UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF ADMINISTRATIVE LAW JUDGES

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In the Matter of the Investigation of *
Southwest Airlines Co., Flight 1248, * Docket No. DCA-06-MA-009
Boeing 737-7H4, N471WN, *
Chicago, Illinois, December 8, 2005 *
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National Transportation Safety Board
490 L'Enfant Plaza East, S.W.
Washington, D.C. 20694

Wednesday,
June 21, 2006

The above-entitled matter came on for hearing, pursuant to Notice, at 9:00 a.m.

BEFORE: MARK V. ROSENKER, Chairman

BOB BENZON, Hearing Officer, Investigator-in-Charge, Major Investigations Division

DR. VERNON S. ELLINGSTAD, Director, Office of Research and Engineering

JOHN CLARK, Director, Office of Aviation Safety

APPEARANCES:

Technical Panel:

CAPT. DAVE KIRCHGESSNER
DR. KATHERINE LEMOS
DR. KEVIN RENZE
MARK GEORGE

On behalf of Federal Aviation Administration:

STEVE WALLACE, Director, Office of Accident Investigations

MARK TOMICICH, Office of the Chief Counsel

DON STIMSON, Performance Engineer, Transport Airplane Directorate

JERRY OSTRONIC, Flight Standards Service

DAN DIGGINS, Team Leader, Office of Investigation

BOBBY HEDLUND

TONY JAMES

On behalf of Southwest Airlines:

TIM LOGAN, Director, Flight Operations

CAPT. TED LAWSON, Manager, Flight Safety

JEFF GRENIER, Manager, Flight Safety Response

DEBBY ACKERMAN, General Counsel

CAPT. MARK CLAYTON, Director, Operations

DANE JACQUES, counsel

On behalf of Southwest Airlines
Pilots Association (SWAPA):

CAPT. JEFF HEFNER, Coordinator/Chief Accident Investigator

CAPT. JOHN GADZINSKI, Performance Group

CAPT. LARRY KLINE, Weather and ATC

CAPT. JIM DUFFY, Systems Group

FIRST OFFICER CHRIS PERKINS, Ops Group

CAPT. JOE EICHELKRAUT, President, Southwest Airlines Pilots Association

NICH ENOCH, counsel

On behalf of the City of Chicago:

NURIA I. FERNANDEZ, Commissioner, Department of Aviation

ALBERTO RODRIGUEZ, Chief Operations Officer
Midway Airport

AL PEREZ, Assistant Commissioner for Operations
Midway Airport

JAMES SCZCESNIAK, Assistant Commissioner for Planning
Department of Aviation

BRANDT MADSEN, counsel to the Airport

RAMON RICCAONDOT, Aviation Planner

On behalf of Boeing Co.:

MARK SMITH, Air Safety Investigation Group
Boeing Seattle

ROBERT J. ORLOWSKI, Aerodynamic Performance Specialist

BRUCE A. DICKERSON, Senior Manager, 737 Program

CAPT. JAMES RATLEY, Senior Technical Pilot, 737

RICHARD BREUTHAUS, Director, Air Safety Investigation

JOHN DILLOW, counsel

PAUL D. GIESNMAN

Witnesses:

ROBERT J. ORLOWSKI
PAUL D. GEISMAN
JERRY OSTRONIC
DON STIMSON
BRIAN GLEASON
CAPT. JOHN MILLER

I N D E X

P R O C E E D I N G S

(9:00 a.m.)

CHAIRMAN ROSENKER: Good morning. My name is Mark Rosenker, and I am the Acting Chairman of the National Transportation Safety Board and the Chairman of this Board of Inquiry and this hearing this morning.

I thank you all for joining us and participating. My colleagues on the Board of Inquiry, I'll reintroduce. To my left, Dr. Vern Ellingstad, to my right John Clark, and our Hearing Officer, Bob Benzon.

Our Technical Panel is back. Our Parties are back including the Southwest Airlines Company, Southwest Airlines Pilots Association, Boeing Commercial Airplane Company, City of Chicago and the Federal Aviation Administration.

We covered two of our topics yesterday. They were measurement of runway friction and the methods used to relay runway friction estimates to landing flight crews. Topic 2 was runway safety areas at Midway and other airports with land use constraints.

Today we will have three panels dealing with Topic 3. That's aircraft landing performance including landing on contaminated runways, manufacturer's landing data, the use of OPCs and use of thrust reversers.

Mr. Benzon, will you please call the first witness panel from Boeing Airplane Company?

MR. BENZON: Yes, sir. The Board calls Mr. Bob Orlowski and Mr. Paul Geisman. I'll swear you in from here guys. So raise your right hands.

(Whereupon,

BOB ORLOWSKI and PAUL GEISMAN

were called as a witnesses, and having been first duly sworn, was examined and testified as follows:)

MR. BENZON: Please have a seat. And we understand you have a presentation for us.

MR. ORLOWSKI: Yes, we do.

MR. BENZON: Proceed.

MR. ORLOWSKI: First, I'd just like to introduce myself. I'm Bob Orlowski from the Commercial Airplane Company. I work in the performance certification group which flight tests the airplane to derive performance parameters, which are used to calculate airplane performance.

Good morning. Mr. Geisman and I are here to address Boeing's landing performance calculations and the use of data generated by those calculations. Boeing publishes two sets of data for its aircraft, certification and advisory data.

I will address the certification landing data and how Boeing derives the landing performance data. Paul is present to answer questions regarding the use of certification landing data and how it is used to prepare the operational advisory landing data. For simplicity and continuity, I will deliver the entire presentation on this topic using the 737-700 as an example. In addition, to insure accuracy, I will read from notes.

Boeing publishes two sets of landing data for airline operators. To help differentiate between the certified and advisory data, I'll be using a blue and green color coding. These two sets are the certified data which are shown in blue, and the advisory data which are shown in green.

The certified data are also known as dispatch or factored data. The advisory data are also known as en route, unfactored or operational data. For consistency and simplicity, I will refer to these two sets of data as certified data and advisory data.

I'll start by addressing the high level distinction between the two sets and get more detailed as I progress.

The first difference I will address is the location of the data. These two sets of data reside in different publications. The certified data are published in the airplane flight manual. The airplane flight manual or AFM contains certified performance landing data. The advisory data are located in the quick reference handbook or QRH. The QRH is a convenient size notebook, which is in the possession of a flight crew and contains tabular sets of data of airplane performance.

Another difference is in the use of reverse thrust.

The certified data do not include the use of the effect of reverse thrust in calculation of landing distance. The advisory data include the effect of reverse thrust in calculation of landing distance.

Each set of data has its own distinct purpose. I will further address the data differences in more detail. The purpose of certified data is to provide landing distances for dry and wet, slippery runways. These data are located in the AFM. The purpose of the advisory data is to provide landing distances for various breaking configurations and runway conditions such as dry, wet, snow or ice. These data are found in the QRH.

Both sets of data have origins in federal regulations. The certified data fulfill the requirements of C.F.R. 14, Part 25, and C.F.R. 14, Part 121 of the Federal Aviation Regulations or FAR. The advisory data fulfill the requirements of C.F.R. 14, Part 121.

The certified data are used to determine the landing distance requirements prior to dispatch. Should conditions warrant, the advisory data are used to aid the flight crew in making operational decisions en route to determine landing distance.

I will now address the basis for the landing distance data by starting with the certified distance calculations. The certified distance is based on data derived from Boeing flight testing. The calculations are broken into three segments. The air distance segment which encompasses a calculation from 50 feet above the runway threshold to touchdown, the transition segment which encompasses the deployment of speed brakes and initial braking, and the stopping segment that continues the calculation to full stop using maximum manual braking. Note the calculations for the transition and maximum manual braking segments are based on a dry runway without the effect of reverse thrust.

These three segment calculations are the basic building blocks for the data in the airplane flight manual. Before it is incorporated into the AFM, additional factors must be applied to the data. The factors that are applied to the certified data are legislated by Part 121 of the FARs. Part 121 requires the inclusion of landing data in the AFM for a FAR dry runway and a FAR wet or slippery runway. The calculations are based on a dry runway, automatic speed brakes, maximum manual braking and do not include the effect of reverse thrust.

Using the regulatory requirements, the FAR dry distance is obtained by multiplying the calculated dry distance by a favor of 1.67. The FAR wet, slippery distance is obtained by further multiplying the FAR dry distance by a factor of 1.15. Note, I have included a dotted line to show the certified wet, slippery runway distance. I will use this as a reference point for my next slide.

As with the certified data, the advisory data also reflect the demonstrated airplane capability. One difference is the effect of reverse thrust. That is included in the calculation. As is shown here, the effective reverse thrust is modeled by adding several more segments to account for the pilot action, the reverser deployment and a cutback to idle reverse thrust at 60 knots. If the regulations permitted the effect of reverse thrust, the certified factored wet, slippery runway distance would be reduced by 100 to 200 feet.

I would like to point out the difference in the air distance segment between the two sets of data. The air distance for the certified data is a variable value that is calculated for each set of conditions. The advisory data is a constant 1,000 feet. The reason for setting the advisory data to 1,000 feet is to make it easier for the operators to adjust their air distance according to their operational requirements.

Now that the basis for the advisory data has been discussed, I'll explain how these data are expanded for use in the QRH. Similar to the AFM, the QRH supplies data for dry and other runway conditions. The QRH expands beyond the certified data to include additional runway surface conditions specifically not contained within the AFM. In addition to dry, the QRH provides data for the following runway surface conditions: wet which Boeing maps to good braking, snowing -- snowy which Boeing maps to medium braking, and icy which Boeing maps to poor braking.

The braking actions are used to differentiate the runway condition to the flight crew. Using the braking action shown on the chart, data are calculated to define the landing distance. For each condition, the basis for the calculations are the same except for the runway condition. The runway condition is reflected by a change in the airplane braking model. The model reduces the airplane braking capability as the runway surface condition deteriorates.

The reference runway line defined in the previous slide shows for -- conditions, that an airplane may stop beyond the FAR wet, slippery landing distance as defined in the certified data set.

To summarize, there are two sets of data produced to determine landing distance for the airplane, the certified data and the advisory data. Both sets of data fulfill regulatory requirements but are different. The certified data are based on a dry runway without the effect of reverse thrust used in the calculation. Also, the certified landing distance is determined by applying a factor of 1.67 for a dry runway and an additional factor of 1.15 is applied to calculate the landing distance for a wet or slippery runway.

The advisory data fulfill other regulatory requirements, include the effect of reverse thrust and do not apply factors to the calculated distance. In addition, the advisory data also uses specifically defined runway surface conditions which Boeing correlates to braking action.

As I mentioned, the certified data are located in the AFM and the advisory data reside in the QRH.

I'm going to expand on how the landing distance data are presented in the QRH. This slide shows an example of a 737-700 QRHP. Data are included to address various runway surface conditions and braking conditions such as manual braking and auto braking. The first column of data reflects a reference distance which is based on a 130,000 pound landing weight. QRH landing distance data is based on the assumptions highlighted in the notes at the bottom of the page. The calculations for the chart use the inherent assumptions listed in the notes.

I will highlight three assumptions in the notes that are germane to this discussion. The first assumption states that the reference distances are based on a standard day, no wind or slope, an approach speed of V rev 40 in addition to the use of 2 engine D-10 to reverse thrust. The second assumption states that the data are actual unfactored distances. Again, this is done so that the operators can adjust the data as required to plan margin for their individual operations. The third assumption stipulates that the air distance from 50 feet above the threshold is a fixed 1,000 feet.

There are additional adjustments that can be made to the data to reflect the actual conditions the flight crew may experience en route to their destination. These include adjustments for gross weight, airport altitude, wind, runway slope, temperature, approach speed and the removal of the effect of reverse thrust.

As we have seen throughout this presentation, one of the differences between 737 certified data and advisory data is the effect of reverse thrust in the calculations. Historically for dispatch calculations, the FAA certified data for the 737 has never contained the effect of reverse thrust and the 737 contaminated runway advisory data has always included the effect of reverse thrust in the calculations.

Landing margin is provided in the certified data per the Federal Aviation Regulations. This is accomplished by factoring the data by 1.67 for a dry runway and applying an additional factor of 1.15 for a wet or slippery runway. Advisory data reflect airplane capability and do not include any margin. Margin may be added by operators to reflect their own operational requirements. Under the auspices of JAR-OPS 1, the European regulations require a factor of 1.15 to be applied to the advisory data. Boeing provides QRH data similar to the FAA QRH page shown earlier but with a factor of 1.15 included in the calculations for European operators. Additional margin may be added by operators to reflect their own operational requirements.

Boeing provides additional guidance relative to operations on slippery runways. The following is from the 737 NG Flight Crew Training Manual. Pilots should keep in mind slippery, contaminated runway advisory information is based on an assumption of uniform conditions over the entire runway. This means a uniform depth for slush, standing water or a contaminated runway or a fixed braking coefficient for a slippery runway. The data cannot cover all possible slippery contaminated runway combinations and does not consider factors such as rubber deposits or heavily painted surfaces at the end of most runways. With these caveats in mind, it is up to the airline to determine operating policies based on the training and operating experience of their crew.

In summary, Boeing provides the airline operators two sets of data. These are the certified data and advisory data. These data serve different purposes in their application. The certified data reflect the demonstrated airplane capability without the effect of reverse thrust. Additional factors are applied to the landing distance to determine the required landing field length for either a dry or wet, slippery runway. These data are required for dispatch.

The advisory data include the effect of reverse thrust in the calculations. This data set shows the actual landing performance capability of the airplane in various conditions. Factors are not applied. Operators may add margin to reflect their own operational requirements. These data may be used by the flight crews en route to make operational decisions regarding landing distances.

Thank you for your attention.

CHAIRMAN ROSENKER: Thank you very much. Mr. Geisman, do you have a presentation as well?

MR. GEISMAN: No, sir, Mr. Chairman.

CHAIRMAN ROSENKER: Okay. Thank you very much. We'll begin with the questioning from our Technical Panel. Dr. Renze.

DR. RENZE: Thank you. Good morning. Please define in your own words what actual or unfactored data means.

MR. ORLOWSKI: Actual or unfactored data is basically the airplane capability. In other words, it's what the airplane is actually capable of doing and it has been determined within the flight testing that we've conducted at Boeing.

DR. RENZE: So does it more accurately represent flight test operations or line operations?

MR. ORLOWSKI: It more accurately reflects flight test operations.

DR. RENZE: Okay. Could you bring up your slide number 8 please? Thanks. Just for clarification, which of these data are actually flight test demonstrated?

MR. ORLOWSKI: The actual flight test demonstrated are the dry distance basically, the dry runway. The dry distance on the top is the actual demonstrated one.

DR. RENZE: Okay. So what about the advisory category? The dry distance there, is that demonstrated?

MR. ORLOWSKI: Yes, that is demonstrated. We do flight testing to also get the effect of the reversers.

DR. RENZE: Okay. But the good, medium, poor would be modeled through airplane breaking coefficient changes for example as opposed to actually demonstrated through flight tests.

MR. ORLOWSKI: Could you repeat that please?

DR. RENZE: Would the good, medium and poor performance results be calculated results by changing terms in the equations or are they actually demonstrated in a flight test environment?

MR. ORLOWSKI: By changing the terms in the equation.

DR. RENZE: Okay. I'm sorry. Could we back up to slide number 6? And I'm going to be going through a couple of slides here. Okay. Thanks. How are the advisory data, the configuration schedules themselves documented and communicated to operators?

MR. ORLOWSKI: Mr. Geisman, I think can correct me, but as I discussed in the -- earlier when I talked about the QRH page, the notes at the bottom basically describe the assumptions that are used within that data.

MR. GEISMAN: May I go ahead, Kevin?

DR. RENZE: Certainly.

MR. GEISMAN: We in the flight crew operating manual, we have text that describes the assumptions or some of the assumptions in the slippery runway data. We also have text on the landing charts, the actual data or the charts themselves that describe the assumptions that are in it. We have information in the flight crew training manual that discusses that. We have performance engineer classes for the airlines that when they come, where we discuss this. When we do flight crew training or dispatcher training, this is typically a topic of discussion. At flight operations symposiums over the last 20 years, we have had presentations on this particular item including an article written in 1993, and we also had discussions at performance and engineering conferences. We also did a presentation at the International Meeting of Airplane Performance on Contaminated Runway in 1996 and 1999 on this subject.

DR. RENZE: So, for example, for the slide you prepared for the presentation, this slide, if we could bring it back up. Within the many communication mechanisms that you described for publications, for example, the graphical depiction of the scheduling for the advisory data, somewhere that is available to operators. It's not just available to us today as a result of our public hearing?

MR. GEISMAN: In the publications themselves I guess I don't remember a specific drawing like that. It is in our classes typically when we show it to the operators at that point, okay, and it's described verbally if you will in the publications and the notes on the publications.

DR. RENZE: Okay. If we could forward the slide to number 9 please? My question is with respect to quick reference handbook data, and whether or not these data or similar data are available for all current production models.

MR. GEISMAN: Yes, they're available for all current production models. They're all current production models.

DR. RENZE: Okay. What about post-production models?

MR. GEISMAN: For some of the post-production models it's available. The 757 has this information in the quick reference handbook. The 737s all the way back through the 100 have this in the quick reference handbook as cockpit commonality issues with the new airplane, our part of that. It is not available in this specific format on the 727 or 747-200 generations.

DR. RENZE: Okay. Are thrust reverser adjustments available for all Boeing models in advisory data?

MR. GEISMAN: All Boeing models, no, it's not available. We've done it as you see here for the new models and typically on request of operators if they ask a request, we will provide a package of data for them on some of the models that don't have the same publications.

DR. RENZE: I have a hypothetical question now. Suppose advisory data contained thrust reverser effects and no performance adjustment exists for that particular airplane model, how could an operator perform an operation calculation if a thrust operation were inoperable?

MR. GEISMAN: Many of the operator -- excuse me. In what's called the performance engineer manual, we do have information, generic information on the effect of thrust reverser on stopping distance as compared to brakes only, reversers only and so on. So some of that information could be used by the operator. Otherwise, there's not necessarily a direct calculation available for some airplanes.

DR. RENZE: Okay. If we could forward to slide number 12 please. My question regards performance adjustments, and I'm interested in why all the performance adjustments you show here weren't available for instance for the 37-300 back in 1984?

MR. GEISMAN: In 1984, at that time, we put this type of information in the performance engineer's manual, not in the flight crew manual, and we did have some of those performance adjustments but we did not have all of them as you said. I do not know a specific reason on why it was not done at that time.

DR. RENZE: Okay. Are there any additional adjustments that you would foresee in the future to be added to this list?

MR. GEISMAN: I do not see anything that would be added at this point.

DR. RENZE: Okay. Thanks. I want to refer to a slide from your presentation yesterday now and we can keep this slide up for reference purposes for the discussion. Yesterday you noted that in a scenario in which reported braking action were medium, or I'm sorry, reported braking action was good, but the actual condition was medium, that that would equate to a roughly 1300 foot distance in terms of actual performance. And I was just wondering if you could walk us through from this reference page where that 1300 number could be found.

MR. GEISMAN: Okay. And I'll apologize for not remembering the exact reference conditions that were used, but if you go to this chart here, and if you enter the max autobrake setting data for medium at the referenced conditions, you see that there's a distance of 5290 feet for --

DR. RENZE: Yes.

MR. GEISMAN: -- for that referenced condition, and if you work backwards and look at the referenced distance for good, you see that that number is 4120. So the increase there would be roughly 1200 feet. Also you have to take into account a couple of the other corrections because I believe I used V rev plus 5 because that's often a standard landing speed. So that would add a little bit more difference, but that's the basic idea.

DR. RENZE: Sure.

MR. GEISMAN: Is that what you're looking for, sir?

DR. RENZE: Yes. Thank you. Are you familiar with the notice, notice 8400.C082 and its proposal to add, for instance, a 15 percent factor?

MR. GEISMAN: Yes.

DR. RENZE: For the example that we just talked about, would that 15 percent factor provide adequate margin for the example that you presented yesterday?

MR. GEISMAN: I'm not sure I understand the question, Dr. Renze.

DR. RENZE: Sure. So suppose good reported braking action was the best information available, and we were planning to use max autobrake, and we entered the quick reference handbook and we determined that the actual performance expected, and we used the referenced conditions for simplicity was 4100 feet, but the actual condition of the surface was more like medium, so closer to 5300 feet, if we were to factor the 4100 number by 15 percent, would we provide 1300 feet of margin?

MR. GEISMAN: As you see from the map, that would not be the case but the actual margin is dependent on the runway that is actually being used for the landing.

DR. RENZE: Sure.

MR. GEISMAN: So if there is additional runway available, it certainly could be more or less than that.

DR. RENZE: Right. Nick, could you bring up the study, page 14, there's a table at the bottom of the page. Thanks.

With respect to this table, why did Boeing associates these numeric values with the reported braking action conditions that are shown?

MR. GEISMAN: The question is why did Boeing chose the airplane braking coefficient values and correlate them to good, medium and poor the way it is set up in that table?

DR. RENZE: Right. Well, let me back up.

MR. GEISMAN: Okay.

DR. RENZE: First of all, is that the correct mapping between nomenclature for good, medium, poor reported braking action and numeric values that are used to generate your quick reference handbook tables?

MR. GEISMAN: Yes, that is the correct mapping.

DR. RENZE: Okay. So my following question is why was that particular numeric mapping chosen?

MR. GEISMAN: As neither Mr. Orlowski or myself were involved in the actual mapping of that, that was done by the engineering staff in their evaluation of various or of the information available. Part of that was that the good description is felt to be representative of the wet runway and we have significant flight test data that shows that .2 is a valid airplane braking coefficient for a slippery, wet runway. It was also felt that the poor should be representative of the wet, ice runway as a conservative site calculation and .05 was chosen as a very poor braking. So I can't give you a specific answer on all the things that were considered but that's how it works out.

DR. RENZE: That's fair. Thanks. Do operators know that this is the mapping that you use in your quick reference handbook tables?

MR. GEISMAN: This mapping is covered in our performance engineer classes that we do, what is called our operations class and it's provided to them, and we also answer in our office roughly 8,000 correspondence with operators a year, obviously all not on this subject, but if they ask questions, we will tell them what that is, but also with further explanation of the difference between airplane braking coefficient if you will and not -- a warning that it's not tire to ground friction.

DR. RENZE: Okay. In your opinion, should there be flexibility for operators to choose a different mapping?

MR. GEISMAN: Operators know their operating environment much better than we do in that, and they can be more conservative if they choose to also. So there's -- we provide the data of the capability, the operators need to adjust it to their operations as appropriate.

DR. RENZE: Okay. Thanks. I'd like to discuss the notice briefly. From your understanding, what actions are required at Boeing as a result of the notice?

MR. GEISMAN: We're still evaluating some of what is required on that but the biggest part of the notice or the part that will be addressed directly or most likely is in there it says the information or data supplied to the European operators to meet the JAR requirements is adequate for appropriate data, and so for roughly 3 to 500 of our operating manual, we will probably take that JAR data and put it in the operations manual just as you saw it there only factored by 15 percent assuming everything stays the same. So that would be 6 to 12 months on the revision, the normal revision cycles to put that into the data. And then on some of the other airplanes that do no have it in the flight operations manual, we anticipate that we will have to send the JAR data packages or the data packages that were created to those operators and they will have to implement them similar to what those operators on those airplanes did for the JA requirements in Europe. Basically we plan to do the same thing that we would have done for the -- that we did for the JA operators.

DR. RENZE: Okay. Thanks. Is there any additional action you would recommend?

MR. GEISMAN: Nothing that I've thought of -- thought about in the past.

DR. RENZE: Has Boeing evaluated what landing margin is adequate?

MR. ORLOWSKI: Not to my knowledge, however, there has been some discussion lately regarding what that may be and how to define that.

DR. RENZE: So it's still a work in progress?

MR. ORLOWSKI: It's work in progress. It's in the infancy.

DR. RENZE: Okay.

MR. GEISMAN: If I may remind that margin can come in other methods also, not just factoring. It can be a fixed distance. It can be assigning a different airplane braking coefficient to be ultra-conservative. So there are other methods that airlines could use to create margin also.

DR. RENZE: Okay. My final question regards the location of data. Is there an advantage for data to be located in the airplane flight manual for example versus the quick reference handbook in terms of safety implications or operational use?

MR. ORLOWSKI: The reality is that the flight crews are not looking in the AFM. They're using the QRH data for the most part or some sort of on-board computer. My concern is just that the operators and the flight crews have the information that they need to make an educated decision at the time.

DR. RENZE: Okay. Thank you. That's all I have.

CHAIRMAN ROSENKER: Thank you, Dr. Renze. No other questions from the Technical Panel. So we'll move to City of Chicago?

COMMISSIONER FERNANDEZ: The City of Chicago has no questions for the witnesses.

CHAIRMAN ROSENKER: Southwest Airlines?

MR. LOGAN: Just a couple, Mr. Chairman. Could you pull up the chart that had the correlations between the braking action reports and the mu values?

MR. ORLOWSKI: I'm sorry. Are you talking about the study, the table and the study?

MR. LOGAN: Yes.

MR. ORLOWSKI: Okay. Thanks.

MR. LOGAN: Okay. That's it. Yeah, thanks. Mr. Geisman, you're aware that flight crews report braking action in poor, good, fair and nil conditions. What does Boeing equate those braking action reports to, to a coefficient value?

MR. GEISMAN: Okay. As a reminder, that's airplane braking coefficient --

MR. LOGAN: Right.

MR. GEISMAN: -- not tire to ground friction. And we have provided write ups and information equating poor to poor, if you will, between the -- let me back up a second, sir.

The good, medium, poor we use is based on ICAO terminology, okay, which is what most of the world uses. We have provided information showing fair and medium as being equated at various points. We have also shown information with poor. Quite frankly, there has been times in the past that we have also shown that nil and poor between the ICAO on the FAA. I can't say that it's been consistent over all the years from that, on the lower end of the spectrum.

MR. LOGAN: Okay. What's nil? How does that --

MR. GEISMAN: Well, nil is not a performance level that we deal with. You really should ask the flight crew on that particular question, what they feel nil means to them. Like I say, we operate for performance coefficient in that.

MR. LOGAN: Okay. Thank you. The other questions is, and I'm not sure which, Mr. Orlowski or Mr. Geisman, but on the data that's provided in the simulator packages that go into the flight training simulators, is there a mu value that Boeing provides in that, that are consistent across these types of braking action reports?

MR. ORLOWSKI: I'm not capable of answering that question. That's actually a different group that works with that. I don't have expertise in that. So I cannot answer that question, however, we can take that request and get back to you with that information if you so desire.

MR. LOGAN: Okay. I appreciate that. Thank you. That's all the questions I have, Mr. Chairman.

CHAIRMAN ROSENKER: Thank you very much. Southwest Pilots Association.

CAPT. HEFNER: Thank you, Mr. Chairman. And I'm not sure which one of you all to address this to but the Boeing landing module that was provided to Southwest Airlines for the OPC, that is proprietary Boeing software. Is that correct?

MR. GEISMAN: I believe it is labeled that way.

CAPT. HEFNER: So the embedded assumptions that are in that data, spoilers within a second, thrust reverser deployment in 2 seconds, thrust reverser spool up 4 seconds after deployment to 75 percent N1 and held until 60 knots, those are all in that landing module, correct?

MR. ORLOWSKI: That's correct.

CAPT. HEFNER: Okay. And is that defined to the operator that those embedded assumptions are indeed part of that landing calculation?

MR. ORLOWSKI: I do not know. I don't think there's anywhere where it's actually written down what those transition times, if that's what you're speaking to, the times and the actual sequence of events.

CAPT. HEFNER: That and just the fact that the embedded assumptions do exist in there, and that's part of the landing performance calculation that the flight crew is actually making.

MR. ORLOWSKI: Yeah, I don't believe that is made.

MR. GEISMAN: That distinction, if you will, is certainly made in many of our performance engineer classes, and we talk about the software and the relations to the operations manual and the data that goes there, because those calculations are the same.

CAPT. HEFNER: Okay.

MR. GEISMAN: So we do talk to them about that in our performance engineering class.

CAPT. HEFNER: In the performance engineering classes.

MR. GEISMAN: Yes.

CAPT. HEFNER: But as opposed to the actual operating crew member that is making these landing decisions predicated on that data in the cockpit at that point in time, that information is not really readily accessible, correct?

MR. GEISMAN: I'm sorry, sir. We can't answer that because that's dependent on the airline and what the airline has chosen to supply to the flight crew.

CAPT. HEFNER: But that's not in the landing module itself. I think it's pretty clear.

MR. GEISMAN: It's not an output from the landing module, that's correct.

CAPT. HEFNER: I appreciate that. That's all the questions that we have. Thank you.

CHAIRMAN ROSENKER: Thank you very much. The FAA please.

MR. WALLACE: Thank you, Mr. Chairman. I want to just go over again this discussion about the correlation. I noticed, Mr. Orlowski, in your presentation, you equated various runway contamination conditions to various braking actions, good, fair, poor, but you do not include mu values or any equivalency, any correlation to runway friction measuring device readings. Is that correct?

MR. ORLOWSKI: That's correct.

MR. WALLACE: Just to be clear, in your presentation yesterday, Mr. Geisman, where you included the runway friction measurement test taken before and after the accident with the values of .67 and .4 and .41, whatever it was, that does not correlate to the values we saw up on the white chart from the study just a minute ago?

MR. GEISMAN: At Boeing, we have not made a correlation between the airplane braking coefficient and the friction values as you just said. That's correct.

MR. WALLACE: I'm a bit confused because yesterday I believe it was in Mr. DeGroh's presentation, you put up a correlation table as well, and I was very surprised to see in the table we just saw a correlation of .4 with either good or dry.

MR. GEISMAN: Sir, I remind you that the table we just saw was airplane braking coefficient and not tire to ground friction.

MR. WALLACE: Okay. And so when we talk about these friction measuring devices that we discussed at length yesterday, those are measuring tire to ground friction?

MR. GEISMAN: Correct, sir.

MR. WALLACE: The inclusion of thrust reverser data, I believe you said, Mr. Orlowski, that the 737 data always has thrust reverser. I just want -- there was some discussion about this earlier. I just want to be clear. For the, for the older aircraft, is that say 727 or earlier models of 737s, a 737-200, is that data on thrust reverser not in the advisory data?

MR. ORLOWSKI: Mr. Geisman can correct me, but I believe that the older airplanes do have the reverse thrust data included but there are no way of backing out what that effect is. In other words, you don't have like the QRH page there where you can take out the effect of one reverser or no reversers being operated. There's no way to actually on those data to back out the use of no reverse in the calculation.

MR. WALLACE: And, Mr. Orlowski, in your presentation you said that the operators can, talking about the unfactored data in the advisory data, that the operators can then put in whatever air distance they believe is appropriate for their operation, use 1,000 feet as a nominal distance but the operators can adjust that air distance?

MR. ORLOWSKI: That's correct.

MR. WALLACE: And then I assume it is up to the operators to add whatever further margins or conservatisms or factors they choose.

MR. ORLOWSKI: We provide the airplane capability specifically so the operator can add the margins they need because their operations are different and certain operations require different margins. So it's up to the operator to decide what should be based on that. Boeing should not be telling the operators how to operate their airplane in terms of margins added to the distances.

MR. WALLACE: And does Boeing become involved in that as sort of a customer service? I mean you obviously deal with operators that probably have greatly varying levels of sophistication, their engineering departments or whatever?

MR. GEISMAN: As I mentioned, we answer many questions from the operators at all times. And so if an operator asks questions on that, we will not tell them what the final answer is. We may tell them some examples that we are aware of, how other operators do it and why. We will tell them some of the considerations they may want to take into consideration when they look at that. And typically we'll also tell them that the JAR Regulations and the operators in Europe are required to use that 15 percent factor.

MR. WALLACE: Okay. My final question, and if this is a question that I can -- I may have to wait for the -- Mr. Gleason from Southwest, but I'm curious to know if you are involved in or can explain how the data gets into the operations performance computer that's taking the Southwest case. In other words, is Boeing involved -- the first question is, is there some other vendor between Boeing and Southwest who is involved in the calculation or computation of that data and/or does Boeing have a role in that?

MR. GEISMAN: Boeing provides to the vendor, the operations manual and the computer program if you will. I think I said vendor. Boeing provides to the airline, the operations manual and the computer program. Then the airline may take that and transfer it to a vendor, you know, to create the calculations. So they -- the airline is the ones. So you're correct. It's more appropriate to talk to Mr. Gleason about that.

MR. WALLACE: And is Boeing in general, do you deal only with your airline customers or do you, in fact, occasionally deal with vendors of this -- the third party vendors with this sort of data or this sort of computational equipment?

MR. GEISMAN: In most cases, I certainly would never say all cases, we deal with the airline and the airline's responsible for dealing with the vendor. The reason I make a small hesitation there is Boeing owns Jepson and so they do have direct access to some of our data which other vendors do not. So there's a little bit of a different relationship there.

MR. WALLACE: Okay. Thank you very much. No further questions.

CHAIRMAN ROSENKER: Thank you. Finally, the Boeing Company?

MR. SMITH: Boeing has no questions.

CHAIRMAN ROSENKER: Thank you. To our Board of Inquiry. Dr. Ellingstad.

DR. ELLINGSTAD: Just a couple of questions to try to clarify my understanding of some of your assumptions and calculations.

With respect to the factors involved in creating your landing margins, where do the 1.67 and the 1.15 come from?

MR. ORLOWSKI: That comes from 14 C.F.R. Part 121. I believe it's 25 or 121.195(d).

DR. ELLINGSTAD: So basically they're given to you by the FAA?

MR. ORLOWSKI: That is correct.

DR. ELLINGSTAD: Okay. You had -- I'd like to also follow up in terms of your differences between your certified landing distance calculations and your advisory data, and sort of get at some of the issues of assumptions that SWAPA was raising. You indicated that your, your QRH data are entirely derived from calculations. Is that correct?

MR. ORLOWSKI: The dry calculations are based on flight tests.

DR. ELLINGSTAD: Right.

MR. ORLOWSKI: The other calculations are derived, engineering derived in the office.

DR. ELLINGSTAD: Right. So that the -- okay. So your dry calculations are taken from your certified landing distance. Your medium and poor would be some adjustments in your coefficients?

MR. ORLOWSKI: That's correct.

DR. ELLINGSTAD: And they make some assumptions about a variety of different kinds of procedures in terms of thrust reverser deployment and when that happens?

MR. ORLOWSKI: Yes. Basically as I stated in the presentation, the sequence of events is identical. The only difference is the braking model to account for the difference in runway condition.

DR. ELLINGSTAD: Okay.

MR. ORLOWSKI: So the same time sequence is involved that I showed on the chart in terms of --

DR. ELLINGSTAD: Okay. My question is are any of these calculations and the results that they will having on the braking distance validated empirically.

MR. ORLOWSKI: The transition times, the reverser times are all based on flight testing. The braking is not from direct flight testing of the 737.

DR. ELLINGSTAD: Okay. But your assumptions having to do with reverser deployment, these kinds of things are based on a flight test?

MR. ORLOWSKI: Those are based on the 737-100 flight test, that's correct.

DR. ELLINGSTAD: Okay. Thank you.

CHAIRMAN ROSENKER: Mr. Clark.

MR. CLARK: You talked a little earlier about the advisory material, or the advisory stopping distance, that information and then the information that's required to be put in place by certification. And I guess the summary of that is the difference between the advisory and the certification is that it's all based on flight tests. There is some engineering evaluation on the assumption of a friction coefficient, and then the difference would be the use or non-use of thrust reversers. Is that --

MR. ORLOWSKI: Yes, that's correct.

MR. CLARK: And so essentially we're talking about unfactored data which means there's no corrections to buy safety margin for the pilot. Is that correct?

MR. ORLOWSKI: That's correct. For the advisory data.

MR. CLARK: But that's what Boeing's business is, providing the performance data for the airplanes, and I think you just said earlier that the business of applying factors should be at the operator's level or FAA's level. Is that correct?

MR. ORLOWSKI: The operators, yes, as far as the advisory data. That's correct.

MR. CLARK: Have you participated in or are you aware of the announcement that the FAA just came out with to provide an additional 15 percent margin to the unfactored data?

MR. ORLOWSKI: Yes.

MR. CLARK: You participated in that or discussed with FAA?

MR. ORLOWSKI: I had some minor involvement in terms of reviewing the draft.

MR. GEISMAN: And so did I, and we provided comments to an earlier draft.

MR. CLARK: Okay. So the question is, in your estimation, is the 15 percent enough to provide an adequate margin?

MR. GEISMAN: The 15 percent has been used in Europe for the last 10 years and I'm unaware of any problems associated with that in the use in Europe.

MR. CLARK: My only question is, in some of the examples is, if the braking action were poor, I think in your presentation to us earlier, it's in the docket, suggested that sometimes the length of the landing distance may increase by 5,000 feet in this type of scenario with poor braking?

MR. GEISMAN: I'm sorry. The number that we were using -- let me back up. What are you referring the 5,000 feet to?

MR. CLARK: Landing distance if you land on a runway with braking conditions is poor and no thrust reversers, those distances may get out quite a bit longer than the dry or the dispatch type landing distances.

MR. GEISMAN: Yes, they would assess it with no thrust reverser or if the runway is poor as in Mr. Orlowski's presentation, and some of the material I showed yesterday, yes.

MR. CLARK: And I guess my concern is that what we've heard earlier is the -- certainly the runway friction measurement equipment may have scatter in it or the pilot reports may have scatter, and I may be landing on a runway that has poor landing conditions and if I don't get my thrust reversers out, would the 15 percent factor provide me the protection I need?

MR. GEISMAN: The 15 percent factor would not be of a magnitude for no reverse thrust.

MR. CLARK: Right.

MR. GEISMAN: It also may not be of a magnitude for no spoiler deployment or no use of the wheel brakes.

MR. CLARK: Right. What provides you with the most stopping margins, spoilers or thrust reversers?

MR. GEISMAN: On a --

MR. CLARK: Stopping performance I mean.

MR. GEISMAN: On the slippery runway that we are talking about at this point, it would be the thrust reversers if we're talking of a poor runway. If we're talking on a dry runway, then the spoilers are much more important in the distance calculation if you will.

MR. CLARK: Or wet, such as in our Little Rock accident?

MR. GEISMAN: Wet, I'd have to look at the data to see. Somewhere you have a crossover between the effect of use of the reverser and the spoilers based on how slippery the runway is. The benefit of the spoilers is mostly in the wheel brakes. Yes, there's a drag benefit, but getting the load on the gear as the runway gets more slippery, of course, the wheel brakes become less effective. So the additional benefit of load on the gear is not of as big a magnitude.

MR. CLARK: Okay. Then there was some discussion here just a second ago about embedded assumptions in the data. Does Boeing keep that type of information secret?

MR. GEISMAN: No, sir.

MR. CLARK: How would an operator find out about so-called embedded assumptions?

MR. GEISMAN: Well, there's like the labeling on the charts, as you've see, have certain of the assumptions in there, and in any of our classes, those assumptions are in there, and the procedures in the flight crew training manual that talk about prompt deployment of reverse thrust and so on are consistent with the way we provided the data, and it's consistent. So there are multiple sources. And like I said earlier, we have also spoken at many symposiums and conferences on this subject to make sure everybody is aware of the data we provide.

MR. CLARK: And you answer the telephone?

MR. GEISMAN: Absolutely, 8,000 times a year we do.

MR. CLARK: All right. Thank you.

CHAIRMAN ROSENKER: Thank you, Mr. Clark. Mr. Benzon.

MR. BENZON: Just one perhaps naïve question. Why doesn't Boeing go out and find slippery and wet runways to actually test their new aircraft on rather than use extrapolated data?

MR. GEISMAN: The test, the typical test is for certification purposes, and it's done to meet the certification requirements. On our later airplanes, like the 37-700, there is wet testing done for the purpose of some engineering methods involved but for creating the wet runway data to meet the latest certification requirements. We also have a significant amount of wet data from the early sixties and seventies on many of the airplanes which became an acceptable engineering position for calculating it. Similar with some of the slippery runway. You know, it's become -- there is information from older airplanes in history that we have used that's become an acceptable engineering estimate.

MR. ORLOWSKI: If I may add one thing also, when we do our flight testing, we do conduct it per Advisory Circular AC 25-7A which is the FAA flight test guide which basically prescribes what we are to flight test and how we are to flight test it.

MR. BENZON: That's all I have. Thank you.

Dr. Ellingstad and Mr. Benzon covered the areas. I guess it's a small price to pay to be the last questioner but I have no questions. Thank you so much for your testimony. We appreciate your participation today. The witnesses can be excused.

MR. ORLOWSKI: Thank you.

MR. GEISMAN: Thank you.

(Witnesses excused.)

CHAIRMAN ROSENKER: Mr. Benzon, will you call the FAA and the next witness panel please?

MR. BENZON: Okay. The Board calls Mr. Jerry Ostronic and Mr. Don Stimson please. Gentlemen, could you please stand to be sworn in?

(Whereupon,

JERRY OSTRONIC and DON STIMSON

were called as witnesses, and having been first duly sworn, was examined and testified as follows:)

MR. BENZON: Okay. Please have a seat and give us a little bit of your background at the FAA.

CAPT. OSTRONIC: Thank you very much. My name is Jerry Ostronic. I'm an Operations Aviation Inspector with the Federal Aviation Administration, assigned to the Air Transportation Division here in Washington. I’m also an airline transport pilot myself, type rated in a Boeing 737. I've been an inspector for approximately 11 years, in two different stints in the military. I spent 16 years with a major U.S. carrier as a captain and instructor pilot on a 737 and a DC-9. More important to this group, I'm the Team Lead for the FAA Air Transportation Landing Performance Team.

MR. STIMSON: Good morning. I'm Don Stimson. I've got 26 years of experience now in airplane performance, in the specialty of airplane performance, the last 15 of which have been with the FAA, and my current position now with the FAA is as an engineer who's responsible for the policies, regulations and guidance having to do with airplane performance and airplane handling qualities relative to transport category airplanes.

CHAIRMAN ROSENKER: Captain Ostronic, do you have a presentation to begin with?

CAPT. OSTRONIC: Yes, we do, sir --

CHAIRMAN ROSENKER: Let's proceed.

CAPT. OSTRONIC: -- but I can't find it on the computer here.

CHAIRMAN ROSENKER: Okay. I see a bunch of slides up there.

CAPT. OSTRONIC: We'll get it off the disk we have with us.

CHAIRMAN ROSENKER: Thank you very much.

CAPT. OSTRONIC: After the Southwest 1248 accident, there was quite a few questions being asked within the Agency itself, in the press and also by the National Transportation Safety Board. Some of the questions you can see on the slide there that we were being asked is are the regulations adequate and adequately understood to cover landing performance and landing performance on contaminated runways. The other question obviously being asked was the accuracy of the information computed and disseminated through the use of electronic flight bags, not only electronic flight bags but by tab or graphical data that were being used for that purpose. And last Boeing presented, are thrust reversers allowed to be factored in the landing performance calculations? Next slide please.

The FAA Air Transportation Landing Performance Team was tasked, first of all, to evaluate those questions identified on the previous slide along with any other questions that were associated with that. In order to do that, we evaluated the regulations and policy and guidelines, both internal and through other publications. In addition, we looked at what the current practices were of the air transportation operators, and later we were tasked with analyzing the NTSB urgent safety recommendations for the disallowance of use of thrust reversers in landing performance calculations at time of arrival. Next slide please.

The team consisted of a broad scope of FAA specialists, and that was intentional so that we looked at the entire picture. As you can see, we had aircraft certification performance engineers, operations specialists, dispatch specialists, airport division personnel, air traffic oversight office, human factors and also members from the accident investigation specialist team.

The first question, were the regulations adequate -- regulations policy adequate and were they adequately understood?

There are a lot of mixed answers to that. One of the things that we heard repetitively was a statement that legal to dispatch, legal to land.

The other question was is there a requirement to do a recalculation of landing distance at the time of arrival?

Well, we looked at the pre-flight landing requires in 121.195 and in sister regulation 135.385, and there's a segment in one of the subparagraphs, allow an aircraft to actually be dispatched knowing that it cannot land in the conditions that are forecasted if an alternate airport is provided? Obviously, clearly as stated there is a requirement to do a calculation at the time of arrival to assess whether conditions have changed that would allow a safe landing at that time. Next question.

Are thrust reversers allowed to be factored in landing distance performance calculations?

Once again, as Boeing presented previously, there currently are no authorizations for the use of thrust reversers in the certification of landing distance performance calculations. That's a longstanding policy, not prohibited by regulations, but a longstanding FAA policy. Being that the specific requirements for doing at time of arrival landing calculations, there's no specific regulatory requirement addressing that. It does not address whether thrust reversers could be used for that determination or not.

Manufacturers, as Boeing presented, often have thrust reverser data factored into their calculations for use at time of arrival landing calculations.

What safety margin is required in the landing distance assessments at time of arrival?

Once again, Boeing presented it very well. The 1.67 factor for a dry runway for dispatch requirements and also the additional 15 percent for wet runway requirement.

Regulations require operators and pilots to stay informed at the airport of runway contaminations and meteorological conditions and to restrict or suspend such operations if they cannot be conducted safely. Air carriers are also required to operate at the highest level of safety. To operate at the highest level of safety implies that the safety margin is provided for. Next slide please.

Are the landing distance computed by electronic flight bags accurate for all conditions?

Once again -- electronic flight bags but tab data or even graphical data. Some of this data for runway landing distance performance calculations may be different from the advisory data prepared by the manufacturers. There's a couple of reasons for this that we found out, that some of the data may have been changed since the original advisory data was created by the manufacturer and not adjusted, and there are also some third party vendors that take the data from the manufacturer and manipulate it or misinterpret it to produce the advisory data whether it be in tab or electronic format.

Team findings. Although not specifically spelled out, the following requires are embedded in the operational regulations in fundamental to safe operating practices. An assessment of required landing distance is required at the time of arrival, runway conditions, the actual braking capability must be accounted for in the assessment at the time of arrival, and a consistent adequate safety margin must be available for the runway of intended landing. Recommended that the elements contained in the previous slide be specifically identified in the applicable regulations. In addition to that, the team recommended that the manufacturer be required to supply the contaminated runway landing performance data in an approved section to the AFM per an established standard.

The implementation plan, in a short term, what we've taken action already for, is the issuance of operation specification C82 to explicitly identify the requirement to do a landing assessment at time of arrival. We also published in the Federal Register a notice that talks about how the content of that operation specifications and how our inspectors are to evaluate an operator's procedures for the issuance of that operations specification. We're also in the process of developing a safe code to advise operators of the possibility of misleading advisory information.

Long range goals. Work with industry to revise Part 25 and the applicable operation rules. Number one, to work to get the advisory information for contaminated runway operations from the advisory section of the operator's manual system into the approved portions of the flight manual. And because of the way the regulation structure is, we would need to do a parallel change to the operation rules to have that data applicable to aircraft that are already certified.

And to move the more explicit language that is in the ops spec into the -- to be more specific actually in the regulations, to address that.

I'm trying to read from the slide, and it's a little difficult.

Team findings on a longer range, also is to work with industry and other government groups to find more accurate ways of determining runway conditions and to disseminate that information onto the operators and the users. Next slide please.

Content of the operations specification, C82, once again, it will require an assessment of the landing distance at time of arrival, take into account the actual meteorological conditions, the runway conditions and whatever de-acceleration devices that is planned to be used on the landing itself for the actual runway that will be used.

The procedures the operator develops to comply with the ops specification must yield results that are at least as conservative as the currently approved or advisory data generated by the manufacturer and the worst runway condition for the portion of the runway that would be used in the landing must be used in that calculation process. And in addition to that, the operations specification require that at least a 50 percent safety margin be available beyond that landing distance.

Also a training element in the notice, the one aspect of the training element is that both dispatchers and flight crew members be trained on all the assumptions -- on the operator's procedures for doing at time of arrival landing calculations and all the assumptions that that landing distance is based on.

Second of all, a second training requirement would be a briefing of flight crew members on the procedures to be used for landing on contaminated runway, in contaminated runway conditions, and the third training element would be at the next cycle of flight or simulator training, that the crew members have training on landing on contaminated runways and be evidenced on that performance. Next slide.

MR. STIMSON: What I'd like to do now is walk you through an example of the implementation of the notice and the ops specs C82, and what effect it would have on a landing distance calculation.

What we've chosen to show you here is an example based on the accident flight and how the distance that would be required to land would be affected by the notice.

I draw your attention first to the notes at the top. Those are the conditions for the accident flight that were known to the crew prior to beginning the approach. These are the actual conditions that were input into the Southwest on-board performance computer to derive the landing distance information. And I note that it's for maximum autobrakes and it includes the effect of reverse thrust.

Now in the table is shown for both poor and fair braking conditions. You've got both landing distances and in parentheses, the approximate stopping margin which is the number that is shown to the crew by the Southwest on-board performance computer. The condition that was run for fair by the crew you see in the pre-ops spec line in the parentheses is 560 feet, and you should recognize that as the number that was discussed yesterday as being the approximate stopping margin available under the conditions that the crew input into the OPC.

After the ops spec comes into effect, since the conditions were reported to the crew as various, fair to poor, good to poor, they would be required to use the poor runway description and it shows there that they would have a negative stopping margin and would not be able to land.

I want to also point out that under poor conditions with the asterisk there, Southwest's own limitations are that they will not land in more than five knots of tailwind. So those numbers calculated there are actually calculated with five knots of tailwind and there would be given a note to the crew, a message to the crew from the computer that the tail wind limits have been exceeded and would not permit them to land even if the distance were appropriate.

The second thing I'd like to caution you about is trying to calculate those approximate stopping margin numbers from subtracting out the distance as shown her from the actual distance available on the runway. The available landing distance is 5,826 feet on Runway 31C, and you'll notice if you subtract out the numbers, there is some rounding in those approximate stopping margin numbers.

CAPT. OSTRONIC: Mr. Chairman, that's the end of our presentation.

CHAIRMAN ROSENKER: Thank you very much. We'll go with the Technical Panel, and we'll begin with Dr. Renze please.

DR. RENZE: Thank you. I just wanted to clarify a couple of points about the notice versus Part 121 dispatch requirements that have been in place for a long period of time. So I would like to begin with, how will Part 121 dispatch calculations change as a result of the notice?

CAPT. OSTRONIC: They will not change at all.

DR. RENZE: Okay. And what role with those calculations play in determining whether an arrival calculation is necessary per the notice?

MR. STIMSON: In most cases, because of the large factors on the dispatch calculations, those will provide sufficient field length to -- for the operator to be able to make a simple assessment that there is at least a 15 percent safety margin under the conditions. For normal dry runway conditions, for example, the dispatch requirements would override or would be more critical, be more constraining than the 15 percent margin at arrival. It's only when runway conditions get worse than good. Once they get to fair, depending on what the air distance is used, then the 15 percent margin will come into play.

DR. RENZE: Is there an intent as implemented in operational practice that a dispatch calculation be used as a source for comparison?

MR. STIMSON: There's an intent that the operator will have to look at both. They will start off, they will need to run the dispatch calculation and presumably they will look at the on arrival calculation as well to see how it may impact them.

I do want to -- I want to correct my previous answer a little bit and add something to that. As Mr. Ostronic noted that the dispatch requirements allow you to depart an airport and depart for another one, even if the conditions at the time of dispatch are such that you could only land on the most favorable runway, in other words, the longest runway, but at the time of dispatch that runway is not available to you for some reason, and the most suitable runway, the runway that you are probably going to land on, you would not meet the dispatch requirements but then you are required to look at that when you get there. So in that case, the 15 percent margin comes into play as well.

DR. RENZE: Okay. I'd like to move on briefly toward some of the history and certification related issues.

Captain Ostronic, you noted that there is no FAA regulation that prohibits thrust reverse credit in landing certification but there is a longstanding policy. Why is that policy in place?

CAPT. OSTRONIC: If you don't mind, I'll let Don answer that as the performance engineer.

DR. RENZE: Thank you.

MR. STIMSON: Mainly for historical reasons. When the regulations first came into being, thrust reversers were not seen as being reliable enough to count on. Also as has been pointed out, the regulations address dry runways and they address wet and slippery runways on a factored basis. There is no direct specific calculation for different runway contamination conditions. So as we start to address those specifically, and we've done this on the takeoff side, RTO, for wet runways, as you get more and more slippery, reversers tend to be a bigger part of the stopping distance equation. So we'd be essentially taking away -- we'd be requiring them to account for much more restrictive conditions but not allowing them to take credit for the most effective braking device.

DR. RENZE: Okay. Mr. Ostronic also noted that there has been a longstanding practice of incorporating the credit for reverse thrust in operational landing data, and that there is no regulation or policy that prohibits doing so. Is the fact that there's no policy in this area adequate to justify the practice?

CAPT. OSTRONIC: I'm not sure I question understand the question, Doctor. Could you restate exactly the question?

DR. RENZE: Sure. You noted that there's no regulation or policy prohibiting the use of thrust reverser credit in operational landing data. So as I understand, industry practice has been to incorporate reverse thrust credit in advisory data that they've put out. Does the fact that no policy exists itself justify the incorporation of this credit in the advisory data or is practice just good practice and the FAA hasn't chosen to compose anything in this area?

CAPT. OSTRONIC: Once again, to state what I believe Don just stated, on those conditions, on those advisory conditions where this data is provided, if thrust reversers were removed from that element, you'd be taking away in many cases the most effective stopping system available to the operator in those contaminated runway conditions. Some operators -- there are some manufacturers for certain models that do not provide data with thrust reversers but in the vast majority, it is provided, and as far as policy statements, we have no regulatory requirement to say you can or you cannot provide that data in that manner.

DR. RENZE: Okay. Thanks.

MR. STIMSON: If I could add something to that. Actually, we do have some advisory material, AC 91-6A, which there's also has been a draft, 91-6B, for a number of years, and in that, it recognized that reverse thrust credit was permissible.

It's also -- if we can look at the regulatory authorities in other countries as well, it's recognized that once you start accounting for contaminated runways, as long as the reversers are reliable enough, then credit has been accepted for them.

DR. RENZE: Okay. Why don't the certification rules require flight test demonstration on surfaces other than dry runways?

MR. STIMSON: Once you get off that dry runway -- well, you've all seen the data variability issue with the IRFI values, think of as you get off that dry runway and you get to a wet runway, you start having to ponder how wet is wet, and you actually start getting to that data variability issue as soon as you get to a wet runway. Different depths of water, what are you going to specify for the tire tread depth. You start dealing with a whole host of variations and to take an airplane in a flight test program out to demonstrate on a few wet runways or in a compressed flight test program in that kind of time limited environment, to try to hit what you would consider to be the critical wet runway, you're going to have a difficult time doing that.

Now extend that to ice covered, snow covered. There's various -- there's a lot of variability as soon as you start putting a contaminant on the runway, be it water and all the way down to slush, ice and snow.

So, instead what we do, there's been an awful lot of test data since the early 1960s on a wide variety of airplanes and I think as was mentioned the other day by Dr. Clark, when you've got this data variability issue, can't you just draw a line through near the bottom of that? So what we've done is taken this whole host of data which has this big scatter in it, for each type of contaminant, be it water, be it compressed snow, be it dry snow, be it ice, slush, and we've taken what we've considered a conservative fairing through all of that data, and then we've defined this to be the braking coefficient of friction that will be used. That's what's typically been done. Once you make the distance calculation, it's all physics anyway, and so you can put in the appropriate braking coefficient. It would be a much more difficult matter to go find the appropriate surface to test on.

DR. RENZE: Just to clarify, are you saying that the FAA provides the definition of airplane braking coefficient for some of these data or specifies the coefficient to be used?

MR. STIMSON: You asked about wet. I think your question was specifically wet, and for wet runway, that is exactly how we do it. The Europeans have certification requirements for contaminated runways. We work with them on that, and they have defined with our participation a similar definition for contaminated, and that's what we would intend -- that's what we intend to accept for these types of advisory data as well.

DR. RENZE: I'd like to transition toward some of the discussion concerning the notice. First of all, just for clarification, does the 15 percent factor apply to both the air and the ground distance?

CAPT. OSTRONIC: You say apply to both. It's the total. It's the conglomerate air and ground distance, yes. It's not broken into segments. It's the total air and ground distance.

DR. RENZE: Okay. Thank you. Where does the 15 percent come from?

CAPT. OSTRONIC: Well, there's actually 3 derivatives of where the 15 percent comes out of. One is the current dispatch requirement for a wet or slippery runway condition. There's a 15 percent additive there. Also to harmonize with what the JAR-OPS says, has in their current operational requirements, there's a 15 percent additive for contaminated runway operations. There also is some historical Advisory Circular references to a 15 percent additive for doing wet runway demonstrations and not accepting the standard 15 percent, 115 of the dry factor distance, to add a 15 percent factor. So those 3 elements together is where we come up with the 15 percent as being for right now what I heard from data the best number to use.

DR. RENZE: Was there a specific attempt to evaluate that 15 percent was adequate?

CAPT. OSTRONIC: If you're talking, Doctor, through a data collection of some sort, no, we did not collect specific data to do an evaluation.

DR. RENZE: Okay. Should the margin of safety for a contaminated runway be comparable to that for a dry runway?

CAPT. OSTRONIC: Could you rephrase that?

DR. RENZE: Boeing presented this morning the certification requirements for Part 25, for a dry runway, and the various factors they're applying to determine if they are dry and if they are wet or slippery. So there's a very conservative margin of safety incorporated, for example, into the dry runway data in the airplane flight manual, and I’m just curious as to your thoughts on whether or not that margin or any other margin should be comparable for any other runway surface condition.

CAPT. OSTRONIC: I'll try to clarify. Boeing, I believe, Boeing provides their data in their flight manual, in their digital flight data, in a factory basis. They add the 1.67 factor and so forth. That's not a technical requirement of the regulations. Other manufacturers choose to present the raw data, the unfactored data of which the operator, the 121 or 135 or the other operational rule, would have to add the appropriate factor for a dry runway distance or an additive for the wet runway condition.

Under the notice in the operations specification, at time of arrival calculations, the same additive of the 15 percent based on all the present conditions is applicable to a dry runway or a wet runway or a contaminated runway based on the unfactored distance that the manufacturer provides.

So I guess a more direct way to answer your question is there is not a difference from the notice in the ops spec perspective for the additive for a dry runway or a wet or contaminated runway beyond wet.

MR. STIMSON: The total margin of safety I think you'll find through the notice though, because it's composed both of a distance -- cushioned distance margin, the same 15 percent that's applied to both, but there are additional conservatisms we believe for as the runway is more contaminated. It's composed basically of two pieces, additional pieces. One is that you must take the worst report that's applicable to the runway distance that you will be using. So, for instance, if you get a mixed report of fair to poor, you will have to use poor, and the second being that you will need to map that the way that the airplane manufacturer has done which in this case was a conservative representation. The airplane braking coefficient of .05 or the .1 for medium or fair, and a .2 for good, are considered conservative.

DR. RENZE: Okay. I'd like to follow up with your comment, Mr. Stimson, with the last slide from your presentation. I just wanted to clarify the stopping margins that are reported in this table. Is a portion of the stopping margin that we see in the second row of the table due to the 15 percent factor and a portion of that margin due to a change in the airplane braking coefficient?

MR. STIMSON: Yes, it is.

DR. RENZE: Okay. And could you just walk us through what the values were used for each row of the table in terms of airplane braking coefficient?

MR. STIMSON: In the first row of the table for poor, it's .1, for fair it's .15. In the second row of the table, for poor, it's .05 and for fair it is .1. Those are airplane braking coefficients.

DR. RENZE: Okay. Thanks. Getting back to the notice, does the FAA plan to approve or accept the data that's used to meet the requirements of the notice?

CAPT. OSTRONIC: By definition of operations specification, that's the procedure that the company uses will be approved. As far as approving or accepting the data, the data itself would be accepted, not approved. The procedure that the company, the air carrier uses to provide that data to flight crew and how it's processed, would be approved by the operations specification itself.

As the notice states right now, the ops spec requires the use of the manufacturer's approved or advisory data. Today in the United States the data is all advisory data. I don't know of a manufacturer right now that's providing data that's actually approved for contaminated runways beyond just wet.

DR. RENZE: Just to restate so that I understand, so the procedures would be approved by the data would be accepted?

CAPT. OSTRONIC: That's correct for right now. All we have is the advisory data from the manufacturer to base this on. If in the future, as we plan to do, that data becomes part of the approved flight manual, through an established formula to arrive at that data, then the data itself would be approved because it would be an approved portion of the flight manual but for right now, it would be advisory data only.

DR. RENZE: Okay. It would help me if you could walk me through some specific examples of methods of compliance that an operator might use for either doing a preflight arrival calculation or a cross check of conditions for a pre-calculated condition or an actual arrival calculation, if you could just provide some specific examples of scenarios.

CAPT. OSTRONIC: Okay. I'll do my best. There's approximately 3,000 different air transportation operators out there right now, and just an approximate number, probably 2,000 more of those will be affected by this notice. So there's going to be a variety of different ways that operators will approach compliance with this ops spec and the notice.

One way that is very clear, obviously there could be tabbed data or reference back to the manufacturer's advisory data. I mean in the most simple form would be the -- for an example, the Boeing QRH where a flight crew would go to the Boeing QRH, take that number for the conditions that are present, multiply it by 1.15 and then compare the runway they're about to land on, whether it's that length or longer than that. That would be one method.

Another method an operator may choose with a sophisticated dispatch system, to lay out a set of conditions that they are anticipating to be present at time of arrival and specify those on a dispatch release. They could cover a fair braking on this particular runway or poor braking, what those numbers would be. So it could be part of a dispatch release if an operator chooses to do it in that fashion.

Another possibility might be that an operator might assess his particular fleet or a fleet type and take absolute worse case scenario under which they operate. For example, they may take a poor runway which is the worst condition they would use, and at 10 knot tailwind at the max elevation of an airport that they service, and say for all of those airports or all of those conditions, use a number of 9,000 feet is an adequate runway in length, and that if for some reason that becomes a limiting runway length for them under any condition for that particular aircraft type or make an model.

They're just some examples. I mean there's probably an infinite number of ways that an operator would choose. The idea behind the notice is that the operator chooses a system that most closely parallels what they're using today, complies with the ops spec but as close as possible parallels procedures that they're using today, and that's to be coordinated with the local oversight FAA office.

DR. RENZE: Okay. Thank you. Just to try and clarify terminology, does an assessment as you use it in your presentation mean a calculation or does it mean something that might include a calculation but might not include a calculation?

CAPT. OSTRONIC: The latter. It could include a calculation or it may not include a calculation. That is based on how the operator develops procedures. For an example, using the previous statement I made where 9,000 feet becomes a limiting value for this particular aircraft type, the assessment may be as simple as to say we're landing on Runway 31C and it's 10,000 feet long. Obviously the assessment was done because the runway they're about to use is 10,000 feet. The requirement for that particular aircraft in the worst case scenario is a 9,000 foot runway. So I mean as elementary as that assessment is, it has an assessment done of those conditions.

An assessment could be as complex as going into graphical data based on the runway you're about to use and under the conditions present and go through the entire graphical data or it could be as Southwest is entering the information into an on-board performance computer and coming up with it.

So the assessment could cover any number of ways -- it could be accomplished in any number of ways.

DR. RENZE: What type of operator feedback have you received since the notice was issued in the Federal Register?

CAPT. OSTRONIC: Since the Federal Register notice, we've received very limited feedback quite honest. Probably the largest comment we have received has been that some folks feel that it was rule making through ops spec, and they're a little concerned about the procedural way that it was accomplished, not so much about the aspects or the safety concerns, but just procedurally how it was being done.

DR. RENZE: And a related question. Have there been any issues that operators have raised in their efforts to meet the compliance deadlines?

CAPT. OSTRONIC: Deadlines?

DR. RENZE: Well, the target schedule of a plan by I think September and implementation by October?

CAPT. OSTRONIC: Actually, I haven't heard too many concerns. The Boeing presentation where they mentioned the time period to get it into the manual system is the first time I've heard that length of a period of time. As far as a timeframe, there are some issues with some of the older airplanes where data is not as complete as it is for some of the newer models, and that is probably a bigger issue right now than the implementation time. I haven't really heard too many comments or questions about the implementation time.

DR. RENZE: Okay. Nick, could you bring up the table from the notice please?

As I understand, this table is intended to be used in the event that there's no advisory data available from a manufacturer, but for instance, there is an airplane flight manual available. And my question is with respect to the factors that are listed in the right-hand column of this table, why are there factors that are less than 1?

MR. STIMSON: There are factors that are less than 1 because we are starting with the fully factored pre-dispatch number. The fully factored pre-dispatch number is the unfactored data multiplied by 1.67. So 15 percent on top of the unfactored data is going to be a smaller number than 67 percent on top the unfactored data.

DR. RENZE: So in terms of trends, it might be consistent with advisory data that were available from the manufacturer for a similar runway condition?

MR. STIMSON: Exactly. This was actually based on looking at a number of airplane types covering the different size airplanes, different operations, and trying to envelope what the advisory data would show for those different airplanes.

DR. RENZE: Okay. I'd like to move onto the braking action reports. What components are required to construct a reliable braking action report?

CAPT. OSTRONIC: I'm assuming that you're taking the reliable term out of the notice?

DR. RENZE: Yes.

CAPT. OSTRONIC: One of the comments we had in pre-coordination of the draft notice and, I know a lot of operators had concerns, that the braking action reports that were provided by aircraft are not similar to what they're operating. For example, at an airport that is both serviced by small general aviation aircraft and air carrier type aircraft, a braking action report by a single engine propeller driven airplane may not really be a valid report when you take that into a four engine turbojet air transport aircraft.

There is a definition in the notice itself of reliable, and I don't have it in front of me but essentially it refers to aircraft of a compatible nature.

DR. RENZE: Suppose that that definition was met, that there was an aircraft compatible to the aircraft receiving the report, what if the aircraft that generated or delivered the report used either light wheel braking or no wheel braking in their landing roll out, how useful is that report?

CAPT. OSTRONIC: As I think it's been identified over the course of the last day and a half, braking action reports are somewhat subjective. Now it is a subjective report.

DR. RENZE: Is there any attempt or effort underway to try to minimize subjectivity in braking action reports?

CAPT. OSTRONIC: The operations specification in the notice outlining how the operations specification should be implemented is phase 1 of the team project that -- as I said, there's short term goals and longer term goals, and one of those longer term goals, something that we intend to work on, is a more clearly defined definition for those braking action reports. They will always be somewhat subjective but we feel there probably is a more defined way of explaining what those values should be and more defined ways of how those conditions should be assessed. That is a work in progress.

DR. RENZE: I had a question related to deceleration devices, and the planned use of deceleration devices. In the example that you provided in the last slide of the presentation, you chose an example that used max autobrake. How would the planned autobrake setting be accounted for, for instance if it was a different autobrake setting?

MR. STIMSON: They would do the assessment based on the autobrake setting that they were planning on using. For this particular landing, they were planning on max autobrake and so that setting was used.

DR. RENZE: Okay. And the last area I have is with respect to principal operations inspectors. What percentage of POIs are proficient with landing performance calculations?

CAPT. OSTRONIC: I can't answer that. I don't know. I've never polled them. I can't answer that. I don't know.

DR. RENZE: Okay. Is there a plan to provide any training to POIs to facilitate implementation of the notice with the operators?

CAPT. OSTRONIC: There is a plan through our internal audiovisual system to provide a Q&A session and a presentation on the notice and how it's to be implemented, yes.

DR. RENZE: Okay. Thank you. That's all I have.

CHAIRMAN ROSENKER: Dr. Renze, thank you for your questions. We'll go to our Parties first beginning with Boeing.

MR. SMITH: No questions from Boeing.

CHAIRMAN ROSENKER: Thank you. City of Chicago.

COMMISSIONER FERNANDEZ: No questions from the City of Chicago.

CHAIRMAN ROSENKER: Southwest Airlines.

MR. LOGAN: Just a couple, Mr. Chairman. Could you pull up the presentation that had the calculations of Flight 1248? I think it was page 16 of the presentation. That's good. Thanks.

Do you know if the -- there were five other transport aircraft that landed before Flight 1248. Do you know if the calculations were run on the effectiveness of the 15 percent if the ops specs order would have been on those aircraft?

MR. STIMSON: No, we did not run those calculations.

MR. LOGAN: Okay. The information that -- Mr. Stimson, you talked about on the performance information in the draft AC and the reverse thrust credit, is that available anywhere?

MR. STIMSON: AC 91-6A I available. A draft of AC 91-6B was never published in the Federal Register but it's been widely distributed, and we can certainly circulate it to you.

MR. LOGAN: Has the FAA published the wet -- you talked about the coefficient of friction that was developed on the wet runway. Has that been published anywhere?

MR. STIMSON: Yes, that's actually in Part 25.

There's an equation given in there in 25 -- 14 C.F.R. 25.109.

MR. LOGAN: Okay. And the JA data that was talked about on the contaminated runways, is that published anywhere?

MR. STIMSON: the JA published a AMJ 25.1591 I believe it is.

MR. LOGAN: Okay. Good. Thank you. That's all the questions we have.

CHAIRMAN ROSENKER: Thank you very much. We'll go to the Southwest Pilots Association.

CAPT. HEFNER: Thank you, Mr. Chairman. You guys have been up there a while. I'll try to keep this short.

For Mr. Stimson, can an accurate scientific model of aircraft landing performance on winter contaminants, not a wet runway, but a winter contaminated runway, be determined without flight test validation?

MR. STIMSON: Well, as I said, the physics are pretty well understood but it's the real life conditions that you have difficulty in determining what you're going to model because the conditions are going to vary. And so what we try to do is look at flight testing that's done in a variety of conditions by a variety of airplanes and attempt to draw a conservative correlation for the braking capability and for the effect of any impingement and clearing drag that takes place.

CAPT. HEFNER: Has there been any consideration of adapting any of the Canadian studies that were part of the joint project?

MR. STIMSON: Much of that data is used. It's not used in the sense of trying to correlate with a runway friction measuring device like the data was collected for, but we -- a lot of that data was used in developing the JAR-OPS, the JAR certification requirements, in terms of what the braking coefficient of friction on various surfaces is.

CAPT. HEFNER: Are you aware of flight test data that exists that indicates 100 percent anti-skid effectiveness for all types of runway contamination?

MR. STIMSON: No, I'm not.

CAPT. HEFNER: And is there a different in anti-skid effectiveness/performance between a hard packed surface and a deformable surface on a contaminated runway?

MR. STIMSON: I guess I can't answer that question directly about anti-skid effectiveness. I think you may be referring to when -- in our wet runway requirements, in our certification requirements, part of that braking coefficient friction that we defined, we defined it as a tired runway braking coefficient of friction. To convert that to an airplane braking coefficient of friction, you need to determine the anti-skid system effectiveness of the airplane and we can either do that through tests or we can do it through knowledge of the type of anti-skid system that it is, basically the generation that it's in, and we have a conservative assessment of the ability of the anti-skid system under those circumstances. When we get to the wet and -- or excuse me, the snow and ice covered runways, we're looking more at -- there's a lot more variability in the braking coefficient of friction of those surfaces. So we're simply establishing a braking coefficient in that case that we expect to see from the airplane based on the test data that's been run on various airplanes without trying to assess the exact anti-skid efficiency on each of those surfaces.

CAPT. HEFNER: Would it be possible to bring that last slide up again that showed the analysis of 1248, pre-C082 and post-C082?

When you were discussing that, you noted that a different braking coefficient was applied to fair and poor and I'm a little confused on that. What generated the use of a different braking coefficient than what was applied to fair and poor in the pre-ops spec?

MR. STIMSON: Dr. Renze I think showed a slide earlier from the performance group study. Maybe you could bring that up again? The pre-ops spec calculation is based on what's listed here as what was in the Southwest Airlines OPC. That's what we were trying to replicate. And so the correlation between airplane braking coefficient and runway condition is as you see under the Southwest Airlines OPC column.

Now the notice will require the operator to use the manufacturer's advisory data straight off which is listed here as the Boeing FPPM/QRH, and so the differences in the airplane braking coefficient that were in that table that I showed distances, reflect the difference in the correlation that was used here.

CAPT. HEFNER: Thank you very much.

CHAIRMAN ROSENKER: Thank you. We'll go to the Board of Inquiry. Dr. Ellingstad.

DR. ELLINGSTAD: Mr. Stimson, I'd like to make sure I understand the terminology you used braking coefficient of friction a number of times. We've also had discussions yesterday about surface friction values that are measured on the runway and we've had braking coefficients discussed. Would you clarify what you're referring to by braking coefficient of friction?

MR. STIMSON: In all of the calculations of airplane performance data, I'm referring to the airplane braking coefficient of friction.

DR. ELLINGSTAD: Okay. Do I understand you had also talked about data variability with respect to the IRFI values which I understand are surface friction measurements. Is that correct?

MR. STIMSON: That's correct.

DR. ELLINGSTAD: And then we've also talked about sets of data that you have looked at and collected on various kinds of aircraft I think since the sixties, you mentioned which I assume that you're talking about airplane braking coefficients in that respect?

MR. STIMSON: Yes, I am. That's correct.

DR. ELLINGSTAD: Okay. Could you explain the relationship between those measurements, the surface measurements versus the braking coefficient measurements?

MR. STIMSON: I think this has been dealt with quite a bit over the last couple of days, that the correlation between a friction measured by a runway friction measuring device and the airplane braking coefficient that's used in the airplane landing distance calculations, that there is no reliable accurate correlation between the two.

As was discussed yesterday, we participated and continue to participate actively in, and have participated in several program to try to find a correlation. I think it's in everybody's interest and everybody's goal is to try to find a reliable way of determining how slippery the runway is and how it's going to appear to the airplane, prior to the airplane actually getting there. Unfortunately, that goal hasn't been achieved yet.

The goal of the IRFI program was twofold. First, it was recognize that we've got a variety of pieces of equipment to try to make that measurement. And so the first thing is to try to get all of those different pieces of equipment to give you one reliable number, to give you the same number. It doesn't help to run one device down and get a .40 and the next device a .50. So that was the first goal before we could ever correlate that to an airplane. Secondly, once you have that tackled, then you try to correlate it to an airplane. Although a standard was developed for IRFI to try to do the first -- to achieve the first goal, we have significant issues with it and concerns that have not yet been addressed and, in fact, although the standard's been defined, it is not yet implementable and no one has implemented it. It foresees a golden device, if you will, called a master vehicle that no matter what that vehicle does, that is the IRFI. When that runs down a surface and delivers a value, that is the value of that surface. All of the other vehicles then need to be correlated to that vehicle. Now it turned out, we found out during the program, that you can run two devices from the same manufacturer, same model device, run them side by side, and get different values. So you can't easily say that, okay, define a manufacturer and model and define a correlation for that manufacturer and model device and correlate to the master. You have to do it for each individual device. Also when you do that, you get that scatter diagram. For each time you run it down there, you're going to get a different reading.

You won't be able to simply take your master device and correlate it with the thousands of devices that are out there. You'll need to go several steps. You'll need to calibrate regional devices or maybe national devices, then local devices and then finally get down to calibrate your other one. Each step adds that variability. So by the time you get to the bottom, you've got so much variability that you don't have -- you certainly don't have anything better than you would from the perceptual or the subjective fair, poor, good descriptions. But what you do have down at the bottom is you've got a number, and we've head that described several times as being a realistic, scientific number, a factual type thing, objective, not subjective, and our concern is that once you give the pilot that number, realizing it's no more accurate than the subjective value, that he's going to treat it differently and that you can actually have more of a hazard by giving them unreliable information that looks better, that will provide the wrong indication of the friction capability of the airplane on that runway.

DR. ELLINGSTAD: So in your judgment, the reporting of those surface measurements is less reliable or valid than the good, fair, poor --

MR. STIMSON: At this point what we've said is that it's no better than, and there's a long way to go to get to there. You have to have the system of calibration. The master vehicle hasn't been defined yet. At first they were going to design and build a brand new vehicle that would have the best and greatest and now they're talking about using an existing vehicle. That hasn't been chosen yet.

The other major concern that we have is that once you try to correlate any device to it, there are no limits on that. There are no constraints. That device, the correlation value is may be very, very widely scattered but there's no cutoff beyond how accurate that system has to be to say that, I'm sorry, that device is not good enough. They'll accept any device as long as they can draw a line through the numbers at this point. And again, that's just the first step. That's correlating devices to each other. We haven't gotten to the point of them correlating devices to the airplane.

DR. ELLINGSTAD: Okay. I'd like to explore just a little bit your, your source of calculations for the various kinds of safety margins. You responded to Dr. Renze with respect to the 15 percent margin is basically I guess the way I sort of interpreted that as coming from engineering judgment and history. Is that a fair characterization?

MR. STIMSON: That's a fair characterization.

DR. ELLINGSTAD: Is that basically where the 1.67 and the 1.15 come from also?

MR. STIMSON: That -- because of the historical part, yes. There is no written definitive record of the 1.67 number. There have been various attempts to back calculate and try to assess where it probably came from. It was -- there was a probabilistic assessment made but it's not delineated exactly what factors were considered and which were pieces of it. The 15 percent we do have a history of where that came from.

DR. ELLINGSTAD: But that history has to do with some discussions and engineering judgments and not empirical validation?

MR. STIMSON: The 15 percent does have some empirical validation to it. There was actual operational landing data recorded shortly into the turbojet fleet history, when the 15 percent factor didn't exist and everything just had the 67 percent factor on it regardless of the runway condition. It was found that in wet and slippery conditions, that that margin was not seen as enough, that the entire 67 percent margin was being used up with no additional margin left over. So from that data, the proposal actually, the FAA proposed that there be a 20 percent margin for wet and slippery runways, and after it went through the rule making process, what came out was a 15 percent margin and with the possibility of if an operator or manufacturer wants to go through a demonstration process with some conservatisms in there and margin applied, and they want to try to demonstrate something other than 15 percent, that capability is there.

DR. ELLINGSTAD: And then on top of that, with respect to the factors that you showed, and you don't need to bring that chart back up, but you're taking less than that with the dry or the wet conditions, the factors of .8 or .9. Those numbers are coming from where? From the same source as the 15 and the 1.67?

MR. STIMSON: Those are trying to reproduce the 15 percent when you don't have the data to do it. All you have is the factored dry distance data and so those numbers in that table are an attempt to reproduce what you would get if you had the actual data, but it's got to cover a wide range of conditions and a wide range of airplanes, what was done on a conservative basis.

DR. ELLINGSTAD: Is there any activity afoot to do any kind of an empirical validation of these kinds of adjustments?

MR. STIMSON: When we get into the rule making process, I'm sure the issue of how large the safety margin needs to be and what type of conservatisms need to be present, I'm sure that will all be discussed at great length.

DR. ELLINGSTAD: Okay. One final question having to do with the various kinds of aids to the pre-arrival landing distance calculations, the flight bags, the on-board computers, et cetera. Do you -- does the FAA review, approve or certify these devices and procedures?

CAPT. OSTRONIC: The procedures will be evaluated by the certificate holding office of primarily the principal operations inspector and they will be approved through the issuance of the operations specification, yes.

DR. ELLINGSTAD: Okay. Thank you.

CHAIRMAN ROSENKER: Thank you, Dr. Ellingstad. I have to apologize to my friends at the FAA. I did not give them an opportunity to question their colleagues.

MR. WALLACE: Thank you, Mr. Chairman. Just one question for Mr. Stimson. The calculations that were shown in the last slide, were those coordinated or agreed generally with Boeing and Southwest?

MR. STIMSON: Yes, they were. They were coordinated and agreed by both Southwest and Boeing.

MR. WALLACE: Thank you. No further questions.

CHAIRMAN ROSENKER: Thank you, Mr. Wallace. Mr. Clark.

MR. CLARK: I've got a number of questions. First, I believe Captain Ostronic and Mr. Stimson, you were both heavily involved in preparing the notice that just went out?

CAPT. OSTRONIC: That is correct. I am the team lead and Don is on the team.

MR. CLARK: Yeah, I just wanted to say that I thought that the discussion throughout that notice was very good and hit on a lot of issues that are pertinent to this investigation and did also go into a lot of other issues that are outside of this investigation that are extremely important. So I do -- in my mind, it's a very good document.

CAPT. OSTRONIC: Thank you, Mr. Clark. I'm sure the team would be glad to hear that.

MR. CLARK: I'll never say that in front of Mr. Wallace again, but --

With all of that, what I -- let's see. Let me -- I may have to bounce around here a little bit, but on the rule making issue, you're taking some push back because of procedural problems with rule making. Is that going to be a problem with any of this?

CAPT. OSTRONIC: We hope not, but that's yet to be determined. We hope it is not going to be a problem.

MR. CLARK: Okay. Well, let me put it in perspective here. What we've seen is that the OPC numbers that were used and what was in place either by regulation or custom out there, for example, this particular accident, the pilots could go through that OPC and end up landing with very, very little margin and doing it in good faith. And it's clear that we didn't have enough margin there. So do you have to go through rule making every time that you discover that we don't have an acceptable safety margin?

CAPT. OSTRONIC: I guess the best way to answer that is that when we do something by ops specs, ops specs are either a restrictive or a further authority but it has to be currently based in the regulation. When we get more specific, in either direction, in either relaxing something or being more stringent on something, it has to have a foundation in the present regulations in order to do that. We went through the notice and tried to delineate how we feel and it's been through our legal counsel as well, how we feel that the current regulations support what we've done in the operations specifications. Our legal staff is standing behind that. It's going to be seen.

So to answer your question, no. If there's a basis in the current regulations where we can be more specific in a requirement and add a safety margin, then we can do that just through the operations specification and that's what we've done in this case.

MR. CLARK: Okay. And I notice in this that the one example, we can bring it up here, the last slide. Okay.

That just specifically under the fair condition, the net improvement or the new requirement for safety margin changed by 1730 feet for this specific example, and I think -- is that consistent with your intent, that for whatever that 0 unfactored flight test type data is, you want another 1730 feet of extra runway before we even attempt the landing.

MR. STIMSON: Again, that difference shown here is due to a number of factors, not just the 15 percent margin. If --

MR. CLARK: There was an improvement in the friction -- how you handle the friction coefficient.

MR. STIMSON: Exactly. A conservative assessment of how you handle the friction coefficient. If, for instance, that friction coefficient had not changed between these two columns, you would have seen about a 1100 foot difference in the first case and about an 800 foot difference in the second case.

MR. CLARK: A couple hundred foot difference in the fair case.

MR. STIMSON: Yeah, about 800 feet, but it's 15 percent. So it is dependent on how much runway you're going to need to begin with. So it will be different for a 5,000 foot runway as opposed to a 10,000 -- excuse me -- a 5,000 foot required landing distance as opposed to a 10,000 required landing distance.

MR. CLARK: So if we would have kept the friction coefficient the same, we would have seen about an 1100 foot or 1,000 foot safety margin added on versus the 1700 foot safety margin, in that order?

MR. STIMSON: In that ballpark, yes.

MR. CLARK: Part of this push back I assume is coming from a number of operators who think they're going to lose a number of landings with contaminated conditions?

CAPT. OSTRONIC: I think that's a fair assumption, sir.

MR. CLARK: It's an economic issue?

CAPT. OSTRONIC: I think that's a fair assumption, sir.

MR. CLARK: Is it also fair to look at this that for years and years they've been operating with kind of an unknown safety margin and we're going to make it known now?

CAPT. OSTRONIC: What the ops spec does is establish a baseline. The responsibility for maintaining an adequate safety or the highest level of safety that's required of an air transportation operator falls on the operator. So what this ops spec does is establish a baseline, a safety margin.

MR. CLARK: This data we're talking about, is this also commonly referred to as the blue chart data? Not the 15 percent, but the unfactored landing perform on contaminated runway?

MR. STIMSON: Neither one of us have ever heard that term, Mr. Clark.

MR. CLARK: Never heard that. Okay. It's come up a couple of recent accidents, I believe it was for landing performance or takeoff performance, that's advisory in nature, printed on blue paper and put in some AFMs but that's -- okay.

On this specific data, I would assume Southwest had assumed a 1500 foot touchdown point, air distance? Is that -- was that carried over in this calculation?

MR. STIMSON: Yes, the 1500 foot air distance is carried over in that calculation.

MR. CLARK: And by a common standard, when Boeing does their work, they use 1,000 foot touchdown.

MR. STIMSON: Boeing provides the data with a 1,000 foot touchdown point, partially because it's easy to make the transition then. If you provide 11 or 12 or 1300, it's a little more difficult to do the math in your head.

MR. CLARK: I have no -- I mean it's just a method to provide the data and to Southwest's credit, they used 1500 foot when they were using the Boeing data.

If you're going to start causing operators to lose landings, they're going to start looking at the numbers much more carefully. How many -- do you have a provision to prevent the operators from going back from the 1500 foot landing to 1,000 foot?

MR. STIMSON: It does state in the notice itself that we don't consider 1,000 feet to be representative of normal operational air distances, and we expect the operators to use something representative for their operations.

MR. CLARK: The -- I guess we had another chart up, we don't need to bring it up, that had the .8 factor. I guess as we go through your values where you take a rational approach to landing distance and add 15 percent onto that, are any of those numbers going to come out less than the 1.67 factor with the 15 percent factor added on?

MR. STIMSON: No, we don't expect them to be. We expect them to be greater than because we're taking an envelope of a wide variety of airplanes under a wide variety of conditions and trying to draw a conservative fairing to come up with those factors.

MR. CLARK: Okay.

MR. STIMSON: I like your use of the term rational landing distance by the way. Ever since the landing distance performance requirements were developed and established, there has been repeated attempts to establish what they call rational landing distances, rational landing distance requirements. And this actually is the first time for any regulatory authority that we will have specific, defined, minimum safety margins based on a rational landing distance calculation or assessment at the time of arrival.

MR. CLARK: And the only thing we're going to be debating is, is 15 percent adequate which is a good start. There's been a number of questions. So I won't particularly go into that. I do appreciate your answers on that.

Dr. Renze brought up a question earlier and it does concern me that I think as you went through this, would you view this whole process that you went through as complicated?

MR. STIMSON: Extremely.

MR. CLARK: And when we started out in this investigation, I said that this was going to be a landing distance, this whole thing that rolls out of basically takeoff calculations and then there's this little piece of landing stuff that's left over is going to be extremely complicated but my question is, for what you've done, it looks pretty simple and straight forward, to put the standard out there, but are your POIs and the operators really qualified to dig through all of those complexities and make good decisions on touchdown points and how that data is going to be implemented and presented? I see you set the standard but I'm worried about how it gets implemented. It's a big world. You've mentioned there were 3,000 operators out there.

CAPT. OSTRONIC: I think you raised a point that we'll -- and I think you said earlier that the notice itself is pretty well constructed. It lays down the fundamental background to all of this, and we're hoping through that and through our question and answer periods with our POIs, that they do have a better understanding of what the requirements we're issuing in the ops spec are, and they may have today. You raise an interesting question and it's one that we'll have to be very alert to make sure it's done correctly.

MR. STIMSON: When I answered the process being extremely complicated to your previous question, it dealt with the process of getting to where the notice is. We think we've done a good job of boiling down an extremely complicated set of issues and processes into a much more simple form where you only need to make a certain number of assessments. One, you take the manufacturer's data and make sure that you're at least as conservative as that. You determine the air distance that's appropriate to use and typically we've been accepting 1500 feet. We didn't specify that as a minimum and we don't have the minimum specified in the document but when it comes down to it, I think we've boiled down an extremely complicated set of issues in a fairly simple form.

MR. CLARK: Okay. That's all I have. Thank you.

CHAIRMAN ROSENKER: Thank you, Mr. Clark. Mr. Benzon.

MR. BENZON: No questions.

CHAIRMAN ROSENKER: Okay. The testimony we appreciate very much. We thank you for your participation and your answers, your candid answers, and the witnesses will be excused.

(Witnesses excused.)

CHAIRMAN ROSENKER: We will take a 15 minute break. We'll promptly begin again at 11:30, and try to complete the next panel before lunch even. Thank you.

(Off the record.)

(On the record.)

CHAIRMAN ROSENKER: We'll reconvene and ask our Hearing Officer to call the final set of witnesses from Southwest Airlines.

MR. BENZON: Okay. Southwest Airlines has requested that we do them separately and we don't see any objection to that. I guess Mr. Gleason and Captain Miller don't like each other or something, but the Board calls Mr. Brian Gleason to the stand please. Sir, raise your right hand.

(Whereupon,

BRIAN GLEASON

was called as a witness, and having been first duly sworn, was examined and testified as follows:)

MR. BENZON: Thank you. Please have a seat and could you tell us what you do for Southwest Airlines.

MR. GLEASON: I'm the Director of Flight Ops Technical at Southwest Airlines and responsible for all of the technical data that our pilots use to operate the aircraft including aircraft performance, navigation data, communications data.

MR. BENZON: We understand you have a presentation to lead off?

MR. GLEASON: Yes, I do.

MR. BENZON: Okay. Can you fire it up? We've got it up already.

MR. GLEASON: I'm going to start off this morning giving you an overview of the on-board performance computer that I know has been referenced quite a bit the last couple of days here. I want to give everybody an understanding of what it is that we use in our operation itself at Southwest, give you a little bit of background about what it is, what we can do with it, some of the background into the calculation engines that are used in it, in addition to specifically talking about some of the landing calculations and then we'll talk about the impact of the FAA notice in our implementation in the OPC.

Just as an overview, I know we've talked about this already, but the FAR requirements essentially require us to do landings at the time of dispatch. However, we've actually gone above and beyond that in our operation at Southwest or that we use some of the advisory data in our calculations at the time of dispatch. We actually require that our pilots do landing assessments prior to every landing. We do use some additional input in addition to the information that's provided including taking braking action reports into account and the use of our heads up guidance system and its impact on performance. As was mentioned before, we do add some additional air distance to our landing distance calculation including some factors that are built into the tailwind factors.

And most importantly what the OPC allows us to do is provide a tool to the crew so that they can very easily and quickly make adjustments to the inputs, to the aircraft configuration or weather parameters and make quick determinations as to the information that's available to them.

A little bit of background, our on-board performance computer has been in service with us since '97. We first put it into place at the time we had Dash 200, Dash 300 and Dash 500 aircraft. We took delivery of the first 700 at the end of that year, and at that point, we incorporated the data for the 700 into the OPC, and just for reference, the OPC is really like a laptop type of computer, a pen tablet that doesn't have a keyboard. It is a Windows based computer, although the computer is actually locked down so that you can't get to the operating system. We have one of these on every aircraft, and it's basically stowed in a cradle when the pilots aren't using it to keep it charged up. And here's just a picture of one of our first officers using the device, so you have an idea of what the size is of it. In this particular case, he's working a takeoff calculation before a flight but that just gives you an idea of how big it is and what it looks like in the cockpit.

In terms of performance modules or performance data that's available on the OPC, we do include the -- we basically have everything the pilot needs in terms of performance calculations, including being able to calculate maximum takeoff weights. Once they have their release and their final weight and balance numbers with their actual takeoff weights, they can calculate the takeoff speeds, calculate what the reduced thrust settings are and then they also have the ability to see what their stopping margins are going to be in the event of an RTO.

We also have information that they can use while they're en route, various crew information, including altitude capabilities, buffet speeds, fuel burn information, in a variety of different formats and depending on what the crew needs at the time, and how they need to look at it.

And then we actually have two landing modules in the OPC, the first being the dispatch landing module which calculates landing weights for use at the time of dispatch and that's really to meet the FAA requirements. In addition, we have the operational landing module which gives the crew then the ability to determine once they're en route and within range of the destination airport, they know what their actual weight is going to be, they know what the weather conditions are going to be, they can enter all that information in, and then calculate things like the landing distances, the max quick turn around weight limitations. The same module actually does the operations spec, -- requirement, to make sure that they're legal to begin the approach to that runway, and all of the information in the landing module is available for both normal landing configurations and non-normal landing configurations.

By procedure, our flight crews are required to use the landing module and look at all of this information on every flight leg, and if for some reason the OPC fails while it's in flight, their primary backup is to get a hold of their dispatcher whose got the same information available to him on the ground and if for some reason they can't get a hold of him, there are performance charts also in our flight operations manual that they can reference.

The calculation engine that is used within the OPC, the OPC is basically doing real time calculations. It was initially developed by a group that's now owned by Teledyne Controls and they did it under contract with Southwest Airlines. Southwest now maintains those programs. The classic programs or the Dash 300 and Dash 500 are basically what's known as a model table type of program. In other words, the charts that are provided by Boeing are digitized and put into a table look up type of format, and then the programs are written to go and look up the values and make the appropriate adjustments. The source data for all of our calculations that we use does come from Boeing, from a variety of different sources to include the AFM, the performance engineers manual and the FPPM.

In the case of the Dash 700 program, Boeing provides to us their Boeing landing module which I know was talked about earlier also, and essentially what we provide around that is the ability for the crews to specify particular inputs. Those are fed into the BLM program. It does the calculations and the outputs are then displayed to the flight crew.

In terms of our dispatch landing calculation, one of the requirements at dispatch is to calculate a runway limit weight, and I think everyone's familiar with the FAA requirement in 121.195 where the FARs require that we calculate a landing weight on a wet or dry runway, predicated on the use of no thrust reverse, that was covered earlier.

Within our dispatch module, we actually go above and beyond that, and we take into account what the runway conditions are anticipated at the time of arrival. And so we actually use the advisory data and instead of using a weight to calculate a landing distance, we use the available landing distance and calculate the maximum weight at which we can land under those conditions, and for a dry runway, that's based on the autobrake deceleration rates. Instead of using the 1,000 foot air distance, we use 1500 feet. In the case of the heads up guidance system, A3 mode, which is specific in that mode in that the heads up guidance system has flare Qs (ph.) as a part of that, we actually use a 2500 foot air distance built into our calculations. And then for a wet runway, we have the three levels of braking -- reported braking actions incorporated in of good, fair and poor. So at the time of dispatch, they can enter in something like a wet, fair runway, and we will do the FAR calculation and determine a weight. We'll do a wet, fair calculation based on the advisory data and whichever of those weights is the most limiting is what we will use at the time of dispatch.

Here's an example of what the input screen looks like on the OPC. For dispatch, you can see in the top left-hand corner, there's basically a place to input the ATIS conditions or the anticipated ATIS conditions at time of dispatch. So you put in the wind and the altimeter and the temperature, and the OPC will make all the appropriate adjustments for that. In addition, we've got the -- just a couple of things to point out here, is on the runway condition options, as I mentioned on the previous slide, basically a dry and three levels of wet that we will use at the time of dispatch in addition, and then the landing flap options where we can basically pick a normal landing flap which in the case of the 737, we have three of them or if we know that it's going to be a low visibility situation, where the flight crew is going to anticipate the use of the heads up guidance system, A3 mode, we can go ahead and plan for that up front also which will take into account the additional air distance required to land the aircraft.

This software is also available for the dispatcher. It's got a different format in terms of how it looks on the input and output but they have the exact same capability in our dispatch office to perform these calculations, and this is what the release is based on. This is just an example of the output, where it will calculate the max landing weight. In this case, you can see for 01 left at max landing weight is runway limited at 123,600 pounds.

The other module that we have in the OPC is the operational landing module as I mentioned, and you can see it's very similar to the dispatch landing module where we have again the crew is now en route, they now know what the current ATIS, they know what their anticipated landing weight is, they know which runway they anticipate using. They can enter all the same information in again, and we have the runway condition options again where they can simply click on the button and select, good, fair or poor braking action. And then under the landing flaps, we have the normal landing flap options, but in addition, we have all of the abnormal landing flaps. So if they need to make a flaps up landing or something like that, they use this exact same input. The only difference is that one toggle to the appropriate configuration then and they will have the data presented to them in the same format that they see for every other landing that they use.

Here's an example of what the landing output screen looks like, and where it will convey to them their max quick turnaround weight, their approach climb limit weight in addition to their landing speeds, and then in the middle there you can see the two runways that have the approximate stopping margin shown for the three different autobrake level settings.

The way that we determine the actual stopping margin or the approximate stopping margin that's displayed is we first off have to start with what's the available landing distance, and we use the most conservative of three landing distances that are available. The first one is what the declared landing distance available is. I know there was a little bit of discussion about displaced thresholds due to runway safety areas. That could be impacted or can impact what the available runway length is. So we use that distance. We'll compare that against the displaced threshold if that's available, in addition to a published glide slope intercept distance and whichever of those three distances is the most limiting is considered the runway available for that particular landing. And on the OPC output, it actually will show you what that distance is predicated upon.

In terms of assumptions in the landing distance, for an air distance, we use the 1500 feet which was mentioned earlier which is certainly more than what's both been published and what was demonstrated in flight tests, and in addition for the heads up guidance system, we add an additional 1,000 feet to that distance which again was more than the system demonstrated in flight tests.

The tailwind component that are incorporated into the distances have a 1.5 percent or 1.5 factor built into it, and then the ground roll portion of that is predicated upon the autobrake information that we've received from Boeing.

Taking a look specifically at thrust reverse assumptions between the different aircraft types, effective the date of the accident, for our normal configurations, the Dash 300 and Dash 500 data for the autobrake roll out distance was predicated upon the airplane flight manual chart which contains a stopping -- autobrake stopping distance chart, and that particular chart did not have any correction for with or without thrust reverser and it was predicated upon the assumption that no thrust reverser was required to obtain those particular distances. In the case of the 700 data, Boeing's landing module provides an input into the distance calculations of whether or not the thrust reversers are to be included. The default is that they are included, and so that's the way the OPC was implemented from the beginning, was to include the effect of thrust reverse in the Dash 700 calculations.

All of the non-normal configurations are basically based on data that comes from the performance engineers manual and for all of the 737s in our fleet, that data is based on the use of maximum reverse thrust, and there's no direct adjustment available for removing the thrust reverse as was mentioned earlier.

In February of this year, we updated the data for the Dash 300 and Dash 500 aircraft, to base that on the FPM normal configuration landing distance chart. That chart is based on using thrust reverse. However, it does have a correction to take out thrust reverse. We implemented it without the thrust reverse credit to be consistent with the guidance that we had already provided in the FOM previously, such that if you select the thrust reverser inoperative in the OPC, which you can do, then you will currently see no difference in the stopping distances. The 700 data has not changed and the non-normal configuration assumptions haven't changed either to date.

Just to take a quick look at the ops spec C082 and what impact that's going to have on our calculations, one of the requirements that we talked a little bit about was to adjust the air distance to something more than 1,000 feet, and we basically already do that. We don't plan to change that. We will continue to use 1500 feet as our standard distance and the additional 1,000 feet with the HGS A3 mode.

One of the other requirements that's in there talks about making sure that you have some type of method for determining when you're going to make this calculation. We basically have this covered already by our policy that covers our flight crew to actually look at the landing calculation prior to every landing. And in addition, to use the most adverse braking action report and again we already instruct our crews to do that.

Some of the items that it specifically lists to be considered, the first being meteorological conditions and as I showed on the input screen, we actually enter the ATIS information directly into the screen so that it can make the appropriate atmospheric adjustments, tailwind component and crosswind component calculations. So that will remain the same. The runway surface conditions, basically dry and wet, is already incorporated into there, and in incorporating braking action reports as I showed, is already incorporated in the OPC.

Additional items that must be considered are the aircraft or the airplane configuration. In other words, the flap setting. That's one of the inputs that the crew makes is their anticipated flap setting that they plan to use in addition to their actual or anticipated weight at the time of arrival.

It also speaks specifically to the intended use of ground deceleration devices. The auto spoilers is the default setting within the OPC. They do have the option to select those inoperative if for some reason it's either been deferred or they just want to be able to take a look at the effect of manual spoilers versus auto spoilers but the default is the auto spoilers since that's the normal configuration for landing.

Brakes, our distances are based as I mentioned on the autobrake deceleration rates. So that won't be changing.

In terms of the thrust reversers, 700 currently does include the effect of thrust reverse. So we're essentially in compliance with this particular requirement already. The crew does have the ability to go in and deselect the thrust reverse to see what the effect is going to be if it is no longer available or it's inoperative.

The Dash 300 and Dash 500 as I mentioned currently is based on no thrust reverse but to be in compliance with this particular notice, we're going to modify it so that it works the same as the 700 so that the default does include the effect of thrust reverse but they'll be able to deselect thrust reverse and see what the effect of removing that is in the stopping distance calculation.

And then the 15 percent safety margin, we do not currently carry a blanket safety margin across all of the distances that we calculate in accordance with the notice, but we will be essentially adding that 15 percent to the distances that we're calculating today.

And that's all that I have, sir.

CHAIRMAN ROSENKER: Thank you very much. We'll turn to our Technical Panel beginning with Dr. Renze.

DR. RENZE: Thank you. Dr. Gleason, I'd like to start with a short discussion about the OPC and the role that the FAA plays in either accepting or approving that device and validation issues. So to begin with, does the FAA accept or approve the OPC?

MR. GLEASON: Yes, they do. They basically were involved in the initial discussions of implementing the OPC into our operation through our POI, our local POI and basically had reviewed everything as we prepared to introduce it into our operation.

DR. RENZE: As you understand it, is that an acceptance process or an approval process or is it split depending on computing device or data issues?

MR. GLEASON: Well, they're really providing us with an approved method to present performance data to our flight crews, and so from that standpoint, it's becomes part of our ops spec and our approved flight manual to present the data in that format.

DR. RENZE: Okay. How are the data in the OPC and calculations validated or substantiated?

MR. GLEASON: The data that was put into the OPC when it was created, along with that was generated an engineering substantiation report which basically compared the calculations that you would make using the manuals, i.e., the AFM charts or the charts in the PEM and such, and validate that what you would go through and do, calculate manually is also replicated within the program itself. And so we basically put together an engineering document that made those comparisons and made sure that everything that you would do by hand was successfully implemented into the program.

DR. RENZE: And is that substantiation document something that the FAA reviews?

MR. GLEASON: The FAA did review that as a part of our approval process to implement the OPC, was to sit down and go through that and review that with us.

DR. RENZE: How are these schedules and assumptions embedded in the landing calculations documented and communicated to your pilots?

MR. GLEASON: Most of the assumptions that are in the OPC are either documented within our flight operations manual or flight reference manual or are essentially embedded in the procedures that we use. In addition to any other types of assumptions that we present to our flight crews, either through training or things like that, you'll have to ask Mr. Miller about those.

MR. RENZE: Okay. Similar question with respect to schedules and assumptions but the interest area now is in how those schedules and assumptions are documented and indicated to the POI.

MR. GLEASON: The POI essentially has the same access to the information that our flight crews do. So there isn't anything additional that's given to our POI beyond what's presented to our pilots.

DR. RENZE: The last slide of the FAA presentation had a footnote on it that noted that there's a 5 knot tailwind constraint for wet, poor conditions. Could you discuss the origin of that constraint?

MR. GLEASON: Within our limitations section, we do have an operational restriction of a maximum 5 knot tailwind component when the braking actions are poor. I do not know personally what the origin of that 5 knots is. It's been like that as long as I've been at Southwest Airlines.

DR. RENZE: Do you know if it's something that is imposed by Southwest as opposed to for instance a regulatory or manufacturer constraint?

MR. GLEASON: That is a Southwest specific policy or limitation and not a FAA or manufacturer limitation.

DR. RENZE: Okay. With respect to that constraint, how information is presented to the flight crew, who made the decision that information calculated in the OPC and presented to the flight crew, would be based on constraint as opposed to for example the information entered?

MR. GLEASON: The decision on what is input and output from the OPC is a collaborative effort between our flight technical group, our flight standards group, and our flight training group, really in addition to dispatch also. So there isn't anyone party involved in the decision of what goes into the OPC.

As far as the specific display of the information based on the limiting condition, the reason for doing that within the landing module is that generally the landing calculations are made a certain period of time prior to arrival at the airport. And by doing the calculation at the limit condition, it provides the crew with two pieces of information, one that a limitation has currently been exceeded but if the conditions come back within limits from the time that they look at the calculations until they arrive at the airport, they know what the data is that's associated with that limitation.

DR. RENZE: Has there been any consideration given to providing the crew with both numbers?

MR. GLEASON: There's really a limitation to being able to do that, and it's really -- and the problem is when you get a 10 knot tailwind, the data is not available for us for anything beyond a 10 knot tailwind. So we can't actually calculate the effect of say a 12 knot tailwind because there isn't data available for that. So we're really limited in terms of a maximum tailwind that we can't generate calculations for anything higher than what the limitation is.

DR. RENZE: Okay. Could we bring up the slide, I believe it's dated December 8, 2005, in the assumptions?

Okay. Thanks. Between this page and I believe it's the next slide, there's a note essentially that there was a change made to the OPC for the 37-300 and 500 between the timeframe of the accident and February of 2006, and I would like you to simply discuss what the motivation was for that change.

MR. GLEASON: The motivation for that change was that during the course of the investigation, we learned that the distances that were published in the AFM chart for the autobrake stopping distance chart, could not always be achieved without the use of thrust reverse which was the basis for what we had published, and we also became aware of the data being available from Boeing that did include the effect of thrust reverse and without thrust reverse in the FPPM. And so at that time, we did make the change and incorporated that into the OPC in February.

DR. RENZE: Is there a reason that February 2006 was the timeframe when you became aware of the QRH or the -- type data?

MR. GLEASON: The only reason we had become aware of it was through the course of the investigation, going back and looking at the data available for the 300.

DR. RENZE: Is there any effort afoot to review simply whether or not that data was in fact available prior to February 2006 and should have been considered I guess for making a change earlier?

MR. GLEASON: No, there wasn't.

DR. RENZE: Is there now?

MR. GLEASON: Yes.

DR. RENZE: Nick, could we bring up the chart from the study, I think it's page 14, at the bottom of the page? We've looked at it several times today.

We've discussed this chart previously with the Boeing witnesses. I'd like you to simply discuss why Southwest Airlines chose the mapping between braking action reports and numeric values that they did that are reflected here in the table.

MR. GLEASON: There's really two reasons behind the mapping that we have incorporated into our ROPC, the first being the Advisory Circular 91-6B which is the draft Advisory Circular that Mr. Stimson referred to earlier and within that Advisory Circular, it defines a number of different braking action reports and how those should be related in terms of braking mu. Included in there is a definition that says first of all, that a wet -- a good braking action is to be considered half of the dry which you can see from here is essentially what we've done, with a dry braking mu of .4 and a wet good of .2 is half the dry. In addition, the Advisory Circular goes on to define a poor braking action should be considered to be 1/4 of a dry braking mu, which 1/4 of again dry being .4 is .1 and that's the definition that we have included in our OPC and then it also says that .05 should be considered nil and a wet ice condition. So that's the first reference that we had.

The second one that we have is really related to the takeoff data that was available for our airplanes in implementing the OPC. The PEM data for the Dash 200, 300 and 500, only publishes adjustments for .2, .15 and .10, which is consistent with the draft Advisory Circular, and in order to keep the data consistent, between the takeoff module and the landing module, we basically made the same assumptions across both landing modules and using the same braking coefficients in both takeoff and landing.

DR. RENZE: Okay. Thank you. I'd like to discuss margin of safety. What components of the landing performance module calculations provide a margin of safety?

MR. GLEASON: Currently, the components that are included as an additional margin of safety are the air distances that we factor in above the 1,000 foot that Boeing publishes, in addition to the factored wind component where the winds are factored as part of the ground speed adjustment in determining the landing rollout distance.

DR. RENZE: Okay. Have there been any changes incorporated in the 37-700 from a safety margin perspective since the accident?

MR. GLEASON: No, sir.

DR. RENZE: And how will the safety margin calculation change as a result of the notice?

MR. GLEASON: As a result of the notice, we'll be simply adding the 15 percent to the distances that are currently being calculated.

DR. RENZE: Okay. Could you bring up another one of your slides. I believe it's a table that differentiates between the required dispatch calculation and the Southwest additional calculation. Given your understanding of the notice, the notice requirements, would the Southwest additional calculations or a portion of them now be required by the notice whereas before they were elective in the Southwest process?

MR. GLEASON: I think from a dispatch standpoint, that the notice does not require that this calculation be done at the time of dispatch. So I don't see that as being us changing anything at least in terms of that. Now we will incorporate the 15 percent as part of our dispatched calculation. Again, the reason we do that is to make sure that we don't dispatch an aircraft into a situation that they can't land, and so if we know that the conditions are going to be fair or poor at the time of arrival, we want to be able to take advantage or make the adjustments before the flight departs as necessary so we can make sure that we can land when we get to the destination.

DR. RENZE: So if I understand, Southwest plans to continue this elective calculation but will meet the notice requirements through their current arrival procedures?

MR. GLEASON: Yes.

DR. RENZE: Okay. Thanks. How will flight crew training be modified to account for the training element side of the notice?

MR. GLEASON: You'll have to ask Captain Miller how the training's going to be changed.

DR. RENZE: Okay. And finally, given the discussion about braking action and mapping to numeric values that has gone on this morning, does Southwest Airlines plan to change the airplane braking coefficient mapping that they use in the

OPC?

MR. GLEASON: The notice specifies that if the manufacturer's data or basically that we can't use anything that is less conservative than the manufacturer's data. Because of that, we will be adjusting our landing data to use the mapping that Boeing publishes.

DR. RENZE: Okay. Thank you. That's all I have.

CHAIRMAN ROSENKER: Thank you very much. Dr. Lemos, do you have questions?

DR. LEMOS: No.

CHAIRMAN ROSENKER: And Captain Kirchgessner, do you have any questions?

CAPT. KIRCHGESSNER: No, sir.

CHAIRMAN ROSENKER: Okay. Let's go to the Parties. Let's start with the FAA.

MR. WALLACE: Thank you, Mr. Chairman. Just one question, Mr. Gleason. You said that the OPC factors the tailwinds with a factor of 1.5 and I'm not quite clear how that works. My understanding was that for landing calculations, the flight crew would simply enter the report or the ATIS winds and the -- I think in this case of the accident flight it was 090 at 11 landing on 31 and that the computer then just computes the tailwind components. Is that correct?

MR. GLEASON: That is correct. However, the data that's available from Boeing and what is done actually within the Boeing landing module is it takes the tailwind component and adds another 50 percent to the entered wind. So if you have a tailwind component of 8 knots, it's actually basing the calculation on a 12 knot tailwind even though the input was 8 knots.

MR. WALLACE: I see. So then it is basing the stopping distance calculation on an assumption that's predicated on 1.5 percent -- 1.5 times the actual tailwind?

MR. GLEASON: That's correct.

MR. WALLACE: So this 1.5 factor doesn't get into the -- in other words, whether or not you exceed the tailwind limit is based on the actual tailwind component. In other words, I think it's 5 knots for poor and 10 knots for --

MR. GLEASON: The limitation is really an input limitation if you will. So you enter a 10 knot tailwind maximum but the calculation will then be accomplished at a 15 knot tailwind.

MR. WALLACE: Okay. Thank you. No further questions.

CHAIRMAN ROSENKER: Thank you. The Southwest Pilots Association?

CAPT. HEFNER: No questions, Mr. Chairman.

CHAIRMAN ROSENKER: The City of Chicago?

COMMISSIONER FERNANDEZ: No questions.

CHAIRMAN ROSENKER: And Boeing?

MR. SMITH: No questions, Mr. Chairman.

CHAIRMAN ROSENKER: And finally, Southwest Airlines?

MR. LOGAN: No questions, Mr. Chairman.

CHAIRMAN ROSENKER: Thank you very much. We'll now ask the Board of Inquiry. Dr. Ellingstad.

DR. ELLINGSTAD: Thank you. Your software in OPC, is that a locally constructed package or --

MR. GLEASON: The software program itself originated out of a group from Teledyne Controls. We actually in our particular situation have control over being able to make changes to that. However, Teledyne has the same software that they support for a number of airlines around the world.

DR. ELLINGSTAD: Okay. I just had a couple of questions about basically a software maintenance kind of a process. What version level are you using right now, and how do you manage your version control across your fleet?

MR. GLEASON: Well, our OPC actually gets updated on a 28 day revision cycle, and it's consistent with -- it's essentially the same revision cycle that our flight management computer data is updated. Typically the only thing that gets updated within that is the airport data, in other words, runway lengths, obstacle heights and distances, things of that nature, that become available as new runways are opened or new surveys are conducted for runways. And so on a 28 day cycle is when we actually update that information. In terms of the software changes, it really depends on, you know, if there's a need to make a change to either a presentation or format or capability or things like that, and if there is, those actually get incorporated in during one of these 28 day update cycles.

DR. ELLINGSTAD: Okay. What process is there for a software validation and review during that process when you do have changes to the algorithms or --

MR. GLEASON: Well, when we make changes to the algorithm, we will basically go through and validate again similar to what we did early on and that is to compare the calculations against a manual method of looking through the charts and doing a hand comparison to make sure that the logic is working as it's supposed to but then we also provide that those changes before they're released out to the aircraft, to our flight standards and our flight training folks, to go through and review and they typically run through a set of scenarios that they either use in teaching or things like that, to make sure that everything is working as they expect it to.

DR. ELLINGSTAD: And is that coordinated with your FAA inspector? Do they do actual review of that -- of those software change processes?

MR. GLEASON: They do see what has been changed before it goes out, yes.

DR. ELLINGSTAD: Okay. Thank you.

CHAIRMAN ROSENKER: Mr. Clark?

MR. CLARK: What is Southwest going to do to try to mitigate the landings that won't happen under the new rule?

MR. GLEASON: I'm not sure I understand the question.

MR. CLARK: Well, if you implement another 15 percent, for example, this airplane could not have landed, our accident airplane.

MR. GLEASON: That's correct.

MR. CLARK: And probably a number of other Southwest airplanes in close order would not have been able to land. So is there anything that Southwest can do to not pull back on the safety margin but still effectively change their operations to be able to keep more landings going into Midway?

MR. GLEASON: Well, from an operational standpoint, there's a number of different things that you can do in order to still meet all the requirements. Under that particular day and that particular scenario, you know, it could have been something as simple as landing with a headwind instead of a tailwind, and everything would have been fine, but if you get into a situation where they become limiting or there's things, you know, either reduce the amount of cargo, reduce the number of passengers or maybe the best option is that you just wait, to operate once the weather is cleared up.

MR. CLARK: Or the runway gets clear. The issue is that you have a number of ways to try to keep those flights going and still do it with this more appropriate safety margin?

MR. GLEASON: Yes, sir.
MR. CLARK: Okay. Thank you.
CHAIRMAN ROSENKER: Mr. Benzon.
MR. BENZON: I just have a couple of questions, and first is right after the December 8th accident, you made some changes. Yesterday I believe I think it was Captain Mosseller talked a little bit about it. What was the first change you made policy-wise, procedurally?
MR. GLEASON: I guess procedurally I'm not sure. I'm responsible for just the performance computer and what it's --
MR. BENZON: Just the computer, but I'm talking about the company. The company, can you talk about any of the changes they made?
MR. GLEASON: You'd have to address that --
MR. BENZON: Perhaps the next witness will be able to help us.
MR. GLEASON: Yes.
MR. BENZON: Okay. That's fine.
CHAIRMAN ROSENKER: Thank you for your testimony. We appreciate your participation. You're excused.
MR. GLEASON: Thank you, sir.
(Witness excused.)
MR. BENZON: The Board calls Captain John Miller to the stand please. Sir, would you raise your right hand?
(Whereupon,

CAPT. JOHN MILLER

was called as a witness, and having been first duly sworn, was examined and testified as follows:)

MR. BENZON: Thank you, sir. Have a seat. And could you please tell us what your role is at Southwest Airlines?

CAPT. MILLER: I'm the Director of Flight Standards and Publications. My primary duties include the training and standardization of our check pilots and also the maintenance of our flight operations publications.

MR. BENZON: Okay. And I understand you do not have a presentation?

CAPT. MILLER: No, I do not.

CHAIRMAN ROSENKER: Welcome, Captain Miller. Thank you for your testimony that you're about to give. We'll begin with our Technical Panel, and that will be Dr. Lemos.

DR. LEMOS: Good afternoon, Captain Miller.

CAPT. MILLER: Good afternoon.

DR. LEMOS: When pilots calculate landing distance, does the OPC display whether or not thrust reverse credit has been taken?

CAPT. MILLER: That display is not available on our OPC. However, it is covered in our flight operations manual and also in our initial training.

DR. LEMOS: Mr. Gleason in his presentation pointed out that the responsibility for decisions regarding the display of information on the OPC is a collaborative effort. Is your department involved in these decisions?

CAPT. MILLER: Yes, it is.

DR. LEMOS: Was there ever any consideration given to annunciating reverse thrust assumptions on the OPC display?

CAPT. MILLER: I don't know if there was. During the two years that I have held this position, it has not been considered to this point. However, we are considering adding a display that could actually show the amount of reverse thrust used in the landing calculations.

DR. LEMOS: So to clarify, Southwest is considering displaying reverse thrust annunciation on the display?

CAPT. MILLER: That is correct.

DR. LEMOS: Can you tell me a little about what reverse thrust variables affect stopping distance?

CAPT. MILLER: There are three variables that affect stopping distance. The first one is the initiation of reverse thrust. The second one is the level of reverse thrust that is used and the third one is the duration.

DR. LEMOS: So what are the pilots actually taught in this regard?

CAPT. MILLER: Our pilots are taught both within the classroom in an online training to initiate reverse thrust immediately upon landing. The amount of reverse thrust will depend upon the runway conditions and the duration of reverse thrust will depend upon the aircraft stopping performance.

DR. LEMOS: How much thrust reverse do pilots use under different conditions?

CAPT. MILLER: Under normal conditions, our flight operations manual specifies a minimum of 65 percent N1 for reverse thrust, and under conditions when the braking action on the runway is less than wet good, we require a minimum of 85 percent N1.

DR. LEMOS: So to clarify, company procedures dictate that reverse thrust is used for every landing?

CAPT. MILLER: That is correct.

DR. LEMOS: At the time of the accident, what was the written guidance regarding monitoring of thrust reverse after a landing?

CAPT. MILLER: Our flight operations manual specifically requires our pilots and more specifically the pilot monitoring or the pilot not flying, to point out any abnormalities as far -- or irregularities with respect to our normal operating procedures and also any system abnormalities as far as anything that is out of tolerance, and in this respect, the thrust reverser is applied.

DR. LEMOS: So has this guidance changed since the accident?

CAPT. MILLER: We haven't changed our guidance. However, we have clarified it with regard to the pilot monitoring being required to monitor thrust reverser operation and we have added a specific call out for reverser.

DR. LEMOS: So the pilot would have to call out reverser if it did not apply?

CAPT. MILLER: That is correct.

DR. LEMOS: Okay. Is there any guidance in the manuals that address how pilots can achieve the maximum stopping performance on the rollout?

CAPT. MILLER: Yes. If pilots need to create a maximum deceleration with the airplane, our guidance is to immediately and simultaneously apply both maximum wheel braking, manual wheel braking and maximum reverse thrust.

DR. LEMOS: And was this in written guidance prior to the accident?

CAPT. MILLER: Yes, it was.

DR. LEMOS: I have no further questions. Thank you, Captain Miller.

CHAIRMAN ROSENKER: Thank you, Dr. Lemos. We'll ask Captain Kirchgessner.

CAPT. KIRCHGESSNER: I have no questions, Mr. Chairman.

CHAIRMAN ROSENKER: And Dr. Renze?

DR. RENZE: No questions.

CHAIRMAN ROSENKER: All right. Thank you. We'll go with our parties. Southwest Airlines Pilot Association.

CAPT. HEFNER: Just one question. The FOM states under it's I believe less than wet good, that we need to achieve an 85 percent N1 value for reverse thrust, correct?

CAPT. MILLER: Correct.

CAPT. HEFNER: Is that achievable in a Dash 700 aircraft on a standard day?

CAPT. MILLER: Under a standard day, it depends on the density of the altitude that we're talking about. 85 percent may or may not be achievable. However, that level of reverse thrust is more than the level of reverse thrust that is used in the calculations for the performance of the landing of the aircraft.

CAPT. HEFNER: As a matter of course, the 85 percent as stated in the manual, is that something that we normally see -- are able to see on line operations?

CAPT. MILLER: In certain instances, yes, it is. It is obviously on the classic aircraft and it may or may not be achievable on the Dash 700.

CAPT. HEFNER: Thanks.

CHAIRMAN ROSENKER: Thank you. The FAA?

MR. WALLACE: No questions, sir.

CHAIRMAN ROSENKER: BOEING?

MR. SMITH: No questions, Mr. Chairman.

CHAIRMAN ROSENKER: Chicago?

COMMISSIONER FERNANDEZ: No questions, Mr. Chairman.

CHAIRMAN ROSENKER: And finally Southwest Airlines?

MR. LOGAN: Just one, Mr. Chairman. There's been discussion about the use of the OPC in landing decisions. Isn't it true that Southwest Airlines has a no default diversion go around policy?

CAPT. MILLER: Yes, we do. Our management supports the decision making of our pilots and none of our captains are questions if their decision is to divert to another airport.

MR. LOGAN: Thank you.

CHAIRMAN ROSENKER: Thank you very much. With no further Party questions, we'll go to the Board of Inquiry. Dr. Ellingstad.

DR. ELLINGSTAD: No questions.

CHAIRMAN ROSENKER: Mr. Clark?

MR. CLARK: No questions.

CHAIRMAN ROSENKER: And Mr. Benzon?

MR. BENZON: No questions.

CHAIRMAN ROSENKER: Perhaps you might be able to enumerate any of the changes and perhaps the chronology of the changes right after December 8th, Captain Miller?

CAPT. MILLER: We did not immediately after December 8th make any changes in our flight operations manual. We currently have a safety analysis team looking at all our procedures as well as, you know, your investigation going forward. We are in the process of implementing some of the recommendations, and I would anticipate that as the team goes further forward through its investigation, that we will in the future also add some more changes as they become available to us.

CHAIRMAN ROSENKER: Okay. Thank you, Captain Miller. I appreciate your testimony. Thank you for your participation today. You're excused as a witness.

CAPT. MILLER: Thank you.

(Witness excused.)

CHAIRMAN ROSENKER: With the last witness having been heard, this concludes the hearing phase of the Safety Board's investigation.

In closing, I want to emphasize that this investigation will remain open to receive at anytime, new and pertinent information concerning the issues presented. The Board may at its discretion, again reopen the hearing in order that such information may be part of the public record.

I know the inevitable question is when will we complete this investigation. I can't answer that yet. There's more work to be done before the staff will present us with a final draft report. For now I would estimate and encourage my colleagues to work in an expeditious manner and perhaps we could even look toward a winter or beginning of the new year as a completion. I’m getting a smile from Mr. Clark.

On behalf of the National Transportation Safety

Board, I want to thank the parties for their cooperation not only during this proceeding but also throughout the entire investigation of this accident.

Also, I want to express sincere appreciation to all those groups, persons, corporations and agencies who have provided their talents so willingly throughout this hearing.

The record of the investigation, including the transcript of the hearing and all exhibit entered into the record, will become part of the Safety Board's public docket on this accident and will be available from the Safety Board Public Inquiries Office or our website. Anyone wanting to purchase a transcript including the parties to the investigation may contact the Court Reporter directly.

I now declare this hearing adjourned.

(Whereupon, at 1:00 p.m., the hearing was adjourned.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	Southwest Airlines Co., Flight 1248, Boeing 737-7H4, N471WN Chicago, Illinois December 8, 2005
DOCKET NUMBER:	DCA-06-MA-009
PLACE:	Washington, D.C.
DATE:	June 21, 2006

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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Timothy J. Atkinson, Jr.
Official Reporter