DCA11MA076

Interview of Gulfstream Personnel (November 2011)

(103 pages)

UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

Investigation of:	*	
	*	
AIRPLANE ACCIDENT	*	
ROSWELL, NEW MEXICO	*	Docket No.: DCA11MA076
N652D	*	
	*	

Interview of: Paul Donovan

Gulfstream Corporation
500 Gulfstream Road
Savannah, Georgia

Thursday,
November 3, 2011

The above-captioned matter convened, pursuant to notice.

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I N D E X

I N T E R V I E W

(9:25 a.m.)

DR. BRAMBLE: Paul, how you doing this morning?

MR. DONOVAN: Fine. And you?

DR. BRAMBLE: I'm doing all right. Thanks for bearing with us here. I know we couldn't get to you last week, and I really apologize for that. We were just running really late that day with Ken, and we just didn't have time, and the rest of the week we were booked pretty solid, so I apologize for having to block up your schedule again this week, but thanks very much for joining us. I think it's important for us to ask you a few more questions and clarify some stuff from last time.

So we've been through this already once. I think you know how it goes, generally, although this time I'm going to ask most of the questions, and we're going to go proceed around the room.

And Tom, also, Bob Combs is in the room right now, and I wanted to have him available just in case you had any questions about interview protocol.

And Bob, if there's anything you want to add, you're welcome to.

MR. COMBS: Tom, I just wanted to give a refresh on attorney or really representative participation in an interview is for the conference with the interviewee, and it's not -- this is

not a joint interview. It's an NTSB interview and it is not a collaborative effort to assist in the interview, but, of course, minor clarifications and things like that are certainly okay, but no questioning of the witness on your part or objecting to questions or things like that. Just anything you do can be communicated through the interviewee.

MR. RAMEE: Well, I certainly -- Bob, I have no idea why I'm given that instruction at this stage of the game. The interview process, I know, with Lorenda had changed a little bit. My only goal in this interview is to make sure that my witness gives fair answers to questions.

And I actually have a subsidiary goal, which you guys seem to find odd for a lawyer, and that is to make sure that the NTSB has all the information that could be useful to it in making its decisions. So sometimes I have suggested an elaboration of an answer. I think that's appropriate, from the witness point of view, that they know that they can elaborate. I try -- I don't put words into their mouths, and we haven't had too many problems.

I can't imagine that in the course of the now 30 interviews that I sat through that I've seen more than a dozen times where I thought that there was some ambiguity in the way that the NTSB asked a narrow question, which I don't think they even intended to ask it as narrowly as they did, and we've worked through those issues.

So if there are specific actions that I have taken

during this process that the NTSB believes is incorrect, unlawful, I'd be happy to hear it.

MR. COMBS: No, just what I just said, not really participatory, other than advising and conferencing with the client.

MR. RAMEE: I was asked to limit my advice to the client, and I've done that for the last 20 interviews, so I'll do that again this time.

And actually, you know, I might even go on mute, so you guys can't hear what I advise the client. Would that be even better for your record?

DR. BRAMBLE: Sure, that'd be fine.

MR. RAMEE: So, Bill, if you just hear -- if the phone goes blank, just assume that I'm saying something off the record to Paul.

DR. BRAMBLE: All right. Although if you go on mute, then you should let us know that you're offline so that we don't try to continue.

MR. RAMEE: Well, okay. No, look, I'm going to make sure that the record's clean.

MR. COMBS: Okay. Thanks, Tom.

MR. RAMEE: All right, Bob.

INTERVIEW OF PAUL DONOVAN

BY DR. BRAMBLE:

Q. Paul, we got your full name already, and so I guess

unless you have any questions, let's just go ahead and proceed.

A. Can I ask who all's there on your side, since I can't see you?

Q. Oh, yes. I'm sorry. Lorenda Ward is here, the investigator in charge; Bob Combs; John O'Callaghan, who was on the phone last time, he's our systems group chairman -- or performance group chairman, I'm sorry -- Mike Bauer, from our data recorders lab; and Marie Moler, who's also an aircraft performance specialist working with John and is new to the group.

MR. RAMEE: Is the FAA on the phone?

MR. BORTON: Jeff Borton from Wichita. How are you, Tom?

MR. RAMEE: Hey, Jeff.

MR. GALLO: And Mitch Gallo from Chicago.

MR. RAMEE: Hey, Mitch. Bob, are you going to hang out for the whole interview?

MR. COMBS: No. I'm not going to be able to.

MR. RAMEE: Okay. Bill, over to you. I think you're ready, right, Paul?

MR. DONOVAN: Yes.

BY DR. BRAMBLE:

Q. So I'm going to be jumping around a little bit, Paul, but I'm going to try and stick in general topical categories. So let's go ahead and get started with talking about the previous wing drop incidents. I know in our last interview, you mentioned

that you were aware of the Flight 88 wing drop prior to the accident, but I couldn't find in our interview transcript anything about whether you knew about the Flight 132 wing drop before the accident. So prior to the accident, were you aware of the wing drop that occurred during Flight 132?

A. Yes, I believe so.

Q. And how did you find out about that?

A. Can you tell me what date that flight was? I can't remember offhand.

Q. It was early March, March --

MS. WARD: 14th.

BY DR. BRAMBLE:

Q. 14th of March.

A. I probably -- I can't remember how I got made aware of it.

Q. Were you in -- you weren't in Roswell at the time of the event, were you?

A. No. That event happened prior to my deployment to Roswell.

Q. Which would have been like the following week?

A. It was a few days after that. That's what I was trying to think, if I was there at the time, but I wasn't.

Q. And in your opinion, should Flights 88 and 132 have resulted in a reconvening of the SRB, and if so, why didn't they?

A. In my opinion, no. From what I've seen after the Flight

88 incident, there was a review by the test team, including the pilots. Flight 88 was Kent's. That was during the V_{MU} where he did an over-rotation, so the review and discussion with the people involved, including the pilot, it was determined that the cause of that incident was the pilot pulled too hard because he was unused to doing that maneuver, so it was attributed to just a bad maneuver. So there was no further discussion/analysis done by that, probably because it seemed like it was such an obvious conclusion, especially when the pilot was the one who was making the statement.

Now, on 132, I think -- I didn't see anything right after the accident or right after that event, but the same thing, it appeared that it was the pilot rotating early and pulling too hard. So again, it seemed like it was an obvious cause for that incident also.

And I think subsequent to that maneuver, they repeated that maneuver and did it correctly and successfully, so since they could repeat the maneuver and do it correct and there were no further issues, there seemed to be no need to do any reconvene of the SRB board.

Q. One second. I'm just going to get the volume adjusted on our phone here real quick.

So the analysis that was used to make the determination that it was a pilot pulling too hard, was that primarily done by the pilot, or was there any other data analysis that you're aware

of?

A. For Flight 88 or 132?

Q. For either one.

A. Flight 88, I believe there was a presentation made that Kent had generated and gave to flight ops. I don't know what other analysis was done or -- and I'm not sure how much involvement Reece or any of the FTEs or engineering support people had in that.

For Flight 132, I'm not aware of what presentations were done.

Q. Or data analysis?

A. I'm not sure what they did for that one because right about -- a couple days later, I was on the way out to Roswell, so I wasn't aware what was going on back here.

Q. And who, in your mind, would have been responsible for analyzing in terms of the underlying physics involved, if anybody?

A. You broke up a little in there. Are you asking who was responsible for analyzing the data from those maneuvers?

Q. Yeah.

A. That would be everybody who was on site during the testing, so the flight test engineers, in addition to the flight science performance group.

Q. One moment. During your last interview, you mentioned that you weren't sure whether the shaker fired during Flight 88. We've been reviewing and trying to figure out whether we can

determine that, and I just wonder if you had a chance to find out the answer since we last spoke?

A. I have not. I didn't know that was an action for me to do.

Q. Oh, I don't think it was an action item for you. I just --

A. No. I have not gone back and reviewed any data from any of those flights.

Q. What processes were in place to encourage the sharing of information about G650 issues across subdisciplines within flight sciences, such as ensuring that the analysis of Flight 88 would be shared between the aircraft performance and the aerodynamics groups for ensuring that these two groups collaborated when making estimates of IGE stall?

A. That was a big question. Can you ask that again, please? Are you asking me what procedures the flight sciences groups had between aero and performance?

Q. Uh-huh.

A. I have no idea what their procedures are.

Q. And how about between Reece and Bob Mills in terms of estimating IG -- or predicting IGE stall angle?

A. I don't know what Reece -- what the specific discussions between Reece and Bob were. I know he worked a lot with them on it. I know Reece came up with his own determination of the in ground effect stall angle, but I don't know what their specific

discussions were.

Q. And were there sort of routine meetings established on a recurring basis between Bob and flight test, or where would Reece typically interface with Bob?

A. He would probably just call him, and I know he did call him, because I sit right next to him, so I know he would be on the phone with him, but I can't recall discussions. There was no regularly-scheduled meeting to discuss results. Probably if there was any questions that Reece might have had on something he saw, he would give Bob a call; so just whenever he needed to, he would call him.

Q. Was the takeoff technique for the 60- to 65-pound pull that was developed for continued takeoff testing expected to be acceptable to the FAA during certification or do you think the team expected that they would back that down in some fashion to a lesser force?

A. No. The intent of going out for the company test was to develop procedures, techniques, and gather data for the method we would use for certification testing. So whatever technique we had, if it was 60 pounds or 65, that's what would be demonstrated with the FAA.

Q. So if they could make the numbers with that technique, then that was what they'd use?

A. Yes.

Q. And do you have any sense of what kind of maximum pitch

rates would have been deemed acceptable for the cert testing during takeoff rotation during a continued takeoff test?

A. Just based on experience, it's been around 5 to 6 degrees per second, but I don't know if there was a different value we were -- well, different value we were getting for 650 or not. I think, like I had mentioned in the previous interview, the takeoff performance, all the continued takeoffs were Reece's focus. I wasn't involved in doing any of that data reduction or analysis; that was all his area.

Q. And I'm just wondering, based on your previous experience and field performance, is there an upper limit in terms of the pitch rate during rotation that you would sort of feel comfortable with for a takeoff maneuver?

A. There's more variables that come into play than just a pitch rate, so I couldn't say that there is a specific number that I would look at right now.

Q. What's your opinion -- we talked a lot last time about the difficulties meeting the V_2 speeds, and they were working on the techniques to try and accomplish that during the continued takeoff testing. What's your opinion regarding why that team continued takeoff testing on the day of the accident after repeatedly exceeding V_2 by more than 2 knots?

A. Well, I think they continued the test because they weren't meeting the targeted test conditions.

Q. They had several cards there, like two, three, six,

seven, and as they worked their way through, they were always exceeding the predicted V_2. So do you think that would normally prompt a team to step back and try and reanalyze the test conditions, or what's your sense of why they pressed on through the cards?

A. I can't answer why they continued through the cards. I don't know what -- I don't know why they did it.

Q. Do you know if strategies other than rotation technique were ever considered as a means to solve the V_2 exceedance problem?

A. Strategies other than takeoff technique?

Q. And pilot technique.

A. You mean like potentially increasing speeds or doing something different like that?

Q. Yeah.

A. The only thing I know that they had been working on was the rotation force and pitch attitude. I don't know that they had been considering anything else. That seemed to be the focus of all the testing from the first time we went out there where they were at 70 to 75 pounds pull, it got reduced, and trying to mainly focus on that.

MR. RAMEE: We're going off the record for a minute, Bill.

DR. BRAMBLE: Okay.

(Off the record.)

(On the record.)

MR. RAMEE: We're back on the record.

BY DR. BRAMBLE:

Q. Okay.

A. Hey, Bill, can I go back to the previous question?

Q. Sure.

A. Where you asked why they -- why do I think they continued or -- can you ask me that again?

Q. Yeah. The question was: What is your opinion regarding why the test team continued takeoff testing on the day of the accident after they repeatedly exceeded V_2?

A. Right. And I said, basically, that I don't know why they continued. But the reason I don't know why they continued is I don't think I have enough information to assess the reason they continued or why they would have maybe wanted to stop. From what I know -- I don't know anything about that flight, what went on in the flight. I don't know any of the details so that's why I said I don't know why they continued. It's not because I think they were doing something incorrectly or outside of our procedures; it's just I don't know what the thought process was or what was going on inside the airplane or in the TM trailer to let them believe that it was safe to continue.

Q. Thanks. I appreciate the clarification.

So one of the things that you mentioned during your last interview was that there was some difficulty meeting predicted

touchdown speeds during the previous week's testing when you were out there, and I wonder if you could review for us again the nature of that problem because it was a little bit unclear exactly what the parameters were that were -- whether just touchdown speed or -- what were you trying to accomplish, and what was the difficulty that you were describing?

A. I think the problem was shown mostly at lighter weights, where we weren't getting speed reduction from 50 feet to touchdown in subsequent review of the data and writing a preliminary report on the landings, so the problem was the airplane didn't seem to have the predicted performance that we were told to expect.

Q. You know, I should have asked you in advance if you could bring your cards from those flights, but last time we asked if you knew how many times you'd repeated those tests before stopping, and you couldn't recall. Have you, by chance, reviewed your cards since then?

A. I did look at the cards. I can't remember specifically, on each flight, how many, but in general, we plan on doing at least two maneuvers. I think at one point in one of the flights, we just said there was no point doing a second repeat because it was just wasting time getting data that wasn't going to meet the requirements. So, in general, we were doing the planned two test points from the test plan, and then we were just sort of skipping the second repeat. So actually, it wasn't repeating; it was deleting test points.

Q. So you would do it the first time and then not do the second time?

A. Correct. Because if we couldn't meet the speed or it didn't seem like the maneuver was meeting the expectations, there was no point doing it again after we had done a few previous maneuvers similarly and they weren't being determined to be acceptable.

Q. And can you just describe for us -- you said that we just said that's it, we're not going to keep trying it, but I'm interested in a little bit more detail in terms of who it was that suggested that and how that discussion went and what various peoples' inputs were. Do you recall the details?

A. I don't recall the specific details, but I know that the pilots were both making comments that they couldn't -- they didn't have enough capability to meet the speeds that were being requested, and it was a joint decision on the airplane to not do any more test points because it didn't seem like it was a worthwhile thing to do.

Q. And did you get any objections from the performance engineers in the trailer?

A. No.

Q. Or anybody else in the trailer?

A. No.

Q. And since you've had a chance to review the landing performance data, have you come to any conclusion about why they

were having difficulty meeting the speeds, or the touchdown speeds?

A. For what I know, when we're going back to Roswell, we're going to evaluate lighter-weight landings with increased approach speeds. So the determination will be probably that we would come in at maybe a 10-knot higher speed so that we would have some ability to stay on the approach 3-degree glide slope and meet the touchdown speeds that are being requested.

Q. So it was somehow related to the difficulty staying on the 3-degree glide slope last time?

A. And meeting all the landing criteria, yes.

Q. Does this have anything to do with having inaccurate speed predictions prior to the testing or something else?

A. I wouldn't -- I couldn't say that it was inaccurate speed predictions for the landings. I think it was just something that we determined during the testing, that the speeds that we were using weren't going to be adequate for the lightweight conditions.

That wasn't a very good answer.

MR. HORNE: Can we go on mute for a second?

(Off the record.)

(On the record.)

BY DR. BRAMBLE:

Q. Paul, did you have something else to add?

A. Well, I just wasn't very satisfied with the answer I

gave you -- I think it was too convoluted -- but I don't know the best way to explain it right now.

DR. BRAMBLE: John O'Callaghan, I think, wanted to ask one follow-up, as long as we're on the topic here, to try and clarify the nature of the problem because I guess it could be interpreted in different ways and my primary interest is in sort of understanding the decision-making that went on in terms of whether to stop the test, but we have to be able to understand what the problem was in order to be able to understand how it unfolded.

So John, go ahead.

BY MR. O'CALLAGHAN:

Q. Thanks, Paul. Sorry to miss you again. I'm going to be on the phone again.

Just trying to understand, in my own head, the nature and the physics of the landing problem you're describing. We also talked with Eric Upton about it a bit, and I think he was -- when we started out talking to him, I think he was referencing the same problem, but then as he was describing it, I thought it was a different problem, and now, based on your latest answer, I'm thinking maybe again he's talking about the same thing.

What he was talking about, it seemed to me, if I recall right, was having the vertical speed for the descent rate at touchdown be too high, and he described it that you couldn't -- as an overconstrained problem. You're trying to specify too many

things, stay on the glide slope and a 3-degree glide slope all the way to the runway and then have the vertical speed touchdown be below a certain value and the airspeed be something, and he said you couldn't specify all three. And if I remember him right, he said that when we discovered that we were slamming into the ground because we weren't flaring, in order to stay on 3-degree glide slope all the way to the runway, that was the problem, and then when you allowed the pilot to flare the airplane, that resolved that.

Now, that sounded like a different problem than what I gathered from the last interview with you. What I thought you were describing there was the speed decay from the 50-foot point to the touchdown, that you would, beyond 1.23 V_{SR} on approach, come over the fence at 50 feet at that speed, then reduce thrust and flare for touchdown. And the speed decay that would occur between the 50-foot point and the touchdown point was not as much as had been predicted, and so the airspeed at touchdown was a bit high.

And so those two things seemed sort of independent, a bit related, in that they have to do with the flare and the speed decay during the flare, but with that background and that explanation of kind of the conversations we've had, perhaps you can help me out and explain if they are all part of the same problem or if I'm way off in my understanding of the whole thing or if that helps for you to describe what you were seeing there on

the landings, so we can just understand how to describe what the problem was and how it was resolved.

A. I think we are talking about the same problem. I don't know for sure what Eric meant by we weren't flaring and then we were flaring. I haven't looked at the data to see if there was a difference between maneuvers for that. But I do remember that the ref speed at 50 feet -- well, the ref speed on approach that we were supposed to hold to 50 feet on a 3-degree glide slope targeting a 6-foot-per-second sync rate -- yeah, to target a 6-foot-per-second rate at touchdown, the problem was we didn't have the ability to keep all those parameters within the tolerances that we were given, so the speeds when we were touching down weren't bleeding off like they expected.

Q. When you say speeds, are you talking about the vertical speed or the airspeed?

A. The airspeed. So they had a predicted touchdown speed that was I can't remember how many knots, but a certain number of knots below the ref speed, and from what I understand, they were using those touchdown speeds in their performance predictions to get the landing distances. So that was kind of driving -- when we didn't reach those touchdown speeds, that would give us longer distances. So that's what I believe the problem was with the maneuvers is we weren't meeting their touchdown speeds, which wouldn't give them their predicted distances.

Q. Okay. Thank you. I think you've reinforced my

understanding from our first interview with you, and I'm reaching the conclusion that the essential problem is this: At that point the pilot initiates the flare maneuver to reduce the sync rate to something at or below 6 feet per second on touchdown on vertical speed, the airspeed that results is going to just fall out of the physics. You can't specify all three of those things --

A. Correct.

Q. -- in terms of power, and that the speed decay, the airspeed decay, that was achieved was not what was predicted.

A. Yes.

Q. And so you had a little bit higher touchdown speed and longer ground roll than the performance folks had predicted, and that was the essential nature of the problem.

A. Yes, from what I understand, yes.

Q. Thank you. That makes perfect sense. Thank you.

BY DR. BRAMBLE:

Q. And in your mind, were there any safety-related implications of repeating those tests additional times and trying to use -- like modify the flying technique to try and achieve the greater decay in airspeed?

A. There were no -- I wouldn't say there was a safety concern because, if anything, we would be flaring higher. So we would be touching down at a lower sync rate, so it would actually make it safer to do it that way. It would be more typical of the normal corporate landing. But that wouldn't meet the parameters

-- probably would not meet the parameters that we had specified for the maneuver, so essentially, it wouldn't have been an acceptable maneuver.

Q. Did you say the strategy, if you were to continue, would have been to flare higher or flare later?

A. Well, to try to slow down, we would be flaring higher, but that wouldn't do their performance numbers any good.

MR. GALLO: This is Mitch Gallo. I just have one question. I know the landing tests indicate the solution may have been to flare higher. Did you get shaker on any of those?

MR. DONOVAN: I don't remember getting shaker on any of the maneuvers, no.

MR. RAMEE: We're going to go off the record for just a moment.

(Off the record.)

(On the record.)

BY DR. BRAMBLE:

Q. I think I'm going to move on to another topic, unless you've got anything else you want to say about that, Paul.

A. Nothing that I can think of.

Q. Was the difference in the estimated V_{LO}s for a pitch target of 9 versus 10 degrees and heavy weight readily apparent in Reece's draft report, or were the data presented in a form that required cross-referencing between charts and/or interpolation? And the reason I ask is because we discussed some of the charts

that Pat created after the accident based on some of that V_{MU} data, but it was a little unclear from the notes whether or not if someone had looked at the V_{MU} report prior to the accident, without doing a lot of additional analysis or massaging of the numbers and figures, whether or not that would have been a comparison that would have been easy to make.

A. Man, you ask long questions, you know that?

Q. Yeah. I apologize for that. Let me see if I can do a more concise --

A. Well, I think what you're asking is did the entire report need to be completed to understand the plots that were in it, or could you have just done the plots and had the information?

Q. Well, no. Let me see if I can re-target a little bit. Here's what I'm interested in. The key information that was pulled out of that data after the accident is this: If you change the target pitch to 9 degrees, your V_{LO}'s going to be too close to your V_2 speed, right?

A. Right.

Q. So Pat was able to determine that or put together a table showing that after the accident. But I guess what I'm wondering is if somebody wanted to go back and look quickly at the draft report Reece had put together, was the data displayed in a way where you could just easily look and see, well, here's the predicted V_{LO} for a 10-degree target pitch, but if we back it down to 9, here's what the V_{LO}'s going to be at heavy weight?

A. Well, basically, the data analysis that had to be done, I mean, you plot the data and you don't need to write the report. So like Pat was able to do quickly after the accident, it could have been done right away based on just the couple of charts that were in the report, so it should have been easily determined without having the report completed.

Q. So when the decision was made to change the target pitch from 10 to 9 -- or from 9 -- yeah, from 10 to 9 degrees for flap 10 in heavy weight, would it have been -- how easy would it have been, based on the data as summarized in the draft report for the figures and charts that Reece had already created, to determine how that would affect the V_{LO}?

A. How hard would it have been to determine the new speeds?

Q. Yeah.

A. I don't think it would have been very hard.

Q. Do you have any idea -- do you have any ideas about why Reece didn't go back and ask flight sciences to recalculate the V speeds or why flight sciences didn't consider the V speeds after they decided to change the target pitch for the --

A. Sorry. You broke up a little bit in that question.

Q. Sorry. I guess what I'm asking is based on your knowledge, looking back at how things unfolded, do you have any opinions about why no one thought to go back and revise the V speeds when they changed the target pitch to 9 degrees from 10?

A. I don't know why they didn't do that. I don't know who

would even be responsible for doing that. All I know is that the speeds that we get come from the flight sciences group, so I guess it would be their responsibility to be aware of what was changing and determine new speeds.

Q. And so by "they," you mean given the composition of the team out there, would that have been Shelly Brimmeier to take the -- would you have expected her to take the lead in that?

A. She was the lead engineer from performance on site, yes, so her and the two other guys that were looking at it, plus whatever reviews they did with the people back in Savannah.

Q. Okay. One second.

And if Reece discussed the change in the target pitch with Pat Connor before he went out there for the testing that began on April 2nd, would you have expected Pat to suggest the V speeds be recalculated?

A. If Reece discussed that with Pat, then yes, I would have expected Pat to have determined what the new speeds were. That's their job.

Q. You mentioned in your last interview that the margin between shaker and aerodynamic stall was a little narrower -- you didn't say a little, but it was narrower for the G650 compared to previous airplanes, and that this was the case because there was a desire to take advantage of more performance capability in the G650, and that this was facilitated by greater tail power and less geometry limiting. So I'm wondering, how was the safety of this

strategy evaluated in terms of how narrow you could make the margin?

A. I don't know all those decisions. They weren't anything I was a part of.

Q. And do you have any kind of sense as to whether or not the assumption was that an alpha limiting system would provide highly reliable protection against stall and that, therefore, a reduced margin would be safe because when the airplane was flown in its normal mode, you'd have that protection?

A. Can you rephrase that?

Q. Yeah. What I'm wondering is was a reduced margin between shaker and stall considered safe because there was an assumption that alpha limiting would provide highly-reliable protection against stall when the airplane was flown in normal mode? And if you don't know, that's fine. I mean, if you weren't involved in any of those decisions, then --

A. Well, I wasn't involved in any of the decisions, but I know there was a significant number of tests done to develop the schedule and determine the margin between the aerodynamic stall of the airplane and where the settings were going to be for the alpha limiter system, so I can only assume that the people doing that work had set the system accordingly to provide sufficient margin.

At some point, you have to trust the other people doing their work and that they're doing it right. You can't end up doing everything. So I would have to say my assumption was that

everything was set with sufficient margin to keep the airplane safe.

Q. I'm just wondering if maybe they established those margins under the assumption that you'd have alpha limiting in place, and then because it wasn't ready to test in normal mode, you guys got handed the airplane with just a stick shaker?

MR. RAMEE: We're going off the record.

(Off the record.)

(On the record.)

MR. DONOVAN: Bill, can you just ask me that one more time, please?

BY DR. BRAMBLE:

Q. So I'm wondering if the narrower margin between shaker and stall in the 650 compared to prior airplanes may have been developed under the assumption that alpha protection would provide highly-reliable automatic protection against stall, and then the airplane was handed to flight test with this narrower margin and just a shaker for protection against stall, but basically, as a result, you guys got an airplane that you had to be a lot more careful with?

A. I guess, yes, we would -- we do have to be more careful, because in first flight mode we didn't have the alpha limiter protection. But as far as where the schedules were set, those -- I didn't have any involvement in those, if that's part of what you asked.

Q. Prior to the accident, was it your understanding that Reece had refined or was going to refine the IGE stall AOA that was briefed during the field performance test SRB?

A. I'm not aware of what he was doing with that in ground effect angle, no.

Q. So it's our understanding that initially, it was briefed that the IGE decrement might be around 2 degrees, and then Reece refined it down to around 1.6; so that part you're not aware of?

A. Well, I'm aware of the numbers. I think the 2 degrees was an estimation from the flight sciences area, and I believe the 1.6 was based on Reece's calculations, so it seemed like those numbers were relatively close and reasonable. So I don't know if there was any intent to change anything or what we were going to finally settle on, whether -- probably 2 degrees, since that would be more conservative.

Q. When did you first learn about shaker activations that were occurring during field performance testing? Actually, I was going to qualify that, but I won't, so --

A. I don't know.

Q. And do you recall receiving reports or having anybody tell you about shaker activations that were occurring?

A. I don't recall.

Q. We talked a little bit last time about the fact that the shaker threshold was set -- shaker threshold was changed prior to the accident, and I think when we spoke, you couldn't recall

specifically how it was changed, but that it was -- but that you knew it was increased to some extent. And before I go on, is that consistent with your recollection?

A. Yes, that sounds right, from what I remember.

Q. And it's our understanding that the shaker setting was changed from 0.85 to 0.9, and what I'm wondering is, in your opinion, why didn't the change from 0.85 to 0.9 result in the reconvening of the SRB when it was a change to a less-conservative state?

A. I don't know that making a change like that would need to be an item that would have to have the SRB reconvened. I don't think we have any specific guidelines for changing a test parameter that causes an SRB to be reconvened.

Q. Now, one of the things that we noted in reviewing the Flights 88 and 132 is that those flights stalled at 0.86 and 0.87 normalized angle of attack, so if somebody had put those -- put two and two together, they might have been able to determine that increasing the shaker setting to 0.9 might not have been a good idea, and so I'm wondering what kind of review do you think could be in place to try and catch details like that that may be missed?

A. Well, those normal stall alphas that you're quoting, are they consistent with what the Gulfstream analysis came up with?

DR. BRAMBLE: John, that's a question for you.

MR. O'CALLAGHAN: Well, I guess I can't speak to the 0.86/0.87 that Bill quoted, but I guess when you refer to the

Gulfstream analysis, are you talking about Bob Mills' CFD work?

MR. DONOVAN: No.

MR. O'CALLAGHAN: What are you referring to by the Gulfstream analysis?

MR. DONOVAN: Well, I'm sure that Gulfstream reviewed all the data at some point. I'm just wondering if we came up with the same number you did, because I thought there was -- I'm pretty sure Reece made a request to one of the flight control guys to look at the shaker setting and whether changing it or wherever it was set would have caught the Flight 88 incident. I think that was something we had to submit to NTSB.

MR. O'CALLAGHAN: Well, my understanding of what you're referring to is this: That for Flight 132, a request was made to flight sciences to evaluate the maneuver to determine if, by raising the shaker settings from 0.85 to 0.9, if the maneuver would have triggered -- my understanding or my interpretation, and I think we've confirmed this, is that the concern at the time was that it seemed to me that there was -- it was hoped for that the 132 event would not have triggered the stall warning. Whoever did the analysis, I think it was somebody probably in flight controls within flight sciences, they confirmed that that maneuver would not have.

MR. HORNE: John, just for clarification, I think what you may have said or meant to say was would not have triggered the alpha limiter?

MR. O'CALLAGHAN: Oh, right, yes, alpha limiting.

MR. HORNE: I don't know if that just dropped out of the phone or you didn't say it.

MR. O'CALLAGHAN: I might have said shaker or something, so alpha limiting.

And I think there was an expectation that if alpha limiter had been activated, that it would increase the stick forces and that sort of thing, and that would be undesirable, so the question was asked to ascertain whether that maneuver could be performed without activating alpha limiter, because if it did, then it would mean they would have a problem. And so the analysis was done, and the conclusion that it would not have done that, and I think that was seen as a green light to proceed forward. Now, in some of the e-mails I've seen and in what Gulfstream has provided to us, it appears Reece also asked for analysis for Flight 88, and then there was something in his e-mails that said that -- to the effect that, yes, it should have caught it, because 88 was understood by everybody to be an overrotation and a stall event.

Unfortunately, I think he referenced the wrong flight number for the analysis, and so there was a delay in getting that done, I think, till after the accident, or something along those lines.

So when we talk about the request that Reece had made to flight sciences to evaluate where these events stood in terms of

alpha limiting and so forth, I believe that's the scenario, and maybe Tom Horne or somebody else could jump in and add to that if I'm not recalling correctly.

MR. DONOVAN: Well, now that you explained it, I was thinking about the one that he asked for 132 and the alpha limiting. That's the one I remembered.

MR. O'CALLAGHAN: Okay.

MR. HORNE: I don't remember -- this is Tom Horne. I don't remember anything from Flight 88 being asked, being analyzed.

MR. DONOVAN: I don't remember anything. I guess it was just 132.

MR. O'CALLAGHAN: And from the e-mails, I think Reece had requested it, and there was a statement to the effect saying that, well, if it didn't catch it, it should have, but when he asked for the analysis, I think he referenced the wrong flight number or test card or something, and so it kind of slipped through the crack, or there was a delay, something like that.

BY DR. BRAMBLE:

Q. So I guess back to the original question. Now that you have heard our rundown of what we thought -- what we think may have happened with that review, Paul, is there anything that you think should have been done differently with that process? I mean, how would you -- was there any flaw in the process, or how would you recommend that changes like that be reviewed to avoid mistakes

in changing settings to safety systems like the stick shaker?

A. That's a hard one to answer. I mean, how do you determine every critical system on the airplane, what's going to be acceptable and what's not? I mean, if we had 10 years to do a test program, then we could review everything we did, and everything that we changed, we could have a new SRB every time we went out for a flight. I don't know the best way to do it. I don't know what the recommendations -- I can't say where I would draw the line on each test and what we change, so I don't know is, I guess, the bottom line.

Q. At the time of the accident, which version of the 1998 Flight Test Standard Practice Manual do you believe would be officially in effect for the flight test organization? We've seen two or three different versions, I think, ranging from F to H.

A. Well, I know there was one that was officially released, which I think is the Rev F. There was a Rev G that never went anywhere, and I don't even know if I can find it, and a Rev H, which had more recent changes, but was never signed off. So the official released one I'd have to say is the Rev F, but the Rev H was more representative of the way we were operating.

Q. And so in terms of the roles and responsibilities for the folks that were sort of defined in the Rev F -- I can read out some position titles. And if you guys have it handy there, you might want to pull it out.

MR. RAMEE: Bill, he has a copy in front of him. Just

tell him what page you're looking at.

DR. BRAMBLE: This is -- the pages aren't numbered, but it's Section 2.0. Did you guys find it?

MR. RAMEE: Oh, yeah, some time ago.

DR. BRAMBLE: Oh, okay.

BY DR. BRAMBLE:

Q. So the manager of test -- I guess what I'd like to try and find out is in your mind how the different sort of roles defined in this manual corresponded to actual people on the G650 program. So for the manager of test coordination, who was that for the field performance for G650?

A. Well, we didn't have a specific manager for test coordination for a specific task. We have, for the overall organization, a manager of the coordinators.

Q. For G650 program as a whole?

A. Well, for the flight test organization as a whole.

Q. And who was that at the time?

A. I think it was Phil Burton, or still is Phil Burton.

Q. And how about the --

A. Sorry. You broke up again.

Q. How about a test coordinator?

A. The test coordinator for -- the way they do it is there's one coordinator for each aircraft, typically, and the one for 6002 was Tony Franzel.

Q. How about the test conductor?

A. The test conductor was Reece.

Q. And the test specialist?

A. It was -- there was more than one. It was all the people on site from flight test engineering. And I guess I should say when Reece was not there, there was another test conductor who took that place. That was me.

Q. That was you?

A. Right.

Q. For the landings and such?

A. Correct.

Q. And how about the test analyst?

A. We had the flight test engineers and the performance engineers who were on site were all performing that role.

Q. And then back in Savannah, was there a test analyst, or were there multiple test analysts for field performance?

A. I don't remember if we had all of the people working the field performance in Roswell at the same time, but the data was all being analyzed in Roswell while the airplane was there. There would have been additional analysis done once we came back with the airplane and brought all the data.

Q. -- occur on-scene in Roswell during the course of a day?

A. I'm sorry. I missed the first part of that.

Q. When did that analysis in Roswell occur in the course of a day during testing?

A. Once the data got off-loaded from the aircraft, so it

could have been in between flights, if there was enough time, or it would have been at the completion of the last flight of the day.

Q. And so how many hours, typically, did the test conductor and the flight -- and the other engineers on scene participate in analysis after testing concluded for the day?

A. I couldn't tell you how long they worked specifically. It's hard to say how long they worked into the night or if they took work home to the hotel. I don't know. I'm sure they did enough -- or they did whatever analysis they felt was needed to support the flight for the next day.

Q. And as a member of the team on the airplane, how many hours could Reece work before he had to go off duty for the day?

A. You're asking what the corporate policy was or how much did they work?

Q. Both, I guess.

A. I'm trying to remember what the corporate policy is. I think it's -- I know it's 13 days in a row, you're supposed to have a day off, and I think it's 12 hours per day, and if you want to exceed that, you have to request exemption by senior VP and HR.

Q. And how often were those limits exceeded, in your experience?

A. Routinely.

Q. By whom?

A. Everyone. Well, everyone -- I'll just speak for the

flight test engineers that I'd been working with. We would exceed that.

Q. And did you typically request that exemption, or no?

A. We were never asked to request that exemption.

Q. We spoke with Lee Johnson, who used to run the flight test organization in the 1990s, and one of the things that Mr. Johnson mentioned was that he tried to divide the responsibilities of test conduct from test analysis and that some of the engineers were reluctant to do that, because they preferred to follow the process from start to finish, but he thought it was better from a workload standpoint to divide it up. Were you around during his tenure, and do you recall how he managed that?

A. I was not around when he was in charge, but I am familiar with that method. I think we'd talked about that a little bit. There's really -- in my experience in industry in every place I've worked, there's really two ways of doing it. You can have flight test engineering, where they're basically test conductors where they make the cards, they fly the flight, and they give the data away, and they're done, or they do it the way Gulfstream does it, where they're more responsible for the entire conduct of the test, the data analysis, results, reports.

So there's really two ways to do it in industry, and I'm sure you're aware of that. Different companies do it different ways, and it's just preferenced by how they want to do it. Workload is all dependent on how much schedule you have. If you

have enough schedule, the workload isn't excessive. So the way we do it here, the people who are doing it prefer it that way. I can't really say either way's right or wrong; it's just two different ways of doing it.

Q. So the people -- when you're saying the people here prefer it that way, the way that the engineer does both the conduct and the analysis?

A. The flight test engineers in our group prefer to do it this way. They prefer to do the analysis for all the tests that they're involved in, yes.

Q. Who, if anyone, championed the flight test standard practices after Lee Johnson left?

A. You mean revising that document?

Q. And sort of trying to make sure that the policies were reflected in the way that the work was being done.

A. I'm not sure who was responsible for the updating of the Rev H, the unreleased version, but I know a few years ago, we had a different manager of flight test who had assigned all the group heads at the time the task of revising and developing a standard operating procedure for each group. So essentially, what he had required us to do was take the standard practice manual and divide it into three pieces, so the flight test engineer group would write their own standard practices, the instrumentation group would write theirs, and then the test coordinators would write theirs. So it basically split the standard practice manual into

three separate procedures.

Q. And who was that manager?

A. That was Dale Coulter.

Q. And what happened to that effort?

A. He took a different position in the company. The draft -- I know I submitted my draft manual to my director, and that's the last I had seen of it. It was never released, although I kept revising it to try to release it. And I don't know if there was any drafts from the other two groups.

MR. RAMEE: We're going off the record for just a second, Bill.

(Off-record discussion.)

MR. RAMEE: Back on the record.

BY DR. BRAMBLE:

Q. So who was it that -- the director that you submitted your draft manual to, Paul?

A. Barry McCarthy.

Q. What was Reece's position title? That's something we just need to -- a minor detail we needed to clarify.

A. The official company --

Q. Yeah.

A. Tech Specialist 3.

Q. And did he go by any other title?

A. Flight test engineer. He was also a DER for the FAA, but I don't remember him ever using that in a title anywhere.

Q. Do you know how many engineers were assigned full time to the field performance testing effort at the time of the accident both from, say, flight sciences and flight test engineering?

A. We had three flight test engineers and three flight sciences people out there during the testing.

Q. And I know you had kind of different shifts of people coming and going, so what you're saying is during any particular test, you had three from each group?

A. Correct.

Q. And in terms of the total number of FTEs and flight sciences engineers assigned sort of full time to field performance, like during all of Roswell-2, how many are we talking about?

A. I think there were probably six people, total, that had been involved in the testing. There was one person that never went to Roswell.

Q. You mean on the flight test side?

A. On the flight test side.

Q. And how about on the flight sciences side?

A. I'm not exactly sure, but it was probably about the same number, six, maybe seven people.

Q. On another topic, when did Dave McCollum begin working with Reece on the takeoff portion of the field performance testing? And the reason I ask is because his name only appears on

the aircraft 6002 flight log for two flights, one air data calibration and one RBSM test flight.

A. Right. His primary task was air data. He got involved because when we were setting up the support for those tests, the one performance engineer -- or the one flight test engineer who was working the field performance had a conflict in the schedule and couldn't go, and Dave volunteered to go out. Well, I guess I asked Dave if he could go out, and he said yeah, he could.

Q. So was the day of the accident the first time that he'd been involved in any field performance testing for 650?

A. Yes. He had not been involved directly with the field performance testing.

Q. And given that, would you expect that he would have been assigned the role of examining the test results in the airplane or monitoring the flight control system?

A. In my opinion, he was probably monitoring the flight controls. I mean, Dave was a smart guy. If Reece directed him, said we're going to be doing these tests, this is what you need to watch, Dave was fully capable of understanding that and knowing what to look for and being able to do whatever was required. So I can't tell you what he was doing on the airplane or what system he was watching, but he would be fully competent to do either.

Q. That's one thing we've had a little bit of difficulty sorting out as far as who was doing which role, and we haven't come to a firm determination yet. In your mind, were those roles

strictly divided, or could somebody do --

A. You broke up at the end of that. Are you asking did they have to be divided roles, or could one person do both, or could they be interchangeable?

Q. Yeah.

A. I think they could be interchangeable. I mean, it would have been -- it would have been up to Reece and Dave to determine what they needed to do, and there's no reason that either one couldn't be monitoring both as a backup to the other person.

Q. And how had Mr. McCollum prepared for his role on the day in the airplane?

A. I can't tell you how he prepared for it. I don't know.

Q. And was this more of a familiarization exercise for him, or I guess from what you said, you felt he was full performance, and it wasn't like it was a training exercise?

A. I wouldn't say it was a training exercise. It was the first time he had done field performance testing like that, so it was to get him experience in doing that.

Q. Was it the first time he'd ever done field performance testing?

A. I can't say for sure. I'm relatively sure that it was the first time ever at Gulfstream, though. I'm not totally sure what his past experience was.

Q. Moving on to a different topic, I wonder if you could compare Bob Mills' and Shelly's roles during the flight test

program when they were supporting different test areas. How did they interface -- did they interface differently with flight test, and did they have different strategies for making predictions about aircraft performance and comparing test results to those predictions as the testing progressed?

MR. RAMEE: We're going to go off the record for a minute.

(Off-record discussion.)

MR. DONOVAN: I wasn't directly involved in tests that Bob was doing any analysis or predictions for, but I was aware that he was deeply involved in the aero stall program and the determination of the alpha limiter system settings.

The way he operates is -- I guess my opinion of the way he operates, he's much more familiar with the flight test operations, so whenever tests are going on that he needs to support or affect him, he's very involved. He provides information in real time, and his understanding of the data is impeccable.

BY DR. BRAMBLE:

Q. And I guess one thing that we kind of had an impression about was that Bob may have been sort of making more precise predictions in advance and then sort of rolling the test results back into his predictions in real -- not in real time, but on a short cycle as testing progressed, whereas, that may not have been the case for Shelly with field performance testing, and I just

wondered if that was consistent with your impression?

A. Yes, that's consistent.

Q. How did Reece and Bill Osborne and Ken Obenshain and Phil relate to one another in the organizational hierarchy and share responsibility for the field performance testing program?

A. So that was Reece, Bill, Phil, and who else?

Q. And Ken Obenshain. I guess what I'm wondering is did they sort of just provide input at the SRB and planning stage and then hand it over to Reece, or were they sort of considered actively involved throughout the process at each step, or how did that work?

A. You're talking about Phil Burton, the manager for the test coordinators?

Q. Well, I guess, you know, considering Phil's role's a little bit different than Bill's and Ken's, why don't we take him out of the list.

A. Yeah. I would say he really had not much input at all, if any.

Q. And how about Bill and Ken?

A. Ken is the -- he's the technical expert staff scientist -- I'm not sure his exact title -- for flight test, so he's the one -- if there's any questions that the flight test engineers can't answer, he's the one that we go to, and Ken usually has the answer. So any concerns or problems, Reece would have gone to Ken for advice or suggestions or any kind of consultation.

I'm not sure Bill's exact title, but he's primarily the lead flight test engineer for the 650 program, and he's probably the one most familiar with the aircraft and all of the flight controls and their impact. So I'm sure Reece would have gone to him with any questions that he would have pertaining to the flight controls, so I'm sure their inputs were used during the SRB as required.

Q. So they would have formal input at the SRB, and then Reece would be able to sort of get their advice on things?

A. I'm sure he would ask their advice before that, and I think -- I'm not sure, but I know they were both -- I think they were both invited to the SRB, and I'm not sure if they were both SRB board members or not.

Q. In your opinion, what would your expectation have been about -- prior to the accident about which engineers, either on the airplane or in the TM trailer, were responsible for reviewing the takeoff -- the max takeoff pitches and AOAs during the takeoffs to make sure the airplane wasn't exceeding any preestablished limit?

A. So you want to know who would be responsible for determining that?

Q. Yeah. I mean, did you expect that there was any one person or set of people who would be sort of reviewing each takeoff and saying, okay, here's the max pitch during the rotation on the ground, for example, and here's how close we got to our --

the limit that we briefed, the desired limit that we briefed, that sort of thing?

A. I would expect that everybody in the TM trailer and in the airplane were looking at the parameters for each maneuver, and if they weren't, they weren't doing their job.

Q. And if you were to do that, if you were to monitor the peak pitch during the takeoff, sort of how would you bound the time interval or the interval in the data in which you would want to analyze that for a takeoff?

A. Are you asking what kind of tolerances I would put on the targets and consider the pitch rates for the maneuver?

Q. No. I guess it's more along the lines of if you briefed a target pitch of 9 and said you didn't want to exceed 11, where, during the takeoff, would you look in the data to see whether 11 was exceeded and after which point it was okay?

A. You mean in a postflight environment or real time?

Q. Postflight.

A. Well, all the data is available postflight in Roswell. It's easily accessed by anybody out there. You can plot time histories of pitch attitude, pitch rates, speeds, anything that you need.

Q. Yeah. I guess what I'm getting at is if you were trying to see whether or not they exceeded the desired 11-degree limit, would that only have been while the airplane was still on the ground, or up to a certain height above ground, or how would that

work?

A. I don't know that it would specify on ground or in air.

DR. BRAMBLE: John wants to ask a follow-up question. Hang on one second.

(Brief recess.)

BY DR. BRAMBLE:

Q. Do you happen to know, Paul, how the monitoring of pitch limits during takeoff will be -- whether it will be the same or different, whether the practices will be the same or different on site during future takeoff testing?

A. It's going to be different.

Q. How?

A. There's going to be a different group of people to support the performance tests, there's going to be different tools that we're working on now to predict takeoff speeds, and there are going to be parameters created to monitor the pitch compared to the CFD-generated in ground effect stall alpha. So those tools that are going to be in the TM trailer are also going to be available on the aircraft.

Q. Will they have triggers that show alerts or something like that?

A. Yes. We're working on those now. The exact trigger point for when we change a color or whatever alert we're going to set hasn't been finalized yet, though.

Q. Do you know how the flight sciences engineers in the

trailer were trained for their roles?

A. Previous testing or the upcoming testing?

Q. Prior to the accident.

A. I'm not sure what training they had when they were out there, no.

Q. And how will that be different?

A. Well, the prime monitoring of the flight data is going to be done by two flight test engineers in the trailer, in addition to one on the aircraft. The support from the aero side is going to be mainly watching some data, but looking for critical parameters, and they are not going to be -- I guess their prime task is going to be evaluating the maneuver as it is compared to the predictions that they're developing, so they're really going to have a different task that has never been done before.

Q. And how about the folks on the airplane? Will the two FTEs on the airplane have different roles than they did before?

A. Yeah. There's only going to be one FTE on the airplane, and the roles on the airplane won't be much different than previous. The same responsibilities will be done, conducting the flight, determining sequence of maneuvers if we want to change test card order, coordinating comments on board, evaluating the data real time, but the FTE on board will have all these new tools available also, so there will be more capability on the airplane and in the TM trailer and more coordination to make sure that all of the predicted speeds match, just for a double-check. So

everyone on the airplane will have the ability to determine everything that the TM trailer and the engineer support will have, and the maneuver won't be conducted unless everybody agrees that all the numbers are correct and match.

Q. You mean from the previous test?

A. Well, from the previous test, but for the first run of the day, there's going to be a speed schedule and speeds predicted, and both the engineers in the trailer and on the airplane will run the same calculations and make sure that both of them agree with the numbers before the maneuver is done.

MR. HORNE: Can I ask a clarification question? You said before the maneuver's done. You can interpret that two ways. You mean before the maneuver is performed?

MR. DONOVAN: Before the maneuver is performed, right, and then after the maneuver is completed, the data will be evaluated compared to any simulation predictions to see how well the maneuver matched the prediction. And then if it matched well, we'll continue. If there was some discrepancy, we'll wait until we resolve the discrepancy to decide whether we press on or not.

BY DR. BRAMBLE:

Q. Prior to the accident, what role did flight sciences play in encouraging flight test to meet performance targets? I'm kind of interested in how those conversations went.

A. Meeting performance guarantees is not really a flight test concern. I know the performance group is pretty much held

accountable for meeting that, since they're the ones responsible for it.

There was discussion, I know, between Pat and Reece and probably Shelly, too, I think, after the first series of field performance tests where the takeoff distances were significantly exceeding the performance guarantee, so that I think the additional test technique development and changes were driven by trying to improve the takeoff distances to meet the guarantee.

Q. On another topic, did you feel that the team in the TM trailer had any -- was sufficiently experienced to provide full support to the on-board test crew during the testing conducted on the day of the accident?

A. You broke up in the first part of that question.

Q. Did you feel that the team of engineers in the TM trailer on the day of the accident was sufficiently experienced to provide full support to the on-board test crew during testing?

A. Yes. I felt they had the capability to do that.

Q. And on another topic, what kind of planning was required for Birmingham to be selected as the airport that was used for refining the takeoff technique in February, and was it required to have a TM trailer present because it was high-risk testing?

A. I'm trying to think if we have any requirement in any of our TSHAs that require a TM trailer. I don't believe any of them specify a TM trailer. I know in the past when we've done field performance, telemetry was not required. In fact, even now, I

don't know that it's required. I think it's a benefit for data reduction and analysis.

Maybe now, in light of the accident, it's required, but I don't believe it was required to be in Birmingham. Why they selected that airport, I don't remember exactly why they went there. I think it might have been an issue with weather. I think they had planned to go to Jacksonville, and I think there was an issue with weather.

Q. They might have planned to go where?

A. I think it might have been planned to go to Jacksonville or to Cecil Field.

Q. One second. Hang on.

Did Reece need to get approval from anyone before selecting Birmingham, or could he make that decision himself?

A. It was -- I'm certain it was a consultation with everybody on board, flight crew decision. I don't know that it needed to be coordinated with anybody else.

Q. Between November and the time of the accident, how were the field performance data supposed to be periodically analyzed and presented and decisions made about whether the airplane was meeting performance goals?

A. In relation to how it was meeting performance goals, I'm not sure what the performance group's responsibilities were for that.

Q. So it was more of a flight sciences responsibility?

A. Yeah. The only thing we do is we reduce the data, we provide them what the actual field lengths were, any of the distances, there's certain data products that we provide them, but compared to the performance guarantees, that's not our responsibility, say the flight test responsibility.

Q. And do they review -- I guess they wouldn't have reviewed with you the takeoff performance relative to the guarantees because you weren't working the takeoffs?

A. Correct, not me specifically. The only way I knew about it is talking to Reece and overhearing the conversations in his cubicle.

Q. And your understanding was basically that they said after the November test that it looked like the field lengths were long, and they were going to need to work on the technique?

A. Correct.

Q. And did you participate in any meetings amongst group heads or managers to discuss that issue?

A. I can't recall being in any of those meetings, but I may have. I just don't remember them.

Q. Do you know how often such meetings were held?

A. No, I don't.

Q. And do you know who would have attended?

A. I don't know who attended.

Q. Shelly Brimmeier said in one of her interviews that she had sort of informal discussions on site with flight test

engineers and -- or basically between flight sciences and flight test engineers, and it seemed that they didn't have enough time to analyze the data for each day of testing before moving on, and they would tend to fall a little bit behind. Did you participate in any of those discussions with her?

A. I can't recall any.

Q. And were you aware of this? Were you aware of it, that they were not able -- that they kind of would fall behind as testing progressed sometimes?

A. In my previous experience, I know that happens, so you do get a few maneuvers and maybe even flights behind, but the preliminary analysis that you do of the data, you kind of know whether the maneuver is a good maneuver or not, which is the key thing. You have to determine whether you have to repeat a maneuver or not.

So once you can determine it's a good maneuver, then you can analyze it as soon as you get a chance. I mean, for some of the maneuvers, if you know that the landing is good, all you have to do is process it and plot it. So if they fell behind a little bit, it probably wasn't -- I wouldn't think it would be a significant impact.

Q. Then more people were needed on field performance testing or that there were enough people?

A. Well, I think with six people out there, it's probably more than enough. I think the problem was there was a concern --

it still -- it was supposed to be one group of people. Whether they were flight test engineers or performance engineers, they were supposed to be analyzing the data consistently, and from what I had conversations with Reece, that wasn't actually happening. There were differing opinions on how to analyze the data, what parameters needed to be looked at, where event markers needed to be determined, and there seemed to be a lot of reanalyzing data that was completed, in our opinion, so the analysis falling behind was not necessarily a flight test problem. I think part of it was driven by analysis that the flight sciences performance people were redoing.

Q. Oh, I see. So the flight sciences people were redoing some analyses that the flight test engineers on scene were performing initially?

A. Yes. And just an example is when we run a maneuver, we'll have an event marker for, say, brakes on speed, so there were differing opinions as to what parameter was the trigger maneuver for that event marker. So when that happens, depending on where you select that, you can get a different braking MU, so there was a lot of looking at maybe improving braking MU by using a different parameter at a different time. And the capabilities of our data system makes it very easy for anyone to go into the data file and change the event markers or create their own data file with event markers that they end up using.

MR. RAMEE: Going off the record for a brief moment.

(Off-record discussion.)

MR. DONOVAN: Just to elaborate a little bit on that example of brakes on speed, there was a difference of opinion -- or there were different parameters that were being looked at for that, trying to determine whether it was the pilot pedal position or a certain pressure on the brakes or even the indication on wheel speed where you were getting the wheel speed start to decrease, so those were some of the parameters that were being looked at and trying to determine which was to be used.

BY DR. BRAMBLE:

Q. That brings me to another question. We've seen the TM trailer and looked at the traces of data that were available at least for some of the display configurations, and it's kind of our understanding that the flight sciences performance engineers in the trailer were marking the data in the trailer, and that those markings would later be married up with the data from the airplane. So were the flight test engineers also marking separate points, or how did that work?

A. Well, in the data reduction plan, I think we had specified what parameters were to be used for the event markers. Because they couldn't get the exact point in real time, they would try to get it as close as possible and then go back postflight, look at the data for those parameters, and adjust them to meet the criteria.

Q. But I guess what I'm saying is it was our impression

that it was the performance engineers in the trailer who were actually marking the data, and that they would then go back and refine that, but it wasn't the flight test engineers who were marking the data in parallel, and that they would then -- that the flight sciences engineers would then have to do it differently?

A. I'm not sure who was assigned to do that in the trailer, but the problem is if one person put an event marker in on the airplane, and they merged those files, I think they all got merged together, so -- and that's the thing is one person can set an event, another person can move it, and there's no record as to why it was changed or who changed it.

Q. So after the fact, the markers would have to be sort of scrubbed entirely to make sure that they were consistent with one interpretation?

A. Correct.

MR. RAMEE: We're going to go off record for just a moment.

(Off-record discussion.)

BY DR. BRAMBLE:

Q. So one question we had, I guess, was with respect to the data reduction plan, how they mark the data points and why the difference in opinions about which parameters and which criteria to use?

A. I don't know why. All I know is it was routinely discussed and reviewed during the testing between the flight

sciences and the flight test engineers.

Q. Have you had a chance to look at the data from the run prior to the accident run?

A. Yes, but not recently.

Q. Do you have an opinion about whether the team in the telemetry trailer could have analyzed that prior run or other runs that day and determined that the V_2 speed was unattainable for Card 7A2 and stop the takeoff testing prior to that run? Or I guess I could rephrase this. What data could the team in the telemetry trailer have analyzed to determine V_2 was unattainable and stop the takeoff testing prior to Run 7A2, if any?

A. I'm not sure. I think -- is that the one where -- I think we were -- I'm trying to remember exactly what that maneuver looked like now.

Q. It looked kind of like a V_{MU} test.

A. That's the one I thought, and that would probably be the first indication where it would appear that the lift-off speed was not the right speed.

Q. That the lift-off speed would not be the right speed?

A. Well, apparently, none of the speeds were the right speed.

Q. Would you have expected somebody --

A. I couldn't hear you on the phone.

Q. Would you have expected someone, an experienced flight test engineer, to notice that from looking at the run after it was

concluded, or a performance engineer?

A. Possibly, yeah, yeah. It's hard to say what everybody's frame of mind is, what they were focusing on. I mean, it's really hard to say.

Q. You mentioned in your last interview that some of the engineering people wanted data access instantly after the test flights. Who is that you're talking about? Is that flight sciences people? And who, in particular?

A. Well, that was just a general request by -- I don't have a specific name, but it was engineering in general, and it wasn't pertaining specifically to field performance; it was just a general requirement for the whole 650 program.

Q. And what was flight sciences sort of expected to do with the data while flight test was analyzing it after the test and developing the flight test report for field performance?

A. Well, the intent I believe Reece was working towards is to have all the people on site, whether they were FTEs or performance guys, looking at all the data the same way and everyone reducing the data the same way to help out with all the tasks out there. I don't think he had intended there to be a specific division of labor, that I was aware of anyway. I know his -- he had had the performance guys, had meetings with them to talk about how we were going to do things. We were trying to coordinate all of our data reduction methods so that there was no difference in the way things were done.

Q. But I guess my question, what I'm wondering is, okay, if flight test conducts the test, produces and analyzes the data, and writes the report, then why do they need to coordinate with flight sciences on that, I mean, in advance or during that process? I mean, why not just say here's how we did it, and here's our report?

A. Good question. It's been a long-standing item between flight test and flight sciences, well, the performance group, as to what role they would really be providing out on the field performance tests off-site.

Q. Were they there just because there wasn't enough manpower or enough personnel from flight test to be there or --

A. No. They were there because they wanted to be there. Now, they usually send at least one person when we do go off in previous programs, and they -- what they provide us are thrust settings when we're doing V_{MU}, what the EPRs are set to. They provide speed schedules when we're doing takeoff performance, and in the past, that's pretty much what they've done.

We provide them time histories for maneuvers. They would look at it after we look at it and agree or disagree as to whether a maneuver was good or bad, but they seem to be much more involved in the 650 program, and I think, in my opinion, Reece was trying to use them to help reduce the data and turn things around quicker.

Q. If the V_{MU} results had been processed and used to model

how the airplane would take off prior to the day of the accident, would that have indicated that it was impossible to reach V_2 for Flight 153?

A. I guess that's possible.

Q. And I guess getting back to our earlier discussion where we were saying what was the role of flight sciences, just to clarify, did you have any expectation that Shelly or her group would analyze the V_{MU} test results in parallel with Reece while he was developing his report?

A. I guess my view is I expected them to be able to analyze it. I didn't expect them to not do anything with the data until the report was released. I'm sure that they had -- well, I know they had access to all the data that the flight test engineers had. I expect that they looked at the maneuvers. I would expect that they would have reviewed that data and certainly reviewed the maneuvers with Reece to make sure that they all agreed that they got acceptable data and had everything that was required before they said they were complete with all the V_{MU} maneuvers.

Q. So we understand that Pat was not -- Pat Connor was not involved in sort of doing the formal analysis, at least for V_{MU} testing, but what you're saying is flight sciences in general may have been looking at it sort of in parallel for their own purposes, but then Pat did analyze some of the early March CTO testing and discussed that with Reece prior to Reece going out to Roswell at the end of March. Do you know why he was involved in

analyzing the March CTO tests and not the V_{MU} test?

A. I don't know why, no.

Q. What was your work schedule like when you participated in field performance testing in Roswell?

A. You mean like a daily hour?

Q. Yeah.

A. Typically, I'd wake up about 4:30 or 5:00, get ready to head in to work. Depending on when sunrise was, about 5:30, we would be at work, out to the airplane. We would try to be there ready to go at sunrise, fly as long as the weather supported the test criteria, and then analyze data plan for the next flight as long as we needed to for the day until we were done. So it was at least a 12-hour day.

Q. And how did the flight sciences engineers on team with you agree with that analysis after the flying stopped?

A. Sorry. Can you say that again?

Q. How did the flight sciences performance engineers assist you with that analysis that occurred after the testing had stopped for the day?

A. I'm not sure exactly what they did, but there were a few days where they were still in the office when the flight test engineers had left for the day.

Q. So were they kind of doing their own thing and -- or were you guys more -- were you doing sort of separate kinds of analyses?

A. I really don't know what they were doing when they were staying late or what analysis they were conducting.

Q. So what time did you typically knock off, then? I guess it would be after 5:30, 6:00 o'clock in the evening or --

A. Yeah, sounds about right.

Q. By that time, or typically, you'd stay later than that or --

A. I don't remember exactly. I mean, we could go look at time cards and see what hours I put down, but yeah, it was probably 6:00, 7:00 at night.

Q. So it was common to work until 6:00 or 7:00 p.m.?

A. Very common.

Q. And then you were typically out there for 2 weeks at a time?

A. Correct.

Q. And then did you typically work 13 days and have the 14th day off, or how did that work?

A. No. We worked every day we were there. As long as the weather would support, we would fly. If the weather was bad, we would reduce data. But that's why we had instituted the 2-week rotation, so that people weren't out there getting burned out, so after 2 weeks, we would send at least one FTE, one pilot, to spell the other guys so that nobody got burned out.

Q. And did you rotate engineers between the trailer and the airplane, or were the people on the airplane always in the

airplane, and the flight test engineers in the trailer were always in the trailer? And I'm speaking specifically of the flight test people, not the flight sciences people.

A. Right. I think Cynthia, I don't know that she flew at all out there. I think she mainly was doing data reduction and TM monitoring. So for her, I don't think she flew. Reece and I would alternate sometimes when we were there together on the airplane or in TM, although I didn't go to the TM trailer all the time, because I was planning other flights for other missions. So the FTs on the airplane were fairly consistent for specific tests, so the takeoff, V_{MU} -- I know the V_{MU}, it was Reece and Valerie for all of those flights. The takeoffs, I think Reece had done every one of those, and Valerie was probably on board for those also. I think the majority of the landings and some of the RTOs were when myself and Chris Booth were out there.

So there was a rotation, but it wasn't randomly between tests. It was typically each test had the consistent FTEs on board.

Q. And was it Valerie who had the scheduling conflict, Valerie Thurston, and was replaced by Dave for the accident?

A. No, it was somebody else.

Q. Who was scheduled to be the FTE aboard that day?

A. Heather Burke.

Q. And had she worked on the field performance testing before?

A. She had been working field performance on 650, yes.

Q. Do you know how the engineer staffing for the field performance -- or for the G650 program was benchmarked?

A. Do you mean -- I'm not sure I know what you're asking.

Q. How did they decide how many engineers from flight test and flight sciences would be needed to support the flight test program?

A. The whole flight test program and not the field performance program?

Q. Yeah. Do you know if they benchmarked it on previous programs or --

A. I'm sure that's what they've used as past history. I think they were basing it off of, well, probably the GV, since that was the last major cert program, and then the GV-SP and GIV-X were the last two big STC programs, so they were using that as a baseline as to how many people were required to support the program.

Q. And how was the schedule, the flight test schedule, managed in the year preceding the accident? Sort of who had a hand in -- who had the authority to make changes in the flight test schedule in the year preceding the accident?

A. I think what would happen is proposed schedule changes would be made. If it was an FTE suggesting that something needed to be changed, that would get passed up to the flight test director, who would then make the change. If he felt that was

required, it would get reviewed with the program manager and the senior VP, and if they agreed to it, it was made, the change was made. If not, they would change the schedule as they felt it needed to be done.

Q. And were there differences of opinion between the flight test engineers and the managers about how the schedule should be revised in the year?

A. Yes.

Q. -- differences in more detail?

A. What was the question again? You broke up.

Q. Can you describe it in more detail, any differences of opinion between the FTEs and the managers that you described?

A. It was mostly on -- well, there were sequence problems, and there were providing sufficient time to do the necessary tests. So as the type certificate date, I think it was the end of October of this year, started to approach, and we didn't have enough testing done, then we would either -- we would still -- the end date would never change, however, the tasks would get rearranged or adjusted or shown on the schedule that we would still meet the end date, regardless of how long it was really going to take.

I think the initial schedule was developed based on a 5-day-a-week flight rate, with one day maintenance and Sunday off, and we ended up flying 7 days a week with no maintenance days being shown on the schedule so that we could meet the end date.

Q. And when did this change occur to a 7-day-a-week flying schedule?

A. I don't remember specifically when.

Q. And was this only during the field performance testing that it was -- that you're talking about a change from five to seven?

A. No. It was well before that.

Q. And are you talking about like in Savannah, too, it was 7 days a week and no maintenance?

A. Yes, yeah. The plan was the maintenance was supposed to be done at night. The airplanes were supposed to be ready and on the line available by 7:00 in the morning.

Q. You mentioned that because the airplane -- in your last interview, that because the airplane came to flight test late with multiple IFRs, tests were delayed and reshuffled, and flight test personnel ended up working 7 days a week and on holidays. Which holidays?

A. Pretty much all the holidays. I know specifically the Christmas holidays for probably the past -- at least the past two years, maybe even three.

Q. And which people were working those kind of hours? I mean, was it everybody who had anything to do with the flight test program or just certain people?

MR. RAMEE: We're going to go off the record for a minute.

(Off-record discussion.)

MR. DONOVAN: Just to clarify the Christmas holidays, the way Gulfstream operates is they take the floating holidays through the year, and they put them in a week shutdown around the Christmas -- between Christmas and New Year's, so those floating holidays at the end of the year were the days -- the specific days we were being asked to work. Asked/required to work. I don't think that anybody was required to be supporting work on the 24th or 25th of December.

BY DR. BRAMBLE:

Q. And for all this extra time that you worked above your normal work hours of 40 hours per week, did you report all of those extra hours as overtime or only some of it?

A. Everyone should have reported it as overtime. I know any hours I did, I put as overtime.

Q. Also in your last interview, with respect to the schedule, you've said that because the schedule was always changing, you said like everybody had to work 7 days a week because a tight schedule was developed, and you also said that because it was always changing, by flight test personnel, so I guess my question is was the schedule something that was really -- that was a source of pressure, or was it something that was just disregarded?

A. Well, it was a pressure and because it was very difficult to have a cohesive plan because it depended on what

revision came out, because if a test got moved from one airplane to another, you had to make sure all the requirements were acceptable on the new airplane, and you had to re-plan that. There were different IFRs on different airplanes, so you had to make sure those were accommodated and that you could do the test when the new schedule showed you were supposed to do them, which it was never an easy thing to do. It was never a time savings to move it to a different airplane, except on the schedule.

What was the second part of the question?

Q. Basically, was the schedule sort of onerous, or was it disregarded?

A. Oh, disregarded. It got to the point where the FTEs would make comments about what could be done, what couldn't be done, and the appearance is that their opinions didn't carry much weight. Changes were made regardless sometimes, just because it seemed to fit better on the schedule, regardless of the impact to considerations that were brought up.

So because the schedule changed so much, I know that the FTEs sort of just disregarded because whatever is on paper this week is going to be changed 2 days from now, so you really can't have a good plan, so no one really pays much attention to it.

Q. So basically, over time during the flight test program, they began to sort of disregard it because they felt like it was going to change so much that -- and they had no control over it?

A. Yes.

Q. And do you think that -- how could this situation have been improved? If you had control over the schedule, what would you have done?

A. I would have changed the end date.

Q. By -- how far would you have pushed it back prior to the accident?

A. I don't know if prior to the accident is -- well, regardless of the accident or not, I mean, there's certain tasks that need to be done, and they take a certain amount of time, no matter how much you try to squeeze everything down, so at some point you just have to admit you're not going to get it done, and you just adjust it as you need to. How much I would have changed it, I can't tell you that, but it certainly would have been -- that would have been the way I would have handled it is just extend the end date of the program.

Q. Now, there is a -- there might be a philosophy that could be offered in support of not changing it, which would be that if you leave it as it is and keep it tight, that it would motivate people to work at their full capacity to get things done. What is your opinion of the pros and cons of that approach?

A. I understand that's a management approach, and there is some -- there is some value to do that, because you do tend to motivate people a little bit more, but, I mean, on the test program, I don't see anybody who needs that kind of motivation. The people who are working this program are probably some of the

most highly-motivated professional people I've ever seen, so you don't need to give them dates that they can't achieve to try to make them work harder. They're all working as hard as they can to do the best job. So I think it's not something -- to use that management tactic is not appropriate.

Q. So how do you decide when you need to back it off and push the end date forward? I mean, at what point does schedule pressure get to be -- the schedule get to be too tight?

A. You're asking the wrong person.

Q. You mentioned in your last interview that you guys had experienced some problems with the flaps not moving from 20 to 39 degrees on 6002. Was this still a problem? Was there an IFR in effect related to this problem on the accident airplane at the time of the accident?

A. I don't know if an IFR was written. I don't believe so. There was probably a squawk written. It was coordinated with engineering, and it wasn't a safety issue. I think it was just due to a new software load on the flap control unit. It was easily resolved by pulling the circuit breakers out, pushing them back in, and then the flaps would move again.

Q. I see.

A. It was mostly an annoyance.

Q. And when did you have to pull the circuit breakers to make them work?

A. Once we determined that the flaps weren't moving, then

the pilots would let us know, or we'd be watching the flap trace. When they select Flaps 39, we would talk about it. They would say, okay, come on up, get the flaps, we'd cycle the breakers, and then go back and sit down.

Q. So in flight?

A. In flight, correct.

Q. And during your last interview, you mentioned that -- you mentioned some concerns about the flight test engineers not being listened to by senior management, and I think you've reiterated that some here with respect to the schedule, but can you give any other specific examples of where flight test engineers' concerns didn't seem to be heard at higher levels?

A. I'm trying to think of examples. I know that there was -- there were flights that we were told to go complete because we had to go fly the airplane, so we were flying drag flights with an airplane that wasn't in the correct configuration, because the perception was that flying was progress, even though we would have to go re-fly those flights, so there were -- that's one example. There's probably more of those where we were flying just to fly. And I know there were a few flights where we took off late in the day and flew for maybe 10 minutes because the -- again, you had to make a flight that day, so we would go fly, come back and land 10 minutes later.

Q. So who was watching that? I mean, who, basically, did you have to submit that evidence to, to say, "Hey, we are flying,

here we did a flight this day for 10 minutes."?

A. Well, that was direction coming from the flight test director, and I'm sure he was getting directed from his management, because we had made comments that we weren't going to be gaining anything by doing these tests, and we were told go fly anyway.

Q. And you were told that by who?

A. That was made by the flight test director.

Q. And has this changed since the accident, the idea that the FTEs -- that some of the FTE concerns and inputs were not being listened to by senior management, in your opinion?

A. I think it has changed a little bit. I think we're starting to get away from those changes, though, because the flight rate has increased. We're still doing a lot of flights recently that have been going against some of the FTE recommendations, but we're being told what we need to support.

Q. And which --

A. Sorry. You broke up again.

Q. Which kinds of flights are those that you're talking about?

A. I think now it's mostly autopilot development flights and FMS flights, I think FMS flights.

Q. And what's the argument that you shouldn't do those flights from the FTEs?

A. From what I've been overhearing is the suggestion is

just do one flight per day, and I think the FTEs are getting directed to fly two flights a day.

Q. Do they have sufficient resources to support that opinion?

A. Yes. They have enough resources because they're using different crews, and I'm not sure what the specific argument is against that. It's just what I've been overhearing.

Q. Did you feel that the schedule in place prior to the accident permitted time for data analysis during the field performance test program?

A. I felt that we had enough people available to do the data analysis and conduct the flights at whatever rate the people there decided to do. If they needed to do -- take a day off and just do data reduction and analysis, then we had the capability of doing that, so I felt, regardless of what was on the paper schedule back in Savannah, we were going to do whatever was required on site to have the job done to go do the next flight the next day or whenever we needed to.

Q. And how about between the major field performance efforts, Roswell-1 and 2, was there enough time to get the necessary analyses and preparation done?

A. I can't say for sure, because I wasn't involved in all of the data reduction, so I can't say.

Q. I imposed earlier that possible explanation of not backing up the end date for the certification flight testing as

being potentially because of a desire to motivate the employees. Is that your understanding of why the end date wasn't changed, or do you know of any other explanation?

A. From what I understand, there are aircraft deliveries tied to the TC date and corporate financials tied to the TC date and aircraft deliveries, so bottom line, it comes down to money.

Q. And do you believe that program scheduling played a role, either directly or indirectly, in any mistakes that may have contributed to the accident?

A. In my opinion, yes.

Q. And can you explain why you think that?

A. I don't know that I can give specific examples, but in general, we never had an airplane that was really completed as far as being in the final configuration to go do the tests. There were always multiple IFRs about some system that didn't work or some limitation that we were having to work with or some work-around because something wasn't completed, whether it was the nosewheel steering wasn't right, whether we didn't have the right flight control software loaded, whether the autopilot was having to be inop-ed, whether the FMS didn't work, whether the flaps didn't work as they were designed or whether there was a speed limitation because of flutter on the gear doors. There was always something that had to be dealt with to continue the program. There wasn't ever any commitment to say we have a problem, we need to stop until we can get this fixed so that we can do the test,

rather than have to redo the test once we fix it later. Does that make sense?

Q. Yeah. But with respect to the accident flight, were any of those limitations or workarounds something that may have contributed to the failure to notice that the speeds were wrong or that the stall protection system was set incorrectly?

A. I can't say that any of those would have an impact on how the speeds were derived or whether they were wrong or not, no. I don't see how they would be related. The only potential would be going out with the version of flight control software that we were in and not operating in normal mode where we would have the alpha limiter and operating in the first flight mode where we had no alpha limiter protection, only the shaker.

Q. And was the original flight test plan designed to have the test flown in normal mode?

A. I don't recall if that's specified in the test plan. It was probably implied that we would be testing in normal mode, because that's the whole intent is you do the tests for company development or company testing to write a report to show the FAA that you're ready for certification testing, so essentially, you should be doing your company tests in the same configuration that you're going to demonstrate to the FAA.

Q. And why wasn't the normal mode available for the field performance testing?

A. The software wasn't available, wasn't available at that

point in the schedule when we were supposed to go to the field performance.

Q. Was it originally scheduled to be completed by that time?

A. I don't know.

Q. Moving on, at the time of the accident, what policies and procedures did Gulfstream have in place to manage the safety of the flight test program?

A. I don't -- I'm not sure. Are you looking for a specific document? I mean, the safety information that we have is probably in the standard practice manual. I don't know that it's detailed anywhere else. I know flight ops has some information in their manual. I'm not aware of anything else specifically.

Q. And has this changed since the accident?

A. What are you asking has changed?

Q. Safety policies and procedures for flight tests or programs.

A. I know there's been a lot more documentation of procedures. I'm not sure that they've been specifically safety related. There have been some things that we've done in the intervening time, and we had done some other things with safety training for the flight test engineers.

Q. Yeah. We went over that some last time.

A. Right. So, I mean, we really haven't done any additional -- or I don't even know that we've actually documented

that anywhere. I can't -- I don't remember.

Q. And at the time of the accident, what procedures did the company have in place, policies or procedures, for reporting and investigating safety-related incidents that might occur during flight testing, such as the wing drops that occurred during Flights 88 and 132?

A. I don't know that there was a specific procedure with criteria for reporting incidents. Usually, it would just be the people involved would look at anything that happened that wasn't planned, try to determine what the cause was, and if there was some question, be coordinated with engineering and potentially a problem report written, or if there was some other issue, then it would be discussed further to see where it went.

Q. How about more general perceived hazards on the part of flight test personnel? Was there some mechanism for -- that you were aware of for -- some sort of policy or mechanism for reporting perceived hazards, aside from the SRB process?

A. I'm not sure what you're asking.

Q. Well, some companies will have anonymous reporting programs and that sort of -- reporting programs, that sort of thing.

A. I'm not sure that anyone was aware, but I think there is or was something being developed, but I don't think we found out about it until just recently, and I can't remember what the name of that program is.

Q. And has this changed since the accident?
A. Yes.
Q. In what way?
A. Well, there's now, I think, the aviation safety office that reports direct to the CEO of the company. I think there's a person assigned to that group in flight test and in flight ops. And again, I can't remember what -- there is sort of the anonymous safety reporting system that's now in place that we were told about probably a month or two ago, but I can't remember the name of it. I think it's -- it might be similar to a program the FAA has been developing.
Q. Like ASAP, Aviation Safety Action --
A. SMS. Does that sound familiar?
Q. Is it an SMS-based safety reporting program?
A. Yeah, I believe that's what it is. So you can report issues anonymously if you want to do that.
Q. And at the time of the accident, was there a single person in the organizational hierarchy who was formally accountable for managing the safety of the flight test program?
A. No. No one had that specific title or responsibility. It was just everybody's responsibility.
Q. And has that changed since the accident?
A. Yes. Now there's -- as I said, there's a person in flight test who is the aviation safety officer for the FTEs and then a corresponding pilot over in flight ops.

Q. And is there a single focal point person at the top of the pyramid, so to speak, who is --

A. Yes.

Q. Who is that?

A. I think it's John Salamankas. He's a pilot over in flight ops.

Q. And in the wake of the yaw damper incident, where the nosewheel steering and yaw damper caused a swerve during a takeoff, I guess that resulted in an SRB and some extensive effort a couple months prior to the accident, do you feel like that was -- that sort of took attention away from maybe some of these issues that may have contributed to the accident or not?

A. I don't know if it took away focus or not. I think it was another -- it may have been another indication that maybe we were doing things that we shouldn't have been doing, like flying with systems that weren't quite ready to be tested, especially -- I think that was the incident the FAA was on board. So that's another one maybe you can look back and say, well, maybe we should just wait until everything's ready to be done before we go do it.

Q. But I can hear someone saying wasn't that how you find out whether things are ready, when you go out and try and use them?

A. Yeah. That's part of the reason we go and test. But you hope you don't go out there and find that the system's been designed incorrectly.

Q. So you feel like there should have been more upfront work to scrub the systems before the flight testing began?

A. In general, yes, not on that system specifically.

Q. And then if the FAA wrote a letter to Anthony Beck expressing concern about that incident with the yaw damper and nosewheel steering malfunction, to perform an internal review of the company's change approval process to ensure that all concerned parties would be informed of changes to the flight control systems and other systems with direct pilot interface, was this review performed? And what lessons were learned or changes implemented as a result?

A. I don't know. I wasn't involved in that.

Q. Was Reece involved in that effort, either the SRB dealing with the nosewheel steering malfunction or this review of the change approval process?

A. I'm not sure if he was involved in it or not. It may have been -- because it was part of the flight controls, it may have been something that Bill Osborne and maybe Ken Obenshain may have been involved in.

Q. The reason I asked was because I think some of these SRB meetings were on Reece's calendar, the nosewheel steering SRB meetings, and I didn't know what role he played or whether that was just a courtesy invite or what?

A. I don't know what role he played. Something like that, he may have just gone to listen in because it was -- I mean, the

nosewheel steering is an important piece in the field performance, so he probably wanted to know what the resolution was going to be.

Q. Are you familiar with the term "safety culture"?

A. Yes.

Q. What's your understanding of what safety culture is or what kinds of safety cultures there can be?

A. Well, the way I look at it, it's how you view what you're doing in the test program, how you manage the risks, how you train people, how you put the people on tests that should be there, make sure that everyone's qualified, that everyone understands what's going on, what the safety factors are. It's just the whole -- everything that you do related to safety.

Q. And how would you describe the safety culture that existed within Gulfstream's flight test organization at the time of the accident?

A. I thought that we did pretty good.

Q. And some of these issues you raised about FTE concerns maybe not being received -- listened to at higher levels, do you see that as a problem that's apart from safety culture?

A. Yeah. I wouldn't consider that part of -- well, right now, I would say I wouldn't consider that part of the safety. I mean, looking back on it, yeah, it probably could be considered a factor in there, but I guess I would kind of draw a line around the safety culture as far as just sort of limiting it to conducting tests safely, being aware of how to do things safely,

what the safety reporting processes are, being familiar with those things.

Q. So you think of that more at the working level?

A. Yes.

Q. Is there anything, based on the questions that we've asked in this interview and the last interview, that you think we should be looking at that we don't appear to be focusing on?

A. Nothing comes to mind right now.

Q. And do you have any ideas for improving flight test safety at Gulfstream or maybe more broadly throughout the industry that we could amplify through our investigation? If you can't think of anything now, you can feel free to pass that along to Tom Horne or Rick Trusis.

A. Well, I know we are changing some things safety-wise, and I think there's been some discussion about what else we can do. I think probably one of the things that we ought to do is we need to probably just go through, do a paper for the flight test safety working committee the SETP and SFTE has every year and just explain what happened. I mean, it's a great forum for industry to let them know what potential problems are there, so maybe someone else can avoid the same mistake we made and also share with them some of the changes that we've made to our safety planning, our safety culture, some of the improvements we're doing on the airplane as far as emergency equipment and protection equipment, so I think those are things that would probably benefit industry.

Q. And in terms of what mistakes or try and help them avoid making the same mistakes, what, specifically, are you speaking of?

A. Well, it'd just be everything that's going through based on the company findings and maybe identifying more clearly roles and responsibilities, maybe we put in a system of checks like we're doing now to make sure that the speeds are correct, have some performance prediction and simulations for takeoff, describe more the work that we've done on the in ground effect stall alpha that we didn't do before the program, have predictions on field length and speed comparisons, like we didn't have before we started this program. So I think there's some worthwhile things that are good to have that we weren't doing that we've just developed recently.

DR. BRAMBLE: That's it for my questions, and we're going to get kicked out of our room here in about a half an hour. I would like to give the other members of the group a chance to ask any clarifications.

Do you need a break?

MR. RAMEE: I think we probably ought to take a 3-5 minute break.

(Brief recess.)

DR. BRAMBLE: So I guess we'll try to do this as efficiently as possible with the remaining follow-ups. I'm going to go ahead and hand it over to John O'Callaghan first.

BY MR. O'CALLAGHAN:

Q. Paul, earlier we were talking about Flight 132, and the way you described it, it sounded like from -- sounded like an overrotation to you as well. I was wondering if you ever heard discussions that the roll-off was due to lateral directional effects?

A. Certainly in the subsequent analysis, yes.

Q. Subsequent to --

A. After the accident.

Q. And is that your understanding now? Or I guess please explain the timeline of that. You became aware that Flight 132 was -- but your understanding today of the cause of that is what?

A. The cause of that roll-off?

Q. Yeah.

A. I think it was early rotation and too high of a pull force which caused -- apparently caused the airplane to stall, which caused the roll.

Q. And did Reece ever have a conversation with you about that event and the attribution of it to lateral directional effects?

A. No. The only thing I think that was -- well, I don't even know that he had discussed that with me, because that was about 2 days before I went out, so I don't -- I can't say he had the discussion. It's probably just what I've learned post-accident.

Q. Okay. Thanks. Jumping to the effect of ground effect

on the stall angle attack, I think historically at Gulfstream, it's been about 2 degrees. Do you have a feel, based on your experience, on what the uncertainty around that would be before going to test, I mean, 2 degrees plus or minus a percentage? A degree? Did you have any feel for that at the time before the accident?

A. I would say after Reece's calculation of about 1.6 that I felt that the 2-degree was a conservative estimation, so if I had to put a number on it, I don't know that I have a specific number, but I felt that since the 2 degrees was provided, and he was calculating based on test data 1.6, I felt the 2 degrees was a conservative number.

Q. Regarding the overshoots that were being experienced on this program, have you seen similar problems with other programs where there was a consistent difficulty with overshooting V_2?

A. No.

Q. There was a lot of discussion about the schedule, and from talking to folks, it sounds to me like flight testing is, of its nature, sort of insane when it comes to schedules?

A. To say the least.

Q. So my question is: Where does this program lie with flight testing in general? Is it uniquely aggressive, or is it run-of-the-mill? Kind of typical? What's your feel for that?

A. It's one of the most aggressive schedules I've ever seen in, I guess, close to 27 or 28 years I've been doing it. I've

never seen anything like this. I've never seen a schedule get tasks moved from airplane to airplane, end dates never change. I've never seen the pressure to go fly, just to fly, ever before like this. It's totally unique.

Q. And you mentioned in one of the answers that if you have enough schedule, then your work flow doesn't become excessive, so the rhetorical question is did you have enough schedule on this event, and was the workload excessive in this program, in your opinion?

A. In general on the program, the workload was excessive, just because, like I said, the airplane wasn't in a real valid test configuration until significantly after we started flying it, so the time that we had estimated it would take to do the program, we never had that time to do all the tasks.

For the field performance specifically, like I said, when we were out in Roswell, we were going to work at our own pace. We all agreed that we would take whatever time we needed, regardless of what the schedule said. So if they needed to do a data day, Reece and I talked, and he would take a day, if he needed, just to look at data. So I felt confident that when they were -- when they went and did a flight, they were flying because they were ready, not because they were being directed to go fly.

Q. And along these lines, we were talking about systems not being quite up to snuff for the file configuration, and Bill asked about how that would have affected the accident flight

specifically. I think we talked about the availability of normal mode and the alpha limiter. In your opinion, if normal mode had been available and the alpha limiter had been there, how would that have affected events either on the accident flight or previous ones?

A. I'm not sure.

Q. And then I understand that nobody's going to do a particular test that they don't think the airplane's ready for, and they'll sort of disregard the schedule in that way, but there was still the working 7 days a week, et cetera. Is that correct?

A. That's correct.

Q. And so I guess what it boils down to, in your opinion, were folks being burned out?

A. In Roswell or back in Savannah?

Q. Both.

A. In Roswell, I don't think so. Like I said, we were doing the rotations, so people were working 2 weeks, and if they were working 14 days, I think the policy allows for an exemption if you ask for it. No, maybe it's just 13 days regardless. Anyway, 14 days I don't think was excessive, because the last day would have been a travel day back, so I think that would be okay.

But back in Savannah, people were working 14 days routinely, some of them more, so it is a concern back in Savannah, because it's been going on for so long. I mean, you can only -- you can do that for short periods, but when you do it for 6

months, 9 months a year, it's just not the best thing to do for anybody.

Did that answer the question?

Q. Sorry. Go ahead.

A. Did that answer your question?

Q. Yes, it did. Thank you.

So at the very beginning here of the program, did Ken Obenshain or anybody else ever share with you concerns regarding the staffing for the flight test program?

A. Ken specifically?

Q. Yeah.

A. I don't remember. I know there was some discussion about the budget, the manpower, what we were allowed to have, and how much typically gets reduced prior to getting the go-ahead for the program. There was a general feeling that we -- well, we never -- we feel we never have enough people or budget at the beginning of a test program.

Q. So you think when flight test says, "We don't have enough people or staff," that that concern's not taken seriously because it's like crying wolf all the time, or the managers hear it all the time, so they discount it automatically, or what's your feel there?

A. Well, my feeling is they think we pad the numbers, so when they reduce it by a certain amount, they're just getting back to even. And probably because flight test and flight ops are so

good at getting things done in the best manner with the limited resources they have, and usually pretty close to on time, they just think, well, we'll just -- whatever we give them, they're going to get it done anyway.

Q. Bill asked a question sort of like this, but I'm going to maybe ask it in a different way. All these questions about overtime and schedules and staffing and pressure, honestly, I think we're asking the questions for a reason, but in your mind, is all this questioning in this area even relevant to the investigation of the accident?

A. Yes.

Q. Care to elaborate on that?

A. I think it's relevant. I think the schedule gets into the program pretty significant. Like we've said, my opinion, it's one of the most uniquely scheduled and pressured programs that I've ever been associated with. How could it not have an impact.

Q. Thank you. Just a couple quick questions on the going-forward plan and the -- I understand there's going to be one FTE in the airplane, and I guess I wasn't too clear about how the -- is he doing the job of two people now, or is one of the roles being done on the TM trailer, or how is that working out?

A. We'll be going out with the latest flight control software, which I think all of the monitoring that had been being done is now automated, so there's no flight control monitoring required.

Q. So vibrations and fatigue and all that kind of thing?

A. Right. So all of the oscillatory monitoring and things that we were watching are now to the configuration that we should have been testing when we first started, so the task that I'll be doing is the test conductor roll and monitoring, the parameters required for pass/fail criteria, and doing all of the same calculations that the TM trailer guys will be doing.

Q. And question about the logistics of data monitoring for the FTEs, I think you mentioned there were some critical parameters that are being monitored by the engineers. So if an alert for an alarm is triggered there or the FTE sees something that is getting out of bounds, how does he alert the crew, or what's the process? I mean, if it's something like a takeoff, things are happening pretty fast, and seems like the crew would probably be concentrating on something. So can you just describe how the FTE would intervene if he sees something he doesn't like?

A. Well, we haven't worked out the specific details on what it's going to be. What we're trying to do is get all these tools working and see if we can put them into the ITF, or an integrated test facility, to try to run through it a few times, just because the rates are going to be quick, to see when we need to make a call, how much lead time, if there's something better we need to do, and try to work on crew coordination.

But in general, when an alert comes up that we've set the threshold for aborting the maneuver, then either the test

conductor in the TM trailer or the FTE on board will just call and abort, and we'll have our abort procedures defined, and we'll follow those.

Q. Well, thank you. That's all I have. Thank you for your time.

A. You're welcome.

BY DR. BRAMBLE:

Q. Real quick, I'm just going to interject here, Paul. I'd like to get a feel of which categories of people were actually working the 7-day-a-week schedule that you're talking about and sort of roughly how long a period of time are we talking about?

A. The flight test engineers, instrumentation engineers, the test coordinators, flight test mechanics, and inspectors, pilots. Those are the ones that I specifically know. There was probably engineering support over the weekends. There were certainly people on call. I couldn't give you any other specific groups, though.

Q. That's fine. Thanks.

DR. BRAMBLE: Mitch, do you want to proceed?

MR. GALLO: I'm going to take up -- how much time do we have left?

BY DR. BRAMBLE:

Q. I'm sorry. We didn't get the whole answer on that last one. How long was that going on, roughly?

A. I was going to mention that. I would say almost from

first flight, which was when?

MR. HORNE: November 2009.

MR. DONOVAN: So about 2 years.

BY DR. BRAMBLE:

Q. The 7 days a week, I thought it backed up --

A. Well, I don't remember when the 7 days a week started, but we've been under the gun pretty much from the start, so there may have been people working maintenance, working other things, and they had been working 7 days a week, but the official schedule showing 7 days a week, I don't know when that came into effect.

DR. BRAMBLE: Mitch, go ahead.

BY MR. GALLO:

Q. What prompted Reece to go back and look at the in ground effect margin from 2 degrees going down to 1.6?

A. I'm sorry. I missed the first part of that.

Q. What prompted Reece to go back and take a look at the in ground effect margin of 2 degrees?

A. I don't know if he did it because he didn't have the predicted value or if he was just double-checking the engineering estimate.

Q. Do you recall Reece discussing with you a change in the shaker setting from 0.85 normalized to 0.90?

A. I don't think he ever discussed it with me. I think he had maybe discussed it with Ken and maybe -- I'm not sure if he discussed it with anyone in flight ops or not. I think he did.

Q. And was that something that he conceptualized?
A. I don't know.
Q. When did Reece begin working on his presentation for the October 7th SRB for field performance testing?
A. I couldn't tell you when he started working on that.
Q. And during that October 7th SRB, did you attend that meeting?
A. I don't believe I did.
Q. You had mentioned that the change in target pitch from 10 degrees to 9 degrees would have prompted a change in your lift-off and some other speeds, which should have been --
MR. RAMEE: One second. He's looking at the flight test safety review board listing.
MR. GALLO: Okay.
MR. DONOVAN: Yeah. I was not at that SRB.
BY MR. GALLO:
Q. That's fine. My next question goes to the change in target pitch from 10 to 9 degrees and then the subsequent changes that would result in the V speeds. You had mentioned that flight sciences would be the responsible party to recalculate those speeds. Within flight sciences, who was the person that was doing the actual calculations for those values?
A. I don't know specifically who the person was.
Q. Because we've talked a lot about Paul Donovan and Shelly Brimmeier.

A. You mean Pat Connor?

Q. I'm sorry, Pat Connor and Shelly Brimmeier. And so of those two, do you think one would be more involved than the other in V speed calculations?

A. I know on previous takeoff test programs I've done, Pat has been the one providing the speeds, and I would assume it was either -- it was one of those two who provided us speeds.

Q. And the calculation of the speeds, is that something that's done in Savannah with flight sciences using their model for field performance, or is it done off a laptop-based program?

A. I'm not sure that they have a model. I think they've got -- whatever programs they use, I think they were available to be accessed in Roswell. Whether that was able to be done or not, I don't remember, but that was the intent.

Q. So to your best knowledge, that's something that could be calculated right there at the briefing?

A. Yes.

Q. You mentioned that the AOA limiter for field performance testing was not available -- actually, scratch that question, because it was leading to another question I had.

Do you know why a test request was not received from flight sciences for the takeoff development portion of testing?

MR. HORNE: Can I clarify that, Mitch?

MR. GALLO: Yes.

MR. HORNE: Are you talking about the test requirements

document?

MR. GALLO: What I'm asking for is the test request.

MS. WARD: Test requirements document --

DR. BRAMBLE: Test requirements document, why wasn't one submitted to flight sciences is what you're after, right?

MR. GALLO: Right.

MR. DONOVAN: Yeah, because we do have a test request form that's something different. No, I don't know why there was never one provided by flight sciences or performance.

BY MR. GALLO:

Q. Were you aware of the GIV in ground effect stall occurrence during testing?

A. Is that the V_{MU} incident?

Q. Correct.

A. Yes.

Q. And were you aware of that before the accident?

A. Yes.

Q. After Roswell-1, did you attend a meeting to discuss that the airplane was unable to meet its performance guarantees?

A. That does sound familiar, but I can't recall for sure.

Q. Do you attend any weekly certification issues meetings that are held on Fridays?

A. I have been lately, yes.

Q. But prior to the accident, were you attending those?

A. I don't remember when I started attending them.

Q. You mentioned that during the takeoff development testing, the focus of force and pitch came about. Do you remember who conceptualized those two concepts?

A. You mean who set the force and pitch targets?

Q. Yeah. Who started -- who took the lead on developing the force and pitch techniques?

A. I'm not sure if that was an input from the performance group or not, so I don't know.

Q. Have you heard from any of the pilots that were involved in the takeoff development testing that V_2 should be increased or that V_2 could not be captured, or it was an impossible speed to capture?

A. I'm not sure I know how to answer that one.

Q. Did you hear any discussion from the pilots saying that V_2 should be increased after Roswell-1 after 132?

A. Well, I think that's what -- that's what the result is that we're operating under right now is that all the speeds are increased, and that's, I believe, the intent when we go back to do the field performance is that all of our V speeds are going to be increased.

Q. That's all the questions I have. Thank you.

DR. BRAMBLE: Okay, Jeff.

MR. BORTON: I'll go ahead and hold my question till we're done here, to make sure everyone else gets it in. I'll ask it if there's time at the end.

DR. BRAMBLE: Tom Horne.

MR. HORNE: A couple of quick ones, I hope.

BY MR. HORNE:

Q. Do you know if touchdown speeds in your landing tests, were they a ratio of what was provided from GV and ratioed up to GVI, or was it an inactive type modeling that they did? Do you know how they came up with those speeds?

A. I don't know that it was any kind of modeling. I believe it was a ratio of GV because that was kind of the way they were working the takeoff speeds to.

Q. And just a clarification question. Would you say that when flight sciences changed event markers that from what the flight test people had marked, that was probably mainly just a way to look at different parameters to help optimize performance?

A. It was -- yeah. I think they were using -- they may have been using different parameters, rather than the ones that we had identified in the data reduction plan, so I think the intent was to try to improve the performance numbers.

MR. HORNE: That was it.

DR. BRAMBLE: Lorenda?

MS. WARD: No.

DR. BRAMBLE: Marie, do you have anything? Mike?

MR. BAUER: Paul, just hopefully, I guess, two quick questions.

BY MR. BAUER:

Q. The CTO testing, you discussed that normal log would have been ideal to have for the CTO testing, and the software didn't support it at that time. Did the CTO testing need to be conducted using alternate log for certification?

A. No. I don't believe we dispatched in alternate mode, so that's not a configuration we would need to test.

Q. For the new round of testing, is telemetry going to be a requirement? And if so, is it going to be documented in a TSHA?

A. We haven't made the final changes to the TSHAs. I don't know if TM is going to be a requirement, because we're going to have redundant calculations on board, so I don't know what the final resolution of that will be. That will be a fallout from the SRB.

Q. Would you not requiring TM just be because of the redundancy on the airplane or to avoid scheduling conflicts?

A. No. The only consideration -- if we make it a requirement, if something happens to the TM trailer or we lose TM contact, you don't want to abort the testing just for that. If everything is available on the airplane that's in the TM trailer, we would like to continue testing as long as we felt it was safe.

Q. That's all I have.

BY DR. BRAMBLE:

Q. I had just one brief clarification about the schedule. You've mentioned that the end date never got moved back. We had an understanding that maybe the end date originally was in March,

and then it was pushed back to late summer/early fall. Do you know if and when that occurred, end date meaning the certification date?

A. Yeah, that does sound familiar now, but I think what it was is there's an internal schedule and an external schedule, and I think the external schedule was always somewhere in third quarter or fourth quarter, whenever that is, so yeah, that's right, the internal date did change.

DR. BRAMBLE: Okay. Jeff, you've got about 3 minutes.

BY MR. BORTON:

Q. Okay. Just one question, Paul, just to understand the safety culture a little bit. We've had a lot of questions about the schedule, schedule pressures. If you could just ask -- if I could ask you about the Roswell, typical day in Roswell, if you were working 12-plus-hour days as flight test engineers, were the pilots working that same type of schedule, or were they aware of what you guys were doing as far as your long days?

A. They were aware of what we were doing. If it looked like we were going to be staying significantly later, they would leave at about a 10-hour day.

Q. That's all that I have.

DR. BRAMBLE: I think that's it for us, then, unless anybody else has anything else.

Paul, thanks very much for your time, we appreciate it, and good luck with the rest of the testing.

MR. DONOVAN: Thank you.

(Whereupon, at 1:00 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 Paul Donovan
DOCKET NUMBER:	DCA11MA076
PLACE:	Savannah, Georgia
DATE:	November 3, 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.

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Marie Bauer
Official Reporter