotated and he rotated and put too much elevator in, it appears, and rotated and overshot somewhat. I don't know how much. And the airplane rolled off and then we flew away.

And at the time, we reviewed the event and we were doing this without a yaw damper and since the angle of attack was approximately 11½ and the stall angle of attack was determined to be approximately 13, I said, look, I don't think this is a stall event; we're below the stall angle of attack. It's mostly likely, since it was into the dead engine, the result of some CL beta roll duty yaw and I think that's what it seemed like to me. So, we're not going to do these anymore until we get the yaw damper fixed.

Now, it looks like -- now, it appears that it might have been a stall.

Q. At the time you thought it was a CL beta effect?

A. It seemed like according to the data and the engineering stall numbers, yes. I mean, you don't get a stall that's a degree and a half below stall. You get a stall at stall. So we had numbers at 13. We were at 11 ½. It was highly likely that it was more related to CL beta than stall.

Q. Did you have discussions with Vivan at the time about that?

A. Reece and Vivan was there as well, yes. I think Vivan was there, yeah. Reece and I talked about it, looked at the data and discussed it.

Q. How about in the cockpit immediately after the event?

A. I think there was some discussion about rotating too high or too fast or something, but I don't know exactly. I can't recall. There was a lot of -- I did probably over 100 points out there. I don't recall.

Q. But in your discussions with Vivan about rotating too high, did you have the idea of the CL beta effect then or was that something that came later after reviewing data?

A. It seemed to me that it would probably be something like a stall at that point probably, I would guess.

Q. Your initial impression was that it was a stall but then upon reviewing data, you thought it was CL beta and then after more, I guess, engineering work, it looks like it confirmed your first impression that it was a stall. Is that an accurate summary?

A. It probably is. I don't know what I really thought it was. I don't remember conscious thought. But, yes, it seemed like it was a stall-like event. It was a roll. I didn't feel buffet. I didn't feel a rapid drop. It was just kind of more of a smooth roll that felt CL beta-ish not with a quick break with a stall. But I --

Q. And do you remember getting stick shaker?

A. I don't recall.

Q. Okay. Just give me a second here. So after the event on Flight 88, Kent had you put together a briefing that we've discussed. Was there any analogous briefing after the event on 132?

A. I did not put one together or give one, no.

Q. During the takeoff performance tests, are you aware of any runs in which the stick shaker was activated even briefly?

A. Yes.

Q. Can you describe some of those?

A. It happened to me. Well, two that I -- one that I remember, maybe two. I remember it happening that I had when I was intercepting V_2 after the rotation. I hit stick shaker at least one time.

Q. Do you recall were you still in-ground effect at that point?

A. Probably, yes. I was probably below 35 feet.

Q. And you don't recall getting any roll though?

A. No. There was -- no.

Q. Do you happen to know what flight number that was or where we could look for it?

A. No, I don't. It was during some of the takeoff testing at Roswell while I was there.

Q. Do you know about what dates the first Roswell test?

A. At Roswell, it was when I was at Roswell. I was only out there one time. I might have been -- I don't know. It was the day before.

Q. Engine out?

A. I think they were pretty much all engine out. I don't recall.

Q. Okay. Thank you. And how many of those -- you recalled one. Any more than one?

A. It might have been twice. I recall once. I know it happened at least once because I remember saying something like, that's no good now; that voids the maneuver, something of that nature.

Q. Okay. I'm trying to understand a little more about the flight control system. Can you just describe the various modes, the normal mode and the first flight mode and what the differences are?

A. Well, the normal mode, the first flight mode is -- now, I can't really. The NZU versus the first flight mode. We're essentially operating with the gear and flaps down in the first

flight mode, in those configurations. The difference is in this area are minimal.

Q. In terms of alpha limiting or anything like that?

A. There wasn't any alpha -- no, there is no alpha limiting. We had no alpha limiting.

Q. Would there be in normal mode?

A. Pardon me?

Q. Would there alpha limiting in normal mode?

A. There will be at some point and we've looked at alpha limiting in the normal mode. Even the normal mode with the gear down in that area, yeah, there should be alpha limiting at some point. It wasn't activated when we were testing.

Q. Pardon me for, I guess, I'm not following clearly. So, in normal mode, when the airplane is out there certified and people are flying around and they'll be in normal mode and they will have alpha limiting protection, in ground effect, all flaps settings, et cetera, but this was not active during the test program and that's what makes it the first flight mode?

A. No. No. It just -- the flight control, the algorithms haven't been developed and put in yet.

Q. I see.

A. They're not active.

Q. So it's not really a normal mode as would be used as would eventually be found on the production airplane.

Well, just in general about the alpha limiter, can you

describe how that has evolved over the test program, like, what the initial settings were and then if it changed at all during the testing?

A. Well, it's evolved and it's still under development. And no, I can't describe it completely because there's a lot of pilots involved in it, but there was some discussion about alpha stall and then V_{SR} stall reference speed. That's going to be one degree or a half degree below alpha stall. And then when did the alpha limiting start, when did the shaker start, 85 or 90 percent.

There was all kinds of developmental processes for different types of alpha limiting that we were investigating. There was a lot of stuff. You'd have to go into a fairly significant engineering discussion to find out exactly what limits at what -- you know, it was a moving target at this point.

Q. That's a good point. That's something that will fall to me to follow up with the engineers as we go on, on the details of that. So thanks.

I had something now it's -- oh, right. The technique for rotating and sort of the step input versus the ramp input. I know there was discussion and evolution in the forces to be used, but the rate of onset of those forces, like the kind of step input, can you describe the evolution of that technique?

A. Well, okay. The G5, it was 75 pounds and within a half a second and it was something similar to that. You know, you put a rapid input in, just a rapid input not to exceed 75 pounds and

to intercept the angle.

Q. And when Vivan was flying with you, did he apply that technique in the way you are used to seeing or were you surprised by it or what was your opinion when you saw him rotate an airplane?

A. I had seen it before and we did it a few times and we did some buildup. After the roll-off event, there was a buildup maneuver and pilot buildup that was built into the test cards to prevent the maneuver that happened with Kent and Jake.

And I guess the first day I got out there, we went out and did a bunch of these maneuvers and worked up to it. And Vivan got a lot of practice in it but he had had an event where he overcontrolled and at this point, he overcontrolled as well.

Q. Did Jake have a conversation with you or the other pilots following his work in Birmingham to develop that technique and what was coming out of it, of those efforts?

A. Yeah, he talked about the technique. He talked about the technique.

Q. Do you recall what he said about it?

A. Pardon me?

Q. Do you recall what he said about it?

A. Rotate to, you know, make kind of a rapid pull not to exceed just what I said. That's what he said to do. And it takes a little bit of practice. You can sit there and get practice with it. The good thing about this airplane is that, you know, the

flight controls at any point feel the same, kind of. So you can sit there in the hold short or sit there stopped, with the airplane stopped and get an idea of the force and displacement necessary to get 70 pounds of force, 75 pounds.

Q. Very good. And then after the roll event on 132, was the test plan altered at all or did you just proceed as --

A. I think they lowered the rotation angle 1 degree. I didn't do any of these anymore.

Q. But on that day following the roll event, do you recall -- did you proceed down your list of test cards or did you do anything different?

A. I don't think we did any more. We didn't do any more of those.

Q. What kind of run did you do after the --

A. I don't remember. I have no idea, frankly. I guess they could dig the cards up. I don't know. There's a lot of stuff that we were doing. We were doing up and away stuff and takeoff performance but we didn't do any more of that stuff.

Q. Do you recall any of your conversation with Vivan after the event on 132 while you were flying back to the airport?

A. All right. I said he rotated too much. It was too much. I don't know.

Q. All right. Well, thank you very much.

A. I can't recall exactly. Sorry.

Q. All right. That's great. Thanks.

MR. O'CALLHAN: That's all the questions I have.

(Off the record.)

(On the record.)

DR. BRAMBLE: Let's go on the record.

I guess it's me.

BY DR. BRAMBLE:

Q. Sorry for the delay here. Just one second.

Were there any formal procedures in place to notify management or safety personnel about safety related events during flight testing?

A. Yes, there's form that you can fill out. Yes, in the manuals, if something would come up.

Q. Which types, what kind of forms do you have? What are the different categories? Do you have anything other than --

A. We have an IFR. You know, you can generate an in-flight restriction if you have some type of safety-related and that's pretty much all we ever -- all I would ever use.

Q. For safety reporting?

A. Right.

Q. Okay.

A. If you had something you need to restrict the airplane for, yes.

Q. Have you ever had an issue in a flight and requested, like, a convening of the Safety Review Board or something like that to a review a problem or is that something that's done or --

A. It is done. I haven't. I have not.

Q. In what type of situation would that be done for?

A. You mean, what -- well, if someone determined that something was unsafe and it needed a review. I can't -- I don't know if it has been. I guess it's doable.

For instance, if you wanted to change a TSHA or you wanted to change the restrictions, you know, flying with nose wheel steering or you wanted to do something of that nature, you would probably want to convene a board or you may just say, we're not going to do this anymore; we're not going to fly this until we get this resolved and then that's what you would do.

Q. Did you hear any comments from the flight engineers about the test schedule and whether or not they thought the test schedule, the time available to complete the flight test field performance flight test program was sufficient for them?

A. The only comment I heard was that, you know, they want us to fly every day but we need to take some time off. There's pressure to fly every day but we need to take some time off to review the data.

Q. All right. And who did you hear that from?

A. Reece, and it was not really in the context that he wasn't getting the time off. It was that he needed to take some time off. Because I asked why we're not flying. He said, well, you got to review the data sometime. We can't fly all the time. You've got to review the data.

Q. So he actually was taking a break from the flying for a while and you were asking why and he said, because we have to review the data?

A. In that context, yes. And we also had time -- there were other times when the runway was tied up. There was data review, yeah. Sometimes the comment was in that nature, yes. Sometime we have to stop, we need to review the data, we can't fly all the time even though there are people wanting us to fly all the time.

Q. Was it just pilots who were urging him to fly all the time?

A. No, I'm sure that there's, you know, there's all the reports to go out and if you don't fly, people want to know why. And that's not necessarily a negative thing but they want to know why. Why do you have this many people out there; why are you not flying?

Q. Did you get the impression from Reece that he was able to take enough time off to analyze the data or that he felt like he was having difficulty taking enough time off to analyze the data?

A. I don't know if he was having difficulty but it felt like it was something that he had to spend some time making sure he had -- spend some time ensuring that he did have time to review the data.

Q. And did anybody else make comments to that effect?

A. No.

Q. What was Reece's role like as the test conductor in the back as far as how he interacted with you and your developing techniques? How did that interaction tend to go and how much of the sort of input and suggestions about technique came from him and how much came from you guys?

A. The technique, I guess Jake Howard came up with a technique originally and told us what we were going to do and how they wanted to do this.

Reece came up with the numbers. He was an experienced field performance guy. And we pretty much performed it. If we had anything we wanted to change or do differently, for instance, you could use the HUD if you wanted. You could use a head down display if you wanted. You could use different symbology on the head down displays and it was up to the crew to determine what they wanted to do, how they wanted to perform the actions. The pilots, I guess, pretty much came up with the techniques and as far as operating the machine, and Reece came up with how you would -- you know, the numbers and, you know, when to pull the engine back to idle and that sort of thing.

Q. Was there ever -- do you recall any occasions where a pilot would suggest a technique and Reece would suggest that you not do it that way?

A. Are you talking about takeoff performance? I don't think so.

Q. You and John on the phone were talking about the V_2 speeds, how to achieve the V_2 speeds, and I understand there was some difficulty hitting the V_2 speeds because they were being overshot?

A. Yes.

Q. So what was the option? If you were pitching -- if you got the pull technique down and you were hitting the 9-degree pitch right on --

A. Uh-huh.

Q. -- and repeatedly blowing past the V_2 speed, then what was the option -- what other options did you have to try and make the numbers?

A. There were no options. The options you had was to try to get closer. The technique was you rotated the pitch attitude, then you'd increase the pitch attitude to intercept the V_2 speed. As you're increasing the pitch attitude in a very minor fashion, you're increasing the angle of attack of the airplane because you're applying more G.

So as you do that, you're close to the stall angle of attack, you would get closer to the indication of shaker which voids the maneuver. If you hit that shaker, if you touch that low speed awareness indicator, the maneuver is -- you've failed the maneuver.

So, your goal is to intercept V_2 while getting as close to that PLI as you can without touching because that's the danger

angle of attack and it voids the maneuver if you get that close. That's the technique.

Q. So it was to sort of squeeze it in between those two limits, the PLI limit and the not exceeding the V_2?

A. Right. And if you can't do it after a while, after a couple of times, you say you can't do this. This is one of the things that, look, this is hard and we're not able to do it.

But in the development of these techniques, you know, there had been several times when we were getting it within a knot or two without hitting it. So we were still in the developmental phase with this.

Q. Did you ever hear anybody suggest that maybe this could be achieved by just having a continuous rotation maneuver, that once you get to the target pitch just continue as needed to get to the V_2 speed or to intercept the V_2?

A. I don't think so, no.

Q. And prior to the accident if somebody would have suggested that, would that have sounded like a reasonable approach?

A. Yeah, that would be reasonable. That would be something you could do. You'd probably have to start it at a higher speed because if you -- because at the current speeds, if you rotated and just continued to rotate you'd never achieve V_2 because you are rotating below V_2 and as you were rotating, the airplane was accelerating. It wasn't a technique that you'd see with the

technique we were using. If you accelerated and went faster, I supposed you could use that.

Q. But with the same numbers, if you kept exceeding V_2 and you decided that as you rotated you were going to keep rotating past 9 so that you didn't overshoot V_2 again, would that seem like a reasonable strategy?

A. It would be something could do if you didn't exceed the PLI but, you know, you can't do it at those rates and a pilot wouldn't try it. Because that's why you rotate it at a rapid rate and then it was a smooth application to intercept the V_2. You couldn't control the airplane to those standards to rotate rapidly and keep rotating, it wouldn't work that way. So you rotate to an angle and then you -- and once you're at that angle, then you smoothly intercept. You can't rapidly rotate. It's too dynamic.

Q. So what you are saying is you couldn't continue the rapid rotation that you used to get to 9, you'd have to change the pitch rate before you tried to intercept the V_2?

A. Well, the pitch rate is so high even if you cut it in half, it's still so high that you couldn't do that. You can't have a pitch rate that high and intercept a V_2. With all engine thrust, perhaps, but your pitch rate is so much higher than your speed increase that really that's not a compatible -- there's no reason to try that and it's not a compatible thing.

Q. If Kent had suggested that to -- if you were having difficulty hitting the V_2, what do you think you would have said

to him?

A. That you keep rotating? Well, if you slow your rate down to a reasonable rate after you hit the initial pitch and then make it a smooth coherent maneuver, that's a possibility. But at the initial rates, it doesn't work. But if rotated to 9 degrees and then didn't completely stop but slowed down to some slow rate and kept the rate going, I mean, that would be fine.

I mean, as a matter of fact, if you're accelerating with higher thrust, that would be the result because you'd rotate to that initial attitude and as you see V_2 approaching, you would continue the rotation not to exceed the PLI. But it's really not, you know -- I understand the question, but --

Q. So as long as you don't exceed the PLI, no problem? As long as you control the --

A. As long as you are in control of the maneuver and don't exceed the PLI, yes.

Q. What kind of relationship did Kent have with Vivan? Was Kent, as the more senior pilot, sort of in a mentoring role or were they sort of more on equal footing?

A. Well, they're on equal footing but I'm sure that it was more of a mentoring role since Kent had been around for so long. That would be typical.

Q. Do you think Vivan would have felt comfortable and been likely to speak up if something happened that where he maybe needed to suggest something or intervene?

A. Well, I'm sure he would had the situation arisen that would cross this specific threshold. And I'm sure that that threshold would be different depending on your relationship.

Q. Okay. And was Kent pretty receptive to input from non-flying pilots?

A. Yeah, as far as I know. Yeah, always was to me.

Q. Did you have any interaction in the 72 hours before the accident with either Kent or Vivan?

A. No.

Q. Wednesday through Saturday?

A. Huh-uh.

Q. Any communication?

A. That was the following week, no. I left on Friday and it was the following Saturday, no.

Q. You left --

A. A week Friday.

Q. A week Friday, okay. How about Reece or Dave?

A. No. I don't think I saw Reece. I think Reece -- I don't even know if he was here or there for that next week.

Q. How was the morale of the flight test engineering group that was conducting the field performance tests when you were working with them in March?

A. It was good.

DR. BRAMBLE: Okay, that's it for me for now. Thanks.

MR. FREEMAN: Uh-huh.

BY MR. PROVEN:

Q. I've got it here on the bottom of my pad. You were here for about 9 years more than Kent. Were you his mentor when he came?

A. No, not really. I mean, he was a -- he'd done in flight tests for a long time and had a lot of experience with bolstering emissions and --

Q. So some but not --

A. As we do with all guys.

Q. Certainly not on a formalized basis anyway?

A. No.

Q. This might be not a legitimate question for you because I don't you had reduced data but flight test engineers reduce data on their day off? How does Reece catch up? I mean, if you don't have a break in the schedule, does he just work later at night?

A. He's not supposed to. I don't know.

Q. Quite a while ago, John or somebody asked you, the 132 discussion was the result of technique and other factors. You talked about the technique. I believe it was an early rotation and a pitch attitude a little too high. Were there any factors? You didn't mention any other factors.

A. Yeah. The airplane stalls at 11½ but not 13. That's the other factors.

Q. That's what caused the wing drop?

A. That's what it appears. It's a guess.

MR. PROVEN: Thank you.

BY MR. REMICK:

Q. Gary, the 132 takeoff with the roll-off, was it flaps 10 or flaps 20?

A. Twenty.

Q. It was 20. That's what I thought. All right.

You mentioned that the reference, pitch reference, was pilot dependent. In other words, it was at the pilot's discretion. Were you using HUD or PFD for your pitch reference for the work you were doing?

A. I used the PFD initially because I liked -- with the HUD, the target was off scale and the rates appeared very high because it was an expanded scale. So I used PFD and I rotated on that because I could see it and adjust my rates more accurately to the initial pitch.

After I had hit shaker and because the scale is compressed, the PLI -- you know how it works, it's a compressed scale. It's very small between your attitude and the PLI. It is very small.

Q. Right.

A. And my goal was to get as close to that as I could without touching it. And it's just like shooting space aliens, you know, you're just controlling the thing to get as close to it as you can without touching it.

Q. Uh-huh.

A. So, once I did that initial rotation, I began -- I transitioned to the heads-up display because it's an expanded scale and I could control more accurately and get closer to the PLI.

Q. Any idea what Kent, Jake, Vivan were using, whether they were using a similar technique?

A. Kent used or Vivan -- the third guy, Jake, used a head-down display and didn't use the heads-up. Vivan I think was a HUD guy, because that's what he'd done, he wanted to use the HUD. And Kent, I don't know.

Q. Just one more. Could you comment, we talked a bit about in other interviews about the use of the simulators, either ITF, Ironberg, Flight Sims; any simulator available for field performance, your thoughts of whether it was used, useful to do in preparation for the field performance testing?

A. It can be useful if you have something that's representative. And I don't know if Kent used it. I know that it's been reported that Vivan did between his first and second and I'm sure it was because of the roll-off event. He wanted to go and practice and get familiar.

MR. REMICK: That's it for me. Thanks.

BY MR. HORNE:

Q. Trying to figure out were you aware of the increase of the PLI onset from 85 percent to 90 percent normalizing effect?

A. Yeah. But I'm not sure, I don't remember exactly when

or where.

Q. So you don't know whether you were using the 85 or 90?

A. I thought I was using 90. I thought I was using 90, I think.

Q. Were you aware that the speeds were referenced initially to 1-degree stall margin and then sometime between January and March, they hanged it to a half-degree stall margin?

A. I know it was changed to a half-degree stall margin. I know that that's what we were using, a half degree from V_{SR}. V_{SR} was half of a degree from stall and then the other stuff was half a degree plus .34 from, you know --

Q. Okay. So that was what was in effect when you were testing?

A. Yes.

MR. HORNE: Okay, that's my only questions.

MR. GALLO: I have just a couple more questions.

BY MR. GALLO:

Q. Going back to in ground effect, you mentioned that the stall angle in ground effect prior the accident was 13 degrees. Do you remember, and you probably may have answered this just now, what was the stall margin between the pitch target and that stall angle in ground effect?

A. From pitch target, it was 10 degrees. Let's go with 10 degrees. Then it was 3 degrees, because on the ground your approximate pitch angle is going to be your approximate angle --

Q. So is that margin then for the initial onset of the field development 3 degrees, was that the initial margin?

A. I guess. I mean, we were in the development, we're developing the process.

Q. Because the test plan talked about including some kind of margin. I'd like to know what that margin was.

A. I don't know. There were discussions about it. There are some e-mails that I could go review. There was stuff back and forth with Reece talking about interception, the margin and two degrees and that sort of thing but I'd have to reference those e-mails again.

Q. At what height above the ground would you be out of ground effect?

A. Half a wing span.

Q. Does that differ based on wing sweep or is that kind of just general rule?

A. That's just a 100 percent rule of thumb. It's not based on anything but a rule of thumb. Pelicans probably, but, you know. You know, you have a swept wing airplane, if you rotate the airplane, the wings get closer to the ground, the wing tips.

Q. Where you aware of any stall speed updates by the aero group during the takeoff performance program?

A. Stall speed updates, no. I wouldn't.

Q. You mentioned that you were using the HUD. Is there a way to expand the PFD to a larger scale?

A. Yes.

Q. Did you ever use that method rather than the HUD?

A. I looked at that and it also didn't have the target on scale so I didn't use it.

Q. Did you ever participate in of the stall testing of the airplane?

A. Yes.

Q. During that testing, would you interface more with flight sciences or with the aero group?

A. I interfaced with, I guess, the aero group and with our flight test engineering, specifically, Bob Mills and our flight test guys. I had many discussions with Bob Mills.

Q. I'm just trying to ascertain whether the group that gets assigned to a certain test mission is dependent on the purpose of the test, such as stall testing, so you would have predominantly aero people versus flight sciences.

A. I don't know what do you mean by that?

Q. Well, for example, if you are going to do stall testing, then --

A. I work with flight test engineering and they work with these other guys. And I typically, you know, I talked with Bob Mills just because we have a personal relationship, and find out what he's doing because we did a lot of weird things with the stalls and that's why I had the discussions on what we're going to do and how we were going to do it. But typically, I would

interface with flight test engineering.

Q. Okay. Let me rephrase the question. During your preflight briefs, for example, for a stall mission, the people that are attending are flight test engineering, but then you start to have somebody from the aerodynamics group attend, whereas if you're doing performance field testing, you won't have aero but you'll have flight sciences there. The composition would change according to the nature of the test.

A. Yeah, and that's not of much interest to me.

Q. To get your information regarding the nature of the tests or if you have questions regarding a test card, do you put more -- do you talk more to the flight test engineer that's assigned to that test or do you go to and contact somebody like Bob Mills or somebody in that specific area?

A. Well, I talk to the flight test engineer.

Q. And while you are flying, what kind of safety equipment do you use? Do you have a parachute?

A. Sometimes.

Q. Do you use your shoulder harness at all?

A. Usually.

Q. Any other safety equipment you are provided with?

A. You know, we've got walk around oxygen bottles. We've got a rope to get to the back of the airplane. We have -- on some testing, we have a low speed and a high speed stall or attitude chutes, parachutes that attach to the back of the airplane. We

have kick out door in 6001 for egress, and you've got, you know, fire hatches, life rafts.

Q. Now, after a test flight -- for example, let's go to 132, did you write up your own report on what happened during the test?

A. No.

Q. The flight engineer writes the report?

A. Yes, sir.

MR. GALLO: That's all the questions I have.

John, do you have any questions?

MR. O'CALLHAN: Two or three.

BY MR. O'CALLAGHAN:

Q. Gary, you mentioned you participated in the stall testing. Did you do a full aero stall in the airplane?

A. Yes.

Q. What's it like?

A. It varies. It depends on the altitude and flap condition but it either rolls left or it rolls right or it pitches up with no roll-off in the clean wing configuration with the stall. With icing, simulated ice on the wing, it varies. With pre-activation ice, which is sandpaper on the wings, the angle -- it didn't roll left or right, just the buffet increased and it gradually increased the angle of attack. And with other stalls, ice configurations glued to the airplane, it varied. There were numerous configurations and that varied with altitude as well.

Q. Were the flaps down flaps 10 stalls predominantly do one thing or another? I mean, were they generally symmetric or more generally you get a roll or was it all over the map or how would you describe that?

A. All over the map-ish. It would roll left, roll right or pitch up. It would either roll or not. I would say that it rolled in one direction or the other more than it just did a straight nose pitch-up.

Q. What kind of roll angles would you get?

A. Not too high, particularly with the flaps, it was low, maybe 20 degrees.

Q. 20 degrees?

A. Maybe 20.

Q. Okay, thanks. You mentioned talking to Bob Mills a bunch. Did he ever show you the CL alpha curves coming out of the cryogenic tunnel?

A. I don't know if he showed me them, but we had some discussion on the flap speed changes or the stall speed changes with flaps and that type of thing. And discussions on mostly what we could expect to see with the icing, simulated ice glued to the airplane but no, I don't know that I discussed that with him specifically.

Q. I was just going to -- what's behind my question is whether you had an opportunity to look at what the stall break looks like in terms of CL alpha curve and the angle of attack

range over which it occurs and that sort of thing.

A. This was all -- we looked at a lot of stuff, and that was 14, 15 months ago. I don't know.

Q. I guess that summarizes it. I mean, do you have any impressions from those conversations about the nature of the CL alpha curve or the nature of the stall or not?

A. No.

Q. So then my last question is, I guess pretty basic, what does the -- at the end of the day, what does the pilot rely on to keep himself away from stalls in the context of this kind of testing?

A. Well, he relies on the indications in the cockpit and then numbers that are computed by engineering.

Q. Meaning the V_2 speeds and the PLI?

A. Yes.

MR. O'CALLAGHAN: That's all I have. Thank you.

DR. BRAMBLE: I don't have I don't have anything, thanks.

BY MR. PROVEN:

Q. You wore gloves during flight testing?

A. No.

Q. Wear a helmet?

A. No.

Q. Flaps 39 stall characteristics?

A. Very similar to the others, left, right roll. I think

-- I seem to remember that your roll-off tends to be a little greater, the roll-off angle.

Q. Okay. Thanks.

A. Not as bad as a G5.

MR. REMICK: No further questions.

MR. HORNE: One more question.

BY MR. HORNE:

Q. Were you briefed on the difference on the PLI between in ground effect versus out of ground effect, where it was accurate and where it wasn't??

A. No.

Q. So what was your impression of the PLI, was it only good for out of ground effect or was it good for both?

A. PLI was a PLI to my knowledge.

Q. So it applied everywhere.

MR. HORNE: Oaky.

MR. GALLO: Any other questions? Do you have anything else you'd like to add or comment?

MR. FREEMAN: No.

MR. GALLO: Well, thank you.

MR. GALLO: We're off the record.

(Whereupon, at 2:00 p.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD
INTERVIEW OF:	Gary Freeman
DOCKET NUMBER:	CEN-11-MA-258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 17, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha Wheeler
Official Reporter

_____

Lourie J. Brown
Transcriber

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*	
	*	
AIRPLANE ACCIDENT	*	
ROSWELL, NEW MEXICO	*	Docket No.: CEN11MA258
N652GD	*	
	*	

Interview of: JAKE HOWARD

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Thursday,
June 16, 2011

The above-captioned matter convened, pursuant to notice, at 8:00 a.m.

BEFORE: MITCHELL GALLO
Accident Investigator

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I N D E X

I N T E R V I E W

(8:00 a.m.)

MR. GALLO: On the record.

This is an interview with Jake Howard.

INTERVIEW OF JAKE HOWARD

BY MR. GALLO:

Q. Thank you for joining us.

A. Uh-huh.

Q. Let me just start off if you could describe your title and your responsibilities in the organization?

A. Right now I'm filling the role of the chief project pilot for the G650 program. And my title is senior experimental test pilot.

Q. And how long have you been with Gulfstream?

A. A little over 10 years.

Q. What other programs have you worked on?

A. When I first got here AVS a little bit, G5SP certification to help with certification effort, a lot of plain view programs, cert Delta, cert Fox-Trot, the G450 I was the project pilot for the G450 and then project pilot for the G650.

Q. And in those programs were there certain areas that you were assigned to that you had worked on? For example, was it just avionics, or was it flight controls, what areas of testing were you involved? I want to get a little more specific.

A. Well, AVS was just avionics. I didn't do a lot of that,

but some of the icing portions I had done that previously. On the 550 it was mostly the handling qualities and performance, did the field performance work on the G550 when we were out at Roswell. On the G450 I was a project pilot on that one, so did the full avionics, handling, quality performance and also did the field performance on the G450. And then on the plain view cert Delta and Cert 5000 project pilot and those were avionics evaluations.

Q. Prior to Gulfstream how did you obtain your test pilot experience?

A. Navy test pilot school in 1990 at Pax River.

Q. What programs in the Navy did you work on?

A. Actually I'm Army.

Q. Oh, Army.

A. The Army goes to the Navy. I tested rotary and fixed wing, both. The 0H58 Delta, improved version, which is the Army version. And airplanes I did the RC12N, which was a recognizance version, did the handling quality performance on that because the Army facility at Edwards did the traditional handling quality performance testing whereas avionics was done at a different location. Also, we did a program where they modified a Shorts 330 and did all the handling quality performance on that also.

Q. Going to the Gulfstream 650 program you say you are chief project pilot. How does that differ from experimental test pilot in the program, with that title?

A. Mostly the project pilot just has the administrative

responsibility. So you are still doing experimental test pilot work but then you also do a lot of the coordination on the development and the paperwork portion.

Q. Is there a chief experimental test pilot?

A. Yes.

Q. Who would that be?

A. That's John O'Meara.

Q. As chief project pilot are you involved in the assignment of crew members for specific test flights?

A. Yes.

Q. Can you describe how scheduling is performed within the department and how crew members are selected?

A. Uh-huh. There is a certain cadre -- I do the selection on the G650 program. There's a certain cadre of the more experienced pilots that I utilize as the primaries that I try to get on every flight depending upon what's being evaluated at the time. And normally we don't find out until maybe the day before what airplane is available and what testing is going to be done. And so from that then we have the list of our pilots that are available for the 650 and then I assign against that.

Q. Are certain pilots within the group doing certain areas of testing or can they be assigned to different areas of test?

A. No. They -- oh, yeah. Well, some can. It just depends on their experiences and their competencies on how they are assigned.

Q. Can you describe how Kent was selected to do the performance field testing?

A. Sure. Kent was actually in Gulfstream world when I first got to Gulfstream did some of the stuff and then he and I went out to Roswell. So he was kind of for the civilian Gulfstream testing, kind of my mentor for doing the field performance out there. Kent had done almost every field performance test we have had because he did the special mission birds since I have been here. I couldn't recall whether he came out on the 450 with me or not.

So he had the experience in doing field performance and so because we were going to be out in Roswell so long, I chose three pilots. There was myself, Gary Freeman, and Kent were the primaries. And then I selected two other pilots that we were trying to get trained up, you know, get their skills honed as we did that. So Kent was the natural selection for field performance.

Q. How recent was the field performance work that Kent did; how recent was that? You mentioned he had the experience in field performance.

A. Probably within the last couple of years I think on the special mission birds. And then he and I had gone out in November on the first trip to Roswell and we did field performance.

Q. And that first area field performance was V_{MU} testing?

A. It was, we were out there for 2½ weeks. It was not just

the V_{MU}, but V_{MU} was part of it.

Q. But the first field performance test point that Kent did was that in the area of V_{MU}?

A. I don't know if we normally trade off flights. I'd have to go back and look at the cards, but I don't think that was his very first test done and at Roswell.

Q. Prior to the 650 field performance testing did Kent utilize any simulators to, as a buildup to the 650 field performance testing?

A. I don't know.

Q. And do you know if Vivan ever made use of a simulator as a part of the buildup for the field performance testing?

A. Yes.

Q. And do you recall when that was and what areas they did in a simulator?

A. For about two days prior to the last trip that he went out on I know that he and Reece went down to the ITF. I know they worked on some of the rotation on the CTOs they were investigating.

Q. Do you remember the most recent flight number that occurred on that, the nearest flight number when they went down to the ITF?

A. The nearest flight number?

Q. Would it be like -- is that near the time of Flight 132?

DR. BRAMBLE: You said 2 days prior to the last trip,

you mean the accident trip?

MR. HOWARD: Right.

MR. GALLO: Okay. Before the accident. Okay. That clarifies that.

MR. HOWARD: Okay.

BY MR. GALLO:

Q. How much is a simulator used in buildup for flight testing?

A. It depends on the test. We will try to use the flight safety simulator; well, that's questionable -- I mean it's getting better now. The ITF depending upon what realm you are going in it's good for procedural training. The simulation itself that, once again, is getting better but isn't, the fidelity isn't as good as you would like.

Q. Do you know if Vivan made use of a simulator or any simulator before Flight 132 in preparation for 132?

A. I don't know.

Q. Do you recall what test points you did within the take off performance test plan? If you can remember.

A. A lot of them. I mean, we are out there in Roswell for 2 weeks, 2½ weeks. Then we did a little bit of an investigation at Birmingham and then I went out again the first deployment. I was out there for the first week before I started the rotation of the pilots.

Q. I'm looking test card from Flight 153 and this is card

that was being used during the accident flight. Did you ever attempt that maneuver, that test point?

A. I did numerous CTOs.

Q. And, again, I'm looking at the card. Did you ever have any difficulty in capturing V_2?

A. Yes.

Q. Can you describe what that difficulty was?

A. Usually you'd get a little fast on the maneuver by the time you captured the pitch attitude and did the transition, then capturing the speed you are a little fast and then have to slow back into it.

Q. Were you ever able to complete that test point within the test plan's goals?

A. We didn't establish a tolerance. You know the target was to get on the speed. So we didn't say plus or minus 5 knots is acceptable. But the ones at Birmingham I think are probably the closest. We were getting I think around 3 knots or so within the V_2 but they were still all fast.

Q. And you were the pilot during that time?

A. Yes. In fact, it was I and Vivan who got to bring it in.

Q. Why did Vivan go with you rather than somebody else?

A. Because he was one of the performance guys going to Roswell in rotation. So the more exposure, he was knew testing Gulfstreams.

Q. Was there any discussion within the experimental test pilot department about any difficulties in doing the field performance testing?

A. There were going to be challenges on, the maneuver is as in all field performance testing it's a very rote procedure to be able to try to capitalize on the performance of the airplane.

Q. And as chief project pilot do you also get involved in the training of other pilots?

A. Yes.

Q. Can you describe what training a new hire would receive as opposed to a mid level pilot and as opposed to a senior level pilot?

A. Well, the training that we would do would normally have pilot that's already flying Gulfstreams for a while. So then it depends on the progression on the type of flying ability before that. Experimental test pilots are given credit for having that knowledge and the thought processes of being that test pilot in the beginning.

Usually on the ones that come in for the 650 we try to expose them to the iron bird and the ITF. We have a little check list that we go through. Some academics, some are in the system. But because of the similarities, a lot of simulators in actual flying the airplane are quite a bit with the 550. So we take that as credit also. And then as we go through the techniques some of it is kind of an on the job and refresher for doing the testings

themselves.

Q. Is being a graduate of a test pilot school a prerequisite to being a pilot here?

A. To being an experimental test pilot?

Q. Yes.

A. No. That is not.

Q. So somebody from production without an experimental test pilot background or, let's say, a graduate of a test pilot school could come over from production because he's got the experience in the aircraft to the experimental?

A. It has happened. It's a rarity though. In fact, our chief test pilot is one of those.

Q. Does the experimental test pilot department have a lessons learned database?

A. You mean a written down database?

Q. A database of past experiences of failures for whatever reason from previous testing, even going back to the G5 program, where somebody could come in and kind of see what other peoples' experiences have been doing the flight test.

A. I don't know that we'd have what could be called an organized folder of such. We do have -- Kent and I kind of created test techniques that are specific to Gulfstream. Just some of the things that we found to work, not necessarily those that have not so much, but normally what would work. And on some of the conditions that there have been other incidences, then

there's normally a published document that is kept. But I don't know that we have a reading file to go to. That is readily available to find out.

Q. You understand what I mean by lessons learned? I'm kind of using the common industry verbiage for that.

A. Right.

Q. Now, you have a system for documenting problem reports. Can you describe how that system works?

A. Sure. During the test program normally after a flight or ground test or any other kind of testing is done, whether it's in the simulator or not, an issue that is found is documented. Almost always it is through the engineer who will put that in a list, a problem report listing and that's communicated to the supplier and then they work out the resolution on that. And each of those is given a certain severity on the PR, number 1 through 4: 1 being that it's a safety flight issue and they wouldn't continue to fly in that regard within that system's purview; 2 is it's got to be fixed before we go for tech certification; 3 is it has to be fixed before we go into an entry into service with a customer; and 4 is hopefully one day it will get fixed.

Q. And how is that disseminated within the flight test organization?

A. (No response.)

Q. Can the flight test engineer pull up the PR?

A. Uh-huh. They are down in PR. It's through our internal

program called LiveLink. So anyone can access the PR listing. Those I have an access to that portion of it.

Q. It's called a problem report, but when does something rise to the level of being a problem?

A. An unanticipated or unexpected result or outcome.

Q. So it could be maintenance related, it could be --

A. Oh, I see what you are getting at. No, not necessarily. A problem report is normally associated with the design of the component or the system. If it's maintenance related, then it's got to be handled differently as the deficiency report that's required. Between the two, sometimes you don't know at the time as the, let's say, the pilot who annotates it. And then it goes into the system and then the engineers get to decide whether it is airplane related, a maintenance related item or it's actually a system item.

Q. And if it's a maintenance related item then it goes into a separate database; it's separate from a PR?

A. Yeah.

Q. PR is engineering related?

A. Yes.

Q. So then you have a maintenance -- database, for lack of a better term.

A. Yes.

Q. How is that disseminated? Can anybody access that?

A. Not anybody. That's through a new system they then --

excuse me, and normally it's only the maintenance folks. Some of the flight test engineers will be able to get in and access that. But at a brief, let's say, a preflight brief normally the pertinent items are presented to the flight crew for review.

Q. And then the last area is what if you have an operational issue? For example, if you go to Flight 088, unless Kent was piloting the airplane on that last test point and there was a wing drop, how is that knowledge or that experience, how does that get disseminated within the organization?

A. That particular event was, it was debriefed, of course. And discussed and through the discussion it was an admitted overshoot of the target. And so then the recovery was affected. So essentially it was, we won't go over that realm again. Should it have been pushed higher? Yeah, possibly so for investigation. But Kent gave an entire brief back here in Savannah when we came back on the out at Roswell, kind of an introduction to Roswell and also on that event.

Q. And then there was another wing drop on 132 when Vivan was flying that test point.

A. Uh-huh.

Q. After that occurred did the level of attention toward wing drop increase?

A. Well, the data that was available at the time, they reviewed it. They looked at data. From the information that was known at the time, because we were having to fly in a mode of that

yaw damper, it was assumed to be a lateral directional event also accompanied with a high rotation rate. And so looking at it with the information we had that it was not likely a stall event because of the data given and that it was a lateral directional event with a wing drop and -- so they just said, well, because of the yaw damper we are not going to do these maneuvers any more.

Q. Did they attribute it to pilot technique in anyway on 132?

A. At the initial, because of possibly pulling at the throttle as before a rotation call, you know, then it was, it -- yes, it was slightly given to a pilot technique.

Q. And I was looking at the flight cards and then there's the test safety hazard analysis for the field performance, and without looking at them specifically for 132 and 153, the risk level is defined as a high risk test flight. Who is the person that authors those test cards?

A. Usually the flight test engineer will be the initial author and then it's coordinated through the flight test pilot will look at that. And then before it is signed, if it's a medium or high risk evaluation then it goes before the Flight Test Standards Review Board. And then that is looked at by the entire board and any other comments or considerations are addressed and then those are also included in the TSHA.

Q. And then the flight test engineer, where is that person getting the inputs or the test hazard, test safety hazard analysis

card?

A. Most all of them are historical within Gulfstream that we have had before. And then NASA has created a database that's also referenced.

Q. So my understanding is the flight test engineer has the NASA historical database and then a historical Gulfstream database and is taking that information and putting it into one card and it is being reviewed by the Safety Review Board?

A. Uh-huh.

Q. Then how is the probability level created on the test safety hazard analysis card?

A. It's determined through experience and exposure and there is no definitive location for setting up the probability.

Q. Is there a definition of probability with the differences between low, medium or high or is it more a qualitative, there's a qualitative basis to it?

A. Well, there is guidance given and FAA Order 4040.26A, which discussed all the risk assessment and risk program and it gives guidelines on how to do all that. And it even gives the examples of what risks or what maneuvers are considered, what risk levels. But overall it becomes a qualitative assessment by those with experience on the determining that.

Q. And with the probability of risk level, you had a wing drop in 088 in the field performance testing phase and then 132, shouldn't the probability level have you been raised from low

because of past occurrences?

A. They are two different maneuvers. The V_{MU} that was done and then the CTO, continuous takeoff, that was done. A V_{MU}, the probability is higher only because the whole intent is to find that -- the minimum speed that you can safely lift off. So the possibility, probability of maybe over exceeding that is higher.

The CTO is a maneuver that is done, it is actually a lower risk level, lower probability because that is the maneuver you are finding that standard pilot will fly in order to get the performance numbers out of the flight manual. While both of those were in exceedance [sic] of a -- could have been a rotation partially on 132, the contribution of yaw damper being off, which wouldn't be normal, it's two different assessments.

Q. Okay. I understand. As far as the probability level, you know, you have got the risk level but then you have the probability level.

A. Uh-huh.

Q. Is there any conduit to take into account past experiences by pilots who have flown test points during the program to raise that probability level from a low to medium?

A. Absolutely. Well, you should assess that and that comes more from the crew selection criteria that you try to utilize. That's one of the mitigators, because not only do you have the probability but you look at the hazard, of course, when you assess on this level.

Q. I'll probably have more questions as the day goes on, but -- what airports have you done testing at other than Roswell? Just the past two previous ones before Roswell will suffice.

A. Oh, Brunswick, Cecil -- you say the past two?

Q. Yeah.

A. There are two. I mean we go to a lot of places.

Q. When you go to some airports, I don't know which airports you go to, and they have airport rescue firefighting facility do you talk to them about the test flight?

A. Uh-huh.

Q. Can you describe what you talk about?

A. We don't necessarily tell them -- well, sometimes we even tell them the maneuvers, but mostly we bring them in and we familiarize them with the airplane, give them a walk around, of course; tell them where all the fire protection equipment is, ingress/egress the airplane. In the cockpit how to shut the engine down and the battery down, the standard briefing that you normally give to a crew. And then you do describe a little bit on what you are trying to do so they know what to look out for. So it's an introduction to the airplane, a briefing for them to let them know that we are testing and then how to get in the airplane.

Q. And they are shown the inside of the aircraft also?

A. Yes.

Q. Has there ever been an occasion where you would request that the airplane rescue firefighting couldn't be standing by the

runway during a high risk test?

A. Yes.

Q. Which tests have you had that don't on?

A. The max breaking kinetic energy test done at Roswell.

Q. Have you been involved in any stall testing on the 650 program?

A. Yes.

Q. And in stall testing how many FTEs did you have on board?

A. I think usually one.

MR. GALLO: That's all the questions I have for now.

John, do you have any questions?

MR. O'CALLAGHAN: Yes. Thank you.

BY MR. O'CALLAGHAN:

Q. Thanks for taking the time to talk to us. Just to give you a heads up to know what to expect, I have written down about 16 questions.

A. Okay.

Q. I think Mitch may have had more than that. But just to sort of scope it out for you ahead of time. And, again, a little bit of a disclaimer that I gave to the folks yesterday, I am an engineer. So I generally don't interview people. Generally I just interview data. So I apologize if it's a little clumsy.

I'm really interested in kind of the conduction -- how the maneuver is conducted and flown the CTO with the one engine

out per the test card. So I'll just, can you just describe how the card procedure is to be flown and just step me through it describing your actions on the flight controls and so forth?

A. Sure. For the CTO the set up is normally you define whatever your target V speeds are for the maneuver. You will stay stationary on the runway for approximately 10 seconds as you get a tear for the DGPS because the whole intent is to try to find takeoff distances as you are doing the testing.

With the maneuver that was being performed then the way the 257A states that you will normally do it by just doing a throttle chop, retard one of the throttles back to idle and then continue to take off. And then you can go back, you will go back and do some almost like spot checks going through with an actual engine cut. You have to define what's your engine failure speed, your V_{EF} speed is and the target is so that as you initiate a rotation, your engine should be back at idle. So that is a time frame depends on what your decel characteristics of the engine are.

I describe that only because as you start the takeoff roll, you know, bring the power levers full up and then do a brake release, once again trying to minimize your takeoff distance, and then 15 to 20 knots a lot of times you have to predicate that on what your accel rate is, then you will retard your critical engine throttle back to idle. And then continue until you get to the rotate speed.

Because there's some delays, you may lead that like a knot and a half just because the accel for the callout so that the pilot response is right at the rotate. You will usually -- the column, because this column is slightly different and the flight controls, it is at the neutral point, you would not do any column input. If you needed to do some roll control input you would do that. But you try to minimize the column input so that you don't induce much of the drag, and also that determines where your rotate is. Usually when you pull it off the traces.

So at the rotate call then you would pull the force that was determined through it because you are trying to get a rate. We did an investigation on trying to determine what that was, but you'll target a force and then capture the pitch attitude, whatever your initial target pitch attitude off the card; on that condition it was 9 degrees. You would go toward the 9 degrees and capture that or the target, because what you are looking for is to capture your V_2 speed. And then as your V_2 speed approaches you intercept your V_2 speed and then keep V_2 speed until passing 35 feet.

Q. Okay. Thank you. And now if we can narrow down on the details there of the transition.

A. Sure.

Q. Talked about this a little bit yesterday. So is the procedure to hold the 9 degrees until you see the V_2 and then pitch up or do you pitch above 9 degrees in anticipation of

leveling off at V_2?

A. You target 9 degrees until you integrate your accel so that you can capture V_2.

Q. So in other words, I guess what that means to me then is that you are going to sacrifice the 9 degrees ahead of time in order to not overshoot V_2, is that --

A. I don't know that I would say ahead of time. Your target and 9 degrees -- see, it depends on thrust to weight and what your accel characteristics are.

Q. Okay. Well, tell me if I'm thinking correctly here. I guess if one were to hold 9 degrees until you saw V_2 -- let's say V_2 is 135 -- until you saw 135 knots on the indicator --

A. Yes.

Q. -- and then at that point, as you mention, it depends what your acceleration is, but presuming that there is enough thrust that the airplane is actually accelerating at a 9-degree pitch attitude as you hit 135 degrees --

A. And it will be, yes.

Q. It will be. Then if at the instance the column is pulled back a bit more in order to raise the nose, inevitably the airplane is going to accelerate above 135.

A. Correct.

Q. Right?

A. Yes.

Q. Now, if one wanted to avoid that and not overshoot 135

but get to a trim pitch so that -- 135, then one would have to pitch above 9 degrees before getting to 135?

A. You would have to start your pitch increase before you get to 135, correct.

Q. Yes. And so which is the preferred option to pitch above 9 before getting to V_2 or to accept the overshoot in V_2?

A. Well, there's no preferred. You need to catch the V_2 because the V_2 is the target speed at 35 feet. If you allow it to accelerate beyond that because of the time frame, because you can't instantly capture it -- and you can't instantly pull up to a pitch attitude without, you know, getting an accelerated stall indication. So it's actually a very gradual increase in pitch attitude to be able to get to whatever that is to achieve your V_2 at 35 feet.

Q. So I guess what I'm hearing you say is that one would pitch above 9 degrees before getting to 132 in order to capture 1 or in order to get -- before getting to V_2 in order to capture V_2.

A. Yes.

Q. All right. Okay. So now the test card is written to, I guess that's -- is that the interpretation of the test card, the test card is written to maintain pitch to V_2 and then capture V_2. So maybe that's not the literal interpretation, but is the interpretation more like what we have just described?

A. The way I described it is the interpretation, you know, the semantics of the card says until V_2, until the capture of the

V_2 is how it's interpreted. Until you have to capture V_2, because otherwise you would never get to V_2 at 35. And if you continue to increase it, it would just never get there.

Q. Okay. I think that makes sense because, yeah, as literally written, as you have described the maneuver can't be done but everybody understands, I guess, that the technique as you have described it in order to accomplish it.

A. Correct.

Q. So then, you know, I'm trying to understand also better the severity, if you will, or the rigor of the pitch limit and like the 9 degrees and then we also heard there was an 11-degree limit. Can you give your interpretation of what the 9-degree pitch limit and 11-degree limits are and when they are relevant and when they cease to be relevant?

A. The 9 degree was the target pitch attitude for the initial rotation. And the 11 was don't get higher than that for the initial. So to pull the 9 until it was necessary to get above that. Don't pull to 11 and then start to pull above that to capture a V_2 or above 11. That's the way I --

Q. Okay. Now, you mentioned --

A. Go ahead.

Q. No, no. Continue please.

A. I was going to say that's the way I understand, you know, after the discussions and all that from being privy to some of the information that Kent and Vivan talked about is what that

11 or 12 would be. If for some reason on that initial pull and prior to getting to the V_2 point, don't let it get above 11 or 11½ or whatever they use, 11 or 12.

Q. Can you define initial, what are the bounds of the initial maneuver you described?

A. Well, in the technique it's to pull and, in fact, you know, even rudder down you do the initial pull is very rapid to whatever that force is. And the great thing with this flight control characteristics is that since it's a spring, the displacement should equal the force each time. It creates a rate and as soon as the rate is initiated -- because what you are trying to do is get that initial start, then you -- it's actually like a half second to a second capture of that initial pitch attitude and then you reference your speed. So you're targeting that initial 9 and then going for the speed target and then, of course, integrating that from the acceleration and then you would just continue to pull the pitch to capture your V_2.

Q. I see. So let me see if this, if I express it this way if it would be correct. That you pull with whatever you decided to pull with, nose comes pitch, you target 9, you will arrest it at 9 degrees until you get close enough to V_2, where you perceive that you are going to need to raise the nose some more in order not to overshoot.

A. Yeah. Then -- oh, go ahead.

Q. And so that would be the initial maneuver is basically

it ends, the initial part ends when the pilot perceives that if he doesn't raise the nose some more he is going to overshoot V_2?

A. Correct. Because remember this technique is not only for the low altitude, low gross weight airplane where you have a really high acceleration rate, it's also for the high end hot conditions where your thrust of weight is greater, and in that case you may have to hold that initial target attitude for quite some time before you need to continue to increase pitch attitude to catch your V2. So it just depends on acceleration rates and those characteristics that you are looking for.

Q. Is the liftoff point relevant in this discussion? Is there like a limit that says you can't pitch above 9 until you reach liftoff, or is liftoff sort of beside the point or what's the role of liftoff in this discussion?

A. Well, it has a lot more now than what we had thought about, because the interpretation before was it really didn't have, using all of the numbers that we were given, it was supposed to just fall out. You know, it was to do the pitch rotate and then capture a V_2 speed.

Q. But then, I think you implied that something has changed since then?

A. Well, the 2 months following the accident.

Q. Uh-huh. And what, what's the new thinking?

A. Well, it is important. You know the pilots did not specifically look for a liftoff point before continuing to do a

pitch pull. Of course, now with all of the discussions on the detriment, the increased detriment of angle of attack than what was initially perceived, you know, that has more impact than what was initially thought. So there are more conditions. You know we have been educated more since then.

Q. Describe what the -- well, I guess I'm curious about the specifics and the details of what has evolved and what the new conditions are and what conclusions have been drawn in your community as it related to what you mentioned.

A. Well, we are doing all of that. And I think there is a better person to talk about that who has been doing the investigation or gathering the information, the engineer that has been doing that.

RAMEE: Let's go off the record for a second.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

Okay go ahead, John.

BY MR. O'CALLAGHAN:

Q. I think the question surrounds the significance of the liftoff point in terms of pitch limits and any evolution of that understanding prior to and post-accident.

A. From the pilot operational standpoint as I mentioned it was to fall out of the technique. So it was not looked at as a specific point of interest while doing the maneuver.

Q. Okay. And since, in the last 2 months things have been examined, has liftoff assumed a different role?

A. Through the technique, once again, if it is, I think it -- you know, it will be looked at. You can't help but not. But if you go through the rest of the procedures and maneuvers then it should still fall out of the condition.

Q. Let me ask it this way.

A. Sure.

Q. I believe Pat Connor, his understanding if I heard him correctly, was that the 9-degree and the 11-degree limits were sort of absolutes that applied as long as the wheels are on the ground, but then after the liftoff point then the pilot was free to go above those; is that your understanding or do you believe something different?

A. We did not use that criteria specifically. We used the 9 as the target and the 11 was don't get above that for your target initial pitch.

Q. Right. And, again, the initial being until you perceive that you need to go above it in order to not overshoot V_2, right?

A. Yes.

Q. Last thing about liftoff. How does the pilot determine liftoff?

A. Well, and see that's where we have to talk about it. There are a couple of ways you can determine whether you have liftoff. One is the, on the landing gear control panel there is a

safety pin that will retract itself once the landing gear weight on wheels switches have gone to air mode. That way you know you have lifted off. Other than that there is really not one for a pilot unless he waits until he gets a positive climb indication. And that's the normal indication that you would use to raise the gear.

Q. Okay. So an operation of trackets (ph.), I guess, and in the field that's what pilots probably uses, the copilot calls -- - well, the pilot not flying calls positive rate then you know he's off the ground. That's enough on that.

Moving on to Flight 088, can you just step through, describe that event from the takeoff roll and what your interpretation of what transpired there? I know you mentioned it earlier in some questions, but if you can just maybe just describe kind of step by step what you perceived happened there?

A. Okay. On that it was a takeoff roll. We were doing a V_{MU} which has a different test technique than on the CTO. I don't know what you are looking for here. What's --

Q. Just kind of like a replay the sequence of events. I mean you line up, we advance the throttles, the airplane rolled down the runway, we lifted off. You know just as you recall the sequence of events, just describe the event for us, please.

A. Okay. What's the objective of that one? I'm kind of curious on it. I'll ask back for an answer on that one.

Q. Number one is just to lay out the sequence of events so

we are all starting from a common page and we all understand that we are thinking about the same thing and that I don't have one idea of what happened and you have another one then we are kind of talking at cross-references. Sort of just kind of level, you know, to get us all on the same page.

A. Okay. And you have the data, correct?

Q. That's correct.

A. Okay. Lined up on the runway. Did our tear. This one required we were reduced thrust overweight. So we initiated the takeoff roll at throttles full forward and what we would do is we would set a piece of tape, masking tape so that you could pull through it in the event you had to abort at the appropriate thrust level for doing the maneuver. Because as you do the takeoff roll then at approximately 60 to 80 knots depending upon what your gross weight was and accel characteristics you retard the throttle back to the appropriate, to the tape, which should bring it back to the EPER (ph.) level for the rotation for the V_{MU}.

Also, at about 6 knots the pilot in the left seat would pull the control column full aft and hold it there until after the rotation is initiated. Once rotation was initiated then the pilot is to capture whatever the target pitch attitude was for that maneuver and then hold that throughout the rest of the maneuver until passing 100 feet. Then we use that as AGO. Usually we keep it going for a little bit more that that.

On that particular maneuver you are talking about, I

guess on the -- are you talking about the one where we had the over-rotation?

Q. Yeah.

A. There's a lot of V_{MU}s.

Q. The Flight 088 with kind of wing drop or roll event, whatever you want to call it.

A. Right. So on that one it was a slight over-rotation and performed corrective actions was a right roll-off on the wing, pushed throttles up and continued on the recovery.

Q. Okay. Now, getting to the physics of the roll-off, in your opinion what were the physics behind that?

A. What were the physics behind it? It was probably very close to a stall event close to the ground with a high pitch attitude. It could have been just some pre-stall roll-off.

Q. By that you mean some close operation --

A. Yes.

Q. Do you recall if you got stick shaker on that event?

A. I do not recall.

Q. Would shaker be expected prior to a roll event like that?

A. Set appropriately, yes.

Q. Yesterday we did discuss PRs and I asked somebody a question about whether the absence of a stick shaker preceding a roll event would be a PR and my recollection is that no, it wouldn't be, but perhaps she had in mind what I think you called a

DR, a defect report?

A. A deficiency. Many times, and it even talks about it in the 257A, you disengage, and I don't recall if we did or not, disengage the stick shaker because you are at close angles and depending upon where that's set you don't want to have to fight against the stick shaker while you are doing the maneuver. You monitor all the other values and determine that so the stick shaker is for a normal op kind of maneuver. But when you are doing close, you know, trying to get information close to that and maybe even higher than where you would normally set a stick shaker you would disengage the stick shaker. And that's why I say I don't recall the stick shaker coming on or whether it was even active for doing the V_{MU}.

Q. All right. Thank you, that's a good segue because I have questions about the alpha limiter system. I've got a question down here: Please describe the alpha limiter system and the differences in the system between the test configuration and the intended production configuration.

That's probably a large question but you can narrow it down to the context of kind of what you were just mentioning for tests and what you might do differently in order to avoid nuisances and so forth.

A. That is still under development on how we are going to implement the stick shaker and, well, the stall warning alpha limiting system.

Q. Describe how it was configured for the field testing?

A. Alpha limiting was not active for the field test. We were doing it in first flight mode. We were not doing it in normal flight control mode.

Q. Can you describe the differences between normal and first flight mode? I mean obviously, I guess, alpha limiting isn't there, but what else is different?

A. The normal mode has some feed backs and incorporates means on getting the NZU cruise mode. Whereas a first flight mode is more of a direct control, the airplane mode. You don't have the protections in first flight mode, the alpha limiting or the ICE speed protection.

Q. And in terms of the shaker, is there any differences there?

A. Yes. In first flight mode we have a set value on the stick shaker that comes on and at a certain normalized angle of attack. Whereas in the normal mode then it is -- you would probably not even see stick shaker; you are getting alpha limiting first. Stick shaker is kind of a last resort following the activation of the alpha limiting.

Now, in our development program we are looking at how we put stick shaker in for takeoff and then have alpha limiting after liftoff. So we are continuing with that.

Q. Is it correct to say that even in -- for flight testing, the stick shaker is there to afford stall protection?

A. It's to afford alerting the crew that they are approaching conditions conducive to stall. We also have what's known as a pitch limit indicator on our primary flight display and they are synchronous in first flight mode.

Q. Was the PLI used for field testing?

A. Absolutely.

Q. Can you describe its role?

A. Yeah. It was used to determine the max available pitch that we could utilize. Remember earlier when I was talking about how we would takeoff, hold the target initial pitch attitude and then we would increase the pitch until we were able to capture V_2. What limited our pitch rate and the actual pitch value was the pitch limit indicator.

Q. So even our, going back to our previous conversation about pitch limits and when you can go above a 9 or 11, in any case at no time could you go above the PLI?

A. We did not go above the PLI. A couple reasons, one is you knew you were getting close; you are eating up the margin that you had with stall. But secondly, from the procedure itself point, that if you encountered the stick shaker then it would essentially negate the maneuver.

Q. And I may be looking at an obsolete document here. Mitch forwarded me something called Field Performance Testing or the G650 Field Performance Test Plan Revision A. I'm wondering if that's the latest version because in there it says that field

performance testing will be conducted in normal control operating mode, normal lock, normal control operating mode. And if I remember right, I think we discussed that it was in first flight mode for the Roswell testing and I'm just curious as to did something change along the way or is that an obsolete document or did it intend to say a first flight or if you knew anything about that?

A. Is that a company test plan or a certification test plan?

MR. GALLO: John, can you reference a page number?

MR. O'CALLAGHAN: Page 9.

MR. RAMEE: We will get the document in front of you, Jake.

MR. HOWARD: I'm just asking --

MR. RAMEE: You can look at it.

MR. HOWARD: All I want to know is the cover. Is it the cert plan or is it the company test plan.

MR. GALLO: Is it called GVI Field Performance Certification Flight Test Plan?

MR. HOWARD: For the certification test plan before we fly with the FAA it would be in the normal mode because they need to fly the airplane in the production configuration.

BY MR. O'CALLAGHAN:

Q. Okay. That makes sense. I've got notes on it. I don't have it right in front of me so I can't tell the title. I'll

probably find it a little later on when --

A. We've got it right here and we got the cover sheet.

Q. So that's the cert?

A. Yes.

Q. So that explains that then. So it's for certification and not the company.

A. Right.

Q. Fantastic. Okay. Just a couple questions again on the stick shaker. What is the expected pilot response to stick shaker?

A. The standard recover of any stall warning system. So it is to reduce the angle of attack and increase thrust if available.

Q. And I guess from your experience what would you expect the pitch and angle of attack behavior following this response to be at various pitch rates, you know, at a lower pitch rate or a higher pitch rate? I guess the question is what sort of overshoots in alpha would you expect as a function of pitch rate when you reach shaker? That might be a little more quantitative than --

A. I don't know that I understand your question. There's not enough information. The higher pitch rate, the higher you overshoot. You have a low pitch rate you won't have much of an overshoot.

Q. That's fair enough.

A. Now, the PLI is adjusted for rate also.

MR. O'CALLAGHAN: Yeah. That's sort of a silly question. So I think I'm done. Thank you. Appreciate your time.

MR. HOWARD: You are welcome, sir

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY DR. BRAMBLE:

Q. Just to follow on in that what you guys were talking about the PLI, just so I understand. Is the PLI predictive? Like if your pitch rate says that you are about to exceed the set shaker trigger level will the PLI give you the little moose antlers before you get there if your pitch rate is real high?

A. Yeah. It's adjusted. In fact, it will change that pitch limit with respect to your rate and then it appears well before so that it isn't, and then you have to encroach upon it with your actual pitch angle or, you know, your waterline.

Q. Okay. So it will appear before shaker if you have a real pitch rate?

A. It appears before shaker regardless of your rate.

Q. Oh.

A. Yeah. For example, it will come on -- we normalize angle of attack as an indicator. And it's just a digital value, but as you go through .75 of the normalized, then the pitch limit will appear above whatever reference you use and whatever flight

path angle type of reference point or your waterline for your pitch. And then as you continue to increase your pitch then when it intersects the pitch limit indicator that is when you would get your shaker.

Q. Okay. That's helpful. Thanks.

So you guys were talking about V_2 and the transition from target pitch to capturing V_2. Would it be, do you think it would be acceptable to if you weren't capturing V_2, if you were overshooting it repeatedly, to just try and perform the maneuver as a continuous maneuver? So you pitch up to 9 and just keep pitching up in anticipation that you are going to be intercepting V_2 immediately after you begin the rotation or --

A. I think it depends on how close you are to you your target speed and what your rate of increase in speed is.

Q. So it could under some circumstances that could be one way to perform the maneuver?

A. Well, you could pitch toward your angle and then if you notice that your speed is really close to what your target is as you approach your target angle, if it's necessary to capture that speed you integrate that accel that you need to then continue to capture it then; then I would say, yes.

Q. And in the real world with sort of standard pilots flying a V_1 cut would they, you think they would make these fine distinctions about holding the target pitch and then later transition to V_2 at 35 feet or do you think they would just pitch

to V_2?

A. So now you are asking my opinion on how they would do the maneuver?

Q. Yeah.

A. Well, it all depends, I guess, on the pilot. In the G550 and the flight manual itself it talks about the technique that you use to derive the data. Normally in my experiences flying with the different pilots in the simulators when we do the actual fuel cuts and everything that normally the rates, everything is slowed down, nothing is done very quickly. It's a very gentle pull. Usually they well exceed V_2 as a pull to capture that.

Q. Okay. So people aren't pulling as aggressively and as a result they are hitting higher speeds more quickly?

A. From what I have observed.

Q. Okay.

A. But then they are not trying to derive the field performance tables for the manual. They are actually responding to an actual engine out condition.

Q. All right. I might have couple short delays here but that's because I'm deleting questions.

A. Oh, that's good.

Q. Have you had any conversations with Reece about the reduced target pitch angle for the continued takeoff maneuvers that he was proposing for the second Roswell trip?

A. No.

Q. Do you know how the 12- and then 11-degree max pitch limits were determined? Do you have any kind of sense of where they were derived from?

A. No. That appeared to have been something that they came up with to say we are just not going to exceed those limits. We know from the V_{MU} stuff that we had we didn't go much above the 11 to 12 to begin with. So they said, okay, we just won't exceed that.

Q. Do you participate in the flight test SRB?

A. Yes.

Q. Did you participate in discussions on the SRB about V_{MU} and continued takeoff testing prior to the accident?

A. Yes.

Q. And what is the nature of those meetings? Like how does that go when you are reviewing V_{MU} and CTO; is it just a process of looking at the NASA and Gulfstream databases and making sure that you kind got that appropriate list of --

A. No, that's not the intent. I mean the entire SRB is to pull together -- and it's not only representatives from Gulfstream. FAA, ACO members, flight test engineers and pilots are invited to participate in that. It actually is to go through the entire test program for that particular test. For example, field performance as you go through that and you delineate the maneuvers and all that and then toward that, since it is a safety

portion of it, you will then hit upon those maneuvers that are classified either as medium or high risk. And then you will go through each of the TSHAs, what the maneuvers are, what the hazards are and then the mitigations to those hazards that are being implemented.

Q. Then those go into the TSHA limits?

A. Into the TSHA, right. And then, but many times from that there are even action items that may still be hanging that have to be completed prior to then going out and doing the test.

Q. Are there, besides problem reports and what was the maintenance database called?

A. It's CELuminas (ph.). DRDIs is what we call them.

Q. Are there any other safety reporting systems that test pilots might use like ASAP type programs that an airline might have or if you have a safety-related incident you might write something up, put it in the database, something like that?

A. There is one that the demo side has. We had not really set one up on the test side.

Q. Do you think a program like that would be useful?

A. Yeah, just to record kind of to keep it in a database, kind of goes back to Mitch's question earlier, yeah.

Q. Okay. Has there been any talk about setting something up like that around here?

A. As of late, yes.

Q. For flight test standard operating procedures we have

this one manual that was dated in 1998 and we've heard some talk about how there might have been sort like newer manuals written for the different departments. Can you describe, you know, what guidance is it that you guys refer to when you are doing flight tests to look at sort of SOPs and that sort of thing?

A. Well, we have our own flight ops manual, which has its own section on the flight test department itself. And then the flight test department, which is separate from us, then they are the ones using the manual you are talking about, the flight test standard procedures. And then they had written a couple of I think it's up to H, it's just none of them have been signed off yet, so none were official. I think FOX was the most recent official document.

Q. Was that for their SOP, the flight test SOP or was that some new manual that was going to be used by everybody?

A. No, that's their, their SOP.

Q. That's going to replace the 1998 SOP?

A. It was mostly appending it.

Q. I see.

A. Yeah, it was just revisions.

Q. Flight 088 the test that resulted, the flight that resulted in the bobble that Kent had that was his first attempt at that maneuver for the 650, I think.

A. Yes.

Q. And so he hadn't participated in the buildup from the

previous day, we understand because he had just come out there.

A. He had been in the right seat for the last two flights that we did V_{MU}s.

Q. Was that the previous days or the last trip or --

A. No, this is all in the same trip because we had two flights of V_{MU}s prior to that one. I had done the maneuvers before that and then it was his turn.

Q. So is that common to then have him switch to the last seat for the final test point?

A. That wasn't the final test point. We did more V_{MU}s after that.

Q. I think it was one of the highest pitches; highest pitch pulls according to the flight test engineers. Like they were walking up with, and it was their -- they said it was I think the highest pitch of the several steps. They said there was a build of that at this point, yeah.

A. I don't recall. I'd have to look through because that wasn't our endpoint because what you will do is you will build down in thrust and build up -- you know, I mean you step it through pitch and thrust and you keep doing that. And so it was, that was not our final because even after that maneuver we came back, talked about it, and then we did more V_{MU}s. He did the rest of those on that flight.

Q. Is it common for one pilot to maybe not do all the steps of the buildup before they start actually flying portions of a

card like that?

A. Well, it depends on what the test is on doing that. It was probably a poor assumption on both of our parts. Kent had a lot of experience in doing field performance. He was in the other seat as I did the other ones. You know, in retrospect, yes, we thought we should have done, you know, at least one maneuver just to see the response.

Q. How commonly are the simulators used to prepare the pilots to perform the test points?

A. Depends upon the test. We will utilize them. As I mentioned before, a lot of times because of the fidelity of simulators, especially in the low altitude or low airspeed regime they are very representative of the airplane itself. It's very good for procedure-wise especially for the crew to coordinate what needs to be done on that. And that's the best benefit of using the SIM.

Q. Okay. And do you feel like it would be beneficial to make greater use of simulators before flying the flight test or to spend more time bringing the simulator fidelity up prior to the actual test flying or is that not even feasible because that depends on the test data?

A. I think it's too difficult. Yeah, because you have to get the data to make the simulator better. So it's one of those circuitous discussions.

Q. Yeah. Okay. All right. How well did you know Kent?

A. Very well, I would say. Like I say, I have known him for 10 years. Worked a lot of different programs. As I mentioned he was kind of my Gulfstream mentor for field performance on the 550 program in either late '01 or '02.

Q. How would you describe his proficiency as a test pilot?

A. Exceptional. I think he was a great test pilot. Very conscientious, good hands.

Q. How about Vivan, how long had you known Vivan?

A. Not very long at all. A few months. Six months.

Q. How about, did you have enough experience with him to sort of form an opinion about his proficiency?

A. I had flown with him a few times. Like I said, went to Birmingham did a couple flights on the 650. He was, you know, he was still learning the Gulfstreams. So he was a medium/moderate proficiency. His familiarity with equipment.

Q. All right. In the Flight 088 did you take any corrective action to assist with the recovery?

A. I didn't know at the time but I did, yes, some.

Q. What was that?

A. Well, I did recall pushing the throttles up. But looking at the data it looks like I also did a rapid control column push, about a half second, and then relinquished back the controls.

Q. Do you think that had any significant effect on the outcome?

A. I don't know. I mean, you can look at the traces the rate was already coming down. I don't know if the additional push had anything to do with it or not.

Q. Did you have any hesitation of jumping in or was it just sort of reflexive?

A. Just reflex.

Q. In your experience with Vivan do you think that his -- do you think that he would have been comfortable, been assertive enough to intervene similarly?

A. I don't know.

Q. Can you describe the personalities of Kent and Vivan and how they seemed to interact, and did they -- did it seem like they were on pretty equal footing or was Kent sort of more dominate in mentoring or --

A. I didn't see them on -- their dynamics between the two of them. So I don't know. I do know that Kent was, you know, he was a teacher. He loved to teach and he did that a lot. You know, very knowledgeable, but I don't know what the dynamics between them was.

Q. All right. So, you know about the problem trying to hit V_2 and overshooting the V_2 and you managed to somehow get within 3 knots. How did you do that?

A. I don't know.

Q. If you were flying this maneuver with Kent and Kent was having difficulty repeating that and he just said, you know what,

I'm just going to fly this as a continuous maneuver; that's how anybody would do it in the real world anyway. I'm just going to pitch for V_2. How would you respond to that?

A. It's hard not to erase what we know now. Well, we would have to talk about it, discuss it because, you know, the procedure before was -- but as long as, you know, the maneuver was capturing the speed you would say, well, we will look and see what it has. If the speeds look good then we would like to maybe continue that.

We were still in that development process on how we were going to do this maneuver. This was one different than how we had done previous Gulfstream because always before you went to a pitch attitude and you just kept it all the way through 35 feet as opposed to now having to go to an initial pitch attitude and then capture a speed for your 35-foot plane.

Q. Given the fact that you were having difficulty capturing that speed, that would seem to be the only solution to pitch more quickly, even pitch continuously to try and capture V_2.

A. Well, but you can't, like I said, you can't say that all the time only because it depends on what your thrust to weight ratio is and what your accel is and, you know, what the speeds are. So it could have been the next -- well, don't wait as long. Or just maybe pause at 9 as opposed to stopping it and then continuing. But it is so respective of whatever the speed is that it just depends.

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY DR. BRAMBLE:

Q. All right. So depending on the circumstances, a maneuver like that might be justified, to continue the rotation to the V_2, and we had this discussion earlier about, you know, can it happen before or after the liftoff. And all of that is beside the point as long as you maintain the stall margin, right?

A. Uh-huh. Indicated by the PLI.

Q. So the thing that you are relying on to make sure that you don't get into a stall is the PLI?

A. And the speeds given. If I have got good speeds and I have got a PLI then that should -- that's all I have.

Q. All right. In the 72 hours before the accident did you have any interactions with Kent or Vivan? It would be Wednesday through the Saturday of the accident.

A. Vivan was still here so, yeah, I saw him off and on probably on a daily basis. He had talked to me that he and Reece were going to go down to the ITF do some work.

Q. How did he seem to be doing in the days before as far as his mood, alertness and health?

A. Seemed okay. You know, this was his second rotation going out so I was making sure that he was okay, you know, just coordinating that he could go out and, you know, that was probably

before the 72 hours, though, just to make sure that he was still able to do that for 2 weeks because that was going to be his rotation. But he seemed fine.

Q. How about -- did you see him outside of work at all?

A. No.

Q. Do you know whether he was working really long hours or whether he was working through a normal schedule?

A. I don't know.

Q. Did he call you from Roswell at all?

A. No. He had just gotten there the night before the accident.

Q. How about Kent? Did you have any communications with him from Roswell?

A. I think I called him a couple of times. I did call him, I think, on the Thursday, how things are going, that the rotation was happening because Chip was coming home; Vivan was coming out.

Q. Did he mention anything about how the testing was going?

A. Nothing out of the ordinary. I mean they were getting, knocking out data points.

Q. Did he mention anything how he was sleeping out there or anything like that?

A. No. I didn't ask.

Q. Did Kent and Vivan use glasses or what type of corrective lenses, if any?

A. I think to read. I don't know if they did. I don't

recall if they did while flying, no.

Q. How about use of alcohol, did they drink alcohol, Kent and Vivan?

A. Yeah, we would. After the flight or whatever.

Q. How much did they typically consume?

A. A beer.

Q. All right. Were you aware of either of them taking any medications that could be potentially impairing?

A. No.

Q. All right. How did you feel about the schedule for the flight test program, did you feel like it was an appropriate time frame?

A. I don't know what you mean.

Q. Did you feel like there was enough time to get all the flight tests performed?

A. Are you talking global for the entire program or I don't know --

Q. For the field performance testing.

A. Well, the plan can be set but the program takes kind of what it takes.

Q. All right. And so you didn't feel any kind of difficulty related to the schedule?

A. For the field performance side?

Q. Uh-huh.

A. You mean the amount of time allotted to test it?

Q. Yeah.

A. I didn't want to be out there for 8 weeks, but there was a certain amount of the testing to do. Now, so -- but we would stay out there until it got finished.

Q. And how about the IFRs like with the nose wheel steering, and the yaw damper was that kind of thing, was that pretty common to have things like that during a field performance testing?

A. There are times when you have to compensate for, you know, the scheduling by the suppliers or the equipment and you still try to get some of the testing done and try to get it done in a safe manner.

Q. So that is a common part of the flight test process?

A. What, having IFRs?

Q. To have IFRs pertaining to systems like, that relate to flight control systems like yaw damper and nose wheel steering?

A. Yeah.

Q. Okay. How did you feel that morale was among the flight test pilots on the G650 program?

A. The test pilots seemed to be pretty good. Like to have been flying more often mostly, but there were frustrations but I think the morale was okay.

DR. BRAMBLE: Okay. That's all I got for right now. Thanks.

MR. HOWARD: You are welcome.

BY MR. PROVEN:

Q. While we are here -- I just wrote this down; it had to do with Bill's question. I think I got a little wordier in the process. The customers have been promised a specific delivery date and, of course, there will be penalties if they don't get that. And that determines the amount of time that you have available to do the flight test program.

MR. RAMEE: I'm sorry. Why are you assuming there are penalties if delivery dates are missed?

DR. BRAMBLE: Let's go off the record.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY MR. PROVEN:

Q. Management gives you general guidelines of when they would like you to finish the program?

A. Yes.

Q. Would you describe the flight test program in the larger sense and also the field performance as being aggressive, relaxed, on average?

A. Oh, I would describe it as aggressive.

Q. I apologize. We are not supposed to interrupt and that's proper, but I have to make notes as we go down and then go back and look for my little scribbling marks.

At Birmingham did you do any flaps 10 takeoffs with this

EIO CTO?

A. I'd have to look at the cards. I thought we did but I'm not for sure.

Q. But you were successful getting to V_2 plus 3 at --

A. Not every time, but we were getting kind of; we were getting much closer to our V_2 speeds using the techniques we were trying to develop.

Q. We were talking about the Flight 132 and you said -- and anytime I don't say what you said just fix me.

A. Yes, sir.

Q. This is what I thought you said. I thought you thought it was a -- the group decision was that it was a high rotation rate with the yaw damper in op and my question was not the pitch attitude, but it was the rotation rate, not where you rotated to.

A. I wasn't on the airplane at the time.

Q. Right.

A. Only involved in some of the discussions afterwards. And so there was probably a combination of both.

Q. Okay. That was my expectation, not just the rate, it's the pitch attitude.

A. Right.

Q. But eventually you decided that you would not do these tests without the yaw damper operational?

A. Yeah. The decision was made they would stop doing the testing.

Q. I think we heard a discussion elsewhere that the wheels will come off the V_{LO} will not occur until 11 to 11.5 pitch attitude; is that your --

A. No, I don't think that's the case, no.

Q. So what if you rotate to 9 degrees and hold that, the airplane will eventually lift off, of course?

A. Given the appropriate speed, yes, sir.

Q. Talking about the pilot knowing when they have lifted off. You talked about the WOW switch, which shows the -- you didn't call it that, but the WOW switch, there's some talk about the wheel spins as the -- and then you talked about possible climb. But my understanding is just being a line pilot is that that's pretty late in the process and will make it very difficult to make your V_2 performance 35 feet if you were to use that?

A. Right. And there's also the synoptic if you are looking at the flight control synoptic we have WOW indicators on there that you could look at that. I mean there are other indicators that you could maybe look at. But --

Q. But that's really not where you want to be looking when the --

A. When the engine fails you are normally looking at speed and outside, yes, sir.

Q. I'm with you. And, again, my lack of test pilot background shows periodically. I think you had a comment about on the V_{MU} testing there was a slight over-rotation and my note --

first of all, I don't think you probably said that. I think I heard that wrong. Because how are you going to over-rotate with a tail on the ground? I suppose you could roll it up on the tail.

A. Well, see, we are not geometry limited in this one. So we would not -- we don't hit the tail until almost 15 degrees or so.

Q. Oh, okay.

A. And usually, at least in the previous ones, you may be off the ground by then.

Q. Okay. All right. So you could actually -- so that's why that's my misunderstanding.

A. Yes, sir.

Q. So you rotate, you have got all of it all the way back and then the nose starts up and then you are going to stop it in attitude, whatever that is, then it will fly up?

A. Right.

Q. And if you go past that you will be in unhappy territory?

A. Where you shouldn't be, yes, sir.

Q. You are not a certification guy -- I mean, you are not a pilot certification guy but we all know that pilots are graded by the practical test standards.

A. Uh-huh.

Q. So if you recall -- and I actually, I think I do, on the practical test standard you get credit for passing if you hold V_2

plus 5 knots that's in the regulations?

A. Plus or minus, yes, sir.

Q. Now, in the certification standard I think it's 2, I think, but that's your job not mine.

A. Yeah.

Q. You get credit for the maneuver. So, in other words, a pilot who is making a takeoff would be expected under normal circumstances to be able to hold V_2 plus 5 knots?

A. Yes, sir.

Q. -- otherwise -- at least on the check record?

A. Yes, sir.

Q. In your inadvertent maneuver, inadvertent push -- and I have been there and done that and said, "I did what?" No conscious thought at all. You describe that you thought it might not have made any difference because the rate was coming down, which would be the rate of movement if up.

A. Right. You are looking at the traces that had already gotten close to peak attitude and, you know, the column was partially -- you know, it wasn't against stop any more. The pitch rate was coming down and so, you know, whether there was -- the little bump helped or not, I don't know.

Q. But you changed the rate to the other direction and the pitch coming down?

A. No. If anything, I may have increased the nose, increased the nose down rate.

Q. He was up? Okay.

A. He was already letting off on the capture or to stop that pitch rate and all I did, looking at the traces, was just a little push. It only lasted for a half to one second. I think it was like maybe 20 pounds of forces off. Just a quick in and then push the throttles up.

Q. I'm just having trouble, and I don't think it probably matters. It doesn't matter, but I don't understand exactly what happened, but it doesn't matter.

And your 3 knots -- I wrote it again, the 3 knots success that you had was that at flops 10 and the answer is you don't --

A. I don't recall. But we can go back and look at the cards.

MR. PROVEN: They ask a lot of good questions in the beginning that makes my job easier. Thank you.

BY MR. REMICK:

Q. Shifting gears just a little bit. The flight test operations manual -- let me see, that's what we call it. You guys call it the '98 manual. Does it prescribe crew duty day limits? And the reason I ask I was doodling yesterday and so I looked at Roswell 1 and Roswell 2 and in those events, I think on the first one you and Kent went a lot of days. You went what I counted -- this is just 2006 so, but you guys were obviously stuck there so you couldn't have been doing anything else, 14 straight days and

17 straight flights and on just before the accident Kent was already up to 9 straight days and 12 flights without a break. Does the ops manual prescribe a crew duty limitation, how many days continuously a pilot can fly?

A. The flight ops manual has 13 days.

Q. Thirteen days, okay. Let me see. Oh, yeah, and the other one was: Test card approval process. The community kind of approaches test cards I think in two different ways, and maybe it's Navy style and Air Force style depends where your organization has its roots. In Gulfstream the flight test plan is approved through the normal chain but the cards are not formally approved; is that right?

A. Correct.

Q. What's the latitude of the test team or the crew to make a modification or redline the cards? At what point can they make a minor deviation or what's the limit as to where they would have to go back for an approval so as not to bother either TSHAs or the flight test plan requirements?

A. None that I know of. I mean, the test plan give you the basic guidelines then you create the cards out of that. I don't know that there is any. You try to create the cards to follow a plan and especially off of the TSHA you would not be able to deviate from a TSHA without getting SRB. At least we would go back to the primary, either Randy or Barry, who are the chairmen of the board.

Q. The reason I ask is because we, you know, we talked about the crews varying techniques a little bit within the card, the interpretation of the card so the test plan is not so prescriptive as to be, as to allow no adjustment at all, so that kind of the question. What if the crew had decided -- well, that's a real good question. At what point could they make a change to the card? You know, how much could they vary the technique before it would say, you know, this doesn't fit within the TSHA or the flight test plan, or how much latitude do you think is actually provided in the test plan or the test card for making adjustments?

A. Well, the whole objective was kind of to find the technique. So -- but the premise of the test plan and the TSHA is you don't change from that without the approval. Through the development process you would have to change maybe techniques to get there but the overall objective is to accomplish the requirements out of 257A and 25, so there's not really any latitude to come out of the test plan. The cards, they are created to accommodate the test plan.

Q. To match.

A. Right.

Q. And that is -- oh, no, I've got one more. We talked about the 9 degrees and the 11 degrees. The target was 9, but the absolute maximum that the crew was observing was 11. That -- see if I'm interpreting that right. That's for the initial pull?

A. Uh-huh.

Q. For the capture of V_2 what kind of -- what were the typical pitch attitudes that you were seeing after capture and tracking of V_2 at those, you know, those weights, those conditions?

A. Once again it depends on thrust to weight and everything else. On the previous maneuver we saw that it was about 14 to 15 degrees.

Q. Fourteen to 15, okay, and that's combined gamma, alpha --

A. That was pitch attitude.

Q. That was pitch attitude, obviously, which was higher than the 11, but the reason is because now we've got gamma?

A. Because you have gamma, yeah.

Q. Okay. That's it, thanks. I guess that was really the questions. The 9 and 11 those were initial capture targets and limits?

A. Right.

Q. But not a limit to actually capture V_2 --

A. Correct, yeah.

MR. REMICK: Okay.

MR. HOWARD: Is it extensive? Can we take a quick break?

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY MR. HORNE:

Q. Jake, a lot of my questions are already covered so that's good news.

A. That is good.

Q. From what we heard yesterday it appears the speed schedule shifted between January and March from a 1-degree stall margin to a .5 stall margin. So I would assume from that, that the speeds that we were targeting went down some on this field performance testing; that's your assumption?

A. Yeah.

Q. But I think they are in this same time, and maybe you can clarify this, I think the PLI also shifted from 85 to 90 percent.

A. Yes.

Q. Do you think those things were combined, the effects, so they possibly could have been that your targets came down at the same time the allowable alpha you could pull to went up?

A. I agree with that statement more than likely. In fact, we made that decision shortly before the flight and I called Reece and expressed my concerns on it getting awful close and he looked at all the numbers from what they had, the available data, and they said, no, we still have some margin.

Q. So do you think this was the first time we did both of

those and they were -- the first time they both appeared was at this juncture?

A. I don't recall the actual decrease in speeds. I'm sure the schedule would have decreased because we would have wanted to take advantage of that reduced, you know, the alpha SR, Vsr would have been lower so we would have taken advantage of those computations. And I'm pretty sure this was the first field performance done with the .9.

Q. All right. We have been asking the question of, and I know you weren't out there for this, but do you have any further insight --

MR. RAMEE: That's my assistant.

MR. GALLO: Why don't we go off the record for a second.

(Off the record.)

(On the record.)

MR. GALLO: Back on the record.

BY MR. HORNE:

Q. I know you weren't out there for the last round of testing, but do you have any insight into what Kent may have been using for his pitch reference and also for his PLI reference; which of the HUD synthetic vision or two-thirds PFDs?

A. I don't know what each one used. I always used the PFD but I don't know what other -- used.

Q. All right. And then some of the other statements we heard had the impression that the technique changed after

Birmingham, that before Birmingham we were holding the pitch attitude until we got to V_2, and after Birmingham we decided we would have to capture V_2, go ahead and pull -- initially establish 9 degrees, I believe, and then go ahead and continually pull. Was that your impression that we changed techniques at Birmingham?

A. Well, we investigated both even on the first time at Roswell. And we talked about doing either one. And it came a little bit through the V_{MU}s seeing how much the acceleration was at the lower attitudes.

And the first time we were at Roswell we even were pulling and just keeping a pitch attitude setting and then they saw all that -- you know, if you did a really gradual rate or anything else how much more distance it was taken up. And in fact, one of the numbers pushed out was if you kept the liftoff, that -- pitch all target attitude it was adding close to 2,000 feet to the entire distance for CTO. Because what would still happen if you did that, then that V_2 number would fall out because you would have to utilize essentially that number if you kept that attitude.

So they said, well, we don't need to keep that attitude so we will do as standard, we will capture the speed, which you would normally do anyway. It's just it was different than what we had done before by just using a constant pitch attitude.

So we even tried that on the first trip, then we said, okay, at Birmingham we need to refine the technique on how we are

going to be able to do that because there is even some concern on the slow rotation, of course, that, you know, it takes time to do that and to be able to get it past that angle so that you can get to the reachable altitude or attitude.

So then we changed pull forces. We went different forces to see what it would take to generate that initial liftoff. And so that's when we kind of played with that out in Birmingham and then that's when we came up with the technique.

And the attitudes we looked at a little bit at Birmingham, but that kind of fell out of some of the data from the V_{MU} stuff and the initial, most of the V_{MU} stuff.

Q. I guess I don't want to use my assumptions, but in the G550 we didn't have initial pitch attitude --

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

MR. GALLO: Back on the record.

BY MR. HORNE:

Q. Okay. So starting back over again. Like I said, the G550 we didn't really have an initial pitch attitude, we had pull force and then once you got airborne, pull to a pitch attitude was in the manual?

A. No, it's actually, a pull force and capture an attitude.

Q. Probably not relevant to the question what I'm asking. But we had a 9-degree pitch attitude limit and a pause. What was

the reason for the 9-degree pitch attitude?

A. Well, that would have been essentially the way it was perceived, the initial 9 to allow -- because you get a lot of induced drag on the initial so that would slow down the acceleration some and then continue that excel, and the technique would be that at that initial you would get the liftoff and then capture and get your -- capture a V_2 speed from that initial attitude.

Q. So the 9 degree was for performance considerations than for ground effect stall or anything like that?

A. Well, it was using that too. Otherwise, we could have used a higher angle. And, in fact, we did have higher angles at the time, you know, independent of whether you were a single engine or a twin engine. Because initially it was 11 and 10 for flaps 10 and it was 10 and 9 for flaps 20. And engine and one engine inoperative.

Q. Okay. So the initial pitch attitude was basically two things: it was a tradeoff in performance and it was to help prevent in ground effect stall?

A. Exactly.

Q. And you think all the pilots understood the basis for that pitch attitude?

A. I think those that were doing field performance, I think so.

Q. And then kind of tying in with your question

(indicating), when we changed the pitch limit from 10 to 9 for flaps 10 takeoff the process that we went through to approve that change, do you want to talk about it a little better? Do you think that process was sufficient?

A. I wasn't even involved in that decision. I didn't know about it until afterwards. In fact, I don't even know if I knew that they were going to change it to 9.

Q. Okay. Let me back up a little bit. I was trying to combine my questions so I didn't get out of order in your mind, but probably got out of order in my mind.

A. My mind is a -- don't worry about that.

Q. At one point in the last couple of questions you said they are relying on the PLI and the speeds to prevent the stall. They are relying PLI and then V_2 speed. How was the PLI or the speeds adjusted for in ground effect? Was there any adjustment? For example, did we target a PLI that was 3½ lower than the PLI until we got out of ground effect?

A. The attitudes were adjusted for in ground effect. The PLI was not.

Q. So you are talking about the 9 degree?

A. Pitch attitudes, right. And those were predicated -- you can go through the TSHAs and that will kind of set up on where our limits on attitudes were. And most were predicated from the abuse tape -- abuse takeoff requirements out of the AC and the cards and then also from the perceived in ground effect or the

understood in ground effect decrement. Then there was an installation area even put in on top of that.

Q. This is just a question to clarify. When you mentioned that the landing gear switch came on at WOW, airborne, isn't that really based on -- at that time it was based on radar altimeter 10 feet was when we went airborne?

A. For you mean the retraction of the landing gear pin?

Q. The retraction of the landing gear pin.

A. I don't know. I thought it was the -- I didn't know the radar had a signal for that.

Q. Yeah, I think it's actually a 10-foot indicator. But we can research that. I just wanted to clarify it for the Board. I think it's a 10-foot requirement before you can raise the landing gear in that current software. We'll need to clarify that. I guess that's important.

A. Okay.

MR. HORNE: That was my only questions.

BY MR. GALLO:

Q. In the experimental test pilot group, can you remember everybody in order as far as seniority at the time of the accident? Is there an order of experience and/or seniority?

A. You mean who has been here longer?

Q. You could start there?

A. To best of my ability. I know who is here. I just don't know exactly when they were hired or when they went through

test pilot school. I mean, it depends on what you are talking -- on experience and whether or not a guy had -- went to test pilot school, did a tour as a test pilot, went back operational before he went back to testing or went and did the desk job. So that's a difficult question to answer.

Q. Okay. As far as here, best recollection who is the most junior experimental test pilot and then who is above that person as far as time here.

A. Time here?

Q. Yeah.

A. Well, the lowest one is our new hire, which is Kevin Claffy; he just got hired on. And the experimental test pilot before him I think was Scott Martin, and then Scott Buethe for experimental. And then it would be myself, and then Tom and then probably Randy Gaston, Gary Freeman and then John O'Meara would, I think has been here the longest.

Q. And then if you would include Vivan, he would be somewhere between Kevin Claffy and Scott Martin or after Scott Martin?

A. Well, that's a good -- I don't know exactly because when Vivan was first hired -- I think he would still be between Claffy and Martin because when Vivan was hired he did 2 years flying the parts airplane. So he didn't do any kind of testing, even production testing when he first got hired.

Q. How about, is there any way to categorize them as far as

duties? Do they -- were any of them assigned supervisory or oversight type duties in that group?

A. Sure. Well, like Tom is the, he's the flight controls lead test pilot for the 650. And then -- supervisory roles?

Q. Or lead roles, I don't know what you would call them in the organization.

A. You know, Scott Buethe knows about control laws so he kind of works that, concentrates on that. And then, of course, Randy Gaston is the vice president of flight ops, and John O'Meara is the chief test pilot.

Q. Is there anybody in the group that are instructors or responsible for training?

A. I think all of us, and I have flown with all of them. Everyone imparts instruction and guidance. So when you are saying training, I don't know there's any dedicated training as such, but you are imparting instruction as you do it and as you go through it. So within the experimental side, the experimental test pilots so --

Q. For example, if there was a new airplane that came on line, a different model, who would train myself if I got hired as an experimental test pilot on how to fly the airplane? Would it be you that would fly with me or it would be maybe Randy?

A. Well, first, after you got hired, especially if you were a new guy, you wouldn't expect to fly the new airplane for a while. And then you would go through learning Gulfstreams. And

you would be brought in doing risk kind of testing and then through that progression. But for a new airplane, since there wasn't one before it, is for the most knowledgeable then would go out and give you academic instruction and the flight instructions depending upon what its flying characteristics were compared to your other airplanes. Then that would have to be put into it that there was a simulator then take it. But as a dedicated individual I don't know that there would be one.

Q. Do you recall when you flew with Kent or even if you worked with him on a problem at work, do you recall what his frustration level would be at work? He would be open to discussing the problem but then at a point he would just say, he would just give up at some point? Did he get frustrated easily if you were working on a problem?

A. Well, that's really an open-ended question. I mean, I don't know exactly what you are looking -- frustrated easily. There are a lot of variables depending upon what the task was. Can you be more specific?

Q. I don't know how to ask the question. That's the problem.

A. Normally Kent liked to find the solution. And he is dogged about doing that. So I don't know what you mean by --

Q. He would remain focused on solving the problem but would he get frustrated or was his tolerance level such that he would just give up on the problem easily or he would change aspects of

the problem? I don't know if you understand what I'm saying.

A. No, I'm sorry.

Q. I'll ask another question.

A. Okay.

Q. Was Vivan open to criticism or did he push back when he was exposed to criticism?

A. No. He seemed open in my dealings with him.

Q. And then I guess we could talk V_2 again.

A. Well, sure.

Q. What flight did you get within 3 knots of V_2; was that at Birmingham?

A. Uh-huh.

Q. Do you recall the flight number?

A. No.

Q. Were you aware of any stall updates from Bob Mills or the aero group that came out in March for the 650?

A. I know that Reece was working the with flight sciences guys on trying to get all those numbers and he had even sent me Excel spreadsheets on all of their calculations. And how, you know, they come up with all of our margins that we needed out in Roswell. So specifically the ones in March from Bob, no.

Q. But you did get some kind of updates before 153 on stall speeds and/or stall margins?

A. I know that Reece was working all of the calculations out. Where he got that I don't know.

Q. Well, since you knew that Reece was working on it, did it heighten your level of concern considering this was field performance development and now an update came from, which may have originated from aero and Reece is working on it? Does that heighten your concern about performing these tests now with maybe changes that may be subsequent?

A. Well, as I mentioned on change in the PLI, I had a concern about making it higher value.

Q. Just to understand the process on how everybody communicates within the organization, the GVI Field Performance Certification Flight Test Plan was given to you, but how do you review that document? What do you do to make sure the data is correct?

A. Well, the test plan is just how you are going to do the test.

Q. But who do you go to if you have questions regarding the test plan?

A. I'll go back to the originator of the test pilot.

Q. Do you ever talk to the other departments like aero or flight sciences to confirm that the plan is correct?

A. They are on the signature. I mean, they review it also. If I have a particular question that the flight test engineer can't find the answer for it, then, yeah, I would go to a different department.

Q. So I guess I'm trying to ascertain your level of trust

with the flight test engineer that's maybe assigned to the plan and to the program. Do you ever go around the flight test engineer and talk to somebody in aero or flight sciences and get their perspective without -- as a double check?

A. One, it depends on the flight test engineer. It depends on the answer. And normally I wouldn't go around, but incorporate it, incorporate the flight test engineer when I went to get the answer. I wouldn't necessarily go around him just trying to find out what the actual thing is.

Q. And I understand there are pre-flight briefings -- there's engineering briefing and there's a pre-flight briefing.

A. Uh-huh.

Q. But are there meetings that are held between flights with the crew that's assigned and the flight test team and other departments that have an interest, like flight sciences and aero, do they meet together to discuss this as a group or are the panels interfacing directly with just flight test engineering on it?

A. Most of the time -- well, it's always a flight test engineering because they are part of the flight. The debrief is, usually the cognizant department, at least that representative will call in and then monitor whatever the results were on a debrief. And then any issues or conditions we find questionable, then they would go back on to that department to provide an answer.

Q. But does this occur between flights also?

A. If it happened between flights. Normally what happens is you find it on a flight, the results are there and, you know, with whatever date is available at the time and then there's a discussion that happens if there is a point of interest. So it's right after the flight happens. If it wasn't until later when data was analyzed then I would guess -- I mean, it could happen then too.

Q. I'm glad that you mentioned cognizant engineer. Can you describe what a cognizant engineer does?

A. Well, a cognizant is just a term; sometimes it's assigned. Sometimes it is the go-to person. And it may or may not be the one that is assigned by his department head. It may be the one that I prefer to go to to get the answer. So it's just whichever one. For example, the cog FTE for field performance would have been Reece. So if you wanted a cog in one of the departments then you would go to that person.

Q. You mentioned there was a flight test manual that was in draft or review form. What would a flight test manual -- standard operation, SOPs that were in effect before the accident?

A. Well, the same ones that -- I mean, there was a flight ops manual and I don't know what the current revision was at the time. I knew the flight test standard.

Q. Then there was a -- I think it was 1998 document?

A. Yeah, that was the flight test standards, the document I was referencing.

Q. Okay. And that was in effect, and was that distributed to everybody?

A. Within flight test it is.

Q. It was a GV-GER-1329.

A. That sounds familiar.

Q. So all the pilots had a copy of this?

A. That I don't know. It's within flight test that is their operating procedures. The pilots can get a copy of that.

Q. Okay. So it's in flight test and you are under flight operations?

A. Right.

Q. And then you said there was a --

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

MR. GALLO: Back on the record.

BY MR. GALLO:

Q. And you mentioned that there's a standard operating procedure, it's in draft form now.

A. Yeah. It's an amendment to the flight standards.

Q. You said it hasn't been signed off on or approved?

A. Yeah, actually it has gone through a couple revisions that weren't formalized.

Q. But has it been distributed?

A. You could request it through flight test. I think I

have a copy somewhere.

Q. But has it been distributed to the pilots, the revision?

A. Well, since it hasn't been formalized then, no.

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

MR. GALLO: Back on the record.

BY MR. GALLO:

Q. All right. Now, you signed -- you are one of the signatories on the certification flight test plan?

A. Yes, sir.

Q. At the completion of the test plan do you sign anything that says the test plan is completed?

A. What do you mean? The writing of the test plan?

Q. Well, after the entire test has been completed.

A. After the test is completed?

Q. Is there anything that you sign that says, okay, we are done with the test?

A. Yes. There's a whole test report that's written and then we will sign that. And through a couple of iterations through the ACO, whether they agree or not, then we will submit it for an 8110 up to -- as DERs we will sign 8110s along with the report saying they recommend it for approval and send it for the ACO.

Q. After a test flight, I understand the flight test

engineer writes a report pertaining to the flight.

A. Uh-huh.

Q. Does the crew write a flight crew report?

A. The flight test engineer is part of the crew. Normally if it is just gathering engineering data, then not. If it is for flying quality something that's particularly the pilot's input or techniques or handling quality-wise, then yeah, they may write up a post-flight analysis.

Q. The pilots will write up their own report if they felt it was significant?

A. Yeah, if it's necessary, especially when it comes to handling qualities, flying qualities, then they will write them. Because sometimes that's pilot-specific items. Gathering engineering data like this, it's the data.

Q. And, let's say, for example, the pilots write up their own report, and the FTE writes up his own report, are these reports kept via the respective departments or are they combined into one database?

A. Normally they are combined. In fact, the flight test engineer reports are disseminated so that on the list there is distribution that anyone can read them usually, at least the primary pilots involved in the project and to the flight test engineers.

Q. There was a discussion of pitch targets for your -- after your liftoff, your initial pitch-up. Was there any

discussion of a target to capture V_2 prior to 153?

A. No. The only thing on that one is on 2-engine we would limit it to 20 degrees.

Q. But it was never part of the test card itself?

A. 20 degree, 2-engine one -- I don't recall if that was on the card or not, but I think it was because that's what the flight director limits it to. So we said we are just going to limit it to 20-degree pitch.

Q. But on the test card itself there was never a reference target saying pitch 20 degrees to capture V_2?

A. No. No.

Q. What safety equipment does is generally aboard the aircraft and that you also use?

A. A flight suit.

Q. Helmets?

A. No. No helmets. Depending upon the test we may use parachutes. We have water wings that we may wear depending upon the test. Leather boots.

Q. Shoulder harness you use during the test?

A. Yeah.

Q. Going back to the pilots, how do you base their performance when you give them a performance review, I guess -- I don't know if you do that annually or semi-annually. What do you base the performance on as an employee?

A. I don't. I don't do performance reviews.

Q. Do you have any issues regarding Vivan's performance as a pilot?

A. What do you mean by issues? I mean, I don't know what that question is.

Q. What do you think of his ability to do the maneuvers when you have flown with him?

A. He was learning. This is a different type of airplane so he was learning the techniques on doing the maneuvers. So he was still novice in flying large cabin Gulfstream.

Q. Do you ever have experimental test pilots go over and do production flights?

A. Oh, yeah.

Q. But you don't have production pilots come back and do experimental pilots?

A. They may be second-in-command depending upon the test. Actually we do that quite often. Lower risk maneuvers.

Q. We talked a little bit about liftoff, how to identify that in -- and the difficulty with the crew.

A. Uh-huh.

Q. Can the FTE on his station in back look at wheel speed?

A. He could look at just about anything he wants.

Q. How often does the Safety Review Board meet?

A. It depends on the test. So we have had probably five in the last week almost or 2 weeks anyway, five or six. So it just depends. It has to before you have a test that includes a medium

or high risk. But then it is also dependent upon the board. Usually the chairman of the boards themselves can call an SRB and board members can request one. So if the concern is brought up then they can just call an SRB and they will go back in and discuss things.

MR. GALLO: That's all the questions I have.

John, do you have any questions?

MR. O'CALLAGHAN: Yes, just maybe five or six.

BY MR. O'CALLAGHAN:

Q. We talked a little bit about the changing speed in -- I think it was March or February, but just to get it all in one spot. Can you please describe the evolution of Vsr over the program as you know it, like how many updates there were and what precipitated those updates?

A. Yeah, I'll try to do that. We initiated a first flight and we utilized -- since the airplane had never flow before, we had taken the wind tunnel data, and there was extensive wind tunnel data on the airplane and all of it was predicted, stall speed was predicted. And from that prediction then was added 2 degrees from the alpha stall to come up with an alpha SR. And so the alpha SR number was utilized then to create the V speeds.

After we got to flying, we completed the stall performance, we did some initial V_{MCA} work. We had completed the V_{MCG} work, looked at some of the margins and said, okay, we are going to bring that down to 1 degree. So there was a 1-degree

margin between alpha stall and alpha SR. And then the V speeds were created from that.

Then there was some continuation on after the stall, actual aerodynamic stall was done, there was some stall characteristics' testing done, some stall performance. Then looking at the performance of the alpha limiter then it was determined that we can bring that margin down to half a degree between alpha stall and alpha SR. And then V speeds are predicated on that half-degree margin.

Q. Okay. Thank you. I understand that. And how about the value of alpha stall itself, did that evolve?

A. No, that was empirical data. We went out and did the stalls.

Q. But I'm presuming it maybe had to be update. I mean, the very first flight was based on wind tunnel prediction and then you actually flew a stall and probably had better data. Was there any adjustment as a result of that?

A. Right. That was when -- I'm pretty sure from that point is when we put the 1-degree margin, but we continued to fly with 2-degree margins for quite some time until we were able to reduce the data and come with what our actual stall numbers were. And they were relatively close to their predictions. And then with that and also with seeing how alpha limiting was going to work, then we reduced that to 1 degree for a while before we came down to a half a degree. And, in fact, there's still a 1-degree margin

for the flaps up condition and it's a half a degree margin for any flap deflected condition.

Q. Let me just summarize briefly and you can tell me if I have got this right. The alpha stall itself would initially predicted based on wind tunnel data and then updated as we held flight testing V speed or Vsr speeds themselves -- well, they would have gone through an adjustment based on that, but then as the confidence was gained and the margin to alpha stall was reduced a bit, that in turn resulted in changes in V speeds. And the latest iteration on that, the latest adjustment to V speed was followed from a reduction of the margin rather than an adjustment to the alpha stall itself. Is all that correct?

A. Yes, alpha stall was never adjusted. Alpha stall is empirical data from the airplane.

Q. Thank you.

A. Uh-huh.

Q. In the first round we were talking about Flight 088 you mentioned that Kent put together a presentation regarding the event. I'm not sure I captured what the content was. Can you recall what the content of that presentation was?

A. I was not able to attend his presentation but I did get a copy of it. It was -- we have our -- it's about a monthly pilot meeting. So part of it was the discussion on Roswell because a lot of the pilots don't get an opportunity to go out there to do the testing. So it was mostly sharing with what we do out at

Roswell, with pictures and showing that. But then it was also what happened during the event and, you know, just to bring up the level of awareness of all the pilots that conditions like this can occur.

Q. Did you have a bullet for like conclusions on that? Was it like a concluding bullet for that in his presentation if you can recall it?

A. I don't know. I would have to go back if there was one, sir. It was mostly a sharing of information.

Q. Yeah, yeah. And I understand that. You said to be aware that this could happen and I was just wondering if there was a "therefore" that went along with that. But I guess we don't recall.

Regarding the techniques that were developed at Birmingham to help capture the V_2 once the technique that seemed to work best was found, how was that communicated to the test pilot community?

A. For those that would be participating in the field performance it was through the test cards.

Q. So was there like a get-together to go over it or was it just through the test cards or was there tutelage? I guess was it communicated only through writing to the test cards or --

A. Well, you know, I discuss it. There are two other primary pilots on it. So there was a discussion on the technique and then -- actually, I guess there was five total that were doing

it. Vivan was with me in Birmingham so he had knowledge of the technique as it was. And then there were the discussions with Kent and Gary on this is what was required. Once, again, it was still a development on that as can be seen as it was evolving, you know. Then they decided, well, the pull force was too high. So that was decided they were going to bring that down; instead of using 70 pounds to use 60 pounds because once again we are still in the development process.

Q. All right. So in terms of the rate of like a staff input or whatever, you -- I guess I'll just ask this way. So you had a conversation about that with Gary and with Kent?

A. Yeah, yeah. And the technique was there. I mean, it's on -- I think it was on the cards, the technique, 70-pound pull and then capture the target attitude until necessary to increase to -- I think the cards had until -- but capture V_2.

Q. And the detail about the smartness of the pull, I mean, I understand 70 pounds, but the rate at which that comes in and -- like I step different versus a ramp or -- was the technique developed to that level of detail?

A. Yes, it was a step input.

Q. And that was discussed with Kent and Gary as well, I guess?

A. Yeah, because when Kent and I went out initially that was the discussion because ramp, for one, is relatively inconsistent, if you try to do a ramp over time, and then it was

to try to get -- to decrease the distance also if you can get a step input then that would assist also in decreasing distance.

Q. I understand. Thank you.

A. Uh-huh.

Q. Now, I've got to phrase this question the way I hear it -- a Board member asking me this question, if we get to a Board meeting. I can visualize the Board members asking me this question in this way. It will be, goes something like this: What ultimately is the safety net from stall for this type of operation? Is it the test card, is it the PLI, is it the stick shaker, is it the speed schedule, is it a combination of those things, but ultimately what is kind of like the final safety net to keep the airplane from stall?

A. Yes, the answer about a combination. Primarily it is the speed schedule that is utilized and the PLI, the reference for alerting the crew member of getting close the reduced margin.

Q. So, there has to be a lot of confidence and trust in the speeds that are given, and then, of course, respecting the PLI.

A. Right. Because the technique you know the initial pitch attitude was predicated on some of the V_{MU} data. So that information was known prior to going and doing that. So, yeah, the rest of that is what's utilized.

Q. And the PLI and the stick shaker kind of go together?

A. They are synchronous. They intercept at the PLI, not the appearance of the PLI.

Q. Right. Right. I understand.

A. Okay, just wanted to clarify.

Q. Just kind of a question out of curiosity. In your experience have you ever had to decline to do a test point out of a concern for it's not going to work or for safety, either on this program or some other program?

A. Declined to perform the maneuver? Yes. Abort the maneuver because of parameters, yes.

Q. And can you give us an example just to have a flavor of how such a thing might play out?

A. Here at Gulfstream or previously or -- I mean, the one that we did, for example, on a V_{MU} maneuver that we aborted it because we weren't meeting the constraints was the thrust level wasn't high enough. So after liftoff, continued without climbing and actually that was, the maneuver couldn't be completed and continued out. You know, just increase thrust and aborted the maneuver.

Q. My last question is kind of more piloting stuff. You know I'm curious about the different -- here at the Board we are usually looking at, you know, airplanes in normal operation and we look at standard operating procedures and checklists and all this sort of thing. And I know the flight testing has to be quite different that it can't probably fit into the same sort of standard procedures that we expect, I guess, from like airlines and things like this just by the nature of the operation and its

development and so forth. Can you just briefly describe in your opinion or outline some differences between SOPs and check list usage and this sort of thing before flight testing and production flights or operational flights?

A. I don't know exactly what you are asking. I mean, we use checklists. We use the flight test card. We use a lot of different references. There are flight test technique guides that all of us went through, the experimental guys learning the techniques. So I don't know, you know, sometimes in developmental testing, though, it may not be as regimented. I know it's not as regimented sometimes within -- as it is in airlines that have a certain SOP on how they do things all the time.

But we do utilize checklists and references and manuals to get to where we want to go. So I don't know that I understand your question.

Q. Well, you are answering it.

A. Okay. That's good. Maybe if I continue to ramble I'll get there.

Q. We can probably just leave it at that. But that's fine; let's just leave it there, thank you.

A. You are welcome.

DR. BRAMBLE: Okay. Back to me.

BY DR. BRAMBLE:

Q. Were shoulder harnesses consistently used by the test pilots in the flight test testing?

A. I don't know. In my cockpit they were. Many times when we are at upper -- at higher altitudes, depending upon the test you are doing, you may release the shoulder harnesses and then reconnect them as you are descending back into a terminal area to do a little altitude work. That's routine.

Q. All right. And in your flight operations manual for flight tests do you have a maximum duty period and a minimum rest period?

A. Yes.

Q. Do you recall off hand what they are?

A. Depending upon the level of risk for testing. Low risk testing is a 12-hour duty day and medium and high risk is a 10-hour duty day. And then is it 12 or 14 hours off. I think it's 12 hours off, a minimum of which 8 hours must be uninterrupted rest.

Q. I'm sorry. Rest period was how much again?

A. Twelve hours rest.

Q. Whatever the reciprocal is of the maximum duty day?

A. Of the 12, yeah.

Q. All right.

A. There's only 24 hours sometimes.

Q. So, and just to recap, at Birmingham the pull force changed from what to what? The technique of the pull force.

A. Well, Birmingham is when we were developing it. So we went through a different pull forces on what we were going to do

for the technique. And at that one it appeared to be 70 pounds was going to be what we were going to utilize. And so we used that for a while, and then during the continued development it was decided to bring it down to 60 pound full force.

Q. And that was at Birmingham too or no?

A. No, no. That was after the fact.

Q. This call that you mentioned with Reece where you guys were talking about getting close to the stall margin and you were checking with him to confirm that, can you just tell us about that call? First of all, when was it? I guess was it a call --

A. No, it was a phone call. We went back and forth sending -- he was sending me his data analysis showing the margins. It was discussion on bringing it to the .9 and then he and I had the discussions because I had reservations on making it .9 and then he sent me data saying, no, it will still work. And that was shortly before they went out on that rotation, maybe a week prior or within a week prior.

Q. So it was just the reduction in the PLI --

A. Right.

Q. -- increase in the PLI as a normal --

A. 8.5 to 9.0, yeah, whichever convention you want to use.

Q. That was the thing you were concerned about?

A. Yes.

Q. And did he resolve your concerns to your satisfaction?

A. He was comfortable with it. The data he showed with the

information they had at the time looked like it would be okay. It did get closer, but knowing on where -- because we were also adjusting the alpha limiter at the time and saying, okay, well, we can adjust the alpha limiter. And looking at all of that we go, well, okay, then. He was okay with it and so then it's like, okay, we will go ahead and change that.

Q. Did you guys have any written communication or was it just by telephone?

A. I know he sent me the data. I don't know if I expressed that in e-mails or not, back and forth. I kind of like the old fashion way of talking.

Q. All right. Was Kent mentoring Vivan as a new pilot or were they -- you said that Kent sort of mentored you on the 550 program. I'm trying to understand what their relationship was. Were they just kind of equals on the flight deck or was Kent sort of the senior guy who might be mentoring him?

A. I would assume so. I don't know. Kent was very senior. He had a lot of experience not only in Gulfstream but, like I had mentioned, in field performance. He had done just about all the field performance here since I have been here on all the different programs. And since Kent's natural demeanor was to teach or at least to be, you know, always doing that, sharing his vast knowledge, which was great, then I would expect for him to be doing that. He was never demeaning though whenever he shared information.

Q. How about Gary Freeman, was he also sort of a mentor?
A. Yeah, absolutely. Whether you wanted it or not.
DR. BRAMBLE: All right. That's all I have. Thanks.
MR. HOWARD: Yes, sir.
MR. PROVEN: I only got one, while I'm looking for another to make sure.
BY MR. PROVEN:
Q. Does this have a crotch strap?
A. Yes, sir.
Q. And you use that?
A. Yes, sir.
Q. He said shoulder harness I was pretty certain.
A. Yeah, that's right. I always leave that one.
Q. I was pretty sure you had a crotch strap.
A. Yes, sir. It's five-point harness.
MR. REMICK: That's your only question?
MR. PROVEN: That was it.
BY MR. REMICK:
Q. Was Kent a CFI?
A. I'm pretty sure, yeah, he was.
Q. I thought he was too. Can you describe how the ITF or any of the other simulators were used in the prep for the field performance? How would you use the various simulators in getting ready for the field performance test?
A. As I mentioned the fidelity was poor. I don't know even

on the initial that we utilized it at all. When Kent and I first went out we used the basic airplane and used the buildup. So we used it as our device for getting airplane characteristics.

Q. And not to put words in your mouth, the reason for not using it really as a predictor was, you said the fidelity is poor, the air model wasn't -- I mean, chicken and egg, right?

A. It's one of those that you would train to something that wouldn't really happen in the airplane. So it's almost like it's adverse feedback.

Q. Right, because you have got to fly the airplane, gather the data, feed it back into the model, iterate it.

A. Right.

Q. Procedurally, did you use them as procedure trainers, at least for -- because control forces would be the same in a simulator; the response would not necessarily be right, but the control forces?

A. Yeah, but without the feedback of the airplane motion, yeah, you could maybe go down there and practice what 70-pound pull is, but you can do that holding short of the runway multiple times because it's always the same.

Q. Do you know whether folks -- did you or other folks that you were flying with do that, actually simulate the pull, the yolk displacements?

A. Many, many times. Not in the ITF, in the airplane.

Q. In the airplane. That's what I meant, yeah.

A. Many, many times. I would do it and before each run I would do three or four or five or whatever to hit the target and say, okay, that's --

Q. Yeah, that's what 60 pounds, 70 pounds feels like or looks like both.

A. And look because -- and it depends on the seated position and everything else because you try to reference it with a location on the control panel. Okay. Well, that's 70. But as you are going down the runway you may not be seated exactly at that same point, so it almost had to be a muscle memory. Okay. That's 70, any displacement that you could feel. Okay. That's 70 pounds or whatever the force was.

MR. REMICK: Very good, thanks.

MR. HOWARD: Yes, sir.

BY MR. HORNE:

Q. This is just like a clarifying question.

A. Sure.

Q. There were comments made about you being successful and achieving V_2 using the technique and I just wanted to question you with this to bring out a little more insight into it.

A. Sure.

Q. Are there some thrust overweight ratios where it's easier to capture V_2 because your V_2 climbout pitch attitude is closer to the initial pitch attitude?

A. I would say, yeah, absolutely. I mean, there are so

many variables on doing that. For example, when you are in all engine it's V_2 plus 10, is what you are trying to capture by 35 feet because it's actually a 35-foot speed, which is a V_2 plus 10 speed. So on that one at a reduced thrust to weight then that's, of course, easier to capture because it's a higher speed and your accel is faster, but then you would be able to do that.

Q. Yeah. I would suppose that at the highest gross weight when you are simulating an engine failure that your initial 9 degree would be closer to your final climb attitude.

A. Right.

Q. And then at a very, very low gross weight you would accelerate through that so fast that you would essentially come off the ground very quickly after getting to 9 degrees?

A. Right. And the other thing about it, too, is everything else kind of slows down because you are not accelerating as fast. You go to whatever your target is, you would have time to wait, and, you know, everything just kind of slows down and you can capture it.

Q. So in reality the conditions we were at here may have been the most critical conditions as far as being able to achieve that V_2 performance?

A. Or even at a lower gross weight, you know, it could be even worse. I don't know if it was the most critical of this condition but there could be conditions that would be more difficult than this one.

Q. I just wanted to clarify that.

A. Yes, sir.

Q. Do you know what initiated the change to go from .85 to .9? What motivated that change?

A. I don't know if this is the only one, but I know on some of the earlier maneuvers on climbout at V_2 if you get a little bit of turbulence you are very close. I mean you are captured at V_2 and you would trip the shaker. And so, anytime you trip any kind of stall warning device then that negates the maneuver. So it was that margin between V_2 and the .85. And that was on climbout. So if you gave a little bit more margin between the shaker, then even on the slightest turbulence you shouldn't trip that. I know that was one of the considerations.

Q. So was that initiated by the pilots, do you think, or by the FTE?

A. I don't know who initiated it. It was not one of the pilots because it would have been, we just can't do that maneuver because we catch shaker.

Q. So some of the engineers, either flight sciences or flight test engineer, one of the two?

A. Yeah, exactly. I guess.

MR. HORNE: Thank you.

MR. HOWARD: Uh-huh. You are welcome.

MR. GALLO: Are there any more questions?

MR. REMICK: One, I forgot.

BY MR. REMICK:

Q. I wanted to clarify this because I, for the record, actually counted in error. When I asked the duty day question you said 13 days maximum and that's exactly what you guys -- what you and Kent had flown on Roswell 1.

A. I didn't remember us busting it.

Q. No. As I looked through 2006's record it was the next consecutive day of the next consecutive month was the 14th. So miscount. It was 13.

A. Okay.

MR. GALLO: Do you have anything else that you would like to tell us, concerns?

MR. HOWARD: No, sir.

MR. GALLO: Thank you. We are off the record.

(Whereupon, at 11:09 a.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD
INTERVIEW OF:	Jake Howard
DOCKET NUMBER:	CEN-11-MA-258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 17, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha J. Wheeler
Official Reporter

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*	
	*	
AIRPLANE ACCIDENT	*	
ROSWELL, NEW MEXICO	*	Docket No.: CEN11MA258
N652GD	*	
	*	

Interview of: MIKE LIMIEUX

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Friday,
June 17, 2011

The above-captioned matter convened, pursuant to notice, at 11:15 a.m.

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Accident Investigator

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I N D E X

I N T E R V I E W

(11:15 a.m.)

MR. GALLO: This case is an interview with Mark Lemieux. Mark, thank you.

MR. LEMIEUX: Mike.

MR. GALLO: Mike, thank you for the correction and for joining us today.

BY MR. GALLO:

Q. Basically, just tell us your title and what your responsibilities are and how long you've been at Gulfstream?

A. I am an aircraft performance engineer. I've been here for 5 years this summer. My main responsibilities at the moment right now, I guess it's a lot of aircraft performance analysis. Lately, it's been a lot of wing re-sizing, kind of preliminary developing for our advanced aircraft programs.

A while back, I was sort of assisting with 650 development, just getting odds and ends jobs there as they came in.

Q. How much have you worked on the field performance aspect of the test program?

A. With regards to the 650s?

Q. Yes.

A. Not much at all. Basically, my main responsibility is at the moment, I'm assigned to the advanced aircraft program. The time for me in Roswell was sort of a training exercise, an

opportunity to gain experience. I went out there to gain experience on what flight testing was about and all of -- my main responsibility was just tracking data, marking data events, test points, things like that, in order to help out with the analysis for the other people.

Q. Was 132 the only portion of the field performance testing you were involved in, the only flight?

A. Of the three in question, I think 132 is the only one that I was there for.

Q. Were you on other ones relating to field performance?

A. I was there for approximately 2 weeks, a week before the incident up until the weekend after this one. So there as field performance for a good chunk of the time I was out there, yes.

Q. Do you remember what those other flights were, the numbers?

A. I don't remember the specific numbers. I'm thinking I probably got there around 126, roughly. The numbers change. Maybe till about 134. The last flight I did I think was the Friday after the 132 incident. I've got some notes here to verify that.

My last test there I think was -- the last thing I monitored was, I think, Friday, March 18th, which might have been 134, around then. I would have been there for the 2 weeks before that so I would have arrived around, I think, March 1st or February 28th or so.

Q. In regards to Flight 132, Vivan was the pilot and so was Gary. Have you ever worked with Vivan before?

A. Not before this, no.

Q. In your experience based on 132, what did you think of Vivan?

A. As far as piloting skills?

Q. As far as piloting skills and also was he open to criticism during any discussions the group had?

A. Vivan, was -- yeah, he was very open to criticism. He kind of was, I guess you'd describe it as kind of someone who seemed newer to the company or newer to the flight testing and was trying to learn.

When I first got there, the pilots, I believe, were Jake Howard and I think Vivan as well. And you could see when Jake was flying the plane that, you know, he was more comfortable when they were doing things as far as like pulls; he was able to match the pulling forces a lot easier and Vivan was a little -- he tended to pull a little harder, tended to not be able to be able to match performances. He was still basically learning like he was still new to the 650. And then when you saw Gary come in again, you saw -- because Gary came in halfway through my time there and he replaced Jake; you could see again the skill set.

Without a lot of flight test experience, I would say that, you know, Vivan was -- yeah, he was always open to learning and had ways to go still -- well, not ways to go but was not quite

at the level based on the numbers I could -- in some of the others -- or not at the experience, I guess. I'm not sure.

Q. During Flight 132's briefing, what briefings -- was there an engineering brief and a preflight brief for 132 or was there just one briefing, preflight briefing, for 132?

A. I would have taken part in the preflight briefing. That's where they would have went through the test reports and the test plans and the hazards. If there wasn't -- what do you mean by an engineering one, like as far as what was driving the testing?

Q. No, I'm just wondering, and I think you answered it, how many briefings were before 132, before Flight 132?

A. I think it's just the one. Later in my time there, we started kind of doing two. We'd do a briefing the evening before the flight so that we can get out early in the morning and then in the morning, we'd do a quick crash course, run through it quickly again.

I don't remember if 132 was to the point where we were doing the ones the morning of and the evening before or if it was just the morning of. At the very least, there would have been one, possibly one, the previous evening.

Q. But you don't remember if you were in the brief on the previous evening for 132?

A. If there would have been a briefing, I would have been at it, yes.

Q. During the preflight brief for 132, do you recall what was discussed?

A. I wouldn't be able to recall exactly what was discussed from one meeting to the next. I don't have access to my notes. I don't have my notes from that time.

Q. Do you remember if they talked about changes in V speeds or changes in stall angle of attack?

A. Not that I can't remember as far as angle of attack. I know there were some chats about methodologies, i.e, as far as monitoring an angle, monitoring the speed for the climbout. I can't tell you if it was 132 or 131 or 130. It's hard to tell. I just remember the context of some of the conversations but just not necessarily when they occurred.

Q. During the preflight brief, did Vivan and Gary discuss techniques to capture any target airspeeds or pitch targets?

A. I remember conversations kind of along the lines of two approaches, be it whether or not they were going to do their pull, do the takeoff and then capture a specific pitch angle or just monitor that, or whether they do the pitch angle and come down and try to follow a speed on a climbout. I can't remember exactly what days that would have occurred, if it was prior to 132 or a different flight.

Q. But did they discuss anything about meeting the pitch target on there or pilot technique?

A. Not that I remember.

Q. During that flight did -- well, let me go back.

Did you ever work with Pat Connor on any portions of the takeoff performance?

A. Prior to flight testing or just in Roswell?

Q. Prior to flight testing in Roswell.

A. With regards to specific flight testing is concerned, Pat gave us a session on basically the FAA rules and regulations regarding takeoff performance and things like that, testing methodologies, basic ways of doing the analysis, things to look for. So we went through a quick course on that. But Pat's also basically my technical lead, so as far as takeoff performance and questions, yeah, he would have helped me or talked to us about that a lot. With regards to specific 650 flight testing, probably not.

Q. During the post-flight brief, was there any discussion regarding the wing drop?

A. Not that I can remember.

Q. Were you involved in any of the data reduction and/or analysis off of 132?

A. When I was in Roswell, I mean, my main job was basically to track for -- we were trying to -- at that time we were trying to figure out how to basically mark all the data, liftoff points, V_2s, when we're going to do pitches. So, yeah, I was a part of going through all the data and marking all the points and things like that.

As far as actual data analysis beyond marking key points, I wasn't a part of it. When we moved on to future phases, I played a little stronger role but not as far as the takeoff.

Q. Did you from 132 to Flight 153, did you work on any of the speed development?

A. No, I did not.

Q. Going to Flight 132, how did you define where the liftoff point was at?

A. The liftoff point was something that we debated a bit. That was one of the main issues of where we were looking for. I was under the belief when we were there that the liftoff point should be marked by the point where the wheel speed sensors start dropping off in speed.

I felt Gulfstream before that had used the weight-on-wheels sensor a lot at that time, which, in my opinion, sometimes occurred a couple of seconds after the wheel speed dropped off. And if you looked at the radar altimeters and the DGP sensors, the plane sometimes would be upwards of, you know, 10 feet off the ground by the time that would flag.

We debated that one a lot while we was there and that was of the main issues. When I was there, we decided after quite some time, just a day or two before I left after 132 occurred, to actually use the wheel speed sensors and it wasn't until just recently I found out that there might have been an issue with the weight-on-wheel sensor at the time, that they might have been

using, one of the raw data signals, but to my knowledge it's been correct from what Shelley said yesterday.

Q. Why were you looking at the liftoff point; why were you focusing on that for your task?

A. I was basically tasked with just trying to mark a lot of the key points. So as far as a takeoff run like 132, I would have been tasked with trying to mark the brake release point where we started taking off, the point where the engine, either the fuel gets cut or the throttle gets cut back, the point where the plane starts rotating, what we thought was the liftoff point, 15-foot altitude and 35-foot altitudes. And those were the points that I try to go through and flag.

Q. Have you ever worked with Reece Ollenberg before?

A. Not before this incident -- not from that time in Roswell. I had met him previously but not working with him.

Q. What did you think of Reece?

A. I thought Reece was -- there were two things that really stood out to me with Reece. One is he seemed very, very safety orientated. He talked a lot -- when we there, he gave tours. He gave tours with the Boeing crew, saw their 747 when they came over. And some of the things that he was talking about was a lot of the safety improvements were the things he brought into 650 and -- in order to make the airplane safer.

If an incident -- like, for example, one of the things he talked about pushing is on the outside of the planes they have

orange boxes where fire crews can cut through if they had to come in. And he wanted to make sure those were all placed in situations where, you know, they weren't coming through and cutting into the wall of the sensor just so they could see some of the changes.

So from a safety standpoint he was very interested in that. One thing that also interested me was, he was also very, very curious about the data itself and really trying to get a solid understanding. When I told you about the issue with the liftoff point, it was basically Reece and I were the two that were debating this the most when talking to the others. Reece, he saw it the same way I did. He had people he said show him -- he said people showed him videos that showed him otherwise. So he was always sitting on the fence but he was very meticulous about understanding the data, where it came from and really trying to understand everything that was going on.

Q. During March when Flight 132 occurred, and even subsequent to the accident, how much time did you spend at work?

A. That week?

Q. Yes.

A. I'd have to check my schedule. I think we were -- we arrived on a Friday. Let me check my calendar, but it's like a week and a half before -- I basically arrived, I think, on the 4th of February, no, 4th of March. We basically worked most days. We didn't work that first Saturday. We worked every other day. We

usually arrived quite early. I think we were averaging maybe upwards of 12 hours a day, 10 to 12 hours a day. And then after 131 or after -- sorry, after Flight 132, Shelley had left, Pat came in and at that point, the hours dropped down.

Q. Did you work on a weekend also?

A. Yes, we did that weekend.

Q. So it was a straight 7-day week that you worked?

A. Yes.

Q. Just a little bit more of your background. Where did you previously work?

A. My previous job before I came here, I worked for a company called Flight Refueling Limited. It's part of Cobham in Wimborne, England. And my main responsibilities there, basically, I worked developing weapons release systems, basically, modeling systems. I also worked in air-to-air refueling systems, modeling those; investigations of UAV flights, a couple of UAV crashes, and then just the test house monitoring and testing weapons systems.

Q. What degrees do you hold?

A. I hold a bachelor's degree in aerospace engineering.

Q. Where did you get that from?

A. I got it from Carlton University in Ottawa, Canada.

MR. GALLO: That's all the questions I have.

John, are you on the line?

MR. O'CALLAGHAN: Yes.

MR. GALLO: Okay, it's your turn.

MR. O'CALLAGHAN: Thanks.

BY MR. O'CALLAGHAN:

Q. I have some questions, just a few here that I count, six. So hopefully it won't go too long.

Something we've discussed a lot with other folks, and I'd like to get your understanding of it as well, is how is both the V_{MU} maneuver and the one engine-out continuous takeoff maneuver to be flown, your interpretation of the test card? If you can kind of just step through the flow of how things go during those tests.

A. I haven't seen any of the test cards. Basically, I only saw the test cards -- basically, they arrived to me the day of the tests. I'm not really in a position, I think, to answer the methodologies behind it because I don't have any other flight test experience other than my 2 weeks there and I haven't really looked at any of the test planning or anything that goes into it beforehand.

Q. Okay. That's fair enough. How about this, then. You were in the TM trailer during these tests; is that right?

A. During 132, I believe, yes, I was. Prior to that and after that, there were two performance engineers at the time there and we would usually rotate between who was in the trailer and who was back in the main building just either analyzing data or taking care of other work.

Q. But you were there for the event on 132?

A. Yes.

Q. Could you just then describe the flow of activity in the TM through the event, like, you know, when an airplane is lining up on the runway, to the takeoff and then coming back and landing and just, you know, what's going on and what's being talked about, is it busy, is it lax, what's going on in the TM trailer and how did things go?

A. I think as far as how busy it is, I think sometimes it depends on the pilot, but what I would do, basically, as the plane lining up, I would basically mark the data as it was coming in on the IADS. I would basically do a test marker at the start of the takeoff run. I'd wait till it would hit about, you know, maybe a 1,000 feet or a certain altitude and then I would stop the data, go back and analyze all the data and mark all the -- flag all the events and the test marks as far as, like I was saying earlier, maybe the rotation points, the brake releases, liftoff points.

Then depending on the flight or the flight that was going on, either at that point, the plane would either be doing a teardrop and coming back, and at which point I would be getting ready to lineup and mark the landings or somebody else would the mark the landing or else they'd go off for a while.

Once all that data was analyzed, I'd usually take a quick look to see if anything stood out as being strange. At the same point, Shelley was usually always over my shoulder and she would be on her own screens tracking everything and looking for

anything, any abnormalities or any other tests.

Usually, with these tests, the takeoff runs, she would be paying more attention to, obviously, the speeds, the rotation speeds, to see whether or not the test basically fit the criteria as far as climbout speeds or the rotation, make sure it didn't have to be repeated, make sure it was valid or to take a look at the takeoff technique.

And all the other times, usually Cynthia was in there as well. But I'm not sure what she was usually doing because her computer station was around the corner from where I was.

So basically, I think she was just tracking things in real time as well and just checking to see if anything stood out and usually in contact with Reece and answering any questions that might come in with regards to the test plans.

As far as how busy it is, I mean, during a takeoff, it can get quite busy. Between takeoffs or landings, a lot of times it's a little more laid back and relaxed, a little more data analysis or at least reviewing the data.

Q. And are you guys talking to each other or are you pretty kind of hunched over your terminals?

A. We're pretty hunched over. It was the first day I was there, Shelley made it quite clear to us that we weren't really allowed -- it's not a social call; we weren't really to be talking to each other. So we were -- I was pretty diligent at being tied over the computer. Now and then, you know, when the pilots are

flying around looping around and trying to cool off the brakes, they might chat a little more on the radio, but other than that, during the takeoff or during the landing, there's not much talk going on.

Q. Was there any -- going to the roll event on 132, did that event make anything unusual happen in the TM trailer or was it pretty much like any other run? If you can remember, did the fact that they had some roll event, did it change anything in your flow of activity in the TM trailer?

A. I'm trying to think. As far as what I was doing, I don't think it really changed much. I can't really say for sure. I don't really quite remember how much things would have changed if they did. I remember the whoa, whoa, whoa, but I don't really remember it as being a huge deal at the time. So if it was a big incident, it's not something that really came across my memory as being a big incident. But it could just be at the time that I had, you know, other issues on my mind sometimes. So I didn't really pick up on everything.

Q. Sure. And along those lines then, were you able to follow the discussion in the cockpit following the event or were you busy with other things?

A. I'd always listen to it a bit just so I could hear what was going on, make sure nothing was -- to get a better idea of when they were coming around for the landings and stuff like that. But basically at that point, I probably -- once they took off and

that, I pretty much just the data and just gone back and started just marking points.

Q. So do you recall anything from their conversation following the event?

A. Following the event, obviously, I remember the whoa, whoa, whoa. That was one of the things that had stuck out in my mind. And then after that, you just remember some of the comments from, I guess it was, I think Gary was the pilot at the time, just giving some feedback to Vivan just about, like, timings. Because a lot of times, back then, they were having issues with trying to figure out the timings and how to do the call for V_1 and rotate. So that's probably the only thing that would have stood out, would have been just them trying to figure out, you know, timing still.

Q. Was the event discussed in the TM trailer?

A. Not that I can remember.

Q. Or did the -- was the data reviewed in the trailer at the time for that event to kind of look at what was going on there -- well, that's the question I guess, yeah, was there a review of the 132 event data performed at the time in the TM trailer?

A. It might have been something that Shelley would have looked into. A lot of times after tests are marked up, her and Cynthia might go over and look at some of the key points or other issues. It's not something I ever went back and looked at as being out of the ordinary based on the data traces that I was looking at. I don't remember them stopping and really diving into

a detailed analysis before continuing. So they might have looked at it; I can't say for sure.

Q. How about after the flight and since, are you aware of any of the analysis of that data that was done?

A. No, I wasn't aware of any of the analysis. Basically, I came back that Friday and after I left Roswell, I never really looked at 650 again.

As far as the analysis is concerned, basically, we really didn't get into too much of the analysis. We were still having some issues with scripting and how to actually flag a lot of the markers and events.

Q. Do you recall any conversation about or mentioning of stall associated with the roll event by anybody?

A. No, not at the roll event. I mean, now and then, you might hear a comment about, like, a stick shaker, but there was nothing that really pointed out to me about as far as conversation with regards to stall.

Q. Do you recall if they got the stick shaker on that event?

A. On that specific event, no, I don't remember. Prior to that on some of the takeoff runs, if I remember -- like, I remember stick shaker being mentioned over the radio on a couple of occasions while I was there. I can't tell you for sure which events there would have occurred on which events because I just don't have access to those points. I know that, I've heard it a

few times and marked it down a couple of times in my notes but after a while, I didn't mark it down all the time.

Q. You mean that they mentioned it as going off or just that they were discussing it?

A. As they were flying out after a takeoff sometimes, I think if I can remember right, you would hear them say, we've got a little bit of shaker on that incident or that takeoff. But there was nothing that was ever really mentioned seriously, obviously it was mentioned, but it's not something that they really dwelled on or continued on. So I just figured it really wasn't that big of an issue because it didn't really seem to concern them.

Q. So you are saying that while you were there, your perception was that there were a few takeoffs where they might have nibbled at that shaker; is that correct?

A. That is correct.

Q. Interesting. But you don't recall specifically which flights those were?

A. No, I would not.

MR. O'CALLAGHAN: I think that's all I have. Thank you very much.

MR. LEMIEUX: You're welcome.

DR. BRAMBLE: Okay.

BY DR. BRAMBLE:

Q. Mike, you weren't involved in the test program for very

long, the flight test portion of that program for very long, I guess. But did you hear any mention from the other flight test engineers about their perceptions of the time available that they had to complete the flight testing?

A. You hear a lot of talks about trying to maintain, not necessarily flight testing, but you do hear chats about deadlines on the flight test in order to make sure that the performance group had enough time to turn around the flight manuals and maintain dates and deadlines for certification. It was always sort of mentioned here, like, on the back of people's minds trying to make sure that deadlines are met.

Q. All right. And were any concerns expressed about not having adequate time to reduce data as they went along through the testing?

A. I think, yeah, it was mentioned a few times not necessarily during the testing but post-testing they were worried about having enough time to analyze the data and kick out the flight manuals. And that was, I think, the main concern with my group, was the whole flight manual portion of it. We had pretty much all been told to expect to be all hands on deck when it came time to doing the flight manuals in order to maintain certification deadlines.

I know while we were there, a lot of times Reece was coming up to us every morning, basically, how did the data look from yesterday, how did the data look from yesterday and

questioning us about it. But a lot of times, we just weren't really analyzing it as we went that often.

Q. So the concern you mentioned or the thing that was expressed was that when the testing over, there would be all hands on deck to get the manuals done?

A. Correct.

Q. Okay.

A. It would have been a -- I think the way the flight testing was lining up, it would have been a tight turnaround from the end of flight testing to the time when Reece would have had to get his reports out to the time when we would have to kick out the flight manuals and get them the publications.

Q. What was your perception of how the data analysis was being shared between flight sciences and flight tests during the field performance testing?

A. Basically, it was kind of an open book. I mean, they sat pretty much right next to us. I mean, anytime we had stuff, we had no qualms with going over and talking with them and they had no qualms with coming over and talking to us if they had questions as well. So as far as sharing data, there were no problems that I was aware of.

Q. So when Reece was asking you in the morning how did the data look, was he -- what did he mean?

A. I wouldn't know for sure. I guess I would just assume that he was talking just to see if there was anything that stood

out, anything strange. I couldn't know.

Q. Did you have any interaction with any of the four crewmembers who were killed in the accident in the 3 days leading up to the accident?

A. I would have -- basically, as far as professionally, personally?

Q. At all, do you remember any conversations with them?

A. We'd basically go to dinners in the evenings.

Q. I mean, the accident -- in the 3 days leading up to the actual accident.

A. Oh, no. Not at all. Sorry, I thought you were still talking about 132.

Q. No, sorry.

A. No, basically, like I said, the minute I got back from Roswell, my responsibilities went back to -- off 650 and back on to advanced aircraft programs and I barely touched it again.

Q. All right. And how would you describe the morale of the flight test engineering team for the 650 program?

A. Since the accident or since we were there?

Q. When you were working with them in Roswell.

A. I think the morale is pretty good. I mean, everyone -- you could tell that they obviously enjoyed being there, they enjoyed what they were doing. I remember, like, you would here people like Valerie who would be, you know, on the plane signing sometimes and when they were out on the breaks. The morale was

high, they enjoyed what they were doing.

DR. BRAMBLE: That's it for me. Thanks.

MR. PROVEN: I think I may only have one.

BY MR. PROVEN:

Q. Are you a pilot?

A. No, I'm not.

Q. That's it. I only asked if you were speaking in context, speaking as an engineer.

A. Okay.

MR. PROVEN: That's it.

MR. REMICK: No questions.

MR. HORNE: I just have a couple.

BY MR. HORNE:

Q. Weight on wheels. Question, do you happen to know if you were using, what parameter you were using to determine weight on wheels?

A. I don't know offhand. I talked to Shelley about this yesterday and she basically mentioned that the weight-on-wheels parameter that we were using then apparently was more -- I think she said it was engine based and not the proper one, so they've converted to the proper weight. So the weight-on-wheel sensor that we were tracking at the time wasn't the proper weight on wheel sensors.

Q. Yeah, if you look at the in air selection that the FCC makes, it makes it based on weight altimeter at 10 feet. So that

may correspond to what you were seeing with the late weight on wheels. It may have been actually an in air.

A. Yeah, it could be. There was a lot of confusion. Like, I didn't understand how the weight on wheels -- I didn't understand how the weight-on-wheels sensor worked at the time. I tried to just to get --

Q. I guess my question would be, are you sure it was the weight-on-wheels signal or was it an air/ground signal?

A. It could have -- the sensor I would have been watching, it would have been called weight on wheels on the IADS, like, just WW then some strange name. I couldn't tell you where it came from or what the source was.

Q. Okay. That's good enough. Do you know what parameter, what rate, what angle caused who ever said, whoa, whoa, whoa? Was it the pitch attitude was too high?

A. What would have caused Gary to say it?

Q. Yeah. Well, I don't know who said it, but on Flight 132, somebody said, whoa, whoa, whoa, right? It was fixed in your mind.

A. It was just something you heard on the radio. I mean, I don't know if it -- I can't say why he would have said it. I don't know if he was --

Q. I don't want you to speculate. I'm just saying, in the debrief, did they ever say what triggered that?

A. Not that I remember, no.

MR. HORNE: Okay. That's it. Thanks.

MR. GALLO: Any other questions?

John?

MR. O'CALLAGHAN: Maybe just one.

BY MR. O'CALLAGHAN:

Q. Who was on the other side of the debate of the weight on wheels versus wheel speed?

A. Reece Ollenberg and myself are sort of the ones on the side of using wheel-speed sensors. Basically, the main person we debated this issue with would have been Shelley Brimmeir.

And then upon her departure, we discussed it with Pat Connor for about a day or so and then at that point, the decision was made to continue with using the weight-on-wheels sensors. And it wasn't until another day or so later that Reece and myself convinced Pat -- or another debate occurred and we decided from thereon to go with the wheel-speed sensors. So the main people on the other side of the debate would have been Pat and Shelley.

Q. And what was their main argument, if you can recall it?

A. I think a lot of it had to do with -- it's hard to understand their reasoning. Pat Connor came in fairly late into the argument after we had been going for a while. His main issue was the fact that he really didn't understand exactly what was going on. He basically had just got off the plane from Savannah when he was, you know, hit with this. And he was under -- he was sort of of the belief that the weight-on-wheels sensors are what's

been used in the past, therefore, you know, don't fix it if it's not broken kind of thing, I guess.

I think Shelley's belief -- I think a lot of that had to do with the fact that I think she's kind of busy and never really had time to completely dive into it, but I think she was under the impression that using the weight-on-wheels switch or flag, it was sort of what was always used in the past and I think she -- I could easily be wrong on this one, but I think she might have felt the data might have better represented predictions had we used weight on wheels as opposed to wheel speed. But again, I'm not 100 percent sure on Shelley's reasoning on that one.

Pat's, I just remember he just didn't quite understand or grasp it and wanted to stick with what we have used in the past.

MR. O'CALLAGHAN: Thank you. No other questions.

MR. GALLO: Any other questions?

(No response.)

MR. GALLO: Do you have anything else that you'd like to add or comment on?

MR. LEMIEUX: Not that I can think of, no. If you guys have more questions, just let me know.

(Whereupon, at 11:55 a.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD
INTERVIEW OF:	Mike Lemieux
DOCKET NUMBER:	CEN11MA258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 17, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha Wheeler
Official Reporter

_____

Lourie J. Brown
Transcriber

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*	
	*	
AIRPLANE ACCIDENT	*	
ROSWELL, NEW MEXICO	*	Docket No.: CEN11MA258
N652GD	*	
	*	

Interview of: VALERIE THURSTON

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Friday,
June 17, 2011

The above-captioned matter convened, pursuant to notice, at 2:20 p.m.

BEFORE: MITCHELL GALLO
Accident Investigator

APPEARANCES:

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I N D E X

I N T E R V I E W

(2:20 p.m.)

MR. GALLO: This interview is with Valerie Thurston. Thank you for joining us.

INTERVIEW OF VALERIE THURSTON

BY MR. GALLO:

Q. I want you to just start out with describing what your position is, how long you've been with Gulfstream and your flight test experience.

A. I am a flight test engineer. I've been with Gulfstream for 9 years now. I spent 4 years as a contractor, so, technically, employed by Gulfstream for 5 years. Gulfstream is my first employment after college, graduating in 2001. I started working here in 2002. All of my flight test experience is in the flight test organization on the job.

Q. What was your degree in college?

A. Aerospace engineering.

Q. Where did you graduate from?

A. University of Arizona.

Q. Do you recall which portions of the takeoff performance test plan you were involved in?

A. Test plan?

Q. Which flights were you involved in? Right now, I've got 088 and 132 and also -- yeah, did you do any other flights between 088 and 132?

A. So basically all of the fights in Roswell but two I was on. Yeah.

Q. All right. Let me just start with 088 just because we'll go in order. Was there an engineering briefing before the flight?

A. Yes, there was.

Q. And then there was a preflight brief?

A. It was one in the same, yeah.

Q. So there was just one briefing before the Flight 088?

A. Correct.

Q. Okay. Were you involved at all in any of the V_{MU} testing?

A. Yes.

Q. So you were with, I believe that was with Jake Howard?

A. Yes.

Q. What was your role during the V_{MU} testing?

A. I was flight control monitoring in the back and also helping Reece with V speeds and such.

Q. During the initial V_{MU} test, the very first one, I'm assuming you were at the very first V_{MU} test with Jake.

A. Uh-huh.

Q. Do you remember what the call max pitch attitude was that they achieved?

A. No.

Q. Do you remember during the V_{MU} test that they got any

stall indications or they talked about any stall indications?

A. I don't recall.

Q. Can you tell me who was in on the V_{MU} briefings?

A. Like preflight briefings?

Q. Yeah.

A. The pilots. So it would be Jake and Kent, myself, Reece, Paul was there and also the performance engineers on site, so Shelley Brimmeir, Eric Upton and Adam Hart and there might have been -- oh, and the Rolls Royce person.

Q. Then you mentioned you were working flight controls, that was your area?

A. Yeah, I was monitoring the flight control system.

Q. All right. Jumping back to 088, was there any discussion regarding changes in V speeds or stalling angle of attack between V_{MU} testing and 088?

A. Change in V speeds, but I don't believe so, no.

Q. How about anything regarding changes in stall margins?

A. Nothing that we hadn't previously discussed implementing before we started V_{MU} testing.

Q. Can you just elaborate what you discussed about the stall margin?

A. We discussed implementing changes into the flight control system to modify the AOA limiters to be more conservative to what they were.

Q. What was -- do you recall what the numerical change was

in the limiter?

A. It's hard to describe. It was half of a degree. It went from 1 degree to half of a degree and then another nearly .2 of a degree more, I believe.

Q. And that was before Flight 88?

A. Yes, we were implementing that on all of the V_{MU} flights.

Q. And in the post-flight discussion on Flight 88 post-flight debrief, was there any discussion about the wind drop that occurred?

A. Sure.

Q. Can you kind of just go over what was discussed?

A. We discussed having had swapped pilots and this sort of being the last endpoint that we needed to get and Kent having done the point previously on previous programs but yet not within, you know, the last -- within the program that we were doing it on. It was an endpoint so he, you know, just pulled too hard.

Q. Did the fact that the margins had changed before Flight 88 come up in a discussion?

A. No.

Q. Now, you are working flight controls on 088. Did that change on 132 or after Flight 88, were you sent to something else or were you always flight control?

A. Yeah. Always flight control monitoring.

Q. And on 132 there was another roll event or wing drop.

What was the discussion about that in the post-flight briefing?

A. I believe that was pilot procedure. Vivan pulled before the rotate call was given, he pulled too hard. So he and Reece spoke about the procedure about when he was supposed to have pulled the column.

Q. Was there any discussion of any changes to the stall angle of attack?

A. No.

Q. Was there any discussion about the change in margins at that point?

A. No. I don't believe so.

Q. And then going to flight -- up to 153, I want to go back between 088 and 153, were there any changes in the PLI settings?

A. Not that I'm aware of.

Q. Now, on 153 you had an engineering brief and a preflight debrief, you had two briefings for -- oh, you weren't there.

A. I wasn't in Roswell for 153.

Q. Strike that. But on the 088 and 132, you just had the preflight briefings? In other words, no engineering briefing?

A. Right.

Q. Do you know why there wasn't any engineering briefing, they were just combined as one?

A. I guess I need some more description on what you consider an engineering debriefing.

RAMEE: Can we go off the record?

(Off the record.)

(On the record.)

MR. GALLO: Let's go back on the record.

BY MR. GALLO:

Q. In working with Reece, did you ever work with him on of the speed development?

A. No, he was working with Shelley's group on that.

Q. Was he working anybody from the aero group?

A. Yeah, that's Shelley's group.

Q. Yeah, Shelley's group is the --

A. Performance.

Q. But then there's --

A. Performance engineering.

Q. But then there's the aerodynamic's group, like with Bob Mills, aero sciences.

A. Oh, I'm sure he was, but to my knowledge, I can't answer to what he did before.

Q. Did Reece ever express any concern about pitch targets in relation to stall margins?

A. He might have and we adjusted those accordingly to lower them but I can't say that he was, you know, safety flight concerned with them. I mean, we adjusted them accordingly.

Q. And between flights, did you ever have any meetings with Reece, and these aren't preflight briefings, but they're just meetings with Reece and maybe some other people from other

departments concerning upcoming flights or issues that come up after?

A. Informal briefings, maybe, yes.

Q. And do you have any memory of what the topics were on some of these informal briefings?

A. No.

MR. GALLO: That's all the questions I have for now.

John, do you have any questions?

MR. O'CALLAGHAN: Yes, just a few. Thank you.

BY MR. O'CALLAGHAN:

Q. And thank you Valerie for coming in and talking to us.

Describe your understanding of how the one engine continued takeoff maneuver is flown, just the procedure, starting from, say, you know, the lineup on the runway to brakes on, through the climb to a 100 feet or so?

A. So, you line up on the runway, set brake pressure. And then V speeds are determined, obviously, before you line up on the runway. We went over those speeds as we lined up. An engine failure speed is chosen based on the V_1 speed, usually based on either weight or speed.

So brakes are set, power is applied, full power. Usually a three count is given on brake release. The pilot releases the brakes and the accel is started. The copilot usually calls out the, you know, out of the gate sort of callouts. He usually calls and 80 and a 90 knot speed and then he'll call an

engine fail speed near V_1 or whatever the engine fail speed was chosen.

The copilot then retards the throttle. I guess for a throttle chop the pilot would retard the throttle. The copilot would retard the throttle.

The pilot would then continue the takeoff with the remaining engine and pull the column back when the copilot calls rotate. The takeoff is continued until usually through 100 feet, usually through 200 feet, I think. Usually, the FT in the back will usually give a call, an off call, you know, we've got enough information, call it off. At which point the pilot takes back control of the retarded throttle and climbout is continued. Gear is usually retracted as soon as positive rate of climb is achieved.

Q. Okay. Thank you very much. In terms of the details of the rotation, it was discussed a lot over the last couple of days about 9-degree pitch targets and capturing V_2. Can you just describe that understanding of how that transition occurs and what the pilot is shooting for?

A. From what I remember, a lot of the stuff we did was based on a pilot input force with a pitch target that he was trying to reach. So when the copilot called for rotate, the pilot would attempt to do some -- a step-type input on the column with a force in mind, usually, below 70 pounds. And then as soon as the nose starts to rotate, he'll relax the column force and attempt to

achieve the pitch attitude that he's trying to reach until V_2.

Q. In terms of the pitch limits, do you have any recollection about those and what their role is in this?

A. Pitch limits in terms of what?

Q. We've heard, like, on the card there's a target pitch, maybe I should say a pitch target. I'm sorry. Like 9 degrees and then I think at one point there was an objective not to exceed 11.

A. Right.

Q. Can you explain the relevance of those numbers or of the pitch target?

A. I don't think I have enough technical background.

Q. Okay. That's fine. Thanks.

Now, I'm curious as to the workload in the back there. Can you just describe your duties during all this, like, what you're looking at, what you're doing throughout this takeoff that you just described?

A. Well, usually I'm watching our IAD screens in the back. We have -- the aircraft is outfitted with a whole suite of instrumentation to monitor the flight control system. So a lot of the information that the flight control computers put out, I have more access to than the pilots have access to and it's what's displayed in cockpit.

So I'm monitoring the flight control system for any anomalous behavior during the takeoff. And also I try and -- the software allows sort of event marking, so I try and event mark the

brake release.

Q. Okay. Thank you. And following the events on 88 and 132, you were following the conversation between the pilots during those or were you busy with other duties or how did that work out on this?

A. You mean during the flight or post-flight?

Q. During the flight, immediately after the event, do you recall the conversation? Were you paying attention to what they were saying?

A. Yeah. I don't remember a lot about the conversation after Flight 88 -- but I do remember after the Flight 132, Gary, you know, he said -- he was calling out that he pulled too high, too fast and too early. And after that, there's not much that I remember.

Q. Do you recall if they discussed anything about stall, stalling the airplane?

A. No.

Q. Following the event on 132, were the cards flown normally or -- never mind. Scratch that.

We discussed also that apparently there had been some history of difficulty in capturing the V_2s during these maneuvers. Were you familiar with that or aware of that discussion or difficulty?

A. I think so. A little bit.

Q. Did you and Reece ever talk about it?

A. Not that I recall.

Q. Following the events, do you recall any discussion about the role of the yaw damper on the 132 event or the role of the flight plan playing a role in the roll-off event?

A. Yeah, all of the sort of what we call Phase 2 Roswell, which was all of the deployment in March, prior -- up to and prior to 132, we had an IFR that restricted us to operate without the yaw damper engaged. After the 132 flight, we determined that the yaw damper was -- not having the yaw damper on was making the airplane too squirrely. So we elected to stop doing takeoff testing after that.

Q. And do you recall any discussion about the squirreliness of either the yaw damper being off, having a role in the roll event on 132?

A. I don't recall specifics. But I do recall, you know, talking about how having the yaw damper off was making the airplane squirrely and also the fact that you're doing a one engine takeoff which induces yaw already, was adding to the pilot workload.

Q. Okay. That makes sense.

MR. O'CALLAGHAN: I think that's all I have. Thank you very much.

DR. BRAMBLE: Okay, so it's me.

BY DR. BRAMBLE:

Q. Who was responsible for reducing the data after the

flights primarily on the flight test engineer -- let me specify. Who was responsible for reducing the data after the flight tests initially?

A. Probably Reece.

Q. How did he interface with flight sciences on that?

A. He -- well, the three of us, Cynthia, Reece and I, were all having discussions about how we were reducing the data and the scripts that we were writing in order to reduce that data, how we pick event markers, but the three of us, you know, Reece and I and Cynthia, were all working with the performance group.

Q. Did you get involved with analyzing the data with Reece or just sort of the marking of the data?

A. I did, but I didn't do a lot of it in Roswell.

Q. What kinds of things did you do to analyze the data when you got back?

A. Well, when I -- now I'm basically in charge of the takeoff data, so I'm doing all of the analysis on it.

Q. How about before the accident; what was your role?

A. When we got back from Roswell the first time after November, I had initially looked at those takeoffs and done a preliminary sort of investigation based on the scripts that we had put together but it was basically just a quick and dirty look at the data to get some preliminary numbers out of it. After I'd finished that, it sort of fell off my radar. I haven't looked at it sense then.

Q. When was that that you looked at it?

A. December.

Q. Did that involve continuous takeoffs or the V_{MU} tests?

A. I didn't look at any of the V_{MU} data. Reece did all of that data. The data I was looking at was the all engine operating and the one engine out CTOs.

Q. When did Reece have a chance to look at the data from November?

A. When we got back. I believe he did most of his data analysis when we got back to Savannah.

Q. When, from November? Or do you mean December he worked on it?

A. Well, I mean, yeah, we got back and there was one week of November between Thanksgiving and December.

Q. Did Reece express any opinions about the flight test plan and the length of time available to perform the flight test?

A. I don't remember. There were always discussions about, you know, how were we going to fit what we needed to do in but that was with all of the testing that we had.

Q. Did Reece express any concerns about not having enough time to analyze the data before proceeding with the tests, with additional tests?

A. I don't recall him ever saying anything like that, no.

Q. Anybody else in the test team say things like that, that you can recall?

A. No.

Q. Did you perceive any unreasonable management pressure to conduct the test plan in a way that made anybody on the team feel uncomfortable?

A. I don't think it was unreasonable. Management does their job to make a schedule and to try and get us to adhere to it. But in my opinion, I think that if someone had a concern about the risks, they would have spoken up.

Q. Okay. Just one moment let me delete some things.

How well did you know the four crewmembers aboard the airplane?

A. I probably knew Kent the best. I worked the most or the longest with Kent. I didn't know Dave or Vivan very well. I'm friends with both of them but didn't really know a lot about them. And Reece, since he started working here, you know, just the flights that we'd been working on. He was just a working acquaintance.

Q. Did you -- you weren't present for any of the 153 activities, correct?

A. No, I was not.

Q. Did you have any interactions with any of the four of them in the 72 hours or so before the accident, like Wednesday through Saturday when the accident occurred?

A. No.

Q. How did you feel about the size of the workforce for the

amount of work that needed to be done on the test program in the time that was available?

A. Can you clarify test program? Field performance test program or the entire 650 flight plan?

Q. Field performance test.

A. Field performance. I thought it was reasonable.

Q. How about morale among the test team?

A. I think morale was pretty good. The previous programs that we've been going to Roswell, it was go there, get it done, every one stays there until it's done.

For this program, because we knew that we were going to be there a while, they arranged to have the team swapping in and out so that we weren't stuck there for 6 weeks on end, which I think did improve morale because we didn't, you know, not away from our families for that long.

Q. And the previous programs that you are referring to, which programs were those?

A. 450 was the program that I was involved in previous.

Q. Was the time frame and number of people assigned similar to that program?

A. Yes.

DR. BRAMBLE: Okay. That's it for me for right now.

MR. REMICK: My questions have all been asked. Thanks.

MR. HORNE: I only have a couple.

BY MR. HORNE:

Q. Do you know how the PLI was set, what angle of attack or what percentage it was set to?

A. I don't know what it was set to.

Q. Do you know happen to know how the main file was labeled, was it labeled so that you could tell that it was a particular setting or not, because you were loading the main file, right?

A. The parameters themselves?

Q. Yeah.

A. I think so. I'd have to look at it again to tell you what each parameter was.

Q. I guess during the time that you were there, did it change any or did it always stay the same?

A. It was always the same, the same parameter file.

MR. HORNE: That's all the questions I have.

MR. GALLO: Anybody have any more questions?

John?

MR. O'CALLAGHAN: I'm good.

MR. GALLO: Do you have anything you want to say or comment on?

MR. THURSTON: (No response.)

MR. GALLO: Okay. Thank you for coming.

(Whereupon, at 3:00 p.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD
INTERVIEW OF:	Valerie Thurston
DOCKET NUMBER:	CEN11MA258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 17, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha Wheeler
Official Reporter

_____

Lourie J. Brown
Transcriber

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*	
	*	
AIRPLANE ACCIDENT	*	
ROSWELL, NEW MEXICO	*	Docket No.: CEN11MA258
N652GD	*	
	*	

Interview of: CYNTHIA TOWNSEND

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Thursday,
June 16, 2011

The above-captioned matter convened, pursuant to notice, at 12:03 p.m.

BEFORE: MITCHELL GALLO
Accident Investigator

APPEARANCES:

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I N D E X

I N T E R V I E W

(Time noted: 12:03 p.m.)

MR. GALLO: On the record.

This is an interview with Cynthia Townsend.

Cynthia, thank you for joining us today. The purpose of the interview is for safety purposes. It has nothing to do with regulation or enforcement actions. We're going to basically ask you some questions about your background knowledge of Flight 153 and maybe on some other flights.

INTERVIEW OF CYNTHIA TOWNSEND

BY MR. GALLO:

Q. I want to just start off with if you could tell us what your title is and what your responsibilities are within the organization.

A. I am a flight test engineer and I am basically working with field performance on the G650 and I will when I go on site when they're testing. I generally make the cards and do any kind of write-up, extra write-up, that goes along with those.

Q. How long have you been with Gulfstream?

A. Almost a year. It will be a year next week.

Q. What did you do prior to that?

A. Prior to that, I worked at Cessna Air.

Q. What did you do at Cessna?

A. I was an aerodynamicist.

Q. How long were you at Cessna for?

A. Almost 14 years.

Q. Can you describe in regards to Flight 153 to me the preflight briefing, what was discussed?

A. Which one?

Q. There is an engineering preflight briefing.

A. Right. Well, there were two preflight briefings for that flight. There was an early one that took place in the afternoon and then there was another one that took place at 4:00 or 5:00 later on that day.

Q. And if you would discuss both of those in order?

A. Okay. The earlier meeting, let's see, the new crew had just come in prior to that day and the cards were not ready at that time when they came in. It was around noonish or so.

And Reece wanted to just set everyone down and generally discuss what we were going to be doing for the next week. And certain things such as the alpha limits we had discussed before. The limit is 12 but because of previous issues we had had, he decided that we weren't going to beyond 11. That was definitely discussed. I remember that.

Everything else was just general, what maintenance had been done on the plane, things that had occurred as far as previous flights, you know, how far we had gotten through the test points. I'm trying to think of what else.

I guess some introductions because I had not worked with Dave McCollum before so we talked about each other's duties were

going to be.

That's pretty much all I can remember. I pretty much came in on the latter half of that particular meeting because I was in the process of working on the cards at that time so I had realized that they had started talking. So I came in and that's when I got in on that at that meeting.

Since, like I said, the group had just got there, we decided, you know, once the cards were made, we were going to meet back at that hotel later that afternoon, give everyone, give the new people, a chance to check in and give me a chance to finish the cards.

So we headed out to the hotel. I'm saying it was about 4:00. I think it was about 4:00. We met in the lunch room, breakfast room, whatever you want to call it. It was Kent, Vivan, myself, Reece, Shelley, Eric, and I don't remember if anyone else was there. At least those six.

Anyway, we were all there and we discussed the next day's cards. This was typical. We usually -- or at least this was the way that Reece liked to do it anyway. We would do the preflight the day before so that first thing in the morning we could step directly to the plane.

So we had our preflight brief. Again, we discussed the alpha limits, we discussed the cards. We went through each card individually. We went through all the TSHAs. We, again, discussed any maintenance that needed to be on the plane. We

discussed fuel. I'm trying to think of anything else we discussed. That's probably all that I can think of right now.

Q. And you said you discussed duties. What were everybody's duties?

A. Okay. There were technically three flight test engineers: Reece, myself and Dave. And usually one flight test engineer -- well, always, one flight test engineer stayed on the ground for fatigue duty. So the other two ran the plane. We needed one FTE to run the FCC and then the other engineer would run the test. So, usually, it was Reece running the test. So then that would involve Dave to do the FCC.

Q. What's FCC?

A. Flight control computer.

Q. Is Reece the lead?

A. Yes.

Q. FTE, or I don't know if there is a formal name when you're the lead.

A. He's my lead.

Q. You just call him lead?

A. Yes.

Q. And then why were you making the test cards; how did you get assigned that?

A. Well, I made the test cards because -- well, Reece -- usually, the way things usually ran -- and actually, I did it with Paul also. I don't know how I got dumped on with that. But

anyway, I always made the cards. I don't know, I always made the cards. Usually, either Paul or Reece or whoever the lead was -- they were analyzing the data. They'd write up the daily -- I don't know what you'd call it, the daily report. There was a lot going on. So they gave me the menial task of doing the cards.

Q. And before I go any further, what's the difference between an engineering brief and a preflight debrief? Both are preflight.

A. The brief is before the flight. Debrief is after.

Q. Oh, I have a typo on my document. What did you discuss regarding the alpha limits?

A. We discussed lots about that but we -- I mean, it was hammered. It was hammered in that we were not to exceed 11 even though the limit was 12. We were not going to exceed 11.

Q. How come you were not going to exceed 11?

A. Well, they had had issues before in Flight 88 and Flight, what was it, 132, where they had exceeded -- well, I guess we -- I think we reached 12. I'm not sure if we exceeded it. But we experienced some roll and Dave said, that's no man's land, we do not want to go there. It was definitely a place to stay away from. So we said, you know, if we back down from that at 11, that that should sufficient.

Q. Who was conducting the briefing at the time, engineering brief, and then who was conducting the preflight brief?

A. They were always with Reece.

Q. Who is the person that's going through the cards; who is the main person talking?

A. Usually, it was the lead. It was Reece on 153.

Q. And then the preflight brief was also Reece?

A. It was also Reece.

Q. Was there any discussion regarding piloting technique by the pilots?

A. Which time?

Q. During the -- on Flight 153 engineering brief or the preflight brief?

A. Yes. There's always discussion whenever we have a brief. We always have pilot input. Actually, anyone at the table has input. The pilots, generally, will -- okay, just to step back for a minute. The takeoff, this takeoff maneuver that we were trying to do, has always given us pause, you know. No matter what we do, we couldn't get it right. There were certain speed limits and at certain locations that we wanted to get correct. We couldn't do it no matter what we did and we continued to, I guess, redefine the technique for using that.

And so usually our pilots, Kent and Vivan, go through and, you know, say, well, this might work better or we might do this. It was always a, what did you say, a conversation that they were wanting to input, to give input, as to how we can make this work.

Q. And I think going back to my question -- maybe I'll have

the terminology right this time -- what's the difference between an engineering brief and a preflight brief?

A. They're the same thing.

Q. After any specific flight, there's a report that's created by the flight test engineer. Do you provide input if you attend that flight?

A. Yes and no. I mean, the post-flight brief, we discuss things and, you know, everyone will put in their two-cents worth, I guess and, you know, how things went, what can be improved if anything. If the test cards met the conditions that we were trying to meet and then, you know, all of that would be put into the report.

Q. But as far as that report, do you at least get to review it? Because I could say you are on my test team, I could say everything went fine but in actuality, I skipped all the test points. Would you have the opportunity to review these? Because there are several FTEs on one flight; does everybody somehow contribute or review the FTE report for that flight?

A. You mean before it's published, before it's sent out to the world?

Q. (Non-verbal response.)

A. No, not really.

Q. Are you familiar with the simulator?

A. Iron bird?

Q. Yes. Are you familiar with that?

A. I'm familiar with it. Let's put it this way, I've heard of it. I've never seen it.

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

DR. BRAMBLE: Back on the record if you're ready.

MR. GALLO: That's all the questions I have.

BY MR. O'CALLAGHAN:

Q. Sorry to have a disembodied voice over the phone but thanks for taking the time to answer questions. I have a few follow-up.

It was mentioned earlier that the pilots were struggling or trying to alter their technique to make things work so they can come together to make all of the different speeds and the pitch attitudes but they were having difficulties. Can you describe specifically what was not working out there?

A. Well, generally what was happening is when they -- the way the card was originally written, okay, it asked for a pitch rate and then it asked for, I think it was, the 50-foot speed. Those were two things they wanted us to hit.

Well, we didn't have a pitch rate indicator. So we then changed the card to read such that, given X amount of pounds of force on the column, you know, you reach the target pitch and you still had to meet that 50-foot speed.

Well, no matter what we did, we never did reach the 50-

foot speed, the target 50-foot speed. Let's put it that way. So they kept changing the technique. We kept changing it and kept changing it to try and meet the 50-foot technique.

Q. Were they fast of slow? Is it 50 feet or 35 feet?

A. It may have been 35 feet.

Q. Fast or slow at that altitude?

A. We were always fast.

Q. Always fast. And the discussions, who all was involved in the discussions of why that might be occurring?

A. Generally, it was -- actually, all of us. The pilots, Reece, myself, Shelley.

Q. Was any TM or on board data used at that point to sort of try to sort out what was going on?

A. Yes.

Q. What were the results of that?

A. We were fast.

Q. But I mean in terms of underlying cause, in terms of can you get there from here physically, would the physics allow it, that sort of thing? Was there any sort of a resolution along those lines?

A. Gosh, no, it was really just a matter of technique or at least we were hoping it was a matter of technique. We had looked at what was happening between reaching the target pitch and reaching, I guess, the 35-foot mark and we were trying to, I don't know, get that, you know, gap to slow the plane down, to do

something to slow the plane down because once we hit the target, you know, we were always too fast.

Q. Where was the liftoff speed relative in the speed range between V_R and the target at 35? Where did the liftoff speed fall in that range? I know it's pretty detailed, I know, but if you can recall it.

A. If I remember correctly, it was always very close. You know, it was like rotate, boom, liftoff. It was always very close, within a couple of knots.

Q. Thank you. Can you just describe sort of the flow of activity in the TM van? We talked to Shelley a bit about this but I'm trying to get a flow of how busy you are and then did things kind of slow up and, you know, can you just lead us through like a run, like just prior to the run and then they do the run and then after the run is declared successful, or whatever? You know, kind of what goes on in the TM van, when are you busy, what are you doing, what are you talking about, that kind of stuff.

A. Okay. Usually, all right, there are three of us -- well, it depends. Flight sciences will either have two or three people and I'm the only one from flight test. And my job is to just make sure they've got weather, you know, the winds and direction, make sure that they are on the right card or if they need fuel or just to make sure messages from flight science are passed on because I'm the only one on the mic.

Flight sciences, they usually go through and process the

run at the end of the run. They will, you know, say whether or not we met our targets. They will say whether or not the -- well, I guess, if the run was successful, whether or not we should repeat the run or whether or not it was good.

Q. Okay. So, again, I'm just trying to sort of like to replay the activity in the van in my mind. So you're all ready to go for a run and the pilots are lined up on the runway and they're ready to go. They've got a wind check. You'll provide them that sort of thing?

A. Yes.

Q. They'll do the takeoff and I'm presuming you're monitoring data and so is flight sciences. And what I'm doing here is I'm sort of filling in the gaps of what -- I'm going to describe to you what I think is going on based on what you've described to me and you can tell me where I'm wrong and fill in the gaps for me, if that makes sense.

So they do their run and then flight sciences and yourself are looking at the target speeds, the rotations, deciding whether the run was successful or not and declaring yes or no. And presuming that if it was correct, there's probably a lull as they circle around to land and get ready for the next one.

A. There is never a lull.

Q. Oh, no?

A. There's not a lull. Usually, by the time they circle around, we are going through the run. We're looking at the

speeds, the pitch, anything and everything; we're going through and looking at all the parameters that we were targeting. Never a lull.

Q. So does that leave you any time then to sort of monitor what the conversation on the aircraft might be or do you pay attention to that or are you busy with your own things or how does that go?

A. Usually, I hear the conversation and comment eventually sometimes.

Q. Was there anything between, on the accident day, between run 7A1 and 7A2? Do you recall anything about the discussion or the data or any changes that might have been proposed between those two runs that comes to mind?

A. Between those two runs, I know Shelley was giving me numbers. You know, usually, I've got the headset in one ear and Shelley is talking to me in the other ear and I am trying to write down what she wants, whether or not -- and usually, she critiques the previous runs so it will be, you know, you were fast, you were a couple of knots fast, your pitch was off, you know, et cetera, et cetera.

Then usually, you know, the pilots and Reece will be discussing something. I'm sure there was conversation. I just don't recall it because I was really trying to keep track of what Shelley was telling me so I could pass it on.

Q. Understand. Okay. And how about on Flight 132 after

the roll-off on that one. Any recollection of what was going on in the discussions in the airplane afterward?

A. No, I can't remember anything offhand. Usually, it was -- between each run, usually, they'll discuss, you know, whether or not the -- I guess I want to say, how it felt, you know, the pilots on whether or not it was, you know, the right amount of force or got the right pitch.

Reece is also monitoring on board so he will say, you know, based on a quick look at the monitors whether or not he thought that the run was a good run.

Q. So then specifically any discussion between Gary Freeman and Vivan and Reece on Flight 132 following that event, anything stick out in your mind about what happened there in their conversations and what they were discussing?

A. No, everybody heard, whoa, whoa, whoa. That was the most of the conversation that I got it.

Q. Thank you. Let's see, I'm blanking out a minute here. You said you did the flight test cards. One thing I'm trying to get a feel of is -- and you also mentioned that the 11 degrees was kind of hammered in the briefings that it shouldn't be exceeded.

A. Right.

Q. So that commandment, if you will, was that formalized or was that on the card somewhere? And I'm also trying to get a feel of if the cards represent limitations that are not to be exceeded or something. It's kind of a two-part question there.

A. Okay. As far as I know, 11 wasn't formal. It was just a, I guess, personal command from Reece. He didn't want to go past 11. Twelve was what was the formal limit.

Q. Now, on the card it specifies the manner and the procedure, the pitch, the target and then capture V_2 after that, I believe.

A. Uh-huh.

Q. So how much deviation from that is allowed or if you want to alter the technique? Is there any process required to -- does everyone have to get around to discuss or can the pilot on his own discretion decide he's going to do something different, or how would that work, if you wanted to alter the procedure of what's on the card?

A. I think that was what was constantly changing because, you know, we were never reaching V_2 and that was one of the things. We discussed it in the briefings. We'd discuss it on the plane. We were constantly discussing what it was going to take to meet V_2.

Q. So does that mean that the pilot has the freedom to sort of disregard the procedure to try to obtain the goal? Or is that over simplifying?

A. I don't think -- I was going to say, I think that might be oversimplifying because generally, you know, again, in the flurry of conversations between runs, suggestions would be thrown out, maybe I should do this or maybe I should do that. Or let's

try this or let's try that. So, I don't think it's a disregard for the card as just that the card wasn't specific enough.

Q. And I think we may have discussed this earlier this morning with you and Shelley but I'll get your point of view. What's the relationship between the cards and the TSHAs?

A. Okay. The TSHA will be -- is our hazards sheet, I guess you would say, what the hazards are for a particular run. We were doing takeoffs so we had the takeoff TSHA. And it basically would go through and say, well, you know, we're not going to do this, you know, in X amount of crosswinds. We're not going to do this, you know, with the wrong personnel on board. You know, all the dos and don'ts of the flight. The cards basically state what the particular run will consist of.

Q. And so the TSHAs is where the 12-degree limit was established formally?

A. I'm not sure. Let's see. I can look at it. Actually, no, it's not in there either.

Q. Do we know where that 12 degrees is specified?

A. I'm almost certain that is a limit that's on the plane but I can't say for sure. I know it was constantly told to us so it must be somewhere, stated somewhere.

Q. Okay.

A. Oh. Well, actually, I do know. It's our shaker limit. Twelve is our shaker.

Q. Well, that's a great segue because I was going to ask if

it is appropriate, would you feel comfortable fielding some questions about the flight control system and the normal mode versus the first flight mode and some of the tolerances and settings of the limiter or would that be better for a different person to answer?

A. And that probably would be better for a different person. I know what they were set to; why they were set there, I couldn't tell you.

Q. Well, that's good enough. So for the limits on the shaker, go ahead, what was the understandings that the limits were?

A. Twelve degrees.

Q. Twelve degrees. That's where it starts to fire?

A. Yes.

Q. And then the actual stall being how far from that, if you know?

A. Gosh, several numbers have been bantered about so I'm not going to say.

Q. Okay. Very good, fair enough.

MR. O'CALLAGHAN: That's all I have.

BY DR. BRAMBLE:

Q. Just to follow along with that same question, Cynthia, several numbers have been bandied about. Was that since the accident or before the accident? Was there a number?

A. Before the accident.

Q. Several had?

A. Several had been before the accident. They changed the shaker limit.

Q. Okay.

A. I mean, it was coming down.

Q. Okay. Are you a pilot by chance?

A. No.

Q. All right. We covered this a little bit with Shelley last time, but is it correct that Reece was sort of conducting the test aboard the airplane and Dave was monitoring the flight computer in the back?

A. Yes.

Q. Okay. And so his responsibility was just to watch the flight control computer? Did he have any other duties?

A. No.

Q. And was he just looking for, like, signs of failure?

A. Usually what the flight control person does -- I can't give a lot of details because I've never done the flight control computer, but usually you are monitoring what the pilot is going to see. You know, you're monitoring everything from airspeeds, pitches; you're also monitoring stuff like -- oh, I'm trying to think -- any kind of cast messages, any kind of amber lights or anything that will come up. So you're actually more concerned about the physical workings of the plane.

Q. Okay. Do you know how it was decided who would be the

flying pilot?

A. No.

Q. How would you characterize the tone of interaction among the crew members on the airplane on the day of the accident?

A. Usual, jovial. They all got along very well.

Q. Were you personally acquainted with any of the four crew members aboard the airplane prior to your coming to Gulfstream? Had you known them?

A. No, just since I've been here.

Q. Okay. And how much interaction had you had with them prior to this week?

A. With Reece, I've worked since I got here. With Kent, I flew with him back in November on Phase 1. And Vivan, I'm trying to think, did I fly with him then? I know I've flown with him, I'm just not sure when but I would say before Christmas.

Q. Were they pretty much work colleagues or were you close personal friends with any of them?

A. Colleagues.

Q. How would you describe Kent's personality?

A. A good guy. He was very knowledgeable. He was, I don't know, reminded me of a big Boy Scout.

Q. And how assertive was he compared to other pilots you have worked with?

A. Assertive. I have met more assertive pilots. I would say, you know, if I had to pick on a scale of 1 to 10, with 10

being the most assertive, I would say he was a 7.

Q. And how about Vivan, how would you describe his personality and his assertiveness?

A. Personality, he is quiet, very nice. Not very talkative. The only time I ever got him talking was when he talked about his boys. I wouldn't -- I just don't seem him as being assertive.

Q. Did you have any doubt that if he had something safety related come up that he would be willing to speak up?

A. Yes, I'm sure he would.

Q. How about Reece, what was Reece's personality like?

A. Reece was funny. A good guy. Again, all of these guys were really good guys. Reece was very knowledgeable. He knew exactly, you know, what he wanted. These were his test points. So, you know, he knew what our targets were, how he wanted to get there.

He would continually discuss this with the pilots, you know, trying to find the best way to not only get the data but fly the plane in a manner that is going to be flown by the customer. So he was constantly, I guess, picking the brains of the pilots to get some kind of middle ground.

Q. How about his assertiveness?

A. Oh, I think he's very assertive. I wouldn't say he's a 10, but he's got to be a 9.

Q. If you had to rate Vivan, where would you put him?

A. I would say a 5. Again, I didn't know Vivan as well so I could be wrong.

Q. All right. Have you -- you had been out the previous week, you didn't just arrive on Friday, did you?

A. No, I had been here the week before.

Q. Okay. And when did you first see the crew members on the day of the accident?

A. When the plane got in. That was -- I'm not sure 11:00 or 12:00, somewhere around there.

Q. The day of the accident.

A. Oh, the day of the accident. I was thinking the Friday before. I saw the crew that morning. We all had breakfast together.

Q. At the hotel?

A. Yes. I'm sorry, yes.

Q. Do you recall what time that was?

A. 5:30.

Q. How would you characterize everybody's health, mood and alertness on the morning of the accident?

A. Same as always. We're up, we're moving, we have our breakfast and we head to the airport. Everyone was great. It was a normal day.

Q. And then when did you see them the night before, or when did you last see them the night before?

A. We had dinner the night before. After our preflight

brief, we went to dinner and then we all went our separate ways after dinner.

Q. What time did you part after dinner?

A. I would say it was probably 7:00.

Q. Okay. And to your knowledge, did everyone go back to their rooms at that point?

A. To my knowledge, yes.

Q. And you first saw them on Friday when the plane got in about 11:00?

A. Yes.

Q. Sorry to jump around. But on the morning of the accident on Saturday, did anybody mention how they had slept the night before?

A. Not that I can recall.

Q. Okay. And in the days before the accident, did any of the crew members aboard the aircraft exhibit any signs of illness?

A. No, I can't think of anyone.

Q. And I mean the crew members aboard the accident flight, those four guys.

A. Oh, no. No.

Q. Do you recall whether Kent or Vivan were using corrective lenses?

A. During the flight?

Q. Uh-huh.

A. I don't remember.

Q. Well, I guess as they prepared to take the first flight test --

A. Sunglasses, that's all I remember seeing.

Q. To your knowledge, did anyone consume alcohol in the 24 hours prior to the accident?

A. I cannot say. I'm just not sure. It was not unusual for any one of us to have a beer but that was -- I cannot say for sure they did the night before.

Q. You don't remember whether they did or not?

A. Right.

Q. How about medications, did anyone mention taking any medications?

A. No.

Q. All right. One moment please.

Do you have any involvement with the approved flight test data reduction plan? Are you one of the people who participates in the data reduction?

A. Yes.

Q. What's your role?

A. I am working on the braking coefficients, braking and rolling coefficients, field performance, in general.

Q. Braking and rolling coefficients?

A. Yes.

Q. Okay. All right. And is it your understanding that two flight test engineers are required aboard the aircraft during CTO

tests because not all of the parameters can be downlinked in real time to the van?

A. Right, yes.

Q. To your recollection, how did the test go on the morning of the accident that preceded the seventh card?

A. I think we were -- I would say, not enthusiastic about the way the test had gone. They were probably the best we were going to get and I think that is where we decided the test point was going to have to be changed.

Q. In what way?

A. Because we just couldn't meet V_2. We just couldn't get it.

Q. All right. And so the earlier tests that morning were all continued takeoff tests?

A. Yes.

Q. And in all of them, you were above the V_2 speed?

A. Yes.

Q. All right. So during the one engine in a CTO test, card 7, when should a pilot transition from pitching to a target pitch to pitching to achieve the V_2 speed and maintain the V_2 speed; at what point should they start adjusting the pitch to track the V_2 speed?

A. That was the $64,000 question that no one could answer. But generally, I think, we captured the target pitch and then if I can remember correctly the way it was done, we captured the target

pitch and then we pitched down, which always costs us speed and then there was another pitch-up.

Q. You said we pitched down which always cost us speed. Would that always cause you to exceed the V_2?

A. Yes.

Q. All right. So what was the strategy for overcoming that problem?

A. We never found it. We were, again, constantly trying to figure out what was going to slow us down. I think from the flights I looked at, we would pitch up, we'd reach our target pitch. We'd pitch down, which sped us up.

Then we'd pitch up again and we were getting to the point where we'd reach our target pitch and instead of pitching down, which caused us to increase speed, the pitch kept going till I think -- I would say that that was one of the issues and what caused the accident.

Q. Do you recall anyone verbalizing that as a strategy?

A. No, that wasn't a strategy. That was not the intent. But we kept trying to slow down.

Q. Do you recall anyone describing or suggesting that they perform the takeoff as a continuous maneuver from the pitching to the target and then continuing to match the V_2 speed?

A. No. I don't remember anyone saying that.

Q. Okay. If you had heard that, would you have thought anything of it?

A. Actually, I probably heard the exact opposite because we knew the dangers of continuous pitch and that was definitely a no-man zone.

Q. All right. What was the bobble that occurred on the second card? Do you recall anybody mentioning the bobble on the second card on the day of the accident?

A. I do remember the bobble. I just don't remember what it was in reference to.

Q. So you mean you heard somebody mention it?

A. Yes, yes.

Q. Okay. And the events during Flight 88 and 132, where there was a roll and reduction in pitch, were those ever considered to be stall events or were they incipient stalls?

A. No, they were referred to as roll events. No one said stall.

Q. Okay. Sorry for the delays here but what I'm doing is actually going through and deleting questions and making your visit shorter.

Okay. Did you guys talk about everybody's -- did you talk about the roles of the test team at Roswell in terms of the titles and duties spelled out in the 1998 Flight Test SOP or was that sort of an old document that didn't really shape how things were organized?

A. We know what our duties are. We were all FTE. We'd flown before. It was Reece's test, so naturally he was running

the test which left Dave or myself as flight control computer FTEs. Dave has more experience on the flight control computer so he was going to do that job.

Q. Had you ever seen the 1998 Flight Test SOP before the accident?

A. Before the accident?

Q. Uh-huh.

A. No.

Q. Who created the TSHA card or the TSHA for card 7 for the CTO test?

A. I'm not sure on that one. It's signed.

Q. Okay.

A. Now, when you say created, do you mean actually wrote it or included it in the test cards?

Q. Who developed the items that are listed on it, I guess is my question?

A. Okay. All right. Then, no, I don't know who did that. I'm assuming it was Reece.

Q. Okay. Was it normal to revise a parameter such as the target pitch and hand write a correction on the test card?

A. Yes.

Q. Was there anything that needed to be -- anything that needed to be filed if you're going to do something like that?

A. No.

Q. Were you aware of a report that Reece had developed in

draft form analyzing data from the V_{MU} test in November?

A. Was I aware of it?

Q. Yeah. Had you heard anything about he said I've got, you know, a completed report from the V_{MU} testing.

A. No, I wasn't aware that he completed it but I do remember him working on it.

Q. Okay. Did you ever see it before the accident?

A. Bits and pieces.

Q. To your knowledge, was Reece the only person who was analyzing the data from the V_{MU} test in November?

A. In-flight test, I think so. Flight sciences was also looking at the data so I couldn't tell you who there was analyzing it but I do know they were looking at the data.

Q. Do you know in Flight 88, Kent came in and the buildups had been done the previous day?

A. Uh-huh.

Q. So his first run was one of the last tests in the testing process?

A. Uh-huh.

Q. How common was that for a new pilot to come in on the last step?

A. Gosh, I really can't say. The pilots don't say when they're switching seats, you know, so generally, I never know who is flying. Because on 153, I didn't know Kent was flying; I thought it was Vivan. So I cannot say who was flying when.

Q. Okay. Do you know if there are any procedures for notifying management or safety personnel about any safety related events that might occur during testing?

A. Do I know of any?

Q. Uh-huh.

A. No.

Q. All right. Compared to other aerospace companies where you have worked, and that includes Cessna -- anywhere else?

A. Yes, Boeing.

Q. Oh, okay. How long did you work for Boeing?

A. Five years.

Q. What did you do there?

A. Aerodynamicist.

Q. And Cessna was 12 or 14?

A. Almost 14.

Q. How is the pay at Gulfstream for flight test engineers and, I should say, how is the pay for certification test personnel at Gulfstream compared to previous aerospace employers where you have worked?

A. Well, technically, it's not fair. I'm a contractor here.

Q. Oh, okay. So you don't have a regular pay scale?

A. No.

Q. Was the pay here better or worse than Cessna?

A. Better.

Q. And how about the leave that was provided?
A. Leave? What's that?
Q. How much leave are you given per year? How much were you allocated in that account, I should say?
A. As a contractor, I work; I get paid. I don't work; I don't get paid.
Q. Okay. How about the amount of overtime that's required, is it more or less than prior employers?
A. I want to say more because in prior jobs, I haven't had a priority program that I had to work on. But this is reasonable -- it's more or less what you feel you need to do. There isn't any required overtime.
Q. How much overtime would you say that you did work per week on the program?
A. Here or Roswell? Here?
Q. Well, that's a good question. Let's say the week leading up to the accident?
A. The week leading up to the accident, how much overtime I made?
Q. How much above 40 hours did you work?
A. I don't have an exact number, but I would say it's probably close to 30.
Q. Hours?
A. Thirty hours over.
Q. How about the last week that you were in Savannah prior

to the accident?

A. Prior to the accident, I did probably between 5 and 10 hours over.

Q. Okay. And compared to -- did you work on a certification flight test program at your prior employers?

A. Yes and no. You asked me hard questions, difficult questions. I worked in aerodynamics but I was on loan on the flight test on several occasions. So, yes, we ran a certification program but I was on loan so I was not a permanent member of their flight test department.

Q. How would you characterize the size of the workforce dedicated to previous certification flight test programs at those previous employers compared to the number of personnel resources dedicated to this flight test program?

A. Well, the two companies I worked with before are larger companies than Gulfstream. So I would say that the number of personnel is proportionate to the size of the company.

Q. So at those companies that have more personnel, what categories of personnel tend to be staffed up more?

A. I can't say. That's hard.

Q. For the flight test program itself?

A. I just can't say. It's a difficult question.

Q. Okay. How was morale among the flight test certification team, the G650, in the month or so before the accident?

A. Of everyone in general or just the crew?
Q. Of everyone in general.
A. Oh, they were good.
Q. How about the crew?
A. And they were good, too. Two members had just come in or three people had just come in and they were fresh and ready.
DR. BRAMBLE: That's all that I have. Thanks.
MS. TOWNSEND: Okay.
BY MR. PROVEN:
Q. My turn. I have to go back to my notes. I'm not allowed to talk, really.
A. Okay.
Q. It makes it -- I approve of the way they do it because otherwise it's too confusing as to who is doing what, but I have to go back into my notes. My ignorance periodically shows up and this is one of those. When we talk about the limit, the 12-degree limit, is that a pitch attitude or an angle of attack attitude?
A. It's actually an angle of attack because that's the angle at which the shaker goes but they were watching the -- I'm trying, I am having difficulties.
Q. Yes, so was I.
A. It's angle of attack. I know for sure, it's angle of attack because that's when the shaker goes off. They were watching the pitch to make sure that we wouldn't reach that and I think there's not a big difference, especially on the ground,

well, in ground effect.

Q. I had my answer created so I'm going to say it and you tell me if I got it wrong.

A. Okay.

Q. In order to ensure that the alpha was not exceeded, where -- were going to present that to the pilot, the pitch attitude, so as to accomplish both tasks simultaneous.

A. Right.

Q. Because I don't see angle of attack. I just drive the airplane at the pitch attitude.

A. Right, right.

Q. The engineer sees the angle of attack.

MR. GALLO: Off the record.

(Off the record.)

(On the record.)

DR. BRAMBLE: Let's go back on the record.

BY MR. PROVEN:

Q. So we are going to control the alpha by limiting the pitch. New subject.

A. Yes, that's true.

Q. How long between the post-flight debrief, which you would have immediately after the flight, I presume?

A. Uh-huh.

Q. And the publication of the results, because there is a report written, if I understand you?

A. That could be a long time. Basically what we did is right after the flight -- well, after the post-flight, we would take a look, a brief look, at the data and see if we really hit it out of the park or if it just needs to be redone.

Generally, flight sciences, Shelley's group, would be looking at that realtime in the trailer, okay, and they could tell us whether or not we need to repeat while we're still on the runway.

Okay. Then we get out and we look at it again after the flight. We don't really make an analysis of it until we get back to Savannah. We don't have time for reports up there. You know, what we do is they'll write up, you know, yes, how many runs we made or how many test points we completed, that kind of thing, nothing details.

Q. Yeah. Anything that sticks out, any out layers or what you call stick figures or something; there was some other term.

A. Right. Right.

Q. Okay. We already discussed that the 12-degree limit is angle of attack.

A. Right.

Q. That's where stick shaker was involved. Just a minor technical point. When the crew came in, you were already there, but when the new folks came in, did they come in on a corporate plane?

A. Yes.

Q. It means nothing except that we came in on an airliner and I just was curious. It would be a whale of a trip from here to there.

MR. PROVEN: Thank you.

MS. TOWNSEND: That's it?

MR. PROVEN: They asked good questions.

MS. TOWNSEND: Okay. All right.

MR. REMICK: I like the characterization of Kent as a big Boy Scout.

BY MR. REMICK:

Q. You had said you had been having difficulty getting -- nailing the test points.

A. Yes.

Q. Because the V_2 speeds were always -- you were always ending up over V_2 speeds.

A. Yes.

Q. Was there any other characteristic that you were seeing, anything that kept happening during the technique, like oscillations in pitch attitude or angle of attack? Obviously, they are always going for a target.

A. Right.

Q. Were they always -- were they having difficulty hitting the target?

A. Well, I think we were running into -- again, this was why we kept altering the test card, the wording of the test card.

Okay. We couldn't reach the target pitch at first. We were having problems with that because, again, the only way we could measure that was by the amount of column force we were putting on it.

So at first, initially, and I think this was what caused Kent's roll-off on 88, was the object was to be aggressive with the pull and he pulled hard, you know, and they said, well, we don't want to do it that way. So then we started, you know, lessening the amount of force on that column force.

Q. Initially, like a step or a snatch?

A. Yes. So yes, initially, we were having some issues getting to the target.

Q. Okay.

A. But I think that settled down, you know, so that we weren't really having those issues.

Q. Because the aggressive pulls made it hard to stop?

A. Yes.

Q. I mean, it was difficult to hit the target?

A. Yes.

Q. Any kind of oscillations as they hit the target, were you seeing that there were often the bobbles and was that common?

A. Again, I think that once we got the targets under control, I think that went away. Initially, yes, we were.

Q. So in order to better capture the targets, eventually the technique was used relaxed the rate of pull.

A. Right.

Q. You said you initially started trying to target pitch rates and then transition to control force inputs. What kind of pitch rates or maximum pitch rates did you see during the initial -- in the early technique?

A. Well, actually, we never even used it because the original test card was written for us to monitor pitch rate. We don't have a pitch rate indicator. So we couldn't do that.

So immediately we changed that to a column force and that was something that was discussed between Reece and the pilots. You know, it was a much more measurable quantity that they could look at or, actually, not even look at but, I guess, you know, feel.

Q. Right.

A. So almost immediately, the test card was changed to monitor column force instead of pitch rate, all right? So then how much column force did we want to put on there and that was the subsequent changes that were made to the card.

Q. Right. The pilots didn't have a pitch rate. The FT station, they could probably call out the pitch rate?

A. Yes, yes.

Q. But you were able actually to display control column force on --

A. Right.

Q. I can't remember what you called the name of the flight

test display on the dash there but they were able to see that?

A. Right.

Q. Were they referencing it, you think, during the actual rotation or just post event?

A. I don't think so. One thing you might notice is usually when they were sitting on the runway -- and I know Vivan used to do this, I'm not sure if Kent ever did it or not, but they would sit there and practice the column. You would see, you know. And just playing -- well, I wouldn't say playing, but practicing on how much column force he wanted to use. So he was ready by the time he came to actually do the run. He knew how much he had to pull on that column.

Q. He was doing buildup?

A. Yes.

Q. Either looking at or feeling the force or looking at the amount of displacement?

A. Right.

MR. REMICK: All right. Well thanks, that's the only questions that I had.

MS. TOWNSEND: Okay.

MR. HORNE: Well, I'm next.

MS. TOWNSEND: Okay.

BY MR. HORNE:

Q. Since you are an aerodynamicist, I'll ask more of the alpha-related questions.

A. Okay.

Q. Basically, did the crew know that the PLI was set to 12 degrees; did they discuss the alpha limit?

A. Yes, yes, repeatedly, repeatedly. I think that was every single brief.

Q. So they knew that the shaker would come on at 12 degrees?

A. Yes.

Q. Did they ever discuss in the briefing or on the airplane who would monitor the alpha limit and what they would do if it was exceeded?

A. No and no.

Q. Did they ever talk about how they were going to use -- whether they were going to use the PFD or the HUD as the primary control instrument for setting pitch attitude, for looking for speed or for looking for the PLI?

A. They weren't using the HUD.

Q. They weren't using the HUD?

A. No. I'm trying to remember. I know they weren't using the HUD. I don't know. I don't remember any discussion about that.

Q. Okay. That's good enough. You made a comment that the test point would have to be changed, it couldn't meet V_2?

A. Uh-huh.

Q. I kind of had a question of who made that determination

and was that communicated to the crew?

A. It was -- first of all, it was Reece's test so Reece would have made the test point change. Generally, it was going to be based on Shelley's group. They were working on the takeoff, the CTOs for -- and the test point was based on what they needed, what their requirements were.

Like I said, Shelley was always giving feedback for each run as to whether or not they met the speeds, whether or not they met the pitch. You know, it was constant interaction between her and Reece through me.

And we had -- you know, I kept telling Shelley, we're not meeting V_2, we're not meeting V_2. Well, actually she was telling me and so we were discussing, you know, what we were going to have to do. These numbers have got to change, the speeds have to change.

Q. Was this during Flight 153 or was it before that just continued through?

A. It's been a continuous conversation, you know, because that's why that card kept changing because we just weren't meeting the V_2s.

Q. And do you have a set of the cards?

A. Yes.

Q. I have one question on card 7 since that's what everybody is looking at that anyway. Step 7 in procedures, it says to maintain a target pitch attitude until V_2 is achieved and

transition to speed.

A. Uh-huh.

Q. What do you think that meant to everybody?

A. It's capture V_2, which we never did. So, okay, we reached the target, we go nose down. The problem was I don't think they were able to -- and this is my opinion, I don't think they were able to reach some kind of happy medium where we pitched over but not so much as to increase our speed too much. And I think we -- I only remember one other time, I think, that we actually pitched over, didn't pitch far enough and were able to get somewhere close to V_2, and that was just nothing -- it wasn't anything we could do consistently.

Q. Okay.

A. Did I answer the question?

Q. I think you answered as best you could.

A. Okay.

Q. I'm not sure it's real clear in my mind but I can't follow the logic.

A. I think that was the problem we were having, you know, transition, what does that actually mean?

MR. HORNE: Okay. That's all I have.

MR. GALLO: I have some additional questions.

BY MR. GALLO:

Q. And on that note, just so we have a base to set off from the argument, what is the maneuver that you were seeking? I know

you were trying to, you know, capture V_2.

A. Right.

Q. But in the big picture, what is the maneuver supposed to look like that you wanted to get?

A. Right. Okay. This is continuous takeoff, single engine. What they were trying to do is we are trying to achieve a certain pitch and a certain V_2 so that we can determine our runway length for takeoff, single engine out. Okay.

And we have to be able to -- I think, I'm not 100 percent sure on this, but I think it had to do with being able to get out of certain runways and still be in a certain field length. Takeoffs aren't my thing so I'm just summarizing what my explanation is or what had been explained to me.

Q. Were you trying to fit a certain profile, a certain climb gradient?

A. Yes.

Q. A constant climb gradient rather than pushing over and maybe accelerating a little bit to catch V_2 and pitching up again?

A. Right.

Q. So if you use that technique, you will not have a linear flight profile?

A. Right.

Q. It will dogleg?

A. Right.

Q. How long has the team, the team comprised of 153 or any

other teams that were working on that aspect, how long have they been working on trying to capture V_2 and get this profile that they want?

A. I would say it's at least since November, Phase 1.

Q. And you mentioned that the angle of attack limit was 12 degrees?

A. Uh-huh.

Q. Is that the stall angle of attack limit or is that the in ground effect angle of attack?

A. I can't say. I want to say -- no, I can't say. I'm not sure. I just know it was 12.

Q. Did you know what the margin was between the pitch target versus the stall angle of attack, what that margin was?

A. We were using 2 degrees. I'm thinking it was 2 degrees.

Q. On the previous question about the HUD, you said the crew wasn't using a HUD. How do you know they weren't using a HUD for pitch?

A. It was inoperable. I'm pretty sure. It should be on the card: limitation, HUD combiner misaligned in pitch; use caution on landing. So we weren't using the HUD.

Q. Do you sit next to Reece?

A. When?

Q. In your office, where are you located in relation to where Reece works at?

A. At Roswell?

Q. No, here.

A. Oh here? No.

Q. You're separate?

A. Yes.

Q. By how far?

A. A long ways. He sits on one side of the trailer; I sit on the other side.

Q. At this location where we're at now?

A. Uh-huh.

Q. Do you know why he was working on the draft report that was discovered after the accident?

A. The draft report of what?

Q. I believe it was regarding speed development.

A. No. I don't know why.

Q. But you mentioned you'd seen portions of it?

A. Yes.

Q. Is this a standard report as part of the flight test process or was this a side project?

A. For V_{MU}? No, it was just a standard report.

Q. In testing, is there anything such as validation testing, because so far I've seen development and cert, but is there a validation testing of any kind that goes on?

A. Not that I know of.

Q. Had you heard anything about an update to the speed schedules in March?

A. Yes.
Q. When did that come out?
A. Oh, it was shortly before we went out to Roswell.
Q. What was the format, was it in a report, how was that presented to everybody?
A. To me, the tables just appeared magically before me.
Q. But did they have a report number or anything on it?
A. The tables appeared. That's all I know.
Q. Okay. Fair enough. Now, you were on Flight 132, right, on that briefing?
A. Yes.
Q. Briefings. I only have one card. Was only one test point done on 132?
A. 132. I don't think so. No, we did several. We did several runs. I think what we did -- I think we ran into winds that day. I'm not sure.
Q. This was with, I believe, Gary Freeman and Vivan Ragusa was the crew.
A. Yes.
Q. After and in the post-flight briefing, because 132 had a roll-off event, what was discussed during the post-flight briefing?
A. About?
Q. About what transpired during the test. Did you meet the test points? Did you discuss the roll-off?

A. We discussed the roll-off. That was evident. As far as I think -- all I remember is, okay, they discussed the roll-off, not to do it again, set a new limit because we still had 12 on 132, yeah, we still had 12. I think that was when we put in 11, The first time I heard 11, Reece had said, you know, maybe we ought to look at 11 as being our limit.

Again, more discussion as to how to change the wording to get this test point correct. I can't remember anything else. There was -- I think there was some discussion as far as if there was a roll-off, you know, to throw in more power but I can't be 100 percent sure that was the instance when that was said. I kind of remember Gary saying it but I can't be sure.

Q. And on the single engine testing, on any of these, like 153, why is the right engine being the engine that's being cut off?

A. Because we found that to be the critical engine.

Q. What makes it critical?

A. Because -- ask me these technical questions -- I know the answer and I just can't explain it.

Q. What area would it be based upon? Let's start with a generic, avionics or hydraulics?

A. It has to do with hydraulics, I do know that, and that's the most that I could tell you. I know we determined it was the right engine because we did do the left and right engine -- we were doing left and right engine cuts, hydraulic cuts, early on

and we do not have as many issues, or let's put it this way, we did not experience the left engine as being as critical as the right. So we did choose the right engine to be the critical engine.

MR. GALLO: I believe that's all the questions I have. And I'll just go around the room.

John, do you have any other questions?

MR. O'CALLAGHAN: No. Thank you.

BY DR. BRAMBLE:

Q. Who was responsible for changing the V_2s if they were being changed?

A. That would have been flight sciences.

Q. Would Shelley have been involved?

A. Yes.

Q. Do you have any idea why they hadn't already made the effort to change them? I guess they did because they provided some new and different tests?

A. Yes.

Q. So basically the conversation during the morning of the accident was that they still needed to be changed?

A. Yes.

Q. Okay. All right. And on the earlier conversation, I was a little unclear, is the pull force displayed, the feedback on the pull force, is that displayed directly to the crew on a monitor in the cockpit or only to the flight test engineers?

A. Only to the fight test engineers.
Q. Okay.
A. But what they would do is look at the position of the column and, you know, determine how far they needed to pull it back.
Q. Okay. All right. And, had there been any discussions about shortening of the schedule for completing the flight test certification program?
A. Shortening the schedule?
Q. That the schedule had been shortened within the last 6 months to a year?
A. No. I know we had a -- there was a date given, or a month given, we were looking at June. That's all I ever heard, was June.
Q. Why?
A. Why, that was the only date I heard or why June?
Q. Why June? And that June to complete?
A. Yes. I don't know why June. All I ever heard was June.
Q. Do you recall any discussions among the flight test team about whether or not the time frame allotted to the flight testing was adequate for the task that had to be performed?
A. Okay. No program I've ever worked in has ever determined we had adequate time. So I'm going to have to say no to that one.
Q. So the schedule seemed similar to schedules that you had

seen in the past?

A. Yes.

Q. Did Reece say anything about the schedule and whether he thought it was appropriate or not?

A. If he didn't, he would have been the only that didn't. Everyone thought that this schedule was very aggressive when we all mentioned it.

Q. Did anybody express any safety concerns related to this?

A. No. I can say that.

DR. BRAMBLE: Okay. That's it.

MR. PROVEN: Yeah, I do.

BY MR. PROVEN:

Q. When they were doing these initial testings and then even up to the -- were they overshooting V_2 all the time or were they undershooting V_2 all the time?

A. Over.

Q. Overshooting. So you said that, I don't mean to put words in your mouth, so stop me if I misheard you but initially with the aggressive pull, they were de-rotating slightly, they were going through a pitch attitude and then lowering the pitch attitude?

A. Well, we were overshooting, yes. They were overshooting the target pitch.

Q. And so they were --

A. Yes.

Q. Okay. And that will, of course, cause an increase in V_2?

A. Yes.

Q. After they adjusted the pull rate and presumably, therefore, the rate of rotation, did that go away or did they have to under-rotate?

A. No, the way the card is written is you reach a target, you level out, you're supposed to level out or --

Q. If you hit 9, you stay at 9 or you push or you release back pressure to stay at 9?

A. Yes.

Q. You stay at 9?

A. Well -

Q. You stay at 9. Okay.

A. Actually no, they didn't stay. You reach your target and you go nose down to level out, okay. They did not stay at 9, I know that for sure. So that is why you got that little bobble. I mean, they didn't go down that far. They just pushed the nose over.

Q. And you saw that on the screens that you looked at?

A. Yes.

Q. Go to 9 and then they would go to 8?

A. No, not even that far, just enough to level out.

Q. Nine, but not 8 or something. But they were always overshooting V_2, right?

A. Yes.

Q. When they got these new speeds that appeared magically, did the speeds move up or did the speeds move down?

A. I can't say. I'm pretty sure they went up. I'm pretty sure they went up.

Q. That would be my expectation.

A. Because there were -- they had no stall speeds and they went up.

MR. PROVEN: Thank you.

MR. REMICK: I have the same questions.

BY MR. REMICK:

Q. So the pitch over that you've described, that was an intentional maneuver to lower the pitch a little bit?

A. Yes, yes.

Q. So as they hit the initial pitch target, were they under V_2 and needed to lower the nose to increase speed to V_2 so that they could then try to capture it?

A. No, we were always over. So by the time they pitched over, after they -- by the time they reached their target, pitched over to level out, okay, they were already over V_2. There was nothing they could do to slow it down after that except to pitch back up again. All right?

Q. Did you ever see a technique where they pitched the initial attitude and just held it right there?

A. I've seen that probably once or twice and I think that

may have been the only time they actually met V_2. Actually, I don't think they ever met V_2 or got close enough, but no.

MR. REMICK: Okay. Thanks.

BY MR. HORNE:

Q. My question is just to clarify the pitch over.

A. Okay.

Q. Did the pilots actually initiate the pitch over or was that the result of the dynamics of the airplane and you just saw the pitch attitude changing as they got to their --

A. No, they pushed it.

MR. HORNE: Okay.

MR. GALLO: I have no further questions.

MS. TOWNSEND: Can I clap?

MR. GALLO: Well, that concludes the interview then.

DR. BRAMBLE: Is there anything else you want to tell us that we haven't specifically asked about that you think might be helpful for the investigation?

MS. TOWNSEND: I can't think of anything. I think the crew did everything the way they were supposed to. Kent, as a matter of fact had got off the plane to talk to Shelley. I think it was just prior to this run or maybe the one before, because still had issues with these runs, with these CTOs. And I don't recall the conversation because I was doing something else but I know that they discussed it and were talking speeds.

And I think he was a very good pilot. I have no

problems ever flying with him. I don't know what caused the accident. I think whatever it was, wasn't pilot error.

(Whereupon, at 1:51 p.m., the interview was concluded.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	AIRPLANE ACCIDENT ROSWELL, NEW MEXICO N652GD Interview of: Cynthia Townsend
DOCKET NUMBER:	CEN11MA258
PLACE:	Gulfstream Corporation Savannah, Georgia
DATE:	June 16, 2011

was held according to the record, and that this is the original, complete, true and accurate transcript which has been compared to the recording accomplished at the hearing.

_____

Letha Wheeler
Official Reporter

_____

Lourie J. Brown
Transcriber