UNITED STATES OF AMERICA

NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF ADMINISTRATIVE LAW JUDGES

In the matter of:	
PUBLIC HEARING IN THE MATTER OF THE LANDING OF US AIRWAYS FLIGHT 1549, N106US, IN THE HUDSON RIVER, WEEHAWKEN, NEW JERSEY, JANUARY 15, 2009	SA-532

NTSB Board Room and Conference Center
490 L'Enfant Plaza
Washington, D.C. 20024

Wednesday,
June 10, 2009

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

BEFORE: ROBERT L. SUMWALT, Chairman
ROBERT BENZON, Hearing Officer, Investigator-in-Charge
JOHN DeLISI, Board Member
JOSEPH M. KOLLY, Board Member

APPEARANCES:

Technical Panel:

ROBERT BENZON, NTSB, Office of Aviation Safety
DAVID HELSON, NTSB, Air Safety Investigator, Operations/Human Performance Co-Chair US Airways Flight 1549 investigation, Office of Aviation Safety
NICOLAS MARCOU, BEA (Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile)
BRIAN MURPHY, NTSB, National Resource Specialist – Aircraft Structures, Office of Aviation Safety
JOHN O'CALLAGHAN, NTSB, National Resource Specialist - Aircraft Performance, Vehicle Performance Division, Office of Research and Engineering
JASON FEDOK, NTSB, Survival Factors Investigator, Office of Aviation Safety
MARK GEORGE, NTSB, Survival Factors Investigator, Office of Aviation Safety
KATHARINE A. WILSON, NTSB, Air Safety Investigator, Operations/Human Performance Co-Chairman of US Airways Flight 1549 Investigation, Office of Aviation Safety
HARALD REICHEL, NTSB, Aerospace Engineer, Powerplant Group Chairman of Hudson River Flight 1549 Investigation, Office of Aviation Safety

Parties to the Hearing:

PAUL MORELL, US Airways
CAPT. RUDY CANTO, Airbus
CAPT. DAN SICCHIO, US Airline Pilots Association
CANDACE KOLANDER, Association of Flight Attendants
BRUCE MILLS, CFM International
HOOPER HARRIS, Federal Aviation Administration

PETER KNUDSON, Public Affairs Specialist

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Topic 5: Cabin Safety: Training, Procedures, and Equipment

Witnesses:

Jeff Gardlin, Aerospace Engineer, Transport Airplane Directorate, Transport Standards Staff - Airframe, Cabin Safety Branch, Federal Aviation Administration

Hans-Jurgen Lohmann, Senior Manager, Customization Engineering Programs, Airbus

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P R O C E E D I N G S

(9:00 a.m.)

CHAIRMAN SUMWALT: Well, good morning. And we are back in session. Yesterday proved to be a very good day of good testimony and good participation by all. And Mr. Benzon, are you ready to call the next set of witnesses?

HEARING OFFICER BENZON: Yes, sir. Our topic for this morning is certification standards regarding ditching and forced landings on water for transport category airplanes, and the Safety Board calls the following individuals to the witness stand: Mr. Phil Blagden, Jeff Gardlin, David Fitzsimmons, Bob Breneman, Gene Arnold, Captain Terry Lutz, and Captain Hugues Van Der Stichel. And gentlemen, please remain standing.

(Witnesses sworn.)

HEARING OFFICER BENZON: And Brian Murphy will begin the questioning.

MR. MURPHY: Good morning, Mr. Chairman. Good morning, gentlemen. What I'd like to do first this morning is I understand Mr. Gardlin has a presentation, but I have several short questions for Mr. Blagden and Mr. Breneman to ask real quick before Jeff gets into his presentation.

HEARING OFFICER BENZON: And before we get to that, I forgot to mention, we'd like to have each individual state your full name and your job title for the record, and we'll start with Mr. Blagden.

MR. BLAGDEN: Phil Blagden. I'm the certification manager for the European Aviation Safety Agency, large airplanes.

MR. GARDLIN: Jeffrey Gardlin. I'm a -- I'll put the mike on. I'm an engineer in the Transport Standards Staff of the Aircraft Certification Service in Seattle. Okay. Jeff Gardlin. I'm an engineer in the Transport Standards Staff of the Aircraft Certification Service in Seattle.

MR. FITZSIMMONS: I'm David Fitzsimmons. I'm the Senior Expert of Structures at Airbus, a mechanical engineer with 25 years of experience in the field of aircraft structures analysis, and the last 20 of those at Airbus.

MR. BRENEMAN: Good morning, my name is Robert Breneman. I'm the Manager of the Transport Airplane Directorate's International Branch in Seattle, Washington.

MR. ARNOLD: Good morning. Gene Arnold. I'm with the Seattle Aircraft Certification Office in Seattle as a flight test pilot.

CAPT. VAN DER STICHEL: Good morning. Hugues Van Der Stichel, test pilot within the Airbus Flights and Integration Test Center. I'm leading the flight test development department.

CAPT. LUTZ: Good morning, I'm Terry Lutz. I'm a test pilot for Airbus.

HEARING OFFICER BENZON: Okay, Brian, I'm sorry for the interruption. Go ahead.

TECHNICAL PANEL QUESTIONS

MR. MURPHY: Okay, Mr. Blagden, could you briefly tell me who performed the initial certification for the A300 -- A320?

MR. BLAGDEN: The initial certification was performed by DGAC France in conjunction with the Joint Aviation Authorities. There were four national authorities involved in the program, DGAC France, the RLD from the Netherlands, the LBA from Germany, and the UK Civil Aviation Authority.

MR. MURPHY: What role did each country play in the certification of the A320, for the structures?

MR. BLAGDEN: Each country had an engineering representative, a structural specialist, on the panel.

MR. MURPHY: Did they each have defined areas for determination of compliances or did they all review the entire structure?

MR. BLAGDEN: They worked as a complete panel and were involved in all aspects of the structural certification.

MR. MURPHY: And much like between the European nations and the United States, was that handled via bilaterals between the four countries?

MR. BLAGDEN: The activity was organized under the Joint Aviation Authorities and it was under a process called Joint Multinational Certification.

MR. MURPHY: Okay, thank you very much. Mr. Breneman, could you please tell me what the FAA's role was in the certification of the A320 and briefly describe the bilateral

agreement between?

MR. BRENEMAN: I'll have to give you a Reader's Digest version because it's a pretty involved process. But the FAA certified the Airbus A320 as an importing authority and we worked through our bilateral agreements with, at that time, the country of France and we use what we call a type validation process, where the FAA identifies with a number of meetings with both the applicant, in this case Airbus, and the foreign authority, on where the regulations that we have are different from their regulations, the areas that the FAA will need to stay extremely involved in, where we have regulatory requirements like special conditions, equivalent safety findings.

And if there's areas of new technology or if the methods of compliance are different than what the FAA would accept, in those areas we would retain full compliance authority. In the areas where we have similar regulations and similar methods of compliance, and that the applicant and the authority are very familiar with what the FAA expects, we would assign a compliance determination to the foreign authority, at which time, when all the documents were completed, the authority, in this case the DGAC France, would make a compliance determination. Then they would report back to the FAA that these certain areas are in full compliance with the FAA regulations. We would take that in conjunction with all the direct compliance findings that the FAA would have and then we issue a type certificate for the aircraft,

which we did for the A320 in 1988.

MR. MURPHY: For the area of interest in our accident, would the Joint Aviation Regulations and the Federal Aviation Regulations be equivalent in the area of ditching or would it require any special review by the FAA?

MR. BRENEMAN: Well, in fact, there were some minor differences which were documented in what we call the G-1 issue paper. It's our cert basis definition. I would have to defer to Jeff Gardlin for those details. But there were some minor differences, nothing of significance, but it was identified that there were some minor differences.

MR. MURPHY: Okay, thank you very much. Mr. Gardlin, I understand that you have a presentation you'd like you begin with this morning.

MR. GARDLIN: Yes, I'll go through just a short discussion of some of the regulatory background and compliance methods and what's required for certification. That's not it. Okay, thanks. Yeah, we can go to the next one.

PRESENTATION BY MR. GARDLIN

MR. GARDLIN: The regulatory history on ditching. I think one thing that may be discussed is terminology. I'll try to cover that in a few slides.

But the original requirements have evolved over quite a long period of time, at least 50 years. The original characterization with an emergency landing on water, it was pretty

clear, as originally stated in the regulations, that the intent was to protect occupants on over water flights. So that was more or less stated as an objective in the regulation as it was first written. The concept of protection for non-over water flights was introduced in 1957 and basically with the goal of providing available exits, irrespective of whether the operation was going to be over water. Most of the changes since that time have related to the types of equipment required for over water and non-over water operation.

So from a type certification standpoint, I guess I'd like to emphasize that everything I'm talking about is from a type certification standpoint. There's two main regulatory considerations for certification: the ditching characteristics, which consists of things like the water entry behavior, the flotation attitude the airplane takes on, any leakage paths and how long that then results in the airplane being able to float, and the structural capability of the airplane to withstand the water entry, and then the ditching equipment. And the ditching equipment we'll talk about in a later panel.

Now this is where we get into a little bit of the terminology. There are basically two ditching scenarios that are addressed in certification and they have become generally known as the planned ditching and the unplanned ditching. The reality of it, those are simple terms and people use them to characterize the two situations. But the reality is there's planned ditching,

which was discussed a little bit yesterday, and then there's everything else. And everything else has kind of been lumped into this broad terminology of unplanned ditching.

So the planned ditching basically is defined as having sufficient time to prepare the airplane and the occupants for a ditching. From a type certification standpoint, in that case the applicant must consider any probable structural damage that would occur. They have to look at the hydrodynamic behavior of the airplane as it would enter the water and evaluate any openings, any orifices like doors and windows, so to either show that they withstand the pressures that would result from that or to account for the fact that they won't withstand the pressures that would result from that.

Now this requirement is optional in that it's based on the way the airplane is intended to be operated. So the ditching certification requirement is something that is elected when the manufacturer is aware that the customer is going to use the airplane for extended over water operation. Most commercial airplanes, if not -- well, almost all commercial airplanes will elect compliance for that.

Now, the unplanned ditching situation, which again is everything else, is a number -- well, it encompasses all the possibilities of an unexpected entry into the water. So it is not a scenario, it is the universe of possible other conditions where the airplane enters the water. From a type certification

standpoint, the way that's addressed is the applicant looks at the most critical gross weight of the airplane, the most critical center of gravity of the location of the airplane. They assume any openings that are adjustable, like ventilation and outflow valve, are in their worst case so that they're open.

And then, for this particular assessment there's no structural breaches that are addressed as part of that certification. And just to potentially address questions that may come up, it's not that there's an assumption that there would be no damage. It's just because of the multiple range of possibilities, in order to have a consistent methodology, that's how it's evolved. And the other parameters that we assume to be a worst case are intended to kind of encompass that.

Now, the regulations that apply, again, I've listed kind of all the regulations that apply for ditching and water survival. The ones that are highlighted in yellow are the ones that are the focus of this panel. There's emergency landing conditions. There's a regulation that specifically addresses structural ditching provisions. And then there's the regulation for ditching itself. And then emergency exits kind of fall into both categories of the behavior as well as the equipment. And I'll briefly cover each of those.

The emergency landing loads -- emergency landing conditions talks about generally protecting occupants in the event of an emergency landing either on land or on water. There are

also some fairly specific load factors for occupant protection and retention of items of mass. And again, it's a requirement that addresses both the land and water case.

Section 25.563 essentially kind of closes the loop between Section 25.801 and the actual requirement to show the structural capability of the airplane when showing compliance with the ditching requirements. So Section 25.801 specifically requires consideration of the behavior of the airplane, its resistance to damage, its ability to withstand pressures and so on, and Section 25.563 is the closure of that, to address the structural capability.

The emergency exit rules I'll probably talk about in the later panel. But basically what they say is that when showing compliance, there has to be a sufficient number of exits available to occupants to enable them to leave the airplane and in the case of a planned ditching, enter life rafts. So that requirement is in consideration of whether or not the ditching certification is elected.

Methods of compliance. Methods of compliance typically are consistent among different programs and applicants. Model testing is done. Computational and comparative analysis is very common for compliance with those sections noted. The method of showing compliance with the exit requirements typically feeds from the data that's generated to show compliance with the ditching behavior requirements, and in some cases there are additional

critical case assessments that are necessary for the unplanned case, the so-called unplanned case. And that is it.

TECHNICAL PANEL QUESTIONS

MR. MURPHY: Thank you. If I understood you correctly, then, from one of the beginning slides, the structural requirements for ditching, the characteristics, as you referred to them, versus the equipment have not changed in the last 50 years or at least since the A320 was certified?

MR. GARDLIN: That's correct. Yeah, there's been no substantive change to those requirements.

MR. MURPHY: Okay. What FAA guidance exists for the manufacturers in evaluating the water landing behavior and structural integrity of the aircraft?

MR. GARDLIN: The FAA has an Advisory Circular, 25-17, which has actually recently been updated to 25-17A. But at the time of the A320, 25-17, which discusses the methods of compliance for ditching, it makes reference to other documents for historical data, and I think that's from an airframe standpoint, that's the principal document.

MR. MURPHY: Does the FAA specify any particular criteria to the manufacturer, as far as power on, power off, the airplane configuration, retentions of the engines during the water landing, or is that solely up to the manufacturer and then left for you to review?

MR. GARDLIN: Yeah, the manufacturer has to present

their approach to ditching certification. So things like whether the engines are retained or not is something that they would show as either part of their design -- part of the result of their design. So behavior in ditching or not, in terms of power on/power off, it's not specified. There are requirements that address landing the airplane without power, but it's not specifically linked to the ditching certification.

MR. MURPHY: Mr. Breneman said there were some slight differences in the ditching requirements between the JARs and the FARs. Do you remember what those were, what's the differences?

MR. GARDLIN: I think they were very much just administrative and nothing substantive in terms of what is ultimately required for certification.

MR. MURPHY: With regards to validating the methods that the manufacturer may use, is it simply a paperwork review by the FAA or is there a more in-depth, detailed review of the approach they use, whether it be computational or models?

MR. GARDLIN: Well, in terms of validation of the method, in the broad sense the applicants have to validate their own methods. So they have to show that whatever method that they're using actually is validated. And if that requires empirical data to support an analysis, then they're required to generate that, too. And what the FAA does is confirms that their method, as well as the validation of their method, is appropriate for the type of data that they're generating. Typically, the FAA

would not do separate testing.

MR. MURPHY: You mentioned some historical data that's used by the manufacturers, that may be referenced to in your AC. I assume that means the use of the NACA studies that I've seen at many of the manufacturers. Do you feel that those NACA papers from the 1950s are still applicable to today's designs for certification during ditching?

MR. GARDLIN: The NACA studies are basically addressing the behavior of certain fuselage shapes into water. And so yeah, those data are still applicable, provided that the shapes are consistent with what was tested.

MR. MURPHY: Okay. Are you aware of any current studies in the areas of ditching, whether it be with the FAA or industry or academia?

MR. GARDLIN: There are some studies in process that I'm peripherally aware of. Mostly all of them relate to rotorcraft and their behavior in water impacts and landings. There have been a few studies that have started in academia subsequent to this accident, to investigate certain things. But the majority of the work that's going on is for rotorcraft.

MR. MURPHY: You made a distinction between the definitions of planned and unplanned, but this is a pretty open-ended question. Why is there a distinction made between unplanned and planned?

MR. GARDLIN: Well, as I was hoping to characterize,

really it's planned and then everything else, and the certification requirements are objective requirements and to the extent that it's possible to do so, we try and have a reasonable scenario for which the applicant can show certification data. So the original ditching requirements pertained to the situation that was discussed yesterday, where something has occurred and the crew becomes aware that they're not going to be able to return to a land landing base. So that is really where the bulk of the certification requirements were generated.

It became clear later that there were other instances when the airplane could go into water, which was not covered by this so-called planned case, and that there needed to be additional provision for that as well. So I think that's really it. It was the recognition that there were two types of situations that could exist, one of which is extremely difficult to define, since it encompasses so many possible scenarios.

MR. MURPHY: However, in the legal sense of the FARs there is no definition of planned versus unplanned?

MR. GARDLIN: I'm not aware of a regulatory definition.

MR. MURPHY: Thank you. What would the FAA consider this accident to have been?

MR. GARDLIN: I think this accident falls into the broad category of unplanned.

MR. MURPHY: Okay. Given our accident and how the results in how it turned out, how applicable or practical do you

consider the FARs as they exist today with regards to ditching?

MR. GARDLIN: I'm not sure that this accident itself says anything directly about how applicable the regulations are. I think in light of this accident, though, it makes sense for us to look at the requirements and see if there's things that we can adjust or whether there's focus that we need to adjust. But I'm not sure that I would say this accident in and of itself comments on the applicability of the rules.

MR. MURPHY: Okay. And then finally, I know you've had a chance to review all of the information and data based on the damages to the structure for this accident. How do you feel -- how does the FAA feel this airframe performed during this ditching or unplanned water landing event?

MR. GARDLIN: I think knowing what we know about the actual flight profile parameters now, I think that the damage and the performance of the airframe is consistent with that, and I think the performance of the airplane was instrumental in the survivability of the occupants.

MR. MURPHY: Okay, thank you, Mr. Gardlin. John, do you have anything?

MR. O'CALLAGHAN: Good morning, everybody. Mr. Gardlin, thank you for your presentation. I just have a couple of follow-up questions to your presentation. In one of the bullets I noted a statement that the critical weight and CG is accessed, and I was wondering if you could specify what in general would be the

critical weight or CG for a ditching scenario.

MR. GARDLIN: Well, for the ditching -- I guess this is where we get into the terminology. But for the ditching scenario, in a regulatory sense, that is the case where there is time to prepare for it. And so it's really in the rest of the cases where the critical weight and CG are assumed. So typically that's going to be essentially at the maximum gross weight, and then the center of gravity location is, again, depending upon the specific airplane, which location would produce the most adverse location attitude.

MR. O'CALLAGHAN: Okay, thank you. And in the critical case with the heavy weight, is there a requirement that the airplane actually get airborne and then have to land at that weight, or can one consider that the airplane never even gets airborne or exclude certain actually landings from that consideration?

MR. GARDLIN: Yeah, the specific scenario as to how the airplane ended up in the water is not addressed. It's assumed to be in the water at that condition.

MR. O'CALLAGHAN: So just to be clear, then. So an actual scenario where an airplane enters the water from being airborne at a heavy weight is not specifically defined or considered?

MR. GARDLIN: To the extent that it is part of this broad unplanned emergency landing into water case, that's correct.

To the extent that it's a weight that must be considered for the planned ditching, then it would be addressed.

MR. O'CALLAGHAN: Okay, thank you. I also noticed in the bullets, under the FAR 25.801, I think it stated that it relates to the planned ditching as opposed to the everything else category. So what regulation then applies to the unplanned, that would provide the equivalent guidance that 25.801 does to the planned?

MR. GARDLIN: Well, the regulations that address that case or those cases are the regulations pertaining to the types of equipment and the regulation that requires the availability of exits. And then the remainder of the guidance for that is discussed in the Advisory Circular I mentioned.

MR. O'CALLAGHAN: Okay. So the flotation times and that sort of thing are not really -- don't really address the everything else category?

MR. GARDLIN: Well, the flotation time, I mean, because the initial conditions may be different, the flotation time may be different, but that is still an element of the substantiation. There still has to be an assessment of the flotation time against the ability to evacuate the airplane.

MR. O'CALLAGHAN: Okay. And maybe to ask the question in the most simple way, you know, it sounds like it's kind of complicated, the definitions and which rules apply. But for this accident we're talking about, when an airplane has an unplanned

landing on water shortly after takeoff at a heavy weight, which sets of regulations apply to that specific scenario, and what do they require, I guess?

MR. GARDLIN: Well, I think all the regulations apply because all the regulations have been addressed as far as the certification. I don't think it neatly fits. But certainly, you know, the substantiation against all of the requirements plays into how the airplane behaves in that case. But it's difficult to characterize it neatly as having fit a specific set of regulatory criteria. You know, the requirements are a collection of safety standards and I think they all work together to provide overall levels of safety.

MR. O'CALLAGHAN: Okay. And could you just remind us briefly what 25.801 states?

MR. GARDLIN: I don't have the actual text in from of me, but -- or maybe I do. But essentially what it requires is that the airplane be evaluated for entering into water, considering its probably hydrodynamic behavior, the resultant loads, and the effects on any orifices, openings, doors, windows and so on. And then it requires that it has sufficient flotation time to enable the occupants to leave the airplane and enter life rafts.

MR. O'CALLAGHAN: Okay. So the first part of that, the dynamic behavior of the airplane upon entering into the water, I'm trying to figure out if that language applies to this case.

MR. GARDLIN: Well, the language is specifically written for the prepared case, where there's time to determine what is necessary and time to potentially reduce the gross weight and so on, and in this case those things did not exist. So it's not literally applicable. However, it think it's broadly applicable in the overall sense that the airplane's behavior into the water is, you know, similar to what you'd expect if it were truly a planned ditching.

MR. O'CALLAGHAN: Okay, thank you. Mr. Chairman, that's all I have.

CHAIRMAN SUMWALT: Thank you. No more questions at all directed towards the panel?

MR. MURPHY: Not right now, Mr. Chairman, but would you like me to continue with the last structures witness, Mr. Fitzsimmons, or move to the parties?

CHAIRMAN SUMWALT: Whatever you'd like.

MR. MURPHY: I think I'll continue on, then, sir.

CHAIRMAN SUMWALT: Thank you.

MR. MURPHY: Mr. Fitzsimmons, I understand you have a presentation you'd like to begin with.

PRESENTATION BY MR. FITZSIMMONS

MR. FITZSIMMONS: Okay. So this short presentation is stripped into three parts. The first part, at the danger of repeating the presentation we've just seen, which I won't do, I just will focus on some of the most relevant aspects of the

certification requirements, as I see it for this case. The second part moves on to show how Airbus demonstrated compliance with the certification requirements for the A320 and looks at aircraft behavior, the integrity of the structure, and the protection of the occupants, and then finally how we show compliance for the flotation requirement.

The third and final part of this presentation is a comparative assessment of the emergency water landing of 1549 compared to the ditching certification baseline. So to fulfill 801 it must be investigated. It's necessary to investigate the overall aircraft behavior either by using a scale model of that aircraft or by comparison to aircraft with a similar configuration with the ditching characteristics known.

The second set of requirements at 561, which is for general emergency landing conditions, and 801, which is specific to ditching, there are some important points I'd like to highlight. Clearly, from the requirement, damage is acceptable. But even in the case of acceptable damage to the aircraft, to the structure, we must make each practical design measure to minimize the risks or to minimize the risk of injury to the occupants and to enable the occupants to evacuate the aircraft.

The third and final looks at flotation time and here we must show that flotation time is sufficient for the occupants to evaluate the aircraft and board the life rafts. So if we move to the second part, which is showing Airbus having shown compliance

with the requirements, first with aircraft behavior, now the basic approached used for the A320 was by comparison to extensive testing which was performed on two similar aircraft or similarly configured aircraft, and that's the A300 B2 and the Mercure. Now for these two aircraft, over 200 ditching tests were performed using scale models and the objective of these tests was to identify the approach scenario in terms of some important parameters.

So it's water entry parameter, the slope at entry into water, the pitch of the aircraft and the speed of the aircraft itself. So we had to identify using these tests and which of these parameters give the best overall behavior during the ditching. In particular, we looked to see whether there was nose diving or loss or control of the aircraft, the general behavior of the aircraft in the water.

Now these scale model tests were also representative of both the stiffness and the strength at specific locations on the aircraft. So it was possible to use two additional criteria to identify the best ditching approach and these were to check if there was break-up of the fuselage or not, which is an indication of the magnitude of the overall aircraft loads during ditching, and secondly, to check the deformation of the lower fuselage, which is an indication of how high the -- pressure is working on the -- so based on extensive testing performed on these two similar aircraft, it was possible, as you read across, to make

recommendations for the approach of the A320 and water entry for this aircraft, and these were to have landing gear retracted and full configuration, that means flaps and slats extended at minimum aircraft speed, and a pitch of 11 degrees and a slope or glide path of minus 0.5 degrees.

And it was mentioned earlier this morning that a lot of good work was done by the National Advisory Committee for Aeronautics. And as you read across, to check where we were in our recommendations, we checked with the extensive data from NACA so that it fits well with the overall industry standard.

If we now move on to the second part, the demonstration, which is the integrity of the structure and occupant protection, the objective here is to verify that design measures exist to give each occupant a reasonable chance to escaping serious injury in emergency landing, ensuring the following: that the ditching accelerations do not exceed the crash accelerations stipulated in JAR and FAR 561, and that the pressure and inertia loads acting on the structure do not result in a global failure of the structure.

The scale model testing which was performed on the Mercure and B2 were instrumented with accelerometers, and that was possible to measure during the ditching the accelerations and inertia forces acting on the aircraft, and these measured accelerations showed that they were well below the values which are specified in JAR and FAR 561. Now reading across, with the A320 to similar aircraft, we expect similar ditching behavior.

This aircraft, of course, is designed to withstand just accelerations of 561 and is therefore also, by comparison, able to withstand the lower ditching accelerations.

Moving on to the water pressure loads acting on the aircraft itself, the models for the B2 and Mercure, as I mentioned, were calibrated in such a way that the water pressure acting on the models could be derived from the deformation of the lower fuselage shell. So it's kind of a smart and representative pressure gauge.

Based on these water pressures, a dimensional formula was used comparing the shape, the mass, the geometry, the characteristics of the A320, and it was possible to derive the pressures then for the A320. Then, for the recommendation pitch of 11 degrees, the max landing weight at minimum speed, and a slope of minus one. So I'd just like to draw your attention to this. It's considered a design assumption of exceeding double the glide path, which has the effect of increasing the loads in the structure simply as a design precaution.

These loads were applied to the structure as follows. So the assumption was, based on extensive testing on circular fuselage cross-sections, that the load distribution was parabolic. That means we have a maximum load at the bottom centerline of the fuselage reducing to zero at the waterline. Counteracting these loads are the inertia loads resulting from the ditching acceleration. So the inertia loads of both the cargo and the

occupants. And these are combined then for the analysis of the structure.

Moving on to the structure analysis or strength compliance itself, these pressures and inertia loads were applied to the aft fuselage finite element model. A finite element model is a mathematical representation of the stiffness of the structure, which is used to calculate the stress distribution in that structure, and finally, using those stresses to calculate the reserve factors for the structure, for these stresses. The results showing compliance or reserve factors greater than one. I'll just remind you, reserve factor, in simplified form, is an allowable stress and applied stress. That means if it's greater than one there is sufficient strength of the structure at that location.

This next slide contains a lot of information. It's important to spend some time on this, because I'll be using this later, as well, to make a comparison between the ditching certification basis and the emergency landing of Flight 1549, so please bear with me.

What you're looking at, the small diagram on the top right-hand corner is showing the view and the main plot. So we're looking down below the floor level on the bottom centerline of the fuselage, which is represented by a dot. And if you move to the main diagram, this dot is the bottom centerline. It's the horizontal red line in the middle of the plot. And if you look at

the left-hand side of the plot there's an arrow, a black arrow, showing direction of flight. So we're looking at the complete pressurized lower fuselage shell starting on the left-hand side, which is just behind the wing and moving all the way back to the rear pressure bulkhead at the right-hand side at C-69 and C-70.

So we expanded out the lower shell. So if we look at the bottom of the plot, we're starting on the left-hand side just below the passenger floor. Moving up through the plot, again, we come to the bottom centerline, and at the top of the plot we're then at the right-hand side just below the passenger floor. And what may help your orientation, there's a large gray box annotated cargo door. This cargo door, then, is on the right-hand side of the fuselage.

The colors are representing the magnitude of the reserve factors in the certification ditching load case. The dark blue colors are the smallest reserve factors and they're between one and 1.15. The light blue colors are between 1.15 and 1.5. The dark green is then between 1.5 and two. And the area which is light green, the reserve factors are greater than two. So more than twice the sufficient strength. You can see it on the cargo door, for example, or indeed you can see clearly the circumvential joint at C-65. The one vertical line in light green is high reserve factors due to the reinforcement at the circumvential joint. So as I say, we'll be coming back to this plot later, when we compare with the 1549.

And finally, compliance was shown for flotation -- the calculation we do is using this formula. We calculate the amount of water leaking into the aircraft, and done step by step, this takes into account things like a coefficient of discharge, leakage area, and the height of the water acting on the leakage area, with some conservative assumptions that just, for example, a five degree rule on the aircraft, towards the cargo doors, which you'll see that the cargo doors are classically the largest ingress of water area.

And the results of this calculation. So what is done then is, using this water leakage, knowing the geometry of the aircraft, an equilibrium, the time step is calculated taking into account the weight, including the water which has entered the aircraft at that time, the buoyancy vectors -- equilibrium, and the waterline is defined. And the result of this calculation is a flotation time greater than seven minutes. Flotation time in this calculation simply means the time it takes for the waterline to reach for the ditching scenario we look at and to reach the lowest sill. The lowest passenger door sill is defined by seven minutes.

If I may move on to the third part of the presentation which compares the emergency landing of 1549 with the certification basis for ditching. And we need to look at this table which compares certain important parameters between the certification basis and what actually happened at the emergency water landing of 1549. So if we start so, you can see in the

table the, on the left-hand side, certification values for the ditching certification, and the right-hand side, emergency landing of 1549. So the assumption in certification was just over 145,000 pounds. It's the maximum landing weight of this aircraft. And indeed 1549, we were both out at 151,000 pounds. This alone increases loads acting on the fuselage, for sure.

Secondly, the pitch attitude, the recommendation, as we saw, was 11 degrees. The aircraft entered the water at 9.5 degrees, which is acceptable and within the tolerance which we see for entry to water. And just to make a point on this, it's also important, of course, to have a yaw and roll close to zero, and this was both the assumption certification and in the event itself. Roll and yaw were close to zero. So that was -- and just to make that comment. It's not in the table.

And most importantly the last two parameters, the glide slope at entry and the rate of descent are vitally important to understand the loading acting on the aircraft and comparing the loading acting on the aircraft between certification basis and the event itself. So the assumption, as you saw, the design assumption was a slope of minus one degrees. In fact, the aircraft entered the water at minus 3.5 degree glide slope. Taking this in combination with the increased aircraft speed, we move from a rate of descent at entry to water of 3.5 per second, up to 13 feet per second. So more than three times the rate of descent assumed for calculated loads and certifying the aircraft

for ditching. Using these parameters, the calculation you've seen for certification was repeated with the higher pressures and the reserve factors were calculated for the rear fuselage for this new load case. Just a few comments on that. First of all, this estimated pressure is beyond the validated calculation range from the testing.

So we had to extrapolate this beyond what we normally do to get to the pressure level. And the calculation itself, it's the standard, if you like, certification calculation, which gives a good indication of where we'd expect the frame failures. But any subsequent post-failure effects are not taken into account in the calculation results you're about to see.

So this, you may remember, was the distribution reserve factors for the certification load case. All above one, so sufficient strength and the strength demonstrated in this fashion. What this plot is showing is a reserve factor calculated and estimated for the emergency landing of US Airways Flight 1549. Here the colors are as follows: in the white area the reserve factor is greater than one; in the red area the reserve factor is less than one. So what does that mean? It means in the red area we would expect to see failures of the frames. If we overlay on this chart the damage extent of the frame damage that we saw on US Airways Flight 1549, this indeed the case. So we see a good correlation.

So just moving on to my final slide to summarize what

you've seen, what I've tried to explain to you. The emergency condition of US Airways 1549 led to rate of descent exceeding the certification assumptions, 13 feet per second instead of 3.5, which led to external pressure, which we estimated to be greater than twice the certification values. The damage to the aircraft is consistent with a high energy impact at the rear fuselage and the ensuing post-impact motion through the water. And despite the high vertical impact velocity and resulting damage to the aircraft, all occupants were protected from major injury and were able to evacuate the aircraft safely. And that concludes my presentation.

TECHNICAL PANEL QUESTIONS

MR. MURPHY: Thank you very much, Mr. Fitzsimmons. Going back to the beginning of how this all developed, going to the A300 B2 and the Mercure, how, in fact, were the scale models used to estimate the pressures that would be experienced in a water landing?

MR. FITZSIMMONS: As I mentioned during the presentation, these models were representative of both the stiffness and strengths. So the stiffness is important in this aspect, particularly. And o what was done was calibration of the model was performed by applying suction, a known suction, an over-pressure to the models. The deformation of the models was then measured during calibration testing. And so it was able to establish the relationship between the deformation of the model

and the pressure applied to the model. So simply then, when the tests were performed, you could look and measure the deformation of the scale model and then reading across to the relationship established gives you in effect the active pressure working on the models during ditching.

MR. MURPHY: This would assume then, in fact, that the scale models were accurate in replicating the strength and stiffness of the structure with regards to the frames and the skins?

MR. FITZSIMMONS: Yes, absolutely. A lot of care was taken to make sure that the aircraft were not only in terms, of course, of the geometry and inertia, but also the strength and stiffness at least at the specific areas of interest -- and to check this was the case. And indeed, during the physical calibration of these models, it was checked, for example, when a frame started to fail, to check across to the actual aircraft -- performed to see if that was in line with that, and that was indeed the case.

MR. MURPHY: And what parts of the aircraft were deformable for the model tests?

MR. FITZSIMMONS: In particular, deformable was the complete lower shell of the aircraft. So really, as I say, the intention was to use this information to calculate the pressures, so it was the lower shell of the aircraft.

MR. MURPHY: Okay. You mentioned there were over 200 of

these tests performed. How many of them were used in the final scenario to describe the behavior of the aircraft?

MR. FITZSIMMONS: I think in total there were around 220 tests. In effect, they were all used. And because all these test results were reviewed and again, the objective was to find those tests and the parameters which gives the best result in terms of maximum chance of surviving this kind of an incident. So from 220, in the end, I believe, it was about seven tests were identified, and from those tests it was possible then to use those parameters for entry into water.

MR. MURPHY: I understand that the tests were used for the behavior of the aircraft, the stability of the aircraft, after entering the water so it didn't pitch up or pitch nose down. Was also the damage taken into account with regard to the model or was it just for the behavior of the aircraft with regard to the model tests?

MR. FITZSIMMONS: For sure, it was -- primarily was to check the behavior of the aircraft on entry into water, whether there would be nose diving, cartwheeling, loss of control of the aircraft. But you know, as I described, these models were well designed and the intention was such that we could, for example, check break-up of the fuselage, which is an indication that in addition to understanding behavior, an indication of whether the overall loads on the aircraft were beyond what the aircraft could withstand, and also due to deformable load parts of the structure,

it was also possible then to use, as I mentioned, these models as an effective pressure gauge.

MR. MURPHY: Based on the presentation, there are two components to the loads that are going to affect the airplane during a ditching and that was the inertia loads and the pressure loads. Both of these obviously would change with time. How were they combined in order to be used in the analysis, the final structural analysis?

MR. FITZSIMMONS: It was simply combining worst with worst. What I mean by that is the maximum pressure measure was applied to the maximum inertia force.

MR. MURPHY: The maximum then not changing with time?

MR. FITZSIMMONS: That's correct, just maximum.

MR. MURPHY: So the pressure would just be, on the A300 or the B2, the max pressure, okay.

MR. FITZSIMMONS: Correct.

MR. MURPHY: There were no tests done on the A320, then? From what I assume, there was an equation used, the Wagner formula or bidimensional equation, in order to determine the pressure distribution on the A320?

MR. FITZSIMMONS: Yes, that's correct. And as Mr. Gardlin mentioned, this is commonplace not to perform testing on all aircraft. And indeed, you know, the requirements and regulations allow for that specifically. So what we did was to take the pressures measured in these two tests and to validate

them, incidentally, by comparing the results of those two tests and then to use the same Wagner dimensional formula you mentioned, into derive as well the pressures for the A320.

MR. MURPHY: So if I understood what you said, the equation that you used for the A320, you did go back and look at the results from the A300 and the Mercure and validate the equation for its use in future aircraft?

MR. FITZSIMMONS: That's exactly. You know, if you've ever done a test, you don't need to derive, obviously for that aircraft, the results. So this -- perhaps it was unclear -- is between the two tests. This method of determining pressure for another aircraft was checked and validated, and then using this checked and validated equation, this time it was used to derive the pressures for the A320, which was not indeed tested.

MR. MURPHY: How important is the vertical descent rate versus if you had to compare it to the pitch, the flight path angle and the pitch during the water landing? How important is that vertical descent rate that you mentioned? I noticed that we had a difference between the two in certification and the accident itself.

MR. FITZSIMMONS: It's very important. The mass, the aircraft speed and the pitch are also very important. But really, in particular, in comparing between the certification basis -- excuse me -- and the emergency landing of 1549, it was the vertical speed that was significantly the most important

parameter.

MR. MURPHY: I notice that in your presentation you used the maximum landing weight during your analysis of the aircraft structure. And if we go back to Mr. Gardlin's presentation he made reference to the critical weight and CG. Why is it just the maximum landing weight used for the Airbus during certification?

MR. FITZSIMMONS: I think if I understand this correctly, and please correct me if I'm wrong, for the -- for, let's say, the unplanned ditching, we used the critical. So typically max takeoff weight for an unplanned ditching. And for the certification basis for ditching, we used the max landing weight, which is what we use for all emergency landing conditions and what was agreed as well, for sure, with the authorities at the time.

MR. MURPHY: Do any of your other -- excuse me. Do any of your other weight variance for the certification in the A320 or A321s during ditching certification, would they have gone up to the weight we saw on the landing configuration for our accident?

MR. FITZSIMMONS: I would need to check exactly what the max landing weights are and I haven't made a comparison between max landing weight and the -- of various aircraft and what we had in the example.

MR. MURPHY: You've already mentioned the effect of the higher landing -- the higher landing weight would have an effect, during your presentation. What effect is the flap setting on the

water landing?

MR. FITZSIMMONS: Indirectly the flap setting will -- I'm not an aerodynamics expert -- but will give us a higher speed at entry and a higher speed will give us higher loads as well.

MR. MURPHY: There's been a good bit of conversation with regards to the engines. What is the expectation for the engines from the Airbus point of view during the water landing?

MR. FITZSIMMONS: You know, the important thing we've got are the engine and the engine -- design, and from a safety perspective, is that if the loads are so high that the engine -- separate, they separate in such a way that the wing box is not damaged, this is important because the wing box is a fuel tank and this is to prevent fuel spillage and fire hazard. And so whether they separate or not is not really the key issue. And even for flotation and whether the engines remain attached or detach, the flotation time is sufficient in most cases.

MR. MURPHY: You beat me to my next question. With regard to our accident, what was the initial contact point on the aircraft?

MR. FITZSIMMONS: The initial contact point was, I believe, around about for M-65.

MR. MURPHY: For M-65. And I think that's also the area where we had the strut come through the floor, that injured the flight attendant?

MR. FITZSIMMONS: That's correct.

MR. MURPHY: Okay. Do you believe the failure of the aft pressure bulkhead was a result of the impact with the water or the ensuing movement through the water?

MR. FITZSIMMONS: I'm sorry, could you repeat the question?

MR. MURPHY: The damage to the aft pressure bulkhead, do you believe that was a result of the impact or the aftereffect of moving the airplane through the water?

MR. FITZSIMMONS: Even from the time we spent on the aircraft in New Jersey and looking at the damage, it seemed quite clear to me that the pressure bulkhead itself was damaged by the water which is ingress. So there's been a failure of the lower shell forward to that area and the water scooping and the water jetting then has done some substantial damage to the aircraft and this, for example, on the rear pressure bulkhead.

MR. MURPHY: Okay. The same last two questions that I gave Mr. Gardlin. Given the accident, how practical or applicable do you feel the current regulations are with regard to ditching?

MR. FITZSIMMONS: You know, as I pointed out earlier, you know, the important part about the requirement, for me, if I can presume to say that, is that it's all about minimizing the risk to the passengers, to the occupants, and to evacuate. And there's nothing -- you know, just to -- which would, from this particular accident, suggest that we need to modify that. The outcome was good and we've done just what the requirement asked

for.

MR. MURPHY: And I'm sure I know the answer to this, but I'm going to ask it anyway. Based on your time spent with the airplane and your time looking at all of the data and analysis that's been done, how do you feel the airplane structure performed overall?

MR. FITZSIMMONS: You know, I think what I tried to show on the presentation was that the structure was what we expected. The frame damage was -- you know, for these very high levels which we had compared to the certification basis, and the frame damage was consistent. And you know, if you compare -- I know that my colleague will show this later, the condition of the cabin, the condition of the structure, the structure did its job. It protected the passengers and I'm certainly satisfied with the behavior of the structure.

MR. MURPHY: Okay, I know that's going to come up later. You're happy with the way the structure performed. That's all, thank you. John.

MR. O'CALLAGHAN: Thank you. And thank you, Mr. Fitzsimmons, for your presentation. Just a couple follow-ups to Brian's questions. In reading the reports about the base and testing, both the ones done by Airbus and also by NACA in the '50s, I found it was very kind of fascinating and I was wondering if you could just briefly describe how one of those tests is conducted, like if you're ready -- you have your model all set and

you want to do a test that'll achieve a certain condition to test, how would you go about doing that? Can you just describe briefly how a test might be performed?

MR. FITZSIMMONS: Okay. So the test we described and there were 122nd scale models. These models were placed on a catapult at a slope, with a block at the end. So effectively you would project the aircraft, and using the slope, with the catapult. The aircraft was free then between release point and into water and to move on all degrees of freedom. But the actual attitude and approach angle was controlled then by trimming the elevator so that the aircraft would strike the water as required by the testing parameters.

MR. O'CALLAGHAN: Thank you. And regarding those tests, I know that part of the objective was to capture the dynamic behavior of the airplane and I think I've seen plots, time history plots, of pitch angle and these sort of things. How was that data collected, like the time history of pitch angle, for example?

MR. FITZSIMMONS: I would need to refer back to the plot. I'm not sure for the details of just how exactly that was measured.

MR. O'CALLAGHAN: Okay, maybe photography or analyzing cinema video or something like that, maybe. Also on the testing, I'm curious as to how sensitive the results are to, you know, changes in initial condition or the pitch angle and so forth. So I guess that would be the question. How sensitive are the

dynamic -- is the dynamic behavior of the airplane and the damage to the fuselage to variations in the assumed touchdown parameters during a ditching, and in particular, like the effects of variation to pitch angle, touchdown vertical speed and water surface conditions? I know that's a big question, but --

MR. FITZSIMMONS: That's fine. You know, to attempt to answer the question fairly briefly, for sure, you know, the behavior, the overall behavior of the aircraft is, in particular in that case, to the pitch. The pitch is very important in terms of nose diving. And you know, if it's too high, the nose will slant and turn hard once we strike the tail. If it's too low, the danger is you enter -- first and also have a very strong nose-down effect.

And generally, you know, if you had increased the mass, you increase the loads, if you increase the aircraft speed to increase the loads, and if you increase the glide path, you in effect also then strongly increase the vertical descent rate at entry, which, as we've described, is a very important parameter. That's best quick answer I can give you to that.

MR. O'CALLAGHAN: Well, thank you, it's a very good answer. And can you say anything about the water surface condition and how that might affect the touchdown assumptions and criteria?

MR. FITZSIMMONS: I guess referring to some of the tests we've done with some other sea states and some information was

extracted from that, but more in terms of general guidance on whether to approach or to land parallel or perpendicular to the swell and this kind of stuff.

MR. O'CALLAGHAN: And in terms of damage to the models, did the sea state have any effect, do you recall?

MR. FITZSIMMONS: I'm sorry, I don't recall that.

MR. O'CALLAGHAN: Thank you. I was wondering, you know, we've pointed out that the accident vertical speed exceeded the certified value by approximately a little bit less than four, and then the certified numbers, three and a half feet per second, we had 13, and I'm trying to get a sense of is the three-and-a-half number sort of a cliff or is there sort of a progression in damage as that vertical speed increases? So if you could, if you could just please describe the expected progression in the damage to the fuselage structure as the vertical speed at touchdown increases above the nominal value or the certified value.

MR. FITZSIMMONS: Okay, for sure, it's not black or white, pass or fail. So you know, as we exceed above 3.5, some of those air factors even at 3.5 percent were, for sure, also above zero, were above 1.0 at that time. And so as we increase the loading, then, initially we'd have some fears of the frames of the structure, and then this will result in large deflections of the skin and will have some skin perforation, perhaps. So as you move on, you know, presuming a full extent of what would happen next, it's a progressive damage. So as you increase the load it's

progressively more and more damage to the structure.

MR. O'CALLAGHAN: And I thank you. On the accident airplane, I don't know if you know the answer to this, but do you have a sense of how long before doors in the over-wing exits remained above the waterline after touchdown?

MR. FITZSIMMONS: I'm sorry, I'm not sure how long they stayed above. All I do know is, you know, the passengers had sufficient time to escape using those exits.

MR. O'CALLAGHAN: Okay, thank you. I think it was longer than -- it was a pretty long time, longer than the seven minutes flotation time that's assumed in the requirements. Is that right? It was longer than seven minutes, probably.

MR. FITZSIMMONS: Absolutely much longer than seven minutes. And seven minutes, again, is just the time it takes in normal conditions to reach the lowest sill level. And even that, again, is quite a conservative approach.

MR. O'CALLAGHAN: Okay, thank you. And so my last question, too, is in general, then, looking at this accident at the testing, is it -- can we say that it's more likely that in a case of a touchdown that exceeds the recommended limits, that it's the aft fuselage that is likely to suffer the most damage, rather than other parts of the fuselage?

MR. FITZSIMMONS: Yes, for sure. You know, that's assuming that, you know, the recommendations are followed. That, for sure, the touchdown point will be round about for M-65, and

the brunt of the damage will be in that area, yes.

MR. O'CALLAGHAN: Okay, very good, thank you. And Mr. Chairman, that's all I have.

CHAIRMAN SUMWALT: Thank you. I would like to finish up this panel of witnesses, so who would be next to question from the Technical Panel?

CAPT. HELSON: Thank you, Mr. Chairman. Gentlemen, thank you all for joining us today, we appreciate your time. We'd like to next have Captain Van Der Stichel. We understand you have a presentation to share with us.

CAPT. VAN DER STICHEL: That's correct. As required by NTSB, I intend to give you some information about the --

CHAIRMAN SUMWALT: Excuse me. Yes, thank you.

PRESENTATION BY CAPTAIN VAN DER STICHEL

CAPT. VAN DER STICHEL: I'll do my best to give you information on the rationale used during the ditching evaluation of the aircraft. This has been some digging for me because this is a remote exercise. I will address with you first some definitions so that you could have an idea of how we proceed. Then address the ditching certification with the planned ditching, to try to cope with what we said before. Then address the dual engine landing -- dual engine failure landing certification and finishes to address how to proceed should you have a dual engine failure leading to a water landing.

So let's go first for the definitions. I think it's

worth addressing what is a forced landing and a planned ditching. The forced landing and the planned ditching have in common that there is a decision from the crew that it is better to land the aircraft immediately or immediately shorter than the destination. The difference between grounding and of course, the planned ditching is that when you land on the ground, and especially on the unprepared landing strip, the touchdown point is very important. So that's the aircraft be arrested before an obstacle at the end, and you usually use the landing gear, provided it's available.

But the landing distance is a key factor, whereas on the ditching on the water, normally the touchdown point is less a concern because of the lengths of the available fields for the water landing, and the vertical speeds on top of the aircraft -- and especially the wings level, the vertical speed is the most important parameter. There are some others that we can derive, but this is very important.

When considering the thrust it is important to consider that the situation is very different when you have thrust and no thrust, of course. And it doesn't mean that the no thrust is not covered, but it is addressed in a way that when you have to prepare your aircraft and all the assumptions which are made is that when you have no thrust -- and that would be the last bit of that slide -- when you have no thrust, you have only one attempt to perform your landing for the change in scenario. The planned

ditching that occurred in the -- has been the -- when the aircraft was considered -- the captain considered that you will be running out of fuel before reaching the land and he elected to land the aircraft before exposing his crew and especially his occupants, passengers and crew, to a greater hazard, which means trying to do the same exercise without fuel.

And planned ditching, as said, I'll make a little difference to announce the fact without engine, particularly when the aircraft overruns the runway at landing or takeoff and it is -- that sticks really what we could imagine as unplanned, unexpected, unprepared. And of course no aircraft handling in the air is considered for that case.

The next one of course is -- and I name it emergency landing without engine. Should it be over water or not, or over land, the primary concern, which is an immediate correction, is to maintain the safe flight of the aircraft, and depending on the case, define a strategy, including trying to relight the engines, that will eliminate the risk to have to land and force the aircraft, and eventually, should it be over water, eventually land the aircraft. Of course, this is a much more demanding scenario.

Let's consider now the planned ditching. I would like to highlight one item which is important to -- about the certification, that it is difficult, especially the safety is a difficult exercise, and most certification requirements are based on aviation experience, that has been exposed before, and on

comparison with existing design or perused design that has proved to be satisfactory. And most of the requirements, as well, are based on design criteria that enables the comparison, and it is important to consider that beyond the design criteria, usually there is no -- as you mentioned, Mr. O'Callaghan, there is no cliff effect. So as it kind of continues -- but globally as a whole, all those requirements do provide the expected safety for the intended operations.

So let's concentrate on the ditching. The 801, as said, provides what's called a general safety objective and the natural, the accepted response, global. In the -- certification process, response is to define some acceptable land and consistent design criteria. And as I am concerned -- procedures, it gives an optimum water entry condition that the aircraft should target. And whatever the reason, the aircraft should enable to reach and approach as close as possible the expected attitudes and provide guidance, if time permits, provide guidance to reach those conditions.

So the planned ditching case, so that means that the pilots have all the means available to configure the aircraft. So the sketches are showing you conventional pitch and glide path and the resulting angle of attack. And the aircraft is to be flown in flaps configuration full and gear up for the water entry. The glide path is assumed, in that case, to be managed by thrust setting. The max achievable angle of attack is 15 in the

specific -- of that case. As regards certification demonstration, the aircraft handling is assessed during the entire development and certification flight test program. There is no specific handling technique to achieve ditching conditions, of course, with engine thrust available. And I will carry on later on with other cases.

Let's address now the dual engine failure landing certification. What we could expect from failure consequences is a loss of two, beyond the three, hydraulic systems. Mainly the yellow and the green may fail but may be available should the engine still be turning, and in case of flame out, we call it windmilling. The flaps normally are unavailable, of course, except if the yellow and the green systems are available for the same reasons.

The aircraft should fall into the emergency electrical power should the generator, which are powered by the engines, would not be available. Of course, if APU GEN is available at that time, the aircraft remains in kind of normal electrical power, and of course resulting in terms of flight control laws, the aircraft reverting an alternate control, which is the first level of reconfiguration of the flight control law.

For the certification -- pardon. For the certification itself, the worst-case assumptions were taken and to complete loss of the thrust. That means that the energy and the trajectory are the priority. The complete loss of yellow and green systems that

leads to the loss of trimmable horizontal stabilizer and flaps, and that triggers the alternate law. And emergency power supply is enforced, meaning there is no APU restart. Those are the assumptions. As we have demonstration -- a dual engine -- a dual hydraulic -- pardon -- failure -- yellow and green is considered. And that has been accomplished in sim and flight, landing included. The emergency electric power supply is accomplished as well. This has an effect on the cockpit cues on board, and that has been accomplished in sim and flight. And for the complete synthetic exercise, where dual engine failure is assessed, that has been accomplished in engineering simulator for use of flight situations.

That specific case I explained. So the initial flight conditions, if you remember yesterday the conditions, we start the exercise for the certification at flight level -- 10,000 feet, and from clean, which is no slats expected. And the scenario is to shut down both engines and to confirm the loss of the hydraulic by switching off the pumps with the controls so it's confirmed. And then the slats are extended because the flaps will not extend because of a loss of hydraulic power. The landing gear will be extended by gravity and the landing is performed on a runway. The aircraft handling has been assessed by us and of course by the authorities and their president and it was meeting the certification requirement. For your interest, the landing on the runway in such a case is more demanding than on the non-

constraining landing strip in time of trajectory planning.

Now, let's consider now the case where you have to combine the dual engine failure and to finish, to complete the flight paths on the water. As just to recall, the dual engine failure has demonstrated a capability to -- the aircraft under case, whatever the flap configuration, of course. So the flight controls have to enable the pilot to attain the target and at least to approach those, and of course depending on the case, to minimize, as if we refer to the ERPER (ph.) requirements, to minimize all the risk for other cases. And our duty is to provide even for cases which are beyond the certifications. The work doesn't stop. Our duty is to provide procedures that enable the crew to keep control of the aircraft and have a greater chance of ditching properly the aircraft.

So the next slide will be an illustration of two cases where we consider no thrust available, of course, and one case where by windmilling you would have some hydraulic power and that the aircraft configuration is made, and the second one, when no hydraulic power as for the dual engine failure considered before. And considering the effects of following the checklist, the procedure which has been certified, because for all those procedures, as per regulations, system failures are assessed and the procedures are assessed, including workload assessment for all those procedures. And for those procedures specifically, that has been assessed for ditching on the paper review with the

authorities. So there's some information as well, on the top of the presentation. This is the resulting speed recommended, which is a kind of envelope case. I recall that when you are no thrust, the main initial concern is the loss of thrust. So the main initial concern for a pilot is to choose the aircraft trajectory, the strategy for the following.

And of course, if time permits and if you have time to reach it, there is -- that speed is to be determined, which is important. That speed, in the worst case, that means if you have no hydraulic power anymore, that speed is displayed on the PFD, trying to mitigate the fact if the crew has no chance to look at the QRH.

So the first line you will see that, in blue, the three is the recommended flap setting, the flap lever setting. Since in that first line the hydraulic power would be considered available, you would get actually slat/flap three and the flight control will remain normal. And if everyone remember, the target would be something like 11 pitch of degrees and with a margin of maneuverability, and the maximum capacity of the aircraft being 17.5, it covers the aircraft ability.

Of course, the maneuverability of the aircraft has been assessed during the flight test, but there is no need to specifically fly that scenario. The second line is the equivalent, an expand of the case I was explaining to you on the dual engine failure with the worst case. So the flap lever is

three. Then because of the system failure unavailability, you get slats two and no flap and the 12 degrees in angle of attack, which is resulting should you fly the minimum speed displayed. And there is capability on the aircraft to flare and that has been assessed during the scenario. I have almost finished.

The assumption, of course, is initial pilot training is given, which is not across specific to be able to make -- landing. That is an assumption, of course, of the pilot skills for doing such exercise. The pilot is trained for no-flap landing, which is a different aircraft attitude, and this is covered by the training. And of course a very important feature is that you need sufficient time to prepare yourself.

To finish, when thrust is available the ditching is from the aircraft handling point of view, not a concern -- from the aircraft handling point of view. As for any aircraft type, no engine is a significant failure case. Whatever the case above VLS displayed on the PFD, aircraft is capable to significant descent, reduce the descent rate and to approach the flight path angle. And of course, despite the aircraft is formally capable of doing it, this scenario and especially one of the -- case, dual scenario requires significant pilot involvement, significant pilot focus and of course time to prepare. And that completes my presentation.

TECHNICAL PANEL QUESTIONS

CAPT. HELSON: Thank you, Captain Van Der Stichel. We

do have some questions for you regarding the presentation. And first we've talked quite a bit today about the definitions of ditching, unplanned ditching, and I wonder if we could go back. Do you still have your presentation available, to your slide number three?

CAPT. VAN DER STICHEL: I cannot -- thanks.

CAPT. HELSON: And I guess what I want to ask you is, under the bullet there for unplanned ditching, runway overrun, aircraft stop in the water, and it states there no aircraft handling. So to me that implies that there's obviously no capability to control the aircraft and it's a very sudden event. Now, we heard Captain Sullenberger testify yesterday that he went through his decision-making process and chose to land on the Hudson River. Would that not make that a planned ditching at this point?

CAPT. VAN DER STICHEL: As I told you, I made the distinction, the distinction, you know, assessment process to address a planned ditching on a very specific case. And of course, as regards Mr. Gardlin, the emergency landing without engine would fall, and especially the case of the Hudson, would fall in the unplanned ditching according to Mr. Gardlin's definition. This is rather the definition for every one. That's design and assessment process -- of course, the Hudson River is not an unplanned ditching, as per that bullet, because where there is no aircraft handling, is when your aircraft is running on the

ground and you continue to haul out into the water because there is no in-air aircraft handling. This is what I meant. That distinction is just there to highlight the difference between such a case, which is a ground, full ground case, if I may say, with the piloted one. You're right, in a sense that if you have a failure, a dual engine failure and you are forced to land your aircraft, depending on the time you have, depending on the skill you put in the scenario, yourself, you may reconnect what I would call planned.

As a pilot it's difficult for me to state that landing an aircraft without engine could be a planned. Of course, this is a question of words. This is not an issue there because, planned or unplanned, our duty is to provide the maximum capability of the aircraft to minimize again and give guidance to the crew.

CAPT. HELSON: Okay, thank you. Now, we saw in Mr. Fitzsimmons' slide, and I believe in your presentation as well, point out the ditching certification criteria assumes a flight path angle of minus five degrees and a pitch attitude of 11 degrees at touchdown. How were flight test evaluation personnel involved making this assumption and how did you determine that that criteria was operational feasible?

CAPT. VAN DER STICHEL: I beg your pardon. I do not recall -- I cannot recall to you what were the actual involvement 20 years ago on that specific case and especially regarding that, because a lot of assumptions were made at the very early stage.

What is sure is that when we assess the failure case, we ensure that the aircraft is, with our knowledge of the aircraft performance, that the aircraft is capable to reach to these conditions. And let's imagine that the aircraft will be unable to provide an angle of attach of five degrees, for instance, or more. Then obviously that would be a showstopper; it is not the case.

CAPT. HELSON: Okay, thank you. Also yesterday we heard Captain Parisis stated that the procedure itself was -- I believe we're speaking in terms of the dual engine failure procedure, if ditching is anticipated. He stated that there were some simulator testing done to validate that procedure. Do you know if any flight tests -- what flight test conditions might've been used to validate this criteria?

CAPT. VAN DER STICHEL: So I'm not sure to have understood. Do you mention sim test or flight test? Pardon.

CAPT. HELSON: Actually, that's exactly what I'm asking, I guess, were there also any flight testing validations done in addition to the simulator?

CAPT. VAN DER STICHEL: It is, as I told you, the dual engine failure, including the complete failure, including the landing, is something that we run on the simulator for safety reasons for the population around, of course. And because a simulator is -- for such exercise, it doesn't prevent us to review partially, not until the landing, but as much as we can, dual failure case in the air as well. So it's a mixture of both, but

I'm unable to give you a clear detail.

CAPT. HELSON: Okay, thank you. Also, yesterday we heard from Captain Parisis regarding the development of procedures. Can you give us some idea of what role flight test evaluation personnel play in developing procedures for flight operations?

CAPT. VAN DER STICHEL: Usually the flight test pilots, all the experts from flight test act as advisor, of course, to the designer for the development process. They are assisted, of course, with the training people that give a good point of view as well, because there is a global assessment. At the end all the procedures, as I told you, link to the failure cases, subject to an evaluation.

And that evaluation has been made by us initially and after that presented, those procedures are presented, the failure case and the associated procedures are presented to the authorities and some are reviewed and assessed by, I would say, engineering or -- and some of them are run by the authorities -- as themselves. Normally do that under your controller. I've got a -- just on my side -- are run by the test pilots from the certification authorities, and this is a global process.

CAPT. HELSON: Okay, thank you. Do you still have your presentation available? I'd like to pull up your conclusion slide. There were go, thank you. Now, the last bullet point, you discussed, you know, the aircraft is capable. If I understand

correctly, what you're saying is, you know, there's a certain combination of flight control inputs that will achieve this certification criteria. But following that, you state that this is a demanding task that requires significant pilot focus and time. Would you expand on that for us, please?

CAPT. VAN DER STICHEL: Yes.

CHAIRMAN SUMWALT: And I've called the audio booth three times. We're trying to get more volume. We've got it turned up as loud as we can. So I want you to speak up really loudly so we can get this on the record. Thank you.

CAPT. VAN DER STICHEL: I will do my best. So to your question, yes, I will give you. The failure, the global failure assessment in the certification process is made on considering different very important criteria. First is the severity of the failure and the potential consequences. The second is the probability of occurrence, of course, and as mitigation to that, a thing you can reduce because there is -- I do my best.

And the pilots, the crew, what we call the crew compensation, that means all the effort which is higher than usual daily business, all the crew compensation to sustain the consequence of the failure. And this is very important. We have that crew compensation. I've put pilot focus because it was more general term rather than technical conventional one, and that's typically what that bullet means. It means that the failure is a significant one. A dual engine failure in that attitude is

something which is far beyond what we usually expect for engine failure, and it doesn't mean the aircraft is necessarily lost, but it means that the aircraft will be handled by a crew and they will bring all their skills they have in that scenario. That's what I mean with demanding task and significant focus. It means that there is some shedding of some less important tasks that normally you could imagine that could occur in the daily pilot life when everything goes normally.

CAPT. HELSON: Okay. If I understood you correctly, I think you said this -- achieving this task would require a higher than usual crew compensation, if I heard you correctly. Now, you being a test pilot, could you speak to the level of training that would be required? For example, is this a task that you would expect a normal line pilot to be able to easily achieve without special training?

CAPT. VAN DER STICHEL: There are a lot of qualifications in your sentence and you say normal, you say easily and without training; it's a lot. With all that combined, I believe it's -- that answer is no, it is not easy. That's the reason of the demanding task. But I'm not really a very specialist on all the training assumptions and program development as posed yesterday. That will be --

CAPT. HELSON: Okay. What would you say would be the best way to prepare pilots for accomplishing a task like this?

CAPT. VAN DER STICHEL: If we remind the assumptions,

it's important that the pilots do experience once the pressure, once in their life, the pressure of having to land an aircraft without any thrust, because it gives you a kind of tempo. That's in terms of threat management, referring to what we heard yesterday, give a tempo of now you've got a limited time to find a solution. That will be the first part. Beyond that, again, that has to be established carefully, but I'm not dedicated for that.

CAPT. HELSON: Thank you, Captain.

MR. O'CALLAGHAN: Good morning, Captain Van Der Stichel. I have just a couple of follow-up questions. Thank you again for your presentation. And kind of focusing in on the landing without thrust on the water, it appears to me, from the conversations, that it really kind of -- well, I understand from your presentation that a lot of the demand and the focus comes from the shedding of tasks and you know, getting kind of to the landing site and taking care of what's important first. But in the end, I guess I want to focus in on that last 100 feet of actually putting the aircraft in the water.

Now you've done everything you needed to do. There's the landing site ahead of you. In this case the Hudson River. And now the pilot has to discover that set of flight control inputs, as Dave -- as Captain Helson put it, that'll put the aircraft at touchdown within the criteria, that that's expected to meet, you know, all the touchdown expectations. So I was wondering if you could specifically address how difficult that

task is, the actual rounding out of the flare and putting the airplane in the water and if it requires anything special or different from a normal landing and what other special challenges might be associated with that particular task.

CAPT. VAN DER STICHEL: The difference, when you approach the water and you have to imagine approaching the water without any pre-recognition, there will be quite pretty high numbers of parameters that you may discover without engine. First is the adequacy of the wind versus the sea state. That's an important feature. So that puts a demand on the pilot assessing the sea state before reaching.

In our case it was not -- in the case of the Hudson the sea state was most, so that was a good option. That gives an additional difficulty to the task compared to the daily scenario when you're in the aircraft. As regards handling quality, the aircraft will behave, of course, as I told you, provided you had all the conditions that enables you to keep your speeds, of course, it's a usual landing.

The difficulty then is to establish when to start and that's the reason why I explained that's to be exposed to -- of landing once. It's interesting to have that experience of the change compared to the daily landings. But each landing you perform in your daily life, you reduce the thrust before touching. So the final touch is made without any power, usually. But the trigger is more sensitive.

MR. O'CALLAGHAN: Okay, thank you. And I'm going to ask you to comment on Exhibit 2CC. Mr. Smith, if you'd like to bring that up, please. While he's bringing that up I'll mention that it's kind of lengthy and it's worth reading in its entirety, but obviously for the purpose of time here, I'd just like to highlight a couple sentences from it. And as soon as it comes up I'll just quote about three sentences from there and then just ask your opinion about whether it makes sense to you and if you would agree with it.

So here, this is from the Airman's Information Manual and it is kind of describing the pilot activity or task in that last hundred feet for putting the airplane in the water. So starting at the top I'll just, like I say, read about three sentences.

"Once pre-ditching preparations are completed, the pilot should turn to the ditching heading and commence let-down. The aircraft should be flown low over the water and slowed down until 10 knots or so above stall." Then a little further down we read, "Care must be taken not to drop the aircraft from too high altitude or to balloon due to excessive speed. The altitude above water depends on the aircraft. Over glassy smooth water, or at night without sufficient light, it is very easy, even for the most experienced pilots, to misjudge altitude by 50 feet or more." And then finally at the beginning of Paragraph 1 there, it says, "If no power is available, a greater than normal approach speed should

be used down to the flare-out. This speed margin will allow the glide to be broken early and more gradually, thereby giving the pilot time and distance to feel for the surface, decreasing the possibility of stalling high or flying into the water." So those are three statements that I thought were particularly relevant to the case at hand and I would just solicit your opinion on that and if it applies here.

CAPT. VAN DER STICHEL: I think the first paragraph is important, and saying that it's difficult to see when the contact will occur, I agree with you, and that's the reason why the -- available case is much easier, because you can stabilize your aircraft early enough and wait for the contact. That's for the first paragraph.

The second paragraph says that it's advisable to have speed margin above normal cases and which is in most cases as commanded today by the procedures, but some limits and it's difficult to stretch any parameter to its limit not considering the others. And in some cases, if you go too far in speed and depending on the wind, you did plan your final maneuver, having too much speed might be an adverse as well. So there is that combination of all, is typically that the pilot judgment and analysis, that puts demands on his tasks, which is required. That exercise is not an easy one, for sure.

MR. O'CALLAGHAN: Thank you. And so I'll probably conclude my questions with sort of the same one that

Captain Helson asked, but particularly to this flare-out maneuver, is that how do you think pilots could be -- well, number one, is this out of the norm for them, this maneuver and particularly the judging touchdown above glassy water, carrying speed and letting it bleed off? Is that different from a normal touchdown or things that pilots would usually be exposed to, and if so, how best do you think they could be prepared for executing the type of maneuver described here successfully?

CAPT. VAN DER STICHEL: To be fair with you, the very beginning was a bit too fast for me. Would you mind maybe repeating it for me?

MR. O'CALLAGHAN: Sure, I apologize. It seems to me that the maneuver described here and the difficulty, for example, in judging height over water and sort of carrying excess speed and letting it bleed off before touchdown is perhaps a bit different than a normal landing that pilots would usually be exposed to. Number one, that's the question, if you agree with that or not. And then number two, if that is indeed the case, that it's not something they would be normally called upon to do, how could they best be prepared to execute this type of maneuver successfully?

CAPT. VAN DER STICHEL: I will have some difficulty to really deeply go into the best training part, as you can imagine. Nevertheless, as I told you, to be exposed, a pilot -- when a pilot has been exposed to one case and has a capability to use those skills later on, on different cases, so a -- landing will be

interesting. It is not across specific, again. It is something which is -- I agree with you as well that it is difficult in some specific weather or night light conditions. And this is one reason I think relighting the engines is a good option, to avoid having to eventually land into water, if you can avoid. That's the first strategy, of course. Nevertheless, at the end, finishing to your question, that task is beyond -- yes, is beyond the daily use of the aircraft by the pilots. Globally, this is a more serious case than usually, yes.

MR. O'CALLAGHAN: Okay. And I promise, this really is the last one. You mentioned that it might be helpful to expose pilots to this at least once to get an idea of the time pressure, and then perhaps also the actual touchdown. How best do you think that exposure could be accomplished? And for example, specifically, could a simulator be used?

CAPT. VAN DER STICHEL: I will say it again because I'm able not to be clear. That's the reason why I think this is an assumption, that the pilots are exposed once in their life on the initial training. It is possible to make engine-off scenario in the simulator. It is actually the case. And I refer to the discussion yesterday.

That time pressure on that scenario has been addressed in the pilot training today, but not until the end. And that time pressure is present because all pilots -- and I've been through, as well, myself. All pilots -- this landing. And that gives you

quite a -- pressure on your task. And it is a good learning process. Should it be until the final landing, it's another question.

MR. O'CALLAGHAN: Okay, thank you very much, Captain Van Der Stichel. That's all I have.

CHAIRMAN SUMWALT: Any other questions for this particular witness?

DR. WILSON: I have a couple.

CHAIRMAN SUMWALT: Okay.

DR. WILSON: Just to clarify, talking earlier about how the 11 degrees of pitch and the negative .5 degree glide path was evaluated for operational feasibility, could you just clarify for us, are you aware of any simulation tests that were run to ensure that pilots could achieve this in a ditching scenario?

CAPT. VAN DER STICHEL: As far as my memory, no, I do not recall. But what I said during the presentation is that the capability to zero the vertical speed, yes, is assessed in midair and so -- but it's a different case.

DR. WILSON: Okay, great. And going back to your definition of ditching being an event that -- in which the airplane has thrust available, in the checklist for the dual engine failure there is a section for ditching. Is ditching an appropriate word to use in a checklist? Is that something that could confuse pilots, if a different technique is used for landing with engine thrust and without engine thrust?

CAPT. VAN DER STICHEL: I don't think it is confusing because -- but you know, when you -- we must make the difference between the segregating the different case that all together we assess so that we understand each other when we have time to assess and make all the studies and what we provide to the pilot for them to succeed and understand what they can expect. I do not believe that to use ditching in that very end part of the dual engine failure is a problem -- so I see no issue in that.

DR. WILSON: Okay, thank you. And one last question for you. The ditching checklist for dual engine failure calls for flaps three for configuring for landing. The ditching with power calls for flap full. Could you explain the difference and why the differing flap configurations?

CAPT. VAN DER STICHEL: Yes. When you have engine thrust and power, since the strategy for that planned ditching is to minimize the speed and the -- so the maximum -- the checklist says maximum flaps available, and so it could -- to full and since you have all the systems available, it is a good assumption. All the checklists given for dual engine failure, it is a reasonable assumption that you will not get flap selection -- flap extension -- pardon. And that checklist is given globally to every simple, unique path to follow, and flaps three is a reasonable choice. And the assumption is difference between the two cases.

DR. WILSON: Okay, thank you. That's all I have for

this witness, thank you.

CHAIRMAN SUMWALT: Okay, thank you. What I'd like to do is we would like to take a break. We will be taking a late lunch break today, so I'd like to give you a chance to go out and get a cup of coffee or a quick banana snack or whatever it is you want. So let's take about a 17-minute break. We'll reconvene at, by that clock, let's see, about seven or eight after. So seven after. So we are in recess.

(Off the record.)

(On the record.)

HEARING OFFICER BENZON: Can we start taking our seats, please? Please take your seats.

CHAIRMAN SUMWALT: Okay, thank you for your cooperation in getting back in and I hope everyone feels better after getting a little bit of nourishment there. We will reconvene and I'll turn it back over to Mr. Benzon.

HEARING OFFICER BENZON: Okay. Captain Helson, go ahead.

CAPT. HELSON: Thank you, Mr. Benzon, and thank you, Mr. Chairman. Next we would like to speak with Mr. Arnold. We understand you have a presentation you'd like to share with us.

MR. ARNOLD: Can you hear me? Okay, great.

PRESENTATION BY MR. ARNOLD

MR. ARNOLD: Okay, my name is Gene Arnold, I'm a flight test certification pilot with the Seattle Aircraft Certification

Office. Primarily we deal with certification of U.S. aircraft. However, we occasionally are involved in validation flight test activities of foreign aircraft. Since about 2001 I have been involved with Airbus in doing the evaluation of the A340-600, the A318 and the A380. So I want to talk to you a little bit today about operational procedures and how we apply those. So I'll cover the regulatory guidance, what we do in certifying the AFM, ops procedures in service, certification assessment of operational procedures, and finally certification assessment of the ditching procedure.

It's very necessary to point out that an FAR reg, 25.671, is very specific and it states that an aircraft must be shown by analysis, test, or both, to be capable of continued safe flight and landing after any single failure or any double failure that is not extremely improbable. And there's a variant of that, 671(d), that says, with loss of all engines, the airplane must be controllable and must also be able to go ahead and be capable of demonstrating a flare.

And our AC 25-7, Advisory Circular 25-7, the flight test guide, comments to how we would look at that and it states that the airplane should be evaluated to determine that it's controllable following a failure of all engines in the various phases of flight, and it can be flared to a landing attitude from a reasonable approach speed. If the airplane requires some sort of emergency power system to drive the airplane control system,

that should be demonstrated in flight. And we take this paragraph very seriously and it's evaluated during the course of any flight test, typically in aggregate because, as was mentioned before by Captain Van Der Stichel, we don't do dual engine or all engine failures during a flight test program. So we'll fail specific systems. We'll look at the failure of hydraulic systems, say, or electrical systems. They may be separate tests to ensure that the emergency power systems are available to support it.

We also go ahead and take a look at the control effectiveness under those degraded conditions, and then the control authority. So all of those kind of tests in aggregate will allow us to determine that the airplane is indeed controllable even under the serious situation of having lost all engines.

Okay. FAR 25.1585 talks specifically to operating procedures and it states that operating procedures must be provided for appropriate normal procedures, non-normal procedures, and also any emergency procedure which would be foreseeable, you know, but not, you know, foreseeable but unusual situations in which immediate and precise action by the crew may be expected to substantially reduce the risk of that occurring. The next slide.

We in the FAA approve the airplane flight manual. The primary purpose of the flight manual is to go ahead and provide an authoritative source of how the airplane can be safely operated in flight. And there are mandatory AFM data that's prescribed and

that's FAR 25.1581 through 1587, copy or discuss the mandatory elements of what has to be required in an AFM. There's an Advisory Circular as well, that further discusses the AFM. It's Advisory Circular 25-1581, which provides detailed criteria on AFM-required content on how to safely operate the airplane. It specifies specific emergencies that should be included within the AFM. This includes severe engine damage or failure, multiple engine loss, and crash landing or ditching. So that's contained within AC 1581. And that guidance is available to all applicants to go ahead and review and it carries through the certification test program.

Although the authorities approve the AFM, in many cases we find that the applicants, or the manufacturers, will generate their own flight crew operating manual, or FCOM, and this FCOM, in a lot of cases, it's just a little more expansive than the AFM-required -- putting in information that they feel would be appropriate to provide better information to the crews as to how operate the airplane.

This AFM as well, they have an associated quick reference checklist. These documents are accepted the FAA, but not approved by the FAA. The airlines in turn can take a look. They can use the FAA-approved AFM. They can take the manufacturer-provided FCOM QRH, or they can go ahead and develop their own FCOM QRH. Whatever they choose to use, their particular procedures are typically approved by the primary ops inspector for

that respective airline. Okay, the next slide.

And this talks to the QRH and pilot guides that are available, which I've just talked to. So these items are available to the crews, but again, we approve the AFM, but operators may use FCOMs or QRHs.

During the course of a certification, we do look at the operations and procedures quite thoroughly and we do this in a cooperative effort between the certification people involved in that program and also the AEG, or the Aircraft Evaluation Group, operational evaluators. This starts very early in the program, typically well before the first flight of the airplane, even, and before we get into certification we'll look at the normal procedures, the abnormal and the emergency procedures. The AEG operational folks for U.S. certifications will typically validate all the aspects of the checklist, including all emergency checklists, including some of the severe emergencies.

And in validating checklists the primary thing that is done is to systematically go through the steps to ensure the correct system functionality and system response to doing the checklist steps as you go down the line. It's not necessarily an evaluation of the flying qualities of an airplane but an evaluation of the system characteristics in accomplishing each step to ensure that the system responds as it's expected to respond. So we will do this quite often in an engineering simulator, and selected conditions are then performed in flight.

And we do go ahead and take a very extensive look at some very severe degraded conditions in flight, including dual hydraulic failures, failures of multiple electrical systems and buses, severe degraded avionic system failures, to include loss of certain displays. For airplanes with flight control systems, fly-by-wire flight control systems, we'll look at degraded control loss, including down to direct law.

I would comment that when I did the validation for the A318 back in 2002, I only had two flights in the airplane, a forward CG heavyweight and an aft CG lightweight, and we did evaluate the airplane with a green and blue hydraulic failure, a dual hydraulic failure. We flew the airplane in direct law and in direct law we took it down to beyond the stall warning to the G break of the airplane. We did landings in direct law. So we do try and look at a cross-section of emergencies.

However, for a validation program, we only have a very limited amount of time and resources, so we really have to pick what kind of failure conditions we want to look at and it'll typically depend on what the unique features of that airplane are, are there any new technologies involved. Throughout all of this, as I said, we do this in a cooperative effort with our evaluation group pilots. Quite often they will be along with us in the simulator when we perform simulator evaluations. On occasion they may even fly along on one of our flights. We additionally support the Flight Standards Board and the Flight Operations Evaluation

Board. If during the course of certification we see that there are any unique features of the airplane that would be appropriate to pass on to our operational evaluators for training or for procedures, we definitely communicate that. For a foreign aircraft, as I pointed out, we have considerable less time and resources to go ahead and look at an airplane. As I said earlier, for the A318 we had about -- we had one simulator and then two flights.

For the A340-600 we had about four simulators and seven flights. So it depends on how unique the airplane is, and the test program will be adjusted accordingly. But it's not extensive by any means. We look at what we can. We depend on the foreign authority to certify the airplane. We are just validating the airplane.

Now, when we go to validate, the foreign authority will brief us on the status of their certification activities. We are also briefed by the applicant so that we have a good appreciation for where there might be any issues along the way. And if there are certain elements of the airplane that merit a little extra look, we will go ahead and look in that area.

In the case of the A320, I had a chance to go ahead and talk to our flight test engineers who were involved in that program quite some time back. That airplane at the time was the first civil fly-by-wire airplane; had a number of unique technologies. In addition to fly-by-wire, it was the first with a

side stick control, it was the first with non-moveable throttles. And so the predominant focus of their effort was on the flight control system and failure modes of the flight control system. And I would comment that ditching was probably really low on the priority list because they did have a limited amount of time and resources to look at that. During their assessment, I would comment that there's a slight error on that slide. It should be they assessed approximately 33, because I didn't have access to the documents themselves. So it should be approximately 33. But they were both very specific and it was a fairly high number of failure conditions that they did.

And again, this is done through coordination with the foreign authorities and the applicants. They brief us beforehand and then after the fact we brief them. If there are unique observations we have that are concerns, especially concerns regarding operations in training, that will be conveyed to the foreign authority, to the applicant, and also to our operational evaluation folks. And again, bottom line, we would approve the U.S. version of the AFM. There may be cases where the AFM is slightly different between the foreign authority and the U.S. version of the AFM because of some regulatory differences of systems requirements for doing certain kind of tasks, say sensory requirements for an auto land, that sort of thing.

For ditching procedures, as was pointed out earlier, it's primarily a paper review of the approved procedures. The

applicant will go ahead and propose the procedures to us, that are developed as part of their compliance with 25.801(c), which, as was discussed earlier, the probability of the behavior of the airplane must be investigated with model tests or by comparison with other airplanes.

When we take a look at those procedures and validate those procedures, the primary thing that is looked at in validating again is to go ahead and ensure that as you go step by step through those procedures, that the system response to the appropriate step list steps -- checklist steps is correct. We do not do simulator evaluations of the final approach to contact with a surface, and there are a number of reasons for that. One is because of the question of the simulator fidelity. There's also a significant variability in what the potential landing environment might be, the sea state, the winds, even the potential configuration of the airplane. There are so many variables.

With the A320 would it be normal law or alternate law? And there's definitely going to be a difference in the handling characteristics of the airplane for those particular conditions which might affect the pilot flare performance. And obviously one of the big things is the pilot's familiarity with doing such a maneuver. Bottom line: the airplane during flight test is demonstrated capable of being able to go ahead and do the flared landing. But it is a very, very demanding task and there are a lot of variables that play into it. And as to trying to go ahead

and do a simulator test, again, there's questions about the aero model, especially in regards to the ground effect or water effect, how accurate it would be; it just isn't feasible. In researching this, I questioned a number of my FAA flight test pilot colleagues and I also asked my ASA (ph.) flight test colleague, Have you ever, ever done a simulator testing of ditching procedures all the way to contact? And I have not found anyone who has.

Okay, in summary, the primary certification requirement that we feel is an absolute necessity is that the airplane must be controllable, even under the most extreme circumstances of having lost both engines. Given that, then the pilot at least has a reasonable chance of trying to go ahead and deal with a situation, to fly the airplane, to find some sort of reasonable landing area, to be able to go ahead and attempt to land the airplane, as was done in the case of this particular accident.

The operational procedure assessments are an integral part of the certification test program. They go through the certification test program and it's a cooperative effort between certification and the ops evaluators, and also with the foreign authorities for a foreign aircraft. But again, ditching procedure assessment is typically a paper review of the proposed procedures. Thank you very much.

TECHNICAL PANEL QUESTIONS

CAPT. HELSON: Thank you, Mr. Arnold, it was a very thorough presentation covered. You'll be happy to know it covered

a lot of our questions already. I'd like to start out by asking you, sir, that we've talked a lot about the definitions of ditching today versus ditching, planned ditching versus unplanned ditching. Could you tell us, please, how does your definition of ditching compare to that which was presented by Captain Van Der Stichel earlier?

MR. ARNOLD: Well, you know, universally, ditching is being in the water. But unplanned versus planned, it'd really be nice to have the luxury of a planned ditching under any circumstance where you can have the time to go ahead and go through the checklist procedures, prepare the crew in the back end of the airplane and have the passengers properly prepared, briefed on emergency procedures and that sort of thing. If you have the luxury of time to do that, that's great.

The impression I had for this particular incident was that it was a forced landing and you know, they were rapidly running out of options as to what to do and the only available option was a forced landing on the water. So he was, quite frankly, forced into a situation where he had to put the airplane down somewhere and that looked like the only reasonable place to put it down.

CAPT. HELSON: Okay, moving on to ditching certification, we heard Mr. Gardlin earlier state that since the A320 was certified, that there were some changes, mostly to equipment requirements. How about operational requirements, were

there any changes that you're aware of between -- operationally speaking, between when the A320 was certified and currently?

MR. ARNOLD: Not that I'm aware of.

CAPT. HELSON: Okay. And just to clarify something. In your presentation you stated that there were approximately 33 failure conditions evaluated for the A320 and I know you did discuss dual engine failure. Was that part of the A320 certification?

MR. ARNOLD: I don't know specifically what the failure conditions were. I was told that they were predominantly focused on the flight control system. I would comment that there were a number of special conditions against the A320 at the time, again, predominantly the flight condition systems and that. So the primary focus was there.

If there are other severe emergencies, they could be evaluated in the simulator and I'm sure that they most definitely were, because typically when we go to Airbus we will go into an engineering simulator prior to our flights and some of the more severe failure conditions will be looked at in the simulator. I do not specifically remember to go ahead and do any kind of dual engine failure for the conditions that I've flown with him, but we have gone ahead and taken the airplane down to the emergency power. We have looked at dual hydraulics and what the failure conditions might be. So we try to go ahead and assess what we feel are the most critical failure scenarios of interest.

CAPT. HELSON: Okay. And in this case I think you stated that ditching, for example, may have been a lower priority in this particular case. But do you know necessarily if that was part of the evaluation?

MR. ARNOLD: I do not.

CAPT. HELSON: Okay. And in regards to using the simulator for testing, you stated it was not conducted and you gave us a number of conditions. Do you think that a simulator could be used for this? What would be the advantages, disadvantage of using it?

MR. ARNOLD: Again, there are considerable demands on a simulator system for the fidelity, particularly when you go ahead and get the ground effect. I know that we've dealt with simulator certifications in the past, of some systems, and there have been significant issues of the translation of the aero model from the actual aircraft performance over to the simulator.

Even though the aero model may appear to be technically correct from a pilot qualitative assessment, there are some degradations in the simulator characteristics. So it's almost an art, as well as a science, to go ahead and try and enhance the simulator fidelity. Within the course of an engineering test program, you obviously want to go ahead and try and achieve the fidelity for the normal kind of events that you would go ahead and have for an airplane during a test program, and specifically takeoffs, landings, expected failure conditions for takeoffs and

that sort of thing. And so there's a lot of effort for engineering simulators to try and model that correctly. But for something that is extremely remote like ditching, that -- again, you depend on what's accomplished via the water -- the models and what the model testing achieves and what is recommended by the manufacturer.

Does the procedure presented look reasonable and appropriate? Some procedures that we see for various manufacturers, it might be slightly different. There are some aircraft procedures that do not specify a pitch attitude at touchdown. They basically go ahead and say to go ahead and fly the airplane down and then touch down at the minimum rate of sink possible.

So you know, again, does the procedure look reasonable, but to try and go ahead be prescriptive and definitive as to exactly how to do the procedure. Especially at the very end, there are so many variables that could be involved that I think being prescriptive would straightjacket the pilot into thinking that this is going to work for him, and under a number of circumstances it may not work. So he's left to his judgment quite a bit to try and deal with the circumstances.

CAPT. HELSON: Okay, thank you. Excuse me. Okay, you spoke in your presentation about the assessment of ditching procedures. You said it's typically a paper review, obviously, and --

MR. ARNOLD: The procedures in the simulator as well, to go ahead and check the system functionality of the various systems as you go through the steps.

CAPT. HELSON: Okay. And in addition to going through the steps and checking the system functionality, would that also include some of the notes and guidance that is included in a checklist for flight crews? For example, in this case there's a note that I'll read to you here real quickly. We've been talking about it for the last few days. The note basically says to touch down with approximately 11 degrees of pitch and minimum aircraft vertical speed. So in addition to assessing the steps for system functionality, do you also assess those notes in the additional guidance for flight crews?

MR. ARNOLD: We do look at the notes, and again, those notes look reasonable. The primary concern I would have in looking at that, yes, you want to have a certain attitude, but again, I would go ahead and comment that the minimum rate of sink would be a desirable feature. Another concern -- and quite frankly, this should be in most flight manuals. If an auxiliary power system, such as a RAT, has a minimum airspeed use, that minimum airspeed should be provided, and I believe it is within the A320, of a hundred and forty knots or so, because that RAT potentially will have a definite effect on airplane controllability if you drop below the speed of the RAT effectiveness and you're down to the very most severe degraded

situation for the airplane.

CAPT. HELSON: Okay, thank you. Mr. Smith, could we bring up Exhibit 2CC? Now, this is an excerpt from the aeronautical information manual. Mr. O'Callaghan read some of that earlier today. And basically it talks about different technique in able to achieve a successful ditching here. And I just wonder if you could compare for us, you know, how does something like this translate into a specific pitch and minimum rate of descent, as is included in the note in the checklist?

MR. ARNOLD: Well, as commented earlier, if you've got power to be able to set the pitch and maintain the airspeed and maintain a minimum rate of sink during that control condition, as is pointed out in that paragraph, over glassy water, and as I've had the benefit of flying both planes, it is a challenging task to go ahead and recognize your height above the surface of the water, particularly if the water is smooth, if there's minimal texture. So to try and maintain a powered on continuous rate of descent with minimum sink is a desired way to work it.

But if you're in the power off situation, you're not in a condition where you want to go ahead and maintain sufficient airspeed all the way down to the flare condition, where you have authority to flare. But then it's really a judgment factor as to determining how high you're above the surface before conducting the flare. Obviously if you go ahead and start too high or have problems in that regard, you may complicate the situation a little

bit for yourself. This could be exacerbated by the fact that you might be at night, which would make things very, very extreme. You might have weather. So there's a host of variables that are going to go ahead and affect this, and the tools available to you to go ahead and support your decision making are going to be limited.

I understand in this case they had the radar altimeter available to them, but there's a whole host of other things. Information is feeding into the pilot and as was evident on the narrative for the accident, yesterday, you had the ground prox warning systems providing him warnings and that sort of thing. So there's a lot of sensory cues that are coming into play that the pilot has to go ahead and try and pick the best information he's got to go ahead and do the task at hand, and sometimes this might not be very easy.

CAPT. HELSON: Okay. And as we heard from Captain Van Der Stichel earlier, he stated that this also -- he also stated it was a very demanding task. In fact, I believe he said something along the lines of it would take a higher than usual crew compensation to achieve this. Would you agree with that assessment and would you expect any particular exceptional skills to be required to achieve this?

MR. ARNOLD: It's definitely a higher than normal task, and you're also under the stress that you realize you only have one chance to do this, so you have to do it as best you can. If

you have only -- if you have never, ever seen a circumstance like this previous in your life, you are really groping and sorting it out on your own as you go. I know that there are pilots, glider pilots that are familiar with the use of a high key/low key.

For those of us in flight test who have flown fighter airplanes, we've done simulated flame-out landings using high key/low key and managed our conditions like that for a number of cases. So there's some degree of -- if you have some degree of familiarity, the task can be managed a little easier because you've got some background and skills to lean against. If you're being presented with this situation for the very first time in your life, it is going to be an extremely demanding task.

CAPT. HELSON: Okay. And I'll ask the same question we asked of Captain Van Der Stichel awhile ago. Can you give us your opinion of what would be the best way for -- to assure that a pilot had this background and skill available when he or she needed it?

MR. ARNOLD: I think that's a difficult question to answer. You know, are you mandating a level of skill? You know, it'd be great to go ahead and have a pilot that's got float plane experience, that's got glider experience, that's done these kind of maneuvers previously. There are certain pilots, and I'm sure in the airlines, that have got that kind of background, that have gone ahead and done unusual things, maybe flown acrobatic airplanes, that sort of thing. But do you mandate that skill

level across the board? Do you mandate certain training? You know, and even when you do, say, require a specific training event like a ditching landing or I would recommend personally a forced landing scenario if you were going to go ahead and do any kind of training event, it's just one data point for them to go ahead and get exposure to a very difficult, time-compressed situation where they just have one shot to put it down. There should be no penalty for the result.

But if there are, you know -- you know, there's opportunity to see that yes, the airplane is capable of doing this and if they can do it, that's great to go ahead and provide confidence in themselves and the airplane, that it definitely is possible, with engine out, to go ahead and take the airplane all the way down a landing condition and land the airplane or to go ahead and do a minimal touchdown landing on water.

CAPT. HELSON: Okay, thank you. And I want to back up just a second. In your presentation you talked about the concentration during certification, because this aircraft was the first in a number of areas. Could you expand on that a little bit and tell us, how would this evaluation process differ for a fly-by-wire aircraft versus a conventional aircraft?

MR. ARNOLD: You would want to understand the -- obviously the control laws of the airplane. You would want to see the degradation and control loss, what the failure conditions are, what -- you lose certain computers; how does that have an effect?

You lose sensory inputs to the flight control computers. If my air data system or my inertial nav system to the flight control computer has problems, what are the potential effects in flight control system degradation and how well does it fly? You would look at the handling characteristics for the normal law, the alternate law, and down to the direct law, to see what the characteristics are. Is there any difference in characteristics?

And in some cases there definitely are. You want to go ahead and understand the integrity and the robustness of the system and you want to ensure that if there are any degraded situations, particularly ones that potentially are a problem during the lifetime of the airplane, that the crew has the necessary information and tools available to them to go ahead and handle that degraded situation and to be able to go ahead and fly the airplane to a safe conclusion.

CAPT. HELSON: Okay, thank you, Mr. Arnold. Mr. O'Callaghan has a few questions for you now.

MR. O'CALLAGHAN: Thank you, Captain Arnold, for your presentation. Yeah, just a few follow-up. Going back to the simulator fidelity and the ground effect, just a question of clarification there. Can you explain further how the ground effect may not be valid, given that airplanes going in and out of ground effect, or in takeoff and landing, and yet we use simulators to train takeoffs and landings?

MR. ARNOLD: And as I said, it's an art to go ahead and

try and develop that fidelity in the simulator. I was involved in the sim certification of another aircraft from another manufacturer quite some time ago and it was a particular painful process to go ahead and get the simulator fidelity tuned, particularly the lateral directional characteristics of that particular airplane and under conditions of crosswind. The simulator characteristics nowhere near were characteristic of the airplane, even though "the aero model looked very, very good."

And so there's some tuning that is done along the way, in certifying simulators, and as you probably know, simulators are required to be certified annually and the simulators, when they are certified, are heart of the envelop, typical procedural, the training the simulators, for supporting training events for pilots.

When you start getting edge-of-the-envelope conditions or unusual, abnormal conditions, say, alternate law, slow airspeed, particularly airspeed where angle of attack starts increasing, there are questions as to what the fidelity of the simulator to replicate the actual aircraft performance might be, primarily because it's something that is not seen during a typical training environment.

MR. O'CALLAGHAN: Okay, thank you. I understand the difficulty of modeling aerodynamics, having done some of that at Boeing. But at the end of the day, when engineers are done and the proof of matched runs are run, is it true to say that the

simulator represents the best engineering representation of the airplane for normal conditions of angle of attack range and sideslip and that sort of thing?

MR. ARNOLD: Normal conditions for angle of attack, airspeed, it's important to emphasize that.

MR. O'CALLAGHAN: Yeah. And even ditching to touchdown, you'd been within the angle of attack and sideslip range that the simulator is validated for, would you not?

MR. ARNOLD: Potentially. But again, you know, even with the simulator model and if the simulator model had a good fidelity, there are still questions as to what condition is the airplane in, what condition is the environment in as you go ahead and bring it down to a landing condition, and there are absolutely so many variables. And I think it was evident even in the accident scenario. You know, where do you lower the flaps?

I know when I've done numerous simulator flame-out conditions, depending on where you were in relation to the airfield, how high you were, you either put your flaps out early or you delay your flaps to go ahead and adjust your glide angle to get down to the runway surface. So you just can't by procedure say you lower your flaps at this particular point in time or altitude. There's an element of judgment involved depending on how you are in relation to the position you want to be regarding high key/low key, coming around the base turn, and then landing on the runway surface. So there are an extreme number of variables

there and to try and specifically proceduralize some approach to doing it, I think, again, would be inappropriate. It'd be too prescriptive and locking the crew into something where you do what you have to do to put the airplane on the ground. And in the case of U.S. Air 1549, I think they did an absolutely great job of doing that.

MR. O'CALLAGHAN: I agree. And just to make sure I understand the latter part of your answer, I think I heard a distinction between the simulator as a tool and its fidelity and whether it represents the physics of the airplane rate versus using that in a training environment to come up with a rigorous set of procedures or rules that might apply in every case. Is that a distinction that I grabbed correctly?

MR. ARNOLD: The simulator potentially could be used as a training tool. I question its usefulness as an engineering tool. It'd take a lot of extra time and effort to try and go ahead and design a specific landing condition, when there may be so many variables involved in what the landing -- the eventual landing condition or the potential landing condition could be. So the information provided within the procedures is the best information available based on an engineering assessment of the model tests and that sort of thing. And we take that information if it looks reasonable, but we understand that there are definitely going to be variances as to how it may be applied.

MR. O'CALLAGHAN: Thank you. This last question is

addressed to you, Captain Arnold, but also to the panel-at-large, because I'd like to summarize a few things that I think I pulled out of all the presentations and discussion this morning and I'd just like to verify that I'm distilling these correctly and not misrepresenting anything anybody may have said. But let me just -- there was about four of them. I understand that, regarding the dynamic behavior of the airplane upon entry into the water, the language that governs that in 25.801 does not apply explicitly to this accident because of the weight and the landing with no thrust; furthermore, that there's, I think, what we would consider perhaps a demanding tolerance or task on the actual water entry.

The minus half a degree glide slope is what I'm referring to and I think most pilots would probably qualify that as a greaser landing. So you kind of need to do a greaser landing to guarantee the structural integrity. I think we've heard that it's a difficult task which pilots are probably not familiar with, and lastly that this difficult task cannot be trained in a simulator. Have you misrepresented anything in that list of statements?

MR. ARNOLD: It could be demonstrated in a simulator, but again, whenever it's demonstrated it would be just with the qualifications that this is a one-time event to just establish confidence in your ability to do something like this and in the airplane capability. But it may not replicate all the circumstances you're going to be stuck with.

MR. O'CALLAGHAN: Okay, thank you. So then if most of it is largely correct, it sounds like -- I guess the question to the panel would be, collectively, what is the expectation of success in this case and that, in fact, the airplane is going to touch down within the parameters required to prevent some damage to the fuselage? And basically, is that structural capability -- do we have a high level of confidence that that's going to actually be achieved if this event were to happen tomorrow, say?

MR. ARNOLD: If the pilot has favorable circumstances and good weather, I think, and a good landing surface, I think there's a reasonable opportunity that he could do it. Again, it depends on what other facets are -- that he's dealing with to do the event, what kind of cues he has available to him, how well he can interpret his landing above the water. But it definitely is possible to do. And there have been a number of cases in the past where airplanes have been able to go ahead and land on the water, even in rush circumstances.

MR. O'CALLAGHAN: Okay, thank you all very much. And I believe Dr. Wilson has some additional questions.

DR. WILSON: Actually you covered all of mine, so we'll move on to Captain Lutz. Could you just briefly describe for us your experience as a test pilot at Airbus?

CAPT. LUTZ: I've been at Airbus for the last two and a half years and I've been involved in some experimental tests, I've been involved first flights on new aircraft, and other small tests

that were done on a intermediate basis.

DR. WILSON: Great, thank you. And you have a presentation prepared for us, correct?

CAPT. LUTZ: Yes, I do.

PRESENTATION BY CAPTAIN LUTZ

CAPT. LUTZ: My presentation is on the A320 fly-by-wire control system. The control system incorporates angle of attack protections that improve the ability of the pilot to precisely control the airplane at slow speed. With this presentation, what we'll do is a provide a review of the angle of attack protections and a description of the protections that are in play during four selected points as US Airways Flight 1549 approached the Hudson River.

Those points are during the turn to the Hudson River after bird ingestion, during the Engine 1 relight attempt, at 45 feet approaching the water, and at water entry. The snapshots that I will describe were selected mainly as examples, but they provide important insights about the actions taken by the crew to ensure a successful outcome.

The presentation will conclude with a summary of the fly-by-wire protections that were in use during the event sequence. Angle of attack is the angular difference between the pitch attitude of the airplane and the flight path angle.

The angle of attack protection provides positive static stability at the low speed portion of the flight envelope. It

provides protection during dynamic angle of attack changes, such as during go-around or flight through turbulent conditions. The pilot has the ability to reach and maintain a high lift coefficient with full back stick, without the risk of aerodynamic stall. The protections are active only when needed and do not affect maneuvers in the normal flight envelope.

Additionally, maneuver limits are retained to avoid overstress, and as angle of attack increases, the bank angle limit of 67 degrees is reduced to 45 degrees. High pitch attitudes are sensed and automatic trimming stops. The high angle of attack protections described here are available from liftoff until touchdown.

What I've presented here is a lift coefficient curve showing lift coefficient versus alpha, and I've marked the threshold points for the protections as they occurred as angle of attack is increased. On the right-hand side is an example of the pilot's airspeed scale with the protection ranges as they are displayed to the pilot.

Beginning at the bottom and describing the protections from the lowest to the highest angles of attack, the first feed mark is a speed for VLS. VLS is a fixed speed providing a margin to the stall, based on the stall speed in one-g flight. The autopilot and the auto-thrust systems are designed such that they will not automatically reduce speed below VLS even if a lower speed is selected by the pilot. As airspeed slows to the angle of

attack for alpha prot, auto-trimming stops and the pilot must hold aft stick to increase angle of attack. If the pilot releases the stick, angle of attack will decrease and speed will recover to the threshold for alpha prot. This is the classic definition of the term static stability.

If the pilot continues to bring the stick back and commands full back stick, angle of attack will reach and maintain alpha max, allowing predictable control at maximum performance but keeping the airplane a safe margin from the stall. If for some reason angle of attack was allowed to increase to the stall, the airplane could suffer a sudden loss of lift, with the possibility of loss of control.

Green dot speed is not a protection, but it does provide the pilot with the speed for best lift to drag ratio. If speed is maintained at green dot, it will provide the maximum range for glide flight, and in cases where you have one engine inoperative, it is the best overall speed for optimum performance.

I will begin to show you four snapshots of the US Airways flight down to the Hudson River, and I'd like to begin by briefly describing what you see here. First of all, on the lower left-hand corner is the primary flight display as the pilot would've viewed it during the event. On the left-hand side is the speed scale that I've already described, showing the various protections. On the right-hand side is the altitude scale. And up above the PFD you will see a small depiction of the pilot's

control stick position. The information shown on this particular slide is derived from the DFDR information. During the turn to the Hudson, green dot speed was 223 knots. But time was more important than distance.

So flying below green dot speed provided additional time to accomplish emergency procedures. Passing 1700 feet in the turn, speed was 212 knots, and because angle of attack is normally elevated during turns, the speed for alpha prot has exceeded the speed for VLS. The speed is right at the threshold for alpha prot and the airplane remains in trim.

The next snapshot is an analysis of the protections during the Engine 1 relight attempt. At 700 feet the speed is below VLS and equal to alpha prot at 191 knots. But there really are two significant points about this snapshot. First, the crew was able to accomplish relight attempts on both engines, Engine 2 followed by Engine 1. But most significantly about this snapshot is the fact that the APU generator was available due to the early decision by the captain to start the APU. When the master lever for Engine 1 was cycled from off and back to on, N2 RPM did not recover all the way to idle RPM and Generator 1 was lost.

With both generators now off line, having the APU generator available kept the flight controls in normal law, retained all the flight instruments, and kept the angle of attack protections in place. At 45 feet above the water, you can see that the captain has two-thirds side stick deflection to slow the

rate of descent, and one-third stick deflection remaining available. But if you look at the speed trend arrow you'll note that airspeed is decreasing toward the speed for alpha max and very little energy is left to further arrest rate of descent. Very close to the water the airplane is approaching maximum aerodynamic performance.

As the airplane enters the water, the pilot, as you can see in this depiction where his stick position is shown, has reached full back stick, the airplane's at 125 knots, right at the speed for alpha max. The airplane entered the water at 9.5 degrees pitch attitude, with the wings perfectly level. And we find it remarkable that at water entry the captain had achieved the minimum possible speed at alpha max, with the flaps in Configuration 2.

To summarize about this event and the use of the protections and the protections that were in effect at the time of the event, after the bird ingestion and during descent prior to flap selection, the speed reached a peak of 214 knots and slowly decreased to 185 knots. What you don't see in the snapshots is a complete time history of the speed that was flown by Captain Sullenberger. In this particular event, during most the descent, airspeed was at VLS or slightly below. Airspeed was occasionally in and out of the alpha prot range, but for the most part, the airplane remained in trim, with neutral stick forces. After flaps two selection, airspeed decayed into the alpha prot

range and remained there from 140 feet to water entry. Auto-trimming had stopped and it was necessary for the pilot to hold aft stick to continue to increase angle of attack. As the airplane approached the water at 45 feet, airspeed was approaching alpha max, but the captain still had one-third stick available.

Without trust to maintain airspeed, the airspeed continued to decrease, limiting the energy that the captain had available to reduce the rate of descent. As the airplane entered the water, the pilot had achieved maximum aircraft performance, with full back stick and a minimum speed of 125 knots, but most importantly, with no risk with stall or loss of control. Pitch attitude was 9.5 degrees and the wings were exactly level, which assured a symmetric entry to the water. Thank you.

TECHNICAL PANEL QUESTIONS

DR. WILSON: Great. Thank you very much, that was very informative. For those who may not be familiar with fly-by-wire aircraft, could you please describe how a fly-by-wire aircraft differs in terms of stall protections from a more conventional aircraft?

CAPT. LUTZ: Well, what you can do with a fly-by-wire control system is take a look at where the stall protection should be located and then put a limit on the maximum angle of attack, and in doing so, you allow the pilot to go to maximum angle of attack and achieve maximum aircraft performance without fear of going beyond that particular point.

DR. WILSON: So in a conventional aircraft, is that the equivalent to a stick shaker or a stall horn that they would receive?

CAPT. LUTZ: Well, it's not exactly equivalent from the standpoint that, if you just had a stall warning, you would be able to increase angle of attack above that particular point. But in all cases the design of the A320 fly-by-wire system provides you with equal or greater lift capability.

DR. WILSON: Okay, thank you. And just to clarify, I believe that in the case of a dual engine failure, the fly-by-wire protections may not be available during some conditions. Can you explain that further?

CAPT. LUTZ: If in the case of a dual engine failure you lost both generators and you were in the emergency electrical configuration, the airplane would revert to alternative law, and in which case you would have a stall protection but not -- you would have a stall warning but not the angle of attack protections.

DR. WILSON: And you mentioned in your presentation that because the captain had started the APU prior to beginning the checklist, that the APU generator was on line. If the captain had not done that, is it possible that this aircraft would've lost its stall protections?

CAPT. LUTZ: Well, it would be speculation at this point, not knowing exactly whether the engine was capable of

brining Generator 1 back on line. Had it not been brought back on line, the airplane would've gone into the emergency electrical configuration.

DR. WILSON: Okay, thank you. And with the alpha protection system, what cues call the pilot's attention to the energy state of the aircraft?

CAPT. LUTZ: Well, you have two main cues. You have the stick force in the pilot's hand, and the stick force actually is no different than the force required to maneuver the airplane at any other time within the normal flight envelope. What it means is, is that you have positive static stability, whereas, if you release the stick, the airplane will actually decrease its angle of attack back to the top of alpha prot.

DR. WILSON: In terms of cues, they have a visual cue on the speed tape?

CAPT. LUTZ: Yes.

DR. WILSON: And what other cues might be available to let them know that they're at a low airspeed?

CAPT. LUTZ: It's important that you mentioned the speed tape because those cues, VLS, alpha prot and alpha max, are in view all the time, even during normal flight. So the pilot always knows where he is with reference to those speeds.

DR. WILSON: And the aircraft, I believe, also has a speed-speed-speed warning. When is that triggered?

CAPT. LUTZ: The airplane does have a speed-speed-speed

warning. The speed-speed-speed warning will activate with the airplane sensed to be decreasing in speed, if the airplane is sensed to be at a negative flight path angle. So it measures airspeed, it measures airspeed deceleration, and it measures flight path angle. If the altitude is between 2,000 feet and 100 feet, and if the airplane is in Configuration 2, 3 or full, the speed-speed-speed warning will be sounded.

DR. WILSON: And under what conditions would the slow speed warning be inhibited?

CAPT. LUTZ: It would be inhibited if the pilot had applied TOGA thrust, it would be also inhibited if alpha floor had been reached, and it would be inhibited in alternate law or direct law and if radar Altimeters 1 and 2 had been lost.

DR. WILSON: And would the GPWS system also inhibit the speed warning?

CAPT. LUTZ: The EGPWS is a higher priority warning than the speed-speed-speed and it would likely not be heard.

DR. WILSON: Could you describe for us the flare law of the A320?

CAPT. LUTZ: Flare law is a law that's a part of the flight control normal law. What flare law does is take a snapshot of the pitch attitude of the airplane at 50 feet radio altitude. Then at 30 feet RA the airplane automatically begins a slow nose-down movement, up to two degrees of pitch change over an eight-second period.

DR. WILSON: Are there any conditions when the flare law would be inhibited?

CAPT. LUTZ: Well, flare law would be a lesser priority if alpha prot were active. If alpha prot were active, it would take priority over the flare law.

DR. WILSON: So if the aircraft was in alpha prot, just so that I'm clear and to clarify, the flare mode would -- the flare law would not come into effect?

CAPT. LUTZ: Yeah, alpha prot would have priority over flare law.

DR. WILSON: Okay. So in this condition, because the aircraft -- this accident aircraft was in alpha protection from a hundred and forty feet to landing, the flare mode did not kick in?

CAPT. LUTZ: That is correct.

DR. WILSON: Okay, thank you. From reviewing the data, given that the flare law did not come into effect and did not lower the nose of the aircraft, would it be a fair statement to say that the alpha protection system limited how much the captain was able to flare the aircraft for landing?

CAPT. LUTZ: No, I think for the airspeed in this particular event, the airplane -- the captain had achieved maximum aircraft performance.

DR. WILSON: Okay. Have you reviewed any of the data that's been recovered from the accident airplane?

CAPT. LUTZ: The DFDR data?

DR. WILSON: Um-hum.

CAPT. LUTZ: Yes, I have.

DR. WILSON: Is there any evidence in that data that there was an increase in thrust requested by the alpha protection system?

CAPT. LUTZ: No. We looked at that and we were unable to find any evidence that alpha floor had been activated. But to be frank, it's not recorded on the DFDR.

DR. WILSON: Okay, thank you. Given that you've flown several scenarios when several of us from the operations and human performance group went to Toulouse and flew these simulations, how would you describe the workload or the environment that a crew who is faced with a dual engine failure would be having to deal with?

CAPT. LUTZ: I would say that it's fairly intense. The word demanding is probably just a tiny bit understated. The complicating problems are, when you have this scenario presented at low altitude, you have to try to make an attempt to relight the engines and that consumes a large amount of your time. And trying to do that before you have to begin preparing for a water entry is a very, very difficult task.

DR. WILSON: Prior to this accident, had you or anybody else at Airbus performed any ditching procedures or simulated water landings in the engineering sim?

CAPT. LUTZ: Well, at the request of the NTSB, knowing that the NTSB was going to come and perform these landings in the

simulator, in particular the engineering sim, I went into the engineering simulator about a week earlier than the NTSB visit, prepared the simulator properly and did some landings in the water.

DR. WILSON: However, prior to the accident, had any water landings been performed?

CAPT. LUTZ: None that I'm aware.

DR. WILSON: And could you just give us a rough estimate as to how many water landings you think you've done in the simulator since the accident?

CAPT. LUTZ: Well, prior to the NTSB arriving, I conducted both an evaluation on a simulator to make sure that the engineering sim was set up properly in advance of the visit. In that particular preparation flight I did four water landings and I did an additional 16 or observed 16 while the NTSB was visiting, and then I went back in the simulator a week or so afterwards and did another 13.

DR. WILSON: And given the simulator runs that you've performed yourself and also observed, what are your impressions of the results in terms of relative to the target criteria, the 11 degrees of pitch and the negative half-degree glide path?

CAPT. LUTZ: Well, the airplane is perfectly capable of achieving those conditions and I think that's been well stated by all the colleagues here. The difficult is finding the cues available and using the right cues in order to reach those

parameters very, very close to the water. You can achieve them, but getting them in exactly the right place over the water is the difficulty.

DR. WILSON: From our observations there, and I know from the simulations that you also did, when we look at the data it was difficult for some of the pilots to achieve the certification criteria and I recall that you tried multiple techniques to achieve this criteria in the simulator. Can you describe a little bit more the technique that you used to fall within the certification criteria?

CAPT. LUTZ: Yes, I can. First of all, I think it's noteworthy that the work that the NTSB did in the engineering simulator combined just simple landings on a normal runway in the same sim, with looking at landings on the Hudson River. And when I looked at the data, as I'm sure that you did, I was surprised to see that we were very consistent when we landed on the simulation runway and less so when we landed in the water.

And I think the main reasons for that are that when you're landing on a runway environment in the simulator, there is a very large number of cues available to the pilot. Even from a hundred feet back you see all the runway lights, all the runway markings, you can see the control tower, you see the hangars, you have a lot of cuing available to you. And then, as you get very close to the runway, you can see the runway stripes begin to disappear beyond the airplane and you have a very good feeling for

the surface.

But when you approach the water, the simulation does not depict the waves on the water, it doesn't show wakes from boats, it doesn't show boats themselves, it doesn't show wharfs, it doesn't show buildings on either side. It's simply a monolithic presentation of a surface. And I believe that that's one of the reasons that it made it so difficult for us to achieve consistent results on the water.

DR. WILSON: Okay. And if you could describe the technique that you used that worked best, you think, in the simulator. Given the limitations, what technique worked for you in performing the landings that allowed you to achieve that certification criteria?

CAPT. LUTZ: Yeah, what I did was, as I looked at my own technique and tried to vary it, even while the NTSB was in the sim, I was making small changes to my own technique and what I found that I needed to use was, first of all, relying on the call-outs from the radar altimeter to know exactly how high I was up over the water. And then I made my focus completely outside the airplane and steadily increased the pitch attitude of the airplane until I felt the airplane contact the water.

DR. WILSON: And given the amount of landings that you've done in the simulator, if you were to be faced with a situation where you're flying a fly-by-wire aircraft, an actual aircraft, and had to ditch, is this a technique that you would use

to attempt a ditching on the water?

CAPT. LUTZ: I think it's too early to determine that because, in the sim, what you do is you find a technique that works and the technique may be dependent only -- dependent and useful only in the simulator, where, in a broader perspective, there may be other cues and techniques that you can use. My feeling is, is that I had all of the tools that I need to put the airplane on the water at the right pitch attitude and at the right vertical velocity.

DR. WILSON: Do you think that from flying these simulator landings, if a pilot was to be faced with this, do you think that it requires exceptional skills to be able to perform the proper technique to achieve the certification criteria?

CAPT. LUTZ: I don't think that it requires exceptional skills. I do think it is a very demanding task, given the circumstances and your visual cues of the surface of the water. I think we need to go back to that page that's been shown a couple of different times from the Airman's Information Manual. And it really is very clear that even for a highly experienced pilot, below 50 feet, it is very difficult to judge your height above water.

DR. WILSON: Given the procedure that's provided to pilots for ditching, engine dual failure checklist and what Captain Sullenberger and First Officer Skiles had to work with, in your opinion, is the criteria or the guidance that's provided in

the checklist, is that enough for a pilot to be able to achieve the certification criteria?

CAPT. LUTZ: Well, I think the broad answer to that question is yes. But in the event itself, the crew is faced with this dual engine failure at 3,000 feet and they didn't have the luxury of getting all the way through the checklist down to the point where they could review the speeds that should be flown, where they could review the pitch attitude that should be flown. And that would not be the case if the engine failure had occurred at, say, 10,000 feet; they would've gotten to that part of the checklist. As it was, I thought it was very remarkable, based on our own experience in the sim, that they were able to get to the point where they had achieved a relight attempt on both engines.

DR. WILSON: Great, thank you. I have no further questions. However, Mr. O'Callaghan has a few.

MR. O'CALLAGHAN: Good morning, or I guess it's afternoon now. Good afternoon, Captain Lutz.

CAPT. LUTZ: It switched.

MR. O'CALLAGHAN: Thank you again for your presentation. And I just have a couple. Following up on -- regarding the cues in the simulator, I think I understand perfectly what you're saying and how on a runway, you know, you have the runway environment that helps the pilot judge, even in a simulator, their height and so forth. And so it enables them to bring their stick and rudder skills into play and land. And then you mentioned how,

in contrast, on the water you don't have any of those cues nor do you have the ferries or the terminals and these sort of things.

Now, of course, ferries and terminals and wakes would apply to the Hudson case, but of course there may be a water landing that is in more open water and that would not have those cues either. So in that case, where you're landing -- or, I think, like the AIM that you referred to, it talks about like a glass smooth surface. Would the challenges presented in a simulator, because of the lack of cues, be similar to that type of a landing in an open-water scenario?

CAPT. LUTZ: Well, yes, I actually believe that the challenges in landing on open water, say, with no buildings around, no ships available, even the ability to sense the height of the swells, if you have a 10-foot swell, which is a fairly small swell, I've never been out on the open ocean myself, but I can imagine that's fairly small compared to some, it would be very difficult to judge your height on that swell or between swells.

MR. O'CALLAGHAN: Okay, thank you. And if I did my math right, I think I tallied up about 33 simulator runs that you performed and I think Dr. Wilson asked a similar question, but I'll phrase it this way. In light of that experience, if you were to encounter the emergency scenario that we're talking about in this accident, do you feel your experience in the sim would've better prepared you for dealing with that and touching down on the water and so forth?

CAPT. LUTZ: Would my experience in the sim have prepared me for a future event, is that what the question is?

MR. O'CALLAGHAN: Or better prepared. With your experience in the sim, is it beneficial to encountering this emergency in the future? God forbid that should happen.

CAPT. LUTZ: Well, it's always good to practice. Don't get me wrong on that point. But I think that what I learned was, is that I had all the tools available to me, both in my previous training and from what the airplane was telling me, to put the airplane on the water in the ditching conditions.

MR. O'CALLAGHAN: Okay, thank you. Mr. Chairman, that's all for me. Thank you.

DR. WILSON: We have no more questions for any of the witnesses on the panel.

CHAIRMAN SUMWALT: Thank you for the comprehensive questions from the Technical Panel. I want to get a sense for trying to decide whether we break now for lunch or go through. I'll go through each party. Captain Sicchio, how long do you anticipate your questions to be in time?

CAPT. SICCHIO: I would guess approximately five minutes, perhaps a little less.

CHAIRMAN SUMWALT: Okay. AFA?

MS. KOLANDER: Approximately five minutes.

CHAIRMAN SUMWALT: FAA?

MR. HARRIS: Between five and 10.

CHAIRMAN SUMWALT: I'll put you down for 10. And when we say your questions, of course that includes the answers as well. Is that what we're talking about? Okay, Airbus?

CAPT. CANTO: We can plan on 10, depending on how everything else flows. It could be less.

CHAIRMAN SUMWALT: US Airways?

CAPT. MORELL: US Airways has no questions.

CHAIRMAN SUMWALT: And CFM International?

MR. MILLS: CFM has no questions.

CHAIRMAN SUMWALT: Okay. So that's about a half an hour's worth of questions from the parties, and then the Board of Inquiry. So you know, we've got another 45 minutes or so. What would be the consensus of the Technical Panel? Mr. Benzon?

HEARING OFFICER BENZON: Eat now.

CHAIRMAN SUMWALT: You know what, I've never turned down the opportunity to eat. We will come back at 1:30. We are in recess, thank you.

(Whereupon, a lunch recess was taken.)

A F T E R N O O N S E S S I O N

(Time Noted: 1:30 p.m.)

CHAIRMAN SUMWALT: Okay, we're back in session and we will -- Mr. Benzon, anything you'd like to say before we begin?

HEARING OFFICER BENZON: No, sir, I think it's the parties' turn to ask questions.

CHAIRMAN SUMWALT: Very good, sir, thank you. We will start with the parties, and I had it all written down. US Airways, you're next in the rotation, is that correct? Or was it Airbus? I forgot from yesterday.

CAPT. MORELL: Well, we'll take the rotation and US Airways has not questions.

CHAIRMAN SUMWALT: Okay, that was -- thank you, sir. CFM International.

MR. MILLS: Mr. Chairman, we had no questions either.

CHAIRMAN SUMWALT: Thank you. USAPA.

PARTY QUESTIONS

CAPT. SICCHIO: Yes, thank you, Mr. Chairman. Good afternoon, gentlemen. Just a few questions. Mr. Breneman, I'd like to ask if during the certification testing for ditching, did the FAA ever witness the model testing that was completed?

MR. BRENEMAN: Honestly, I don't have that information to answer your question.

CAPT. SICCHIO: Okay. And for Mr. Blagden, were you aware -- now, you are actually with the EASA, is that correct?

MR. BLAGDEN: Yes, that's correct.

CAPT. SICCHIO: And was that testing actually conducted under the JAA auspices?

MR. BLAGDEN: The testing that was conducted on the A300 and on the Mercure was conducted under the DGAC France.

CAPT. SICCHIO: I see. Okay, thank you. So is it safe to say that you're not aware of any regulatory agency supervising that testing or being present at that testing?

MR. BLAGDEN: I wouldn't know whether DGAC France witnessed it at the time.

CAPT. SICCHIO: Okay, thank you. A question for Mr. Gardlin. Good afternoon, sir. Would you be kind enough, if you're aware, earlier in your testimony you mentioned the extended over water operation. Could you define the limits of what is considered extended over water?

MR. GARDLIN: Well, there actually is a definition in FAR Part 1, for extended over water, which I might even have. But essentially -- well, maybe I'll just look it up. Yeah, extended over water operation. Do you want me to read it?

CAPT. SICCHIO: I'm sorry, that's not necessary. I just wanted to have a feel for the kind of distances we're dealing with from shore.

MR. GARDLIN: Basically 50 nautical miles off shore is defined in Part 1 as extended over water.

CAPT. SICCHIO: Okay, thank you. And do you know

offhand, are there waivers to that, that are normally accepted?

MR. GARDLIN: Well, that would be an operational issue and I'm not really that familiar with the operations.

CAPT. SICCHIO: Okay, thank you. Okay, for Mr. Breneman. During Mr. Fitzsimmons' testimony he stated that during testing, the most favorable configuration for ditching was identified. Now, could you tell us what steps the FAA has taken to ensure that that information is transferred over to the operational side of the FAA?

MR. BRENEMAN: Well, when it comes to any data that's necessary for the operational side, the FAA has a good, close working relationship with a group called the Aircraft Evaluation Group and it's actually a flight standards organization that deals with the operations of the aircraft, and the AEG works side by side with us. We share the information with them and they provide us insight as to what type of information they need in order for the aircraft to be used. So the AEG group would be the one that would be working with us in getting that information.

CAPT. SICCHIO: Okay, thanks. And as a follow-up to that, is it that group's responsibility to see that the air carrier offices that actually approve the manuals put forth by the air carriers, are they the conduit for that transfer of knowledge and information?

MR. BRENEMAN: Well, I'm not familiar with how the AEG actually works with the CMOs, and the PMIs, for that matter. But

they are a conduit of information. How much those organizations work with the AEG, I don't know.

CAPT. SICCHIO: Okay, thank you. So just to be clear, then, your office, once you are aware of these potential issues, whether it's a limitation or a certification-driven procedure, you deliver it simply to that group and they are to take it from there, is that how it works?

MR. BRENEMAN: Well, they actually participate with us in our certification activity. So we have issue papers, they're part of that sign-off process. So they're involved in all the activities that we're in. And they would let us know if there's additional information that they need.

CAPT. SICCHIO: Okay, but it is their responsibility to actually act on that and see that the operation side of the house, if you will, is aware?

MR. BRENEMAN: That would be their responsibility to work with that side of the FAA for the operation suitability.

CAPT. SICCHIO: Okay, thank you. Actually, Mr. Breneman, not to pick on you again, in Mr. Arnold's testimony earlier, he mentioned FAR 25.671. Are you somewhat familiar with that regulation?

MR. BRENEMAN: I am not.

CAPT. SICCHIO: Okay. Okay, thank you. Well, Mr. Arnold, I guess we'll go to you. You mentioned that regulation and obviously --

MR. ARNOLD: Yes.

CAPT. SICCHIO: -- being a flight control regulation, you're quite familiar. But do you happen to be familiar with the amendment that is in the pipeline to that regulation?

MR. ARNOLD: No, I'm not.

CAPT. SICCHIO: Okay. Would you happen to be aware that there's one perhaps coming?

MR. ARNOLD: I have not been made aware that there is one coming. I would want to talk to Mr. Don Stimson, who is our transport directorate specialist working those kind of amendments and that, to see what's coming down the road. At some point we would be brought in the loop as to changes to amendments, particularly if they were to have any kind of effect on handling qualities evaluations and that sort of thing. But I'm personally not aware of that and so that's something I'd want to check up on when I get back home.

CAPT. SICCHIO: Okay, thank you very much. Okay, moving along, then, Mr. Gardlin, one question for you. Just to clarify this point and make sure that I've got it correct, as well as maybe others that have questions. For the certification case on ditching, is it assumed then that engine power would be available in order to meet that criteria?

MR. GARDLIN: I don't think there's an assumption one way or the other. I think the -- it's considered to be a prepared case. So I think, you know, it becomes an issue of how much time

is available to complete the preparations, and I think what we heard is, depending upon how much time is available, the procedure can be executed without engine power. It's easier to execute with engine power. But there's no definitive or there's no explicit assumption one or the other on it.

CAPT. SICCHIO: Okay, thank you. One final question for Captain Lutz. We've spent a considerable amount of time this afternoon talking about the landings on water in the case of Flight 1549. Would you be willing to discuss with us the risks that the flight crew would've faced had they made an attempt to land back at La Guardia?

CAPT. LUTZ: Thank you very much. It's a good question. I did evaluate that very pragmatically and looked at all the problems that would be associated with trying to return to an airport and the problems that would be associated with trying to land on the Hudson River, and I can say with certainty that the greatest risk would be trying to return to an airport, thereby making the choice of the Hudson River the proper choice.

CAPT. SICCHIO: Okay, thank you. And thank you, gentlemen. No further questions.

CHAIRMAN SUMWALT: Thank you, Captain Sicchio. AFA.

MS. KOLANDER: I have one question for Mr. Gardlin. This morning, when you said that the performance of the airplane was instrumental to the survivability of the occupants, did you also mean in that statement to include the performance of the

flotation equipment as instrumental in survivability?

MR. GARDLIN: I think the context of the question was the airframe structure, so that was basically the context of my answer.

MS. KOLANDER: So do you believe that the performance of the flotation equipment was instrumental in the survivability of this accident?

MR. GARDLIN: Well, I think the performance of the flotation equipment contributed to it, yes.

MS. KOLANDER: So again, just as a clarification, you do believe that it contributed to the survivability of the passengers on US Airways 1549?

MR. GARDLIN: Yes, I do.

MS. KOLANDER: Thank you.

CHAIRMAN SUMWALT: No more questions? FAA.

MR. HARRIS: Thank you, Mr. Chairman. Mr. Breneman, going back to the discussion of the FAA certification of the Airbus A320 under the bilateral agreement with France, working with the DGAC, does the FAA develop an independent finding of type certification eligibility from the DGAC in that process?

MR. BRENEMAN: Yes, we do. When it comes to issuing the type certificate itself, the FAA makes the final finding of compliance for the aircraft and that encompasses every finding for the -- that is required. We may rely on the foreign authority as we assign them certain compliance determinations and expect them

to reply back whether it meets our regulations or not. But the FAA is responsible for making the finding and compliance and issuing the type certificate.

MR. HARRIS: And by independent, I suppose -- just to make sure we're clarified here. Just because DGAC issues a certificate it does not compel the FAA to do so, is that correct?

MR. BRENEMAN: That's correct, it's totally independent from their issuance, other than we will not issue a type certificate unless they have.

MR. HARRIS: And in terms of understanding of this process, I know that it's often thought of by many people as a serial process. But as I believe Gene Arnold indicated, there were contacts made and significant efforts made well before even first flight, in many cases, on projects of this sort, particularly those with substantial challenges such as new aircraft systems, flight control systems and so on. Could you comment on the amount of -- whether this is a serial process or a more parallel process?

MR. BRENEMAN: The process that we have normally been in with our type validation is a parallel process and it's a very extensive process where we have -- we call it a validation team that we assemble that has all the specialties that would be in a domestic certification of, say, a Boeing product, and those specialists participate in all the panel discussions, or at least most of the panel discussions, with the exporting country. In

this case it would be, well, EASA, currently, in Europe. So we would participate in those meetings with them and Airbus and make sure that we understand how the certification is going to take place, all the regulations. It's very involved and we are doing that side by side with them until the point where we've made a determination what we're going to ask them to do for us.

MR. HARRIS: Could you comment on a circumstance in which a U.S. Federal Aviation Regulation was more restrictive than the standards of the mother country of the aircraft, say, France and the DGAC? What standards would the aircraft have to meet for our certification?

MR. BRENEMAN: Well, the applicants really hate this, because in that case they would still have to meet the FAA requirement even though it's more restrictive or a higher standard.

MR. HARRIS: Thank you, sir. Mr. Gardlin, you're familiar with the emergency landing requirements for structures in Part 25?

MR. GARDLIN: Yes, yes, I am.

MR. HARRIS: And in the case of an aircraft experiencing an emergency landing, is that normally considered at what, five-foot per second value, as I understand, or perhaps I've got that incorrect? Maybe you can illuminate.

MR. GARDLIN: Well, that is a condition under the emergency landing requirements, yes.

MR. HARRIS: And in the case of an aircraft that sustains a vertical speed at touchdown or impact or contact with a surface that exceeded that, do we expect there to be, as I think the term has been used, a cliff where the aircraft meets the requirement and then at some point cascades suddenly to failing dramatically to meet the requirement? Or are we expecting kind of a sequential series of sorts of damages that might occur at higher loads?

MR. GARDLIN: No, it's not a cliff. Yeah, the expectation is that there's a progressive level of protection and of course, the higher the rate of impact, the more damage you might see. But generally speaking, we expect a range of survivable conditions up significantly higher than that. We've used numbers up to 30 feet per second as a survivable impact.

MR. HARRIS: And so survivability trumps damage to the aircraft, in terms of the analysis, correct?

MR. GARDLIN: Absolutely, yes.

MR. HARRIS: So I'd like to turn now our three test pilots, Mr. Arnold, Captain Van Der Stichel and Captain Lutz. Have you all each had an opportunity to look at the flight data recorder information or data at some level?

MR. ARNOLD: Yes.

CAPT. LUTZ: Yes.

CAPT. VAN DER STICHEL: And yes.

MR. HARRIS: And could you -- we've already heard that

the aircraft had a touchdown vertical speed of 13 feet per second versus the 3.5 assumption in the ditching activities, and a descent path substantially steeper, I think, minus 3.5 degrees versus .5. Could you comment, from your observations of that data, as to what might have caused that higher sink rate and/or higher glide path angle?

MR. ARNOLD: First off, I will comment that my review of the data has been just recent and nowhere near as extensive I suspect Hugues Van Der Stichel or Terry Lutz might've been. But from looking at the data, my perception is that in lowering the flaps, the flaps cause a considerable amount of drag to the airplane and the airplane tended to slow down a significant amount once the flaps were lowered and it was fairly close to the terminal portion of the scenario.

And there was also a very, very slight leveling off or balloon during that time and the airplane ended up in a position where it was somewhat high above the surface of the water, at a slower than desired airspeed and that airspeed was then maintained in sort of a sinking flare down to touchdown. And you know, it's something that happens on occasion to, you know, that you might have.

MR. HARRIS: And perhaps in the interest of time, could I ask the other two test pilots, perhaps, to comment relative to Mr. Arnold's statement?

CAPT. LUTZ: Yes, I'd like to comment on that. I really

can't speculate what was going on in the mind of the captain at that time. But I do know the facts in that last two or three hundred feet. First of all, he had a great number of EGPWS warnings going on, on the flight deck. He had completed the engine dual fail checklist down to trying to relight both engines and now it was time to configure the airplane. The altitude that he began to configure was actually just higher than the altitude that you would have when you broke out under normal Category 1 approach. So it was very low to the ground.

The other thing that I can't speculate on is what the visual cues were available to the captain at the time that he began to configure. He may have perceived that he was lower than he actually was or it may have been the opposite. I do know, if you want to go factually, if you look at the transcript of the cockpit voice recorder, First Office Skiles did a good job of calling out the airspeeds as the airplane decelerated.

I also go back to the AIM information that says that it's very difficult to judge height below 50 feet. The snapshot that I showed at 45 feet showed that the captain still had one-third stick available. But I don't know in his mind how high he perceived he was off the ground. If you also go to the CVR, you notice that there were no auto call-outs of altitude because they were also overridden by the EGPWS.

MR. HARRIS: Thank you, sir. Captain Van Der Stichel?

CAPT. VAN DER STICHEL: I think everything has been

fully said.

MR. HARRIS: Okay, thank you very much, gentlemen. And then getting back to Mr. Gardlin. Given the vertical velocity of the aircraft at the time of touchdown, would you see this more the maintenance of the occupiable space in the cabin as a safe place for the occupants, and the fact that the aircraft remained afloat for a period of time for occupants to exit the aircraft, a function more of the ditching standards or the crash worthiness standards of the aircraft?

MR. GARDLIN: Well, I think it's pretty clear that the conditions that we had here are crash worthiness-type conditions to maintain the survivable volume for the people and provide an avenue for safe escape.

MR. HARRIS: Thank you, Mr. Chairman, that concludes our questions.

CHAIRMAN SUMWALT: Thank you, Mr. Harris. Mr. Canto, with Airbus.

CAPT. CANTO: Thank you, Mr. Chairman. And my first question is addressed to Mr. Blagden and Mr. Gardlin. This is concerning Gene Arnold's Q and A with the Technical Panel. At one point in time Mr. Arnold was asked by the Technical Panel whether he thought -- they thought that Captain Arnold, whether this flight, US Airways 1549, was a planned ditching event. And I believe he responded basically, in a classic sense, that it was not, but in a broader sense, it was more like a unplanned event or

emergency landing on water. Mr. Blagden, how would you categorize the event?

MR. BLAGDEN: Having reviewed the data of the impact velocities, we would consider it to have been an emergency landing on water. There was certainly insufficient time to configure the aircraft for a planned ditching.

CAPT. CANTO: Thank you. Mr. Gardlin?

MR. GARDLIN: Yeah, I would agree, I think that's consistent.

CAPT. CANTO: Thank you. Mr. Fitzsimmons, in your presentation you explained that the minus .5 degree glide slope was the optimum condition for a water impact, and that was early on in the presentation, just about maybe two-thirds of the way through. And then towards the end you later mentioned that it was minus .1 degree. Correction, minus one degree. Can you explain the difference in the two values that you expressed?

MR. FITZSIMMONS: Yes, I can indeed. I'm glad you raised that. There seems to be a little bit of confusion, perhaps. Just to clarify that, as you correctly said, from the scale model testing itself, a glide slope of minus 0.5 degrees was identified as being the optimum from the scale model testing. However, for design and certification of the aircraft for ditching, a conservative assumption of one, minus one degree was used.

CAPT. CANTO: Thank you. Captain Lutz, the question was

raised by the Technical Panel, regarding the simulator sessions conducted in Toulouse, and the question is, Were any of the runs that were conducted in Toulouse, simulating the engine dual failure, were they conducted from an altitude of 2,000 feet with the approach portion of the checklist completed and flying the appropriate guidance as specified for the approach portion, ditching portion of that checklist?

CAPT. LUTZ: The runs to the water that were conducted during the NTSB's visit were begun at 1500 feet and a speed of 200 knots. And the objective of the test was not to see a completed checklist. It was to see if the airplane could enter the water at a specific speed and a specific vertical velocity, and that was the only objective.

CAPT. CANTO: Just to further clarify, you mentioned -- what I was really trying to get at is, at 2,000 feet, if they could've maybe put the simulator on freeze and conducted the entire approach checklist, simulating that was accomplished at a higher altitude and followed the guidance as specified in the engine dual failure checklist, what do you feel the outcome would've been, if any change at all?

CAPT. LUTZ: The outcome could've been a more stabilized approach to beginning the flare on the water.

CAPT. CANTO: Thank you, Mr. Chairman, we have no more questions.

CHAIRMAN SUMWALT: Thank you. And I believe,

US Airways, you've already had the opportunity. Any follow-up questions from the parties?

CAPT. SICCHIO: None, thank you, Mr. Chairman.

CHAIRMAN SUMWALT: Okay, thank you. How about the Technical Panel, any follow-up? Great. We turn to the Board of Inquiry, and Dr. Kolly.

BOARD OF INQUIRY QUESTIONS

DR. KOLLY: Yes, I have just a quick point of clarification here for Mr. Fitzsimmons. Regarding the certification testing for ditching, is the testing of the A300 and the Mercure models the basis for the entire family of Airbus aircraft?

MR. FITZSIMMONS: Not for the entire family, no, but for those aircraft which have a similar configuration.

DR. KOLLY: I'm sorry, I missed your --

MR. FITZSIMMONS: Not for the entire family, sir. Not for the entire family but for the aircraft which is considered to have a similar configuration. For example, just to follow up on that, you know, if we take the A380, which is an aircraft which is exceptional in every sense and also in terms of the geometry, simply, and the characteristics, it was decided not to further extrapolate the results of the scale model testing on other aircraft, but to develop some new analytical solutions for the aircraft.

DR. KOLLY: Okay. With respect to engines, how are they

explored? How is the structural integrity of the engine explored either in this test or through the entire certification process for ditching?

MR. FITZSIMMONS: Okay. So during the scale model testing itself, as I mentioned, the scale models, the attachment of the engines and balance of the wing is, let's say, designed and manufactured as such that it's representative of the strength of their connection. So this was then during the test and observed whether the engines would separate or not.

DR. KOLLY: And at this attitude that you have determined, I believe it's 11 degrees pitch and half a degree glide slope, is it intended that the engines stay on throughout that process?

MR. FITZSIMMONS: You know, when answering Mr. Murphy's question on a similar subject, the point really isn't separation or not. The question is how they separate, from a safety perspective. So if they do separate, they separate in such a way, as I mentioned, that the wing box and the fuel tank within remains intact. That's the case here.

DR. KOLLY: But you don't do anything specific to determine whether or not they are intended to stay on in those conditions?

MR. FITZSIMMONS: There's no further consideration given to that, no.

DR. KOLLY: Okay. What could be the possible effect of

an engine loss during a ditching, is it more desirable or less desirable?

MR. FITZSIMMONS: This is really something which I haven't investigated and wouldn't like to speculate on.

DR. KOLLY: Okay, all right, thank you. No further questions.

CHAIRMAN SUMWALT: Thank you, Dr. Kolly. Mr. DeLisi

MR. DeLISI: Thank you. Two general questions that I'm going to consider tossups to the whole panel. First, we've heard from a number of witnesses that the event involving this US Airways airplane did not meet the definition of a planned ditching. I'm curious if anyone on the panel can recall a time where there was a transport category aircraft that did execute something that we would consider a planned ditching.

MR. ARNOLD: I know that, good lord, back in 1958 or so there was the aircraft that was going transcontinental, or from San Francisco to Hawaii, that had engine problems and they went ahead and went through the ditching procedure next to a ship that was able to go ahead and pick up the passengers in that. So that, they considerable time to go ahead and go through the preparation and planning, even to the point where the ship laid down signal flares for them. So in that case, yes, that was a well-planned event.

MR. DeLISI: Great, thank you. Any other recollections?

MR. GARDLIN: Well, it's not a direct recollection, but

I'm aware of one in 1962. I believe it was a DC-6 in the Sitka Sound area, a very similar --

MR. DeLISI: Okay.

MR. GARDLIN: -- scenario.

MR. DeLISI: Thanks. Flight 1549 presents us with a unique opportunity to learn about how a transport category aircraft fares when it is landed in the water. And again, I throw open to the panel. Is there anything that we're learning in this investigation about the piloting techniques or about the structure that we might take away as a lesson learned that would help us to assure a safe outcome in the event of a future ditching or water landing?

MR. GARDLIN: The FAA has initiated a review of all the data that we have available to us. We've actually contracted with a former FAA employee, as well as another expert in the field, to collect as much information as they can from the data that's available and then use that to prioritize what they think are the most critical parameters that we should look at.

MR. DeLISI: Great, thank you. Anyone else?

CAPT. VAN DER STICHEL: If you don't mind.

MR. DeLISI: Please.

CAPT. VAN DER STICHEL: If we look in a broader view about the intent of the certification requirements, which is to minimize injury and to enable escape, I believe that event shows that it does project the intent. It would be exaggerated to

extrapolate, so it would be -- this is an event, and as stated as all of us, I guess, any lesson learned would be interesting, but we need a -- I guess.

MR. DeLISI: Great, thank you. I'm sorry, one more.

MR. BRENEMAN: Yeah, one more. I think in the general scheme of looking at this particular accident versus other accidents that we see, what we except of the pilot when they're faced with something like this, where they've lost -- you know, lost their power, they still have control, the controllability of the aircraft, we're expecting them to look for the most advantageous way of survival for the passengers to survive. And in this case, you know, he was looking for the place of least obstacles where he could put the airplane down. If all he had was a golf course, we would've expected him to put it down there if there was no Hudson River. If there was a freeway that was close by, we would've expected him to do the same thing.

I think in each one of those cases, because it is an emergency forced landing, we would've expected some amount of structural damage, but we would hope that the aircraft is designed based on their certification requirements so that the occupants would have the best chance of survival. And I think what we saw here, as demonstrated by all the presentations and the captains' testimony, is that this aircraft did as expected. Under the circumstances, yes, there was structural damage, but the passengers survived. And I think what we're seeing is what we had

hoped to see in a forced crash landing. I'm sure there's things that we can learn from it, because we always try and learn from the accidents, whether there's survivors or not.

MR. DeLISI: Great, thank you, I appreciate your thoughts.

CHAIRMAN SUMWALT: That was a very good point you just made and I appreciate that comment, Mr. Breneman, and I'd like to follow up. We have heard from most of the members of this panel that this would be, I think, all of those who were asked this question answered that this was a forced landing and not a ditching. What would be the -- you have the opportunity to speak to the NTSB here. What would be the downside of us considering this to be a ditching instead of a forced landing?

MR. BRENEMAN: I'll be answering, not on the technical aspects, since I'm not the technical member on the team, but I think if we were to consider this the industry standard for a ditching, then we would have to look at all of our certification requirements, all of the assumptions, all the methods that had been previously planed for, for what we had planned for initially as a ditching where there was an extended over water flight.

They're not going to be able to reach the land, and they've got to do something and here is the procedures for doing that. And I think if we want to call this a ditching, then we're going to have to scrap everything that we've done in the past and we're going to have rethink about, you know, what does this really

mean and how are we going to address this? But when you look at this in a whole, this really is -- this fits the scenario where, in this case, thank God he didn't have to land in a golf course. We had an area where there was the least amount of obstacles, with the greatest chance of survival.

CHAIRMAN SUMWALT: Thank you. So the potential downside would be that we would be holding the aircraft to a ditching standard, saying that it should've touched down at a half-degree, negative half-degree per second, or a negative half-degree flight path angle and 3.5 feet per second, would be trying to say, well, this airplane, it exceeded those things in a ditching.

But in reality, as you pointed out, it could've been a forced landing. They didn't have a lot of choices. If they would've landed on a golf course or an interstate, we would've expected some damage. In other words, no one expected a ditching to occur under these circumstances. Is that basically a pretty good synopsis?

MR. BRENEMAN: I think that's an excellent synopsis.

CHAIRMAN SUMWALT: Thank you. For Mr. Fitzsimmons. And by the way, the parameters -- and I think this question has been asked and answered and I apologize. Just to clarify, the parameters that you showed in which the A320 was used to certify the airplane, I think it was something like a hundred and forty-five thousand pounds and 3.5 feet per second and a negative half-degree of flight path angle. Those parameters, they were based on

at least one engine operating, is that correct?

MR. FITZSIMMONS: Mr. Chairman, just one point. The way that you mentioned I'll correct it. Just to comment once again, because the glide slope for certification was not 0.5, but indeed one degree, minus one degree in the case that we're looking at, and the sink rate associated with that is 3.5 feet per second. So that's just, you know, for the record. That's what was used for certification, to be very clear on that.

There was no assumption on thrust at all in this. It's not, in a strict context, relevant because it's really just the parameters at entry to the water. In a case of whether thrust or not, it's irrelevant in that context. It's just, you know, what are the right parameters and what is the certification assumption? In the sense of the certification and structure analysis design, thrust or not thrust, it's not relevant in that context.

CHAIRMAN SUMWALT: Thank you for the clarification. And another clarification for my edification. You had commented earlier, I think, to a question from someone on the Technical Panel, that when asked, Was the damage to the aft pressure bulkhead, was that, in your opinion, based on the impact or was it based on the airplane dragging through the water? And I personally did not hear what your answer was.

MR. FITZSIMMONS: Just let me repeat that. And the answer was that the damage to the bulkhead, I believe, from looking at the aircraft after it was recovered from the water, was

not directly due to the impact but due to post-impact and let's say, water scooting or water ingress. There was damage forward to that position and this has simply washed out a lot of the structure and including, as well, the lower portion of the pressure bulkhead.

CHAIRMAN SUMWALT: Thank you. So it was not based on the impact itself.

MR. FITZSIMMONS: That's correct, sir.

CHAIRMAN SUMWALT: It was based on the aircraft scooting through the water.

MR. FITZSIMMONS: Yes.

CHAIRMAN SUMWALT: Thank you for that. Captain Lutz, the radio altimeter, some testimony earlier today had mentioned -- and you answered a few minutes ago that this crew on 1549 did not get the auto call-outs because that was overridden or preempted by other higher priority calls like the EGPWS, I guess, and others. Maybe the continuous, repetitive chime, I'm not sure. But it was not -- the auto call-outs were not received because they were overridden, that's correct?

CAPT. LUTZ: That is correct. I've done some simulator studies, listening to the EGPWS, verifying all the modes that were in play during this event and the ones that are repetitive, occasionally you will hear the auto call-out of the radio altimeter height. But the auto call-out just happens to be timed at the point where you really want it, it would be overridden by

the auto call-out.

CHAIRMAN SUMWALT: Thank you. When we were having some testimony earlier this morning about pilots judging their height above ground and that it can be difficult, I think someone might've suggested that perhaps the radio altimeter could be a useful tool. But correct me if I'm wrong, for ditching, you want the landing gear up, is that correct?

CAPT. LUTZ: Yes, for ditching. And also keep in mind that the radio altimeter is displayed on both PFDs, so it could be a call-out item from a crew standpoint, perhaps.

CHAIRMAN SUMWALT: But is the radio altimeter based ostensibly from the very bottom of the tire? So what's the answer to that?

CAPT. LUTZ: I'm not sure if it's from the bottom of the tire, but it is based on the landing gear.

CHAIRMAN SUMWALT: On the landing gear. Go ahead, sir.

CAPT. LUTZ: Yes. And on my last slide, at water entry, you'll note that it's minus five.

CAPT. VAN DER STICHEL: If you may, Mr. Chairman. If you -- in case of the -- if you have more time to prepare, you would be directed to switch off the GPWS. And in a normal case there will be more freedom, more space, for the RAD ALT to give you the clout.

CHAIRMAN SUMWALT: Okay. And my point was, is that the radio altimeter would be off, not necessarily on this -- well, on

any water landing in which the landing gear is retracted, because the radio altimeter is based ostensibly -- when you touch down on a runway with the landing gear down, ostensibly it should read zero, correct?

CAPT. VAN DER STICHEL: And that's correct, it is -- it is tuned for the gear down and for the landing attitudes gear down. The offset is around a couple of feet, maybe five feet.

CHAIRMAN SUMWALT: Yes, the offset's about five feet. In fact, it's greater than that, because I'm five feet seven inches tall and I can stand up underneath the airplane.

CAPT. VAN DER STICHEL: Pardon me, pardon me, sir. It is at landing attitude, the parking attitude --

CHAIRMAN SUMWALT: Yes, I've never stood under the airplane when it was landing, so thank you. Thank you. So it could be a difference. If you didn't have -- if you were ditching and you had the radio altimeter, if you were relying on the radio altimeter, it could be off by as much as about five feet is what I believe you're saying, is that correct? Thank you.

Captain Lutz, it's been a number of years since I've flown the airplane and I've forgotten a lot about it. In one of the last -- when you were being questioned before lunch, someone asked about alpha floor. But is it true that alpha floor is independent of the fly-by-wire flight control protections, that it is -- you can't really point to a speed scale and say exactly where that will come on. You can point to a speed scale and say

this is VLS, this alpha prot, this is alpha max. But alpha floor is a thrust mode, I believe, and it can come in anywhere between -- it can come in based on deceleration and other factors. Am I correct there?

CAPT. LUTZ: Alpha floor is a function of the auto-thrust system, but it's triggered by angle of attack and that angle of attack will occur between alpha prot and alpha max.

CHAIRMAN SUMWALT: Okay, thank you. By the way, I heard the term flare law and flare mode. Which is it technically? Is it a flare mode?

CAPT. LUTZ: It is flare law.

CHAIRMAN SUMWALT: Flare law. Okay, thank you very much. Let me look over notes. I don't think I have any other questions. And I'll tell you what, we've got another panel coming up here. Let's just take a quick break. Let's take about a seven-minute break. We are in recess and we will reconvene and give the other panel time to set up.

(Off the record.)

(On the record.)

CHAIRMAN SUMWALT: Okay, we're back in session. And Mr. Benzon, you please proceed.

HEARING OFFICER BENZON: Yes, this next topic is Cabin Safety: Training, Procedures, and Equipment, and the Board calls Robert Hemphill, Jodi Baker, Jeff Gardlin, again, and Hans-Jurgen Lohmann to the stand, please. And please remain standing. And

please raise your right hands.

(Witnesses sworn.)

HEARING OFFICER BENZON: Please have a seat. And will need names again, of course. Jeff, one more time, your full name and occupation for the record.

MR. GARDLIN: My name is Jeffrey Gardlin, I'm an aerospace engineer in the Transport Staff of the Aircraft Certification Service in Seattle.

MR. LOHMANN: My name is Hans-Jurgen Lohmann, I'm working for Airbus. I started in 1997 as a mechanical engineer and now I'm engaged in cabin customized engineering since 1995.

MS. BAKER: My name is Jodi Baker, I'm an aviation safety inspector with a background in cabin safety. My current job title is Special Assistant to the Air Transportation Division.

MR. HEMPHILL: My name is Robert Hemphill, I'm the Director of InFlight Training and Standards for US Airways. I began 11 years ago as a line flight attendant and have worked in management positions and training and cabin safety and assumed my current position in July of 2007.

HEARING OFFICER BENZON: Thank you, folks. Jason Fedok has a couple of questions.

MR. FEDOK: Just a couple. Thank you, everyone, for being here today. I'd like to run the panel very similarly to what Mr. George did yesterday with his wildlife panel, in that I'd like Mr. Gardlin and Mr. Lohmann to give their presentations

initially, about the certification of aircraft and the A320 in general and specific, and I'd like Ms. Baker and Mr. Hemphill to follow up after we're done with your questions on the operational side. Mr. Gardlin, I believe you have a presentation.

MR. GARDLIN: Yes.

MR. FEDOK: Please proceed, sir.

PRESENTATION BY MR. GARDLIN

MR. GARDLIN: You can go to the next slide. So this presentation mirrors quite closely the one I made earlier, with the focus now being on the cabin and survival factors. So again, the ditching characteristics in this case, the most significant impact is on the evacuation, the availability of exits and the amount of flotation time available.

Ditching equipment. This isn't intended to be an all-inclusive list, but in broad terms, personal flotation requirements, life preservers, flotation cushions, group flotation requirements, for example, rafts and slide rafts. There's other equipment such as lifelines, transmitters, survival kits, and so on, that are part of the requirement that's normally associated with water and ditching approval.

So again, not to belabor the terminology more than we have for the so-called planned ditching, again, sufficient time is available. We talked a lot about the probable structural damage and that has be a consideration when showing compliance. And the requirements for emergency equipment are fairly extensive to

address that scenario. Again, the everything else, which has been for the type certification purposes, broadly characterizes unplanned. The situation there is that the emergency equipment requirements are not as extensive as for the planned ditching and there are some additional considerations relative to exit availability and how the evacuation is assessed.

So again, this is the same list of regulations that I showed earlier, with the highlights now on the ones more directly associated with the survival factors. Again, exits are a key element here. There is a requirement to have exits available. The requirements for safety equipment are basically contained in two places, section 25.1411 and 1415. Those requirements involve both location and type of equipment. I'll talk about the specifics. We can move on.

Emergency exits. The requirement for exits to be available is applicable, as I noted in the prior session, on whether or not certification under Section 25.801 is sought. So there are exit availability requirements no matter if the airplane is intended to be used extended over water or not. The exits available on the water, it's a little bit different consideration than are for land exits. Basically, the ditching exits are assigned or are given credit individually, whereas, for a land evacuation, we give exit credit when they're in pairs. And for ditching, the amount of credit is a 35-passenger credit per available exit. So even if the exit might have a land evacuation

rating of significantly more than that, for ditching, it's only allotted a 35-passenger credit. Sections 25.1411 and 1415 are the requirements for flotation and survival equipment and also the accessibility and location of the flotation and survival equipment.

Methods of compliance. I touched on this a little bit earlier. But when the airplane is shown compliant with Section 25.801, that information is used to determine the exit availability, which exits are available. And typically, then, there's an additional assessment necessary to look at the critical case for the everything else case. The data may already be available from the studies under Section 25.801, but if not, then additional data would be necessary to show that in the so-called unplanned scenario, that there are still adequate exits available. Compliance with the equipment sections is shown through physical inspection, through demonstration of accessibility, and through review of drawings. I'd say most of it is probably through physical inspection and demonstration.

And then lastly the evacuation aspects. Hopefully there's one more slide. There we go. So in the planned ditching case the flotation time and trim of the airplane must allow occupants to leave the airplane and enter the life rafts under what is termed reasonably probably water conditions in the regulations. For the unplanned envelope of situations the requirement is very similar, except the starting points are

somewhat different, in that you're starting from the most critical gross weight and center of gravity location. The leakage is predicated on not having had time to close valves and things like that. And the evacuation time needs to be completed to allow people to leave the airplane. For type certification, this was alluded to by Mr. Fitzsimmons, but the certification requirement basically says that the evacuation has to be completed by the time the first exit would reach -- the first exit sill would reach the waterline.

So that doesn't mean that the airplane has sunk at that point or is even near sinking. But from a certification standpoint that's our requirement, that they have to complete evacuation by the time that first exit would reach the waterline. And I believe that concludes my presentation.

MR. FEDOK: Thank you very much. Mr. Lohmann, you also have a presentation, is that correct?

MR. LOHMANN: Yes.

MR. FEDOK: I think it would be helpful, before we start discussing the certification issues, if you can give your presentation specific to the A320.

MR. LOHMANN: Yeah, I will do. Can anyone put the presentation, too? It's not here. Give me the remote, please. Thanks. Here we are.

PRESENTATION BY MR. LOHMANN

MR. LOHMANN: My presentation comprises of three parts.

With the first part I will provide some information about the basic certification dates and figures of the aircraft and inclusive of the cabin. I will give some general information and general overview as how the cabin was arranged and which emergency equipment was on board. And I will give information on assumptions done for the cabin certification in case of the ditching. This will be followed by some views on the cabin itself after the aircraft has been recovered, and a summary.

The basic A320 certification took place in -- 84. This was for a Dash 100 type. The basic cabin was an all-tourist class layout, with 164 passengers. The aircraft was -- we were discussing about, was a Dash 214 aircraft. This is a specific variant, with an -- of 77 tons and equipped with CFM 565B4 engines, and the max capacity for this aircraft is 180 passengers. This type has been certified in 1995 by the JAR, the European Airbus Authority, and based on Joint Aviation requirements Part 25, Change 11, and later on by -- this was in 1996, by the FAA, based on Title 14 of Code of Federal Regulations Part 25. And for the cabin there was no change of requirements compared to the Dash 100 aircraft.

The aircraft delivered to US Airways was the manufacturer's Serial Number 1044. The initial delivered layout was a two-class configuration, with 16 business class seats and 126 tourist class seats. This layout has later on been refurbished by an Airbus service bulletin to 12 business class

seats and 138 tourist class seats. The sketch shown here shows the seat arrangement and as well as some locations of the actual exits, as I will refer later on, too. We as aircraft manufacturer do design the aircraft according to JAR/FAR 25, Part 25. To certify an aircraft for ditching the main paragraphs of this was what we referred from Mr. Gardlin, the 25.801 and the 25.807. The first one requires us to show compliance of the characteristics of the airplane in a water landing, and the second one is more or less defining as required emergency exits.

In addition, cabin design has to consider for the ditching case the insulation of safety equipment. Here JAR/FAR 25.1411 and 1415 apply, defining that storage provisions for required emergency equipment must be furnished and must be arranged that the equipment is directly accessible and its location is obvious.

The installed equipment -- the provisions we have considered for this type of aircraft are provisions for life preservers for each occupant of the airplane, enough life rafts to accommodate the occupants of the airplane. Life rafts are equipped with survival equipment and emergency locator transmitter. There is a long-range signal device and there are lifelines to be provided for.

In addition, there's also some optional equipment. One of those is a slide raft installed in the overhead storage compartment. Separately, this selection is normally linked to the

amount of passengers to be carried. The MSN1044 has been delivered by Airbus with all necessary provisions and the equipment installed for extended over water operations in accordance to customer requests. We have installed life vests for each occupant of the airplane and floating cushions at passenger seats; slide rafts to accommodate the occupants of the airplane, lifelines, pyrotechnic signaling device for each life raft, survival-type emergency locator transmitter, and survival kits.

I will give you now an overview on the emergency equipment of this aircraft, the locations where they were installed. The layout shown here is the delivered layout, with 16 business class seats. However, the emergency equipment has not been modified by refurbishing the aircraft to 12 business class seats. We do install, as I said, life rafts. They were at the forward doors and at the aft doors.

We have installed lifelines. They are installed in a provisional compartment of the overhead storage compartment at Frame 38. This is 38-39. This is just between the emergency exits. The lifelines are placarded at the storage compartment and there's also an instruction placard, how to handle them, at the side wall linings. And of course, we have also installed life vests under the seat pan and flotation cushions where the seat cushion was.

So which conditions we considered to compliance in a ditching case. It is given in JAR/FAR 25, 25.807, that we have to

show that the flotation time and trim of the airplane will allow occupants to leave the airplane and enter the life rafts. Ditching certification was done by similarity, based on A320-100 results for this specific aircraft. It has been considered that the aircraft would undergo no destruction likely to create water passage if landed under specific conditions as shown and discussed in the previous panel and discussed by David Fitzsimmons.

Considering this and what we have considered also worse case of center of gravity of 39 percent, aircraft pitch of about .5 degrees, and an aircraft roll of five degrees. It has been calculated that the lowest door height is at the right rear door due to the roll of the aircraft, which is 4.65 inches above the waterline. With these figures we have validated that the lowest doors will remain above the waterline for seven minutes and 15 seconds.

In 1992 we have performed an advanced ditching analysis for 186 occupants. These 186 occupants consist of 180 passengers, as I mentioned before, two flight crew and four cabin crew. Under specific conditions our assumption was that only two doors are available on the same side of the airplane due to rough sea and high wind conditions on the other side, and an additional assumption was that one of the biggest rafts is not available. And in addition for this, an additional slide raft was available, stored in the overhead compartment, also to comply with the amount of occupants. This analysis finally confirmed that 186 persons

can be evacuated into the rafts within 18 seconds, four minutes and 18 seconds. So we're just fairly behind the seven minutes flotation time.

So let's go now through some photos of the aircraft and the cabin. Photos were taken after the aircraft has been recovered from the water. We have seen the structural ditching panel and this now the photo to this significant damage of the rear structure. This picture was taken from the outside onto the rear structure, one from the right hand of the plane and the other one from the aft of the plane. Although we have seen significant damage to the rear structure, there were only minor violations to the cabin.

The picture again is taken from the original cabin of the U.S. Air Flight 1549 after recovery from the water. We do look from the very front end of the tourist class, which means real far, to the aft. We can see that -- and that has been reported, is that the Airbus remained within the requirements of JAR/FAR 25.815. All seats remained intact and was also no damage of seatbelts and so reported. The cabin functioned normally in this area.

We have, of course, also seen some damage. This is the rear cabin, looking to the back. Some overhead storage bins are broken, but we do not know when this -- oxygen masks are falling down. It can be assumed that this was caused by the high force, as we have seen in the rear cabin. But, and this is important for

us, for the cabin, all cabin large structures remained intact in accordance with JAR/FAR 25.789; the retention of items of mass was fulfilled. And it has been reported that overhead bins successfully contained baggage and carry-on items as required by JAR/FAR 25.787.

Even with the significant structural damage, cabin damage was limited to a single strut protruding the cabin floor. You can see it here in this detail. And there were also some floor panels broken. It can be assumed that this was caused by the water rushing into the aft structure from the under-floor. There was a discussion about the aisle widths in the aft cabin, swivel class cabin, between the swivel class cabin attendant seat and the lavatory, because the seat was stowed -- was found in an un-stowed position. We have investigated this. The theoretical figure for this aisle width was 20.74, with a requirement of 20 inch. But this even does not matter because we have done the full evacuation test with the swivel class extended. So under the specific conditions this is not an issue at all. And at the end, what we have seen, the crew evacuated everyone safely.

To conclude from the point of cabin, this event was an emergency landing on water, as it is characterized by the fact that the cabin crew had no time to prepare for an emergency. And although the fuselage sustained significant damage, leading to that the aft doors being unusable, the cabin maintained its structural integrity, thus protecting the passengers and crew from

major injury and allowing safe evacuation of the aircraft. Thank you.

TECHNICAL PANEL QUESTIONS

MR. FEDOK: Thank you, Mr. Lohmann. Can I have Exhibit 6G, please? Gulf. I apologize in advance, but it wouldn't be a panel unless we discussed the definition of a ditching. This is an Airbus document entitled "Getting to Grips with Cabin Safety" that was sent to operators. It provides some cabin safety instruction for operators, in developing their crew training and I'll read the first sentence there. "The definition of a ditching is a deliberate emergency landing on water, where the aircraft touches down under control." With that definition, sir, wouldn't Flight 1549 be characterized as a ditching?

MR. LOHMANN: I'm sorry, I didn't get the point direct. Could you rephrase?

MR. FEDOK: The definition that's on the screen, in the Airbus document, "a deliberate emergency landing on water, where the aircraft touches down under control." Given that definition, wouldn't this flight have been considered a ditching?

MR. LOHMANN: From cabin standpoint, this could be identified as a ditching, from cabin standpoint, because the -- now? Okay -- because we have seen the cabin more or less without any violation.

MR. FEDOK: So you agree that, in fact, from the cabin standpoint, then, this was a ditching?

MR. LOHMANN: From cabin standpoint it was not a ditching, because there was no time to prepare for it.

MR. FEDOK: Okay, I'm just having trouble with those two issues. The definition that's on the screen doesn't talk about time, it just talks about what the aircraft does.

MR. LOHMANN: Yes, but in any case, our assumptions are based on the fact that we can prepare the cabin.

MR. FEDOK: Okay, thank you very much. Mr. Gardlin, touching on some points that ended the last panel, referring to the FAA's report here from March of 1996, it's in a public docket, it's entitled "Transport Water Impact and Ditching Performance." That document indicates that, from the years 1959 through 1996, there would've been one successful ditching that the FAA was able to identify. The report also states that "the current FARs, which specifically discuss over water emergency scenarios, are based on the premise that the water contact will be a planned event. Do you agree with that statement?

MR. GARDLIN: The statement that the premise that the water contact is a planned event?

MR. FEDOK: Yes, sir.

MR. GARDLIN: I believe so. I mean, I think there's probably more context to it than maybe we're covering right now. But I think, yeah, in general principle I think it comes back to what we've been saying all day.

MR. FEDOK: Okay, thank you. When a manufacturer

presents an airplane to the FAA for certification and they intend it to be used in an over water operation, can you just review for us what addition provisions are required compared to a non-over water aircraft?

MR. GARDLIN: Yeah, it's -- there's a combination of requirements in Part 25 and in the operations rules. So some of the Part 25 requirements require provisions for certain equipment and then the operating rules actually require the equipment.

MR. FEDOK: Right. Could you just go over the provisions for equipment for us?

MR. GARDLIN: So basically for when an airplane's intended for extended over water equipment, the provision for lifelines is required. There is a requirement for a life preserver for each occupant. And then there's the requirement for group flotation in the form of life rafts.

MR. FEDOK: Thank you. And I just want to clarify some terminology that we'll be using here throughout the session. Can you describe for me the difference between a life raft and a slide raft? Those two terms are not synonymous, is that correct?

MR. GARDLIN: Well, the requirements and the rule is for life rafts and one way of satisfying that requirement is to use the combination slide raft. And so the slide raft is basically a device that normally functions as an evacuation slide on land, but actually meets requirements for a life raft when used in the water. So that is a form of a life raft as far as compliance with

the regulations go. There are other types of life rafts.

MR. FEDOK: And a slide raft, is that necessarily stored on a door of a transport category aircraft?

MR. GARDLIN: Yeah, it is located at the exit for which it's intended to be used. I think there are -- well, I know there are some cases where it's not literally on the door itself, but it may be located inside a body, say, under the door. But basically it's at the location for where it's intended to be used.

MR. FEDOK: Understood, thank you. A non-over water aircraft, what would that have in place of a slide raft?

MR. GARDLIN: Well, of course, if the airplane is more than six feet -- if a door sill is more six feet above the ground, they're required to have escape slides, and since about 1983 escape slides at doors have provision to be detachable and usable as a flotation device, although they're not -- they do not necessarily meet all the requirements of a raft, but they are -- the basic requirement of being detachable and usable for flotation has existed.

MR. FEDOK: Are all slides detachable or just manufactured after a certain date?

MR. GARDLIN: Well, the -- yeah, probably not all of them are, but I think the vast majority, certainly at floor level exits.

MR. FEDOK: Okay. And how long have slide rafts been in use in commercial aviation?

MR. GARDLIN: The concept of a slide raft began in the 1970s. In fact, I think the concept was explored in the early 1970s, and for a while they were produced in the absence of any actual codified standards. But certainly from about -- I'll have to probably verify this, but I think from about the same timeframe, the early 1980s, the slide rafts have been -- there's a technical standard order that covers the slide rafts and they have been a basic part of certification.

MR. FEDOK: And before that time, the flotation provisions in certification were met through the use of life rafts, is that correct?

MR. GARDLIN: Yes, typically they were met by portable rafts and in some cases they still may be.

MR. FEDOK: And where are life rafts generally stowed? Does the FAA have any guidance on where life rafts should be stowed?

MR. GARDLIN: Well, there's both guidance and regulatory requirements that says the life rafts need to be stowed near the exits for which they are intended to be used. So again, it depends on the specific airplane type as to the exact location, but as a general matter they're stowed near where they're intended to be used.

MR. FEDOK: Which, I assume, is a door of some kind.

MR. GARDLIN: Where they're intended to be used, yes.

MR. FEDOK: Right. And could you tell me how the FAA

determines, on a particular aircraft, how many slide rafts or life rafts are needed to meet the extended over water requirements?

MR. GARDLIN: The raft capacity is required to accommodate all of the seats that are on board the particular airplane, which includes all the flight attendant seats, even though there may not be that many flight attendants, and all the jump seats in the flight deck. And that has to consider, again, the loss of the largest raft. So really, it's airplane specific as to how many are required.

MR. FEDOK: But simply, then, if a person has a place to sit on the airplane, the requirement is that they have a place to sit in a life raft or a slide raft, post-evacuation, with the loss of the largest raft on the airplane?

MR. GARDLIN: Yeah, I think that covers it.

MR. FEDOK: Thank you. This airplane, the A320, is equipped with off-wing slides, which we saw in many of the photographs, that were utilized by some of the passengers. Are they considered part of the flotation equipment on this aircraft?

MR. GARDLIN: On this airplane the off-wing slides are not part of the flotation equipment.

MR. FEDOK: And can you explain why that would be, sir?

MR. GARDLIN: Well, in the simplest sense they're not designed to be, and given the provisioning of the slide rafts at the main doors, they're not necessary in order to accommodate all the people.

MR. FEDOK: Is there a TSO aspect of that as well?

MR. GARDLIN: Well, yeah, there's a TSO aspect, in that the TSO covers different types of escape systems, which include ramps as well as combination ramps and slides, as well as specifically slides leading from an exit directly to the ground, and in this particular case the off-wing slides are both a ramp to the wing and a slide from the wing to the ground.

MR. FEDOK: Correct. And one are the major differences between Type 1 slides, which go from the door directly to the ground, and a Type 4 ramp/slide combinations is that the Type 4s are not required to have a quick release mechanism, is that correct?

MR. GARDLIN: Yeah, that is true, right.

MR. FEDOK: Is there any downside for those off-wing slides to have a quick release mechanism?

MR. GARDLIN: I guess I'll have to ask you to clarify a little bit what you mean by downside from a perspective.

MR. FEDOK: Well, let me go further a little bit with that. In 1985 the Safety Board issued a safety study on over water operations and equipment. One of the recommendations out of that asked the FAA to amend the TSO, at the time, C-69A, to require quick release girts and handholds on emergency evacuation slides and then to require the operational requirements to put those into place. Are you familiar with that recommendation?

MR. GARDLIN: Yes, I am.

MR. FEDOK: Do you know the outcome, what the FAA did in response to that?

MR. GARDLIN: Well, I think the change to the TSO was responsive to most of it. I'm not sure -- I guess I'm not sure about the entire scope of the recommendation, but I think the change for the quick release girts at the Type 1 slides was the major response.

MR. FEDOK: Okay. But Type 4 slides still are not required, to date, to have any quick release mechanisms, is that --

MR. GARDLIN: That is true.

MR. FEDOK: Thank you. Switching tracks a little bit, we touched on this earlier in the other panel, but I just wanted to clarify from the cabin safety standpoint. Can you just describe to us again how a manufacturer determines or shows the FAA how long the airplane will float? What assumptions are used in those calculations?

MR. GARDLIN: Well, I think, again, looking at the two different broad situations, the idea is that all leakage paths have to be assessed and the rate at which that changes the sill height of the airplane, in other words, how quickly it's lowering in the water, determined and the starting point is depending upon whether it's the planned ditching or the everything else case, you know, based on the gross weight and center of gravity that's critical for that case. And then the amount of flotation time

again ends -- the evacuation time, I guess, must be completed by the time that the flotation attitude changes to where the first exit reaches the waterline.

MR. FEDOK: Thank you. One of the reasons I ask is because in my own travels, and probably yours as well, traveling on other aircraft of similar size, with similar max takeoff weights, similar seating capacity, dual engine under-wing aircraft, and I've noticed on the safety information cards that in those airplanes the aft exits would not be usable and that passengers are instructed to go to the more forward exits. Is that strictly a mathematics equation, essentially, where in the buoyancy of the airplane, where those door sills will sit?

MR. GARDLIN: More than likely. I guess the outward geometry of the airplane may not, in fact, be similar when the very specific considerations of buoyancy and locations of the center of mass and so on are considered. So yeah, it's more than likely just the difference in how the actual physics of it is established for that particular airplane.

MR. FEDOK: And do you have any way of knowing or perhaps even guessing what the fleet mixture is as far as how many airplanes use the aft exits versus don't?

MR. GARDLIN: Well, I don't want to guess, but yeah, I think it really depends, I think, on a given airplane type. It could vary if the airplane is -- you know, if the airplane is assumed to be a non-over water airplane and the considerations

were different, that may change the assumptions. So I really don't have an estimate for you on that.

MR. FEDOK: That's fine. But you also mentioned in there a very interesting thing, that you consider the evacuation time for certification to have ended when the water reaches the lowest door sill, is that correct?

MR. GARDLIN: Well, we consider that it must be completed by that time, yeah.

MR. FEDOK: Right, exactly. And Mr. Lohmann's presentation indicated that the lowest door sill on the A320 would be the right aft door sill, which would be 4.65 inches above the water, and that was calculated into a seven-minute, I believe, and 18-second evacuation time, is that correct, sir?

MR. LOHMANN: Yes, that's correct.

MR. FEDOK: So am I led to assume, then, that we have some degree of confidence that the airplane will only sink 4.65 inches in seven minutes and 18 seconds? Either or both.

MR. LOHMANN: It's left to me, maybe. Yes, this is a calculation.

MR. FEDOK: Thank you. Back to you, Mr. Gardlin, switching tracks again. Can you tell us what is a lifeline?

MR. GARDLIN: Well, in the airplane context the lifeline is a line that's intended to be mounted to the airplane fuselage and anchored to a point on the wing that is available to help people steady themselves if they're on the wing.

MR. FEDOK: Thank you. And there is a Part 25 requirement for that, the provisions for that, is that correct?

MR. GARDLIN: That is correct.

MR. FEDOK: And are you -- I know this is outside your area, but if you could help me out. Do you know if there's an operational requirement to have a lifeline on board the aircraft as well?

MR. GARDLIN: Yeah, there is. Ms. Baker may have more to say about it. But yes, there is an operational rule that requires lifelines.

MR. FEDOK: Thank you. And do you have any idea when the requirements for lifelines came into effect? From the certification side, that is.

MR. GARDLIN: Well, the provision for lifelines has been in the certification rules for a very long time. I can't quote you a specific date, but it's been there for a long time.

MR. FEDOK: Thank you, that's fine. And how does the FAA evaluate or determine the best location for a lifeline?

MR. GARDLIN: Well, the requirement is that the lifeline be stowed near the exit or near the over-wing area, to be used in the event of people being on the wing in the water. So when you say the best location, what we have to determine is if it's a compliant location and I think, you know, a stowage location that's in the immediate vicinity of the over-wing and marked correctly would satisfy the rule.

MR. FEDOK: And Mr. Lohmann, Airbus and the A320 meets this requirement by stowing the lifeline in a small bin over the -- near the overhead bins near the over-wing exits?

MR. LOHMANN: Yes, this is all assumption.

MR. FEDOK: I've noticed in my travels that other manufacturers stow them in the doorframe of the over-wing exits, is that correct, Mr. Gardlin? Are you familiar with that?

MR. GARDLIN: Yeah, there are some where that is the location, yes.

MR. FEDOK: Okay, thank you. 25.1411, you talked a little bit about that in your presentation, Mr. Gardlin, requires the rapid detachment and movement of a raft for use other than intended exits. Are you familiar with that requirement?

MR. GARDLIN: Yes.

MR. FEDOK: And can you tell me how the FAA determine what is a rapid detachment?

MR. GARDLIN: Well, there isn't a specific time associated with rapid, but clearly it's in the context of the available flotation time and the evacuation time and needs to be relatively simple and obvious for someone following the instructions. But I don't have -- I can't give you a number of seconds that constitutes rapid.

MR. FEDOK: That's fine. And how do the manufacturers demonstrate this to the FAA, this rapid detachment?

MR. GARDLIN: Well, it's literally a demonstration where

the process of detaching and moving the device is shown and evaluated.

MR. FEDOK: Thank you. Switching into another piece of equipment, the life vests that are required or stowage provisions that the life vests are required. How does the FAA decide the best location to stow a life vest?

MR. GARDLIN: Well, again, the regulatory requirement is that the life preserver be accessible to seated occupants. And so that in and of itself limits the range of possibilities to places that are within reach of the seated occupants and it requires that each person have access to a life preserver. So again, it's not so much that we determine the best location, we have to determine if the location is compliant.

MR. FEDOK: Understood. Going back to that 1985 study the NTSB issued, one of the recommendations from that was to amend Part 25 to require that stowage compartments for life preservers be located where the life preservers will not be susceptible to the water impact crash damage or cabin flooding. Are you aware of any work that the FAA has done on that issue?

MR. GARDLIN: Well, I mean, I know the FAA did respond to the recommendation. I don't know that in the course of reviewing the standards, that we concluded that there was a need to change them, I guess, from that.

MR. FEDOK: That's correct, the FAA's response was that, I believe, the potential ability of passengers to quickly obtain

life preservers, coupled with the flight attendant briefing and safety information card, provided an adequate level of safety. And that recommendation was closed unacceptable action. Are you aware of any recent work that the FAA may have done on life vests or the retrieval of life vests?

MR. GARDLIN: Well, the FAA Civil Aerospace Medical Institute did a review of life vest accessibility, varying certain parameters with different sized test subjects, to see what was important in accessibility and what wasn't, I guess. So I don't remember the exact date of that and I think it's one of the exhibits, but yeah, I'm aware of that study.

MR. FEDOK: It's a May 2003 issue. And one of the results from that was that under the conditions tested, and there were about four conditions tested, approximately retrieval times ranged from between seven and 15 seconds under the best of conditions. Does that sound reasonable to you?

MR. GARDLIN: Well, I think -- I mean, that, I guess, is the factual information from the study. I think if you consider that timeframe as basically -- if you have an airplane, that seven seconds is seven seconds -- it's the same seven seconds for everybody in the airplane retrieving their life vests. It's not sequential. It's not 200 times seven, it's seven. So yeah, that doesn't surprise me too much.

MR. FEDOK: Thank you. Just one last point. I'm going to refer to an FAA report that's also in the docket, entitled --

it's also Civil Aero Medical Institute report. "Analysis of Ditching in Water: Survival Training Programs of Major Airframe Manufacturers and Airlines." It was published in July of 1998 and I just want to read a few passages from that. "Current water survival-related regulations and training are focused primarily on ditchings occurring at sea on extended over water flights.

However, virtually all survivable water-related accidents are inadvertent and occurred near airports. NTSB accident reports show that in inadvertent survival water-related accidents, the aircraft is likely to come to rest in a nose-high flotation attitude, sustain severe damage, experience rapid flooding, and in most cases sink within a few minutes." It goes on to have a table of, at the time, the 50 busiest FAA-controlled airports in the United States and shows that 44 of those 50 were all located within five miles of a large body of water.

And I just want to ask your opinion on something and at the time I want to take issue with something that was said in the earlier panel by Mr. Breneman, that in this accident he saw what he hoped to see. What I saw in this accident was the loss of half of the slide raft in the back of the airplane and a whole lot of people standing on the wing waiting for ferries to come rescue them. Given that information and everything we've talked about here from the certification side of the house, do you believe that the FAA needs to revisit or look at the overall ditching requirements, to perhaps look at the events that we are seeing or

the inadvertent water contacts?

MR. GARDLIN: Well, I think as I said earlier, I don't know that I would say that this specific accident says that there's problems with the regulations. But I do think that this accident should cause us to look at all the requirements and assess what we have and whether there's something different that we should evaluate or whether the focus needs to be changed. But until we go through that process, I guess I can't predict the outcome.

MR. FEDOK: Understood. Thank you very much. Mr. Lohmann, could you tell me, sir, what does Airbus consider to be the primary ditching exits on the A320?

MR. LOHMANN: This is the forward and the aft door, because they are equipped with slide rafts.

MR. FEDOK: Then I am to assume that the over-wing exits would be considered secondary exits, is that correct?

MR. LOHMANN: Yes.

MR. FEDOK: And can you say what the primary difference is -- the difference is between a primary and a secondary exit? Should secondary exits be used in the event of an inadvertent water contact or a ditching?

MR. LOHMANN: You have seen this in this case here also, that it was useful to use the emergency exits, as the people could stay on the wing, yes. So in case if the aft doors are not available, you can use it.

MR. FEDOK: Okay. So from the Airbus perspective, just to be clear, that Airbus believes that all exits should be -- above the waterline, should be used in an inadvertent water contact or ditching?

MR. LOHMANN: First we should use those exits which are equipped with slide rafts. But if this is not possible, we can also use the emergency exits.

MR. FEDOK: Okay, I just wanted to make sure I understood your statement. So the secondary exits should not be used unless one of the primary exits is unavailable?

MR. LOHMANN: Yes.

MR. FEDOK: Okay, thank you very much. Can you please describe the assumptions -- and I think you did in your presentation a little bit -- used by Airbus in determining what ditching exits are for the A320, what assumptions that you utilized?

MR. LOHMANN: Yes, this was the assumption where -- which leveled the doors of the highest are. This was the forward and aft doors, which are equipped with slide rafts. So these were used to be for this analysis.

MR. FEDOK: Is also one of the assumptions, sir, that you're dealing with an intact pressure vessel?

MR. LOHMANN: With an intact pressure?

MR. FEDOK: Pressure vessel, that's there no compromise of the pressure, the systems of the aircraft, the aft pressure

bulkhead.

MR. LOHMANN: Yes, because our assumption was that the pressure would remain intact.

MR. FEDOK: Thank you. And how specifically did Airbus meet the FAA requirements for extended over water operations on the A320 from an equipment standpoint?

MR. LOHMANN: Yes?

MR. FEDOK: How did Airbus meet the FAA requirements for extended over water operations on the A320 from an equipment standpoint?

MR. LOHMANN: As we have installed all that equipment that was request by the customers, because it was an operational requirement.

MR. FEDOK: And what was the capacity of the accident airplane, again?

MR. LOHMANN: The capacity of this airplane was 150.

MR. FEDOK: And what was the capacity of each of the individual slide rafts?

MR. LOHMANN: It was 44 passengers in a normal case and 55 in an overload case.

MR. FEDOK: Mr. Gardlin explained that the manufacturer was responsible for demonstrating the airplane could be evacuated within the flotation time determined with the airplane with the loss of the largest capacity. Can you specifically tell me how Airbus demonstrated this for the A320?

MR. LOHMANN: Yes, this was done by analysis. We took the time, which we have taken as during the normal evacuation analysis. This led to the fact that, per person, we have egressed one person per 1.5 seconds. In addition, we did physical tests, how long it takes to open one door, how it takes -- how long it takes to deploy a slide raft, how long it takes to transport slide raft, because the assumption was that we have two doors not available at one side of the aircraft; how long it takes to transport one -- those two slide rafts to the other doors. And again, we have an additional raft in the over-storage compartment, so this was also in the calculation. And last but not least, how long did it take to deploy this additional raft. This sums up to this four minutes and 18 seconds.

MR. FEDOK: Thank you very much. And for these time-to-moving demonstrations that Airbus performed, how many people carried the slide? The slide raft. Excuse me.

MR. LOHMANN: For the portability?

MR. FEDOK: Yes, sir.

MR. LOHMANN: This was the normal slide raft.

MR. FEDOK: And how many people transported it during the demonstration?

MR. LOHMANN: Two people and extracted by one.

MR. FEDOK: Do you know the weight of the slide raft?

MR. LOHMANN: It's about a hundred pounds.

MR. FEDOK: Thank you. And were these time

demonstrations done in a cabin with passengers?

MR. LOHMANN: No, this would be not possible. But as we have transported this raft to the other doors, this is not an issue at all.

MR. FEDOK: Did you do any scenarios with the loss of the aft two exits?

MR. LOHMANN: No, to my knowledge, no.

MR. FEDOK: But you did do a time demonstration walking down the aisle of the aircraft with the slide raft, is that correct?

MR. LOHMANN: Yes.

MR. FEDOK: Thank you, sir. Can you just tell me at what point Airbus would consider an exit unusable in a ditching or in an inadvertent water landing?

MR. LOHMANN: There are two figures. The one is that the raft is not available or the other that the door sill high is under water.

MR. FEDOK: If there's water in the area of that particular exit inside the cabin, would Airbus think that the crew should try to open that door?

MR. LOHMANN: This depends on the height of the water, yes.

MR. FEDOK: So water inside the aircraft, by itself, is not a limitation? In other words, flight attendants, even if water were near an exit, depending on how high it is, should use

their judgment and still attempt to open that door?

MR. LOHMANN: Not to open the door. You asked me to release the slide raft.

MR. FEDOK: I'm sorry, I changed topics on you, sir. Let me ask it again so we can be clear. At what point would Airbus consider an exit unusable in a ditching, in other words, not to be opened during a ditching or in an inadvertent water landing?

MR. LOHMANN: If the slide -- if the water is above the door sill.

MR. FEDOK: Okay.

MR. LOHMANN: Then the door should not be used.

MR. FEDOK: And if there's water inside the aircraft, should the door be used?

MR. LOHMANN: It depends where this water comes from, yes. So if the door sill highest is still above the outside water, you can open the door.

MR. FEDOK: Okay, thank you. One last question, sir. This morning we heard from the panel that it's very, very difficult to land an airplane on water without any damage to the tail section and that the conditions we saw in this accident, you know, might happen again, being that there's water in the back. Can you explain, you know, given that information, why Airbus relies on the aft doors for stowage for half of the slide rafts on the aircraft?

MR. LOHMANN: This is the certification for this aircraft. So the certification is done and we have no issue to modify this.

MR. FEDOK: Are there enough areas for stowage in the A320, as it is today, where enough flotation capacity could be obtained without the use of those aft two slide rafts?

MR. LOHMANN: We can provide additional slide rafts. As I said, sir, we have optional -- we do offer optional rafts.

MR. FEDOK: And those are overhead compartments?

MR. LOHMANN: They are installed in the overhead compartments, yes.

MR. FEDOK: So an operator could, if they wished, choose to have their aircraft modified with overhead stowage compartments and put additional life rafts on an A320 that's operating today?

MR. LOHMANN: In principle, yes.

MR. FEDOK: Thank you very much. That concludes my questioning for the certification side of the panel. Ms. Baker and Mr. Hemphill, for the operational training side of the panel, I understand you both have presentations, is that correct? I'd like to ask just a couple of questions before we go to those presentations, of each of you, the same questions. Ms. Baker, can you describe what your duties are in your current position?

MS. BAKER: In my current position as a special assistant or in my previous position as the cabin safety inspector assigned to AFS-200?

MR. FEDOK: Excuse me, your previous position.

MS. BAKER: Previously, in November 2006, I started as a cabin safety inspector assigned to the Air Transportation Division here in Washington, D.C., at FAA headquarters. I review existing regulations and policies regarding cabin safety, for adequacy, review newly proposed regulator recommendations, review petitions for exemption. I answer questions from the public. I respond to requests for briefings from upper-level FAA management, Congress, NTSB, other government bodies.

MR. FEDOK: Thank you. And before you were in that position, were you ever a cabin safety inspector for the FAA?

MS. BAKER: Correct, I was a cabin safety inspector in the field from December of 2000 until November of 2006.

MR. FEDOK: Can you describe what duties are for a cabin safety inspector?

MS. BAKER: As a cabin safety inspector I had certificate management responsibility at various points for four air carriers. A cabin safety inspector is responsible for reviewing and recommending approval of the flight attendant manual, the flight attendant training program, the carry-on baggage program, and exit seating program and any other matter relating to cabin safety, MEL provisions, safety information cards and the like.

MR. FEDOK: Thank you very much. Were you ever a line flight attendant?

MS. BAKER: Yes, I worked for a top 10 Part 121 air carrier as a line flight attendant and in their training department.

MR. FEDOK: Were you A320 qualified?

MS. BAKER: Yes, I was.

MR. FEDOK: Thank you. Mr. Hemphill, you described earlier your current position and your duties. Have you ever been a line flight attendant, sir?

MR. HEMPHILL: Yes, sir, I have.

MR. FEDOK: Were you A320 qualified?

MR. HEMPHILL: Yes.

MR. FEDOK: Thank you. I think at this point I'd like, Ms. Baker, if you wouldn't mind doing your presentation.

MS. BAKER: Certainly.

PRESENTATION BY MS. BAKER

MS. BAKER: I'd like to take a few minutes and talk about the requirements, regulator requirements for flight attendant training in general and specifically on flight attendant emergency training. This is a basic overview of the flight attendant training program. Flight attendants receive training in basic indoctrination, which is essentially Federal Aviation requirements, passenger handling, company procedures. They receive initial training on aircraft ground-type training on the specifics of an aircraft. If they are qualified on an aircraft of a particular group, in other words, if they have training on a

previous jet aircraft or they transition and they get additional aircraft training on subsequent jet aircraft, they receive emergency training. If the aircraft, for example, an aircraft is similar but still has differences that require training, that's considered differences training. And example would be between varying sizes of DC-9 aircraft. Flight attendants also receive recurrent training and re-qualification training.

This is an overview. It's essentially a summary of the type of flight attendant training, the programmed hours, when the training is conducted, what is included in each of the trainings, and the regulatory background or the regulatory basis for the types of training.

Initial training is required for a flight attendant who basically has not been a flight attendant before, has not qualified on an aircraft and served as a flight attendant on another airplane of the same group, as I said, either jet or prop. It's the most comprehensive flight attendant training event. Recurrent training is required for a flight attendant who has been trained and qualified by a particular air carrier and will continue to serve in the same aircraft type. Recurrent training is an annual training requirement.

FAR 121.417 is specifically the training for crew members and I want to stress with this that FAR 121.417 is applicable to all crew members, that is, pilots and flight attendants. To summarize FAR 121.417, it requires each crew

member to receive emergency training on procedures, operation of piece of emergency equipment, and operation of exits in the normal and emergency modes.

The emergency training requirement expands to emergency equipment such as individual training on pieces of installed equipment, portable oxygen bottles, fire extinguishers. It includes emergency situation training such as on ditching, other evacuations, rapid decompression. There are certain emergency drill training. That's an opportunity for flight attendants to actually use the pieces of installed emergency equipment, combine it with the situational training they learned, and actually operate in a scenario-type environment. And there are some additional training drills that are observation training drills.

This table summarizes the drill requirements of 121.417 and when they're required. As you can see from the table, we have two one-time drills in 121.417. The first is the use of portable breathing equipment, which is essentially a smoke hood. A flight attendant has to don the smoke hood and use one of the installed fire extinguishers to fight an actual fire.

The second one-time drill is an evacuation drill using one of the actual installed emergency escape slides. And initial, the flight attendant also conducts drill training on use of the emergency exits. That includes normal operation and emergency operation. So in other words, how to open and close the door without a slide attached, how to prepare the exit for -- how to

prepare the exit so that the slide would automatically deploy, and then how to operate the slide -- operated the exit and deploy the slide. There is a requirement to use each type of handheld fire extinguisher, a requirement to use each type of emergency oxygen, including portable oxygen and protective breathing equipment. There is a hands-on drill requirement for the donning and inflation of any installed flotation devices such as life preservers. There is a requirement for ditching training. And the note there is, if applicable, it's for extended over water operators, that ditching drill.

And then the observation drills are the flight attendants have to observe but not actively participate in the removal and inflation of each type of installed life raft. They have to observe slide pack transfer or slide raft transfer. They have to observe the deployment of each type of slide or slide raft, inflation and detachment of the slide. And they have to observe the use -- I'm sorry. They have to observe an actual evacuation with the use of a slide.

MR. FEDOK: Thank you. As we did earlier, I think it would be useful to get an airline perspective on the training. Mr. Hemphill, you have a presentation on that as well?

MR. HEMPHILL: Yes, I do.

MR. FEDOK: Can we bring that up?

PRESENTATION BY MR. HEMPHILL

MR. HEMPHILL: Okay, what I want to do is just take a

few moments and give you an overview of how the principles that Ms. Baker just discussed as the requirements are implemented at US Airways. I'm excited to do it. We're real thrilled with the outcome of this particular event and also really grateful to passenger Campbell's comments yesterday about the great performance on the part of our flight attendants.

I think this is a good opportunity for us because most of the traveling public often just see what they do from a customer service side and it's important to note, as we're doing here today, that the training that they go through, from both their initial to their recurrent training, is very stringent, it's very safety related, and it's designed to prepare them for a situation such as 1549 and a number of other variable and unpredictable situations that they might encounter.

So this just gives you a -- thank you -- a broad summary of the fact that, first of all, we have two approved FAA manuals. One is a flight attendant emergency manual, which covers the curriculum that they -- we are approved to teach them, by the FAA, both an initial and recurrent -- there's actually 21 approved programs within that particular manual -- as well as the flight attendant emergency manual, which is also approved by the FAA. And this is their in-flight operations manual. This is what the flight attendant is required to carry with them on every flight that they operate. It's important to note that we do have two training facilities, one in Phoenix, one in Charlotte, and both

run identical training programs. We have 6400 active flight attendants, approximately. The average years of experience is 19 years. And there we list for you the bases that we operate from. Important to note, Phoenix and Las Vegas flight attendants are the only bases that do attend in Phoenix. All the others accomplish their training in Charlotte.

We have an annual program modification that occurs every May 1st, and I just wanted to emphasize that we do not run the same program every year during our recurrent program. We have a process in place whereby we look at information, based on flight audits, as to where our flight attendants stand in the way of proficiency with emergency procedures and compliance with the various CFRs.

And we evaluate those on a monthly basis with the FAA and the AFA in a meeting called CDAG, very similar to what Captain Hope mentioned yesterday. It's our version of a data analysis group, whereby every single month we're looking at reports from audits, flight audits, safety event reports, injury reports, any and all other forms of information, to make improvements in our training program, or, should I say, recommendations for procedural changes or additions or changes or improvements to the upcoming training program, which changes every May 1st. So it's a collaborative effort and we do this in cooperation with these two agencies and we also work very closely with the other airlines. And that's an important thing to note.

I'm also the co-chair of the Air Transportation Association Cabin Operations Committee. So we work very closely with our other colleagues in the training world, the other mainline carriers, to use and implement effective practices among carriers. Our current philosophy also says that rather than just accomplish a door evacuation at a particular door -- aircraft type that a flight attendant is required on, we ask them annually to do a full evacuation on all aircraft door types that they are qualified on, and there is a proficiency check required.

And I think this is an important note, that there is an ongoing evolution in flight attendant training that really began with the implementation a few years ago as Delta first launched their advanced qualification program for their flight attendants, and others have joined and we have also applied for an advanced qualification program for our flight attendants. The evolution in flight attendant training has gone from classroom presentations, PowerPoint presentations, a demonstration by an instructor, a one-time effort on the part of a flight attendant, to preparation before they come to training and a demonstration of their ability with a proficiency requirement. And I think that's very important.

So the instruction has gone from presentation to scenario-based training with evaluation and remedial training, if required, until a flight attendant is proficient enough to be qualified to operate that ship. We joint train with the pilots.

And in our crew resource management module we also emphasize threat and error management, which was discussed as well yesterday. And I think that's important to note that that's a thread throughout all crew member training at US Airways and that we really teach our flight attendants not just what to do in any given situation but through scenario-based training for them to understand that an unlimited variety of situations could occur with variables.

So threat and error management really is a way to help flight attendants and pilots think through varied scenarios and be situationally aware of the fact that they, as we discussed yesterday, may now be in the red zone, and how to utilize their tools and resources to move them back into a safe mode of environment.

Just a quick summary of the equipment that we have that we use in training both in Phoenix and Charlotte. We do have a full-cabin fixed based simulator that has smoke and video capability. On those particular -- on each one of those devices there are all three types of doors, 319, 320, 321. We have partial cabin simulators, which are identical in Phoenix and Charlotte, which is for B737 aircraft. And then we have freestanding door trainers, a 757 in Charlotte and Phoenix. And then in Charlotte alone, since we operate the 330, 767 and the 190 out of East Coast bases, we have training devices for those aircraft only in Charlotte. We do have a variety of galley

equipment; of course, all the required emergency equipment. We train in scenario-based mode, which means, rather than just a flight attendant putting out a fire, we will give them a situation where there's a galley and they have to go discover a fire or a trash fire or whatever and locate the proper equipment and use that equipment to extinguish the fire. Evacuation slide rafts are in all locations as well. Next.

A real quick summary of our initial training program. We operate a five-week training program. I won't go into detail, but those are the basic breakdowns of the hours that meet the regulatory requirement. Also important to note, at the end of an initial training program, there's a required five-hour initial operating experience whereby flight attendants must be observed by an air transportation supervisor and qualified based on their performance in an actual flight.

Pertinent to 1549, some of the things that are included in our initial training program is four hours of CRM and threat and error management. We do a wet ditch drill, which means, although it's not a requirement, we do in both locations have the ability and do take the flight attendants to a pool and have them board a raft using all of the techniques that they've been trained, working together using the lifelines, pulling one another into the raft, erecting the canopy, identifying and using the various pieces of the survival kit, et cetera. We also do a planned emergency cabin preparation, which is done in the

simulator, and that again is based on the principle that this is a planned ditching at altitude and there's a briefing from the captain and time to perform various functions of preparing the cabin for a planned ditching situation. They do life vest drills and familiarity, along with seat cushions and also lifeline, hands-on emergency evacuation drills and of course, the slide transfer video, so that they at least visually understand how slide portability could occur on our aircraft.

Our recurrent training program. We do have a 12-hour program that consists of one day of distance learning and then one day of classroom learning. Again, we have an hour joint training program, which we think is a great benefit to any emergency situation, to have pilots and flight attendants trained in the same room, not only with tabletop exercises but applying threat and error management principles to real-life scenarios that we've even had at our airline. We have a dry ditch drill that we do every year, although not a 12-month requirement.

We do, every 12 months, do a dry ditch drill, which simply means the flight attendants again become completely familiar with slide detachment from the aircraft. They board the slide; it's not in water; it's land based. They erect the canopy and again review all the emergency equipment associated with a ditching. Also on a 12-month basis they review and do hands-on training with the life vest, seat cushions, and lifelines as well. And they conduct emergency evacuation drills on a 12-month basis

rather than a 24. And also annually they review the slide raft transfer video. Next.

I thought it would just be beneficial to show you some photographs. A picture can also paint a thousand words. This is one of our initial training classes erecting a canopy.

This is an example of what I just spoke of, a dry ditch drill. This is in our Phoenix location.

This is part of a planned cabin preparation. And again, we have something very similar to a quick reference handbook or a section of our flight -- our in-flight operations emergency manual that you see this gentleman holding right here, that's used in emergency landings, that will prompt them to take priority measured steps. This is just an example of giving an ABA briefing, which is an able-bodied passenger briefing.

This is just a life vest training drill which, again, they accomplish annually.

This is an example of an evacuation drill occurring on the full-scale trainer that we have in Phoenix.

And this is an example of how we train flight attendants to assess for fire, smoke, debris and using the back of their hands to feel the door for heat, and they're required to do this prior to opening any exit.

This is one of our freestanding 757 trainers.

And this, lastly, is just an example -- this is our Charlotte training device, example of a flight attendant

performing an evacuation, instructing the able-bodied assistants to go to the bottom of the slide and assist passengers in the evacuation. And that concludes my presentation.

TECHNICAL PANEL QUESTIONS

MR. FEDOK: Thank you, sir. I'll begin with you, Mr. Hemphill. We heard the earlier presentation. I believe Mr. Gardlin gave us the definition of an extended over water operation, which is basically 50 miles or more from shore. Can you tell us, was Flight 1549 in over water flight?

MR. HEMPHILL: No, it was not.

MR. FEDOK: Was MSN1044 an over water equipped aircraft?

MR. HEMPHILL: Yes, it was.

MR. FEDOK: And can you tell us how many airplanes in your A320 fleet are extended over water equipped?

MR. HEMPHILL: We have currently 20.

MR. FEDOK: Of how many?

MR. HEMPHILL: We have 55 that -- 55 A320s that are not EOW, so a total of 75.

MR. FEDOK: And what specific over water equipment did US Airways have on the aircraft?

MR. HEMPHILL: On all of our EOW A320s we have, of course, the crew life vests. We have passenger life vests at every seat. We have 10 additional infant life vests. And in fact, we have 10 additional infant life vests on board every aircraft in our fleet; of course, the two emergency locator

transmitters, the four slide rafts, four survival kits, and four lifelines. And that's what was present on the aircraft involved in this incident.

MR. FEDOK: Thank you. Can I get Exhibit 6 Alpha on the screen? This is my factual report and specifically interested in Page 3. At the bottom there's a table. I just want to talk a little bit, Mr. Hemphill, about the difference between the over water and the non-over water equipment on your A320s.

MR. HEMPHILL: Okay.

MR. FEDOK: Sorry, it would be the table -- go back. That's the table, thank you. That table, sir, indicates that your non-over water equipped A320s also contain or are equipped with four lifelines. Is that accurate?

MR. HEMPHILL: Yes, it is.

MR. FEDOK: So all 55 of your non-over water equipped A320s are equipped with a full set of four lifelines?

MR. HEMPHILL: Yes.

MR. FEDOK: And why is that, sir? We heard earlier that that is not required equipment on a non-over water aircraft.

MR. HEMPHILL: Yes. In our discussions with engineering when we received some of these aircraft, they did come equipped with the lifelines. We are talking about lifelines, correct?

MR. FEDOK: That's correct.

MR. HEMPHILL: Okay, yeah. And there was no benefit at the time for the company to remove those. And there's no safety

benefit to remove them, no cost benefit to remove them. And in fact, them remaining there could, you know, in the future be beneficial to converting these to EOW equipped aircraft.

MR. FEDOK: Thank you. So looking at the column on the right, this flight, this particular flight, Flight 1549, could've been operated by one of your aircraft that had no life vests installed, is that correct?

MR. HEMPHILL: That's correct.

MR. FEDOK: It did not have slide rafts. It only had four detachable slides, is that correct?

MR. HEMPHILL: Correct.

MR. FEDOK: And the primary means of passenger flotation on that aircraft would've been simply the passenger seat cushions, is that correct?

MR. HEMPHILL: That's correct.

MR. FEDOK: Thank you. Ms. Baker, just a question about life vests. Again, going back to the over water study from 1985, the Safety Board made a recommendation to amend Part 121 to require all passenger-carrying aircraft be equipped with approved life preservers, meeting the requirements of the most current revision of the TSO at the time. Do you know if that was accomplished?

MS. BAKER: The FAA did issue a Notice of Proposed Rulemaking in 1988 to require the life preservers. We received approximately a hundred comments. Based on those comments, the

Notice of Proposed Rulemaking was withdrawn in 2003. The reason cited was that the costs of the regulation were going to exceed the benefits, the estimated benefits.

MR. FEDOK: Okay, thank you. There was also a public law involved in that as well, is that correct?

MS. BAKER: Correct, there was a public law in 1987, that the FAA should consider a rulemaking to that effect, which indeed we did.

MR. FEDOK: And of the comments that you received -- I'm looking at the withdrawal paperwork in front of me, which is, I believe, in the docket -- more than half of the commenters actually supported the proposal for -- as a whole, I suppose, is that correct?

MS. BAKER: I believe so, but I don't have the specific numbers in front of me.

MR. FEDOK: It says here that 46 commenters, most from Part 135 air carriers, opposed the proposal. Does that sound familiar?

MS. BAKER: Yes, it does.

MR. FEDOK: Now, the specific recommendation we're talking about here was very specific to Part 121 operators, and I'm not sure, but it doesn't sound like there was a lot of opposition to that. Is this something that the FAA may consider again in the future?

MS. BAKER: It's certainly something that we're open to

reviewing. I can't speak to the specifics of the comments.

MR. FEDOK: Thank you. I'd like to talk a little bit, Ms. Baker, about emergency training and specifically initial training first. And you did this a little bit in your presentation, but I think it would help to revisit. In general, can you tell us the types of training that flight attendants would be required to receive about over water equipment and operations in initial training?

MS. BAKER: Yes. As I mentioned, the emergency training requirement is essentially broken into three sections. It's a training on equipment, training on situations, and then hands-on drill training. Emergency equipment training is instruction on the location, function and operation of the emergency equipment. Examples would include training on life preservers, flotation seat cushions, life rafts, slide rafts, slides, survival kits, and any other equipment that was installed to assist in ditching.

Emergency situation training would include training on ditching, evacuations, including basic practices such as crew communication; training on prior-to-impact and post-impact procedures for a planned water landing and an unplanned water landing; training on appropriate evacuation techniques, including the flotation characteristics of the aircraft and any adverse conditions that the flight attendant may encounter; also training on water survival after the evacuation. In our drill training --

MR. FEDOK: Can I just stop you there? I think it might

be instructive, as you're going through the drills, could be bring up Ms. Baker's presentation again? The last slide in your presentation was very instructive in the way it laid out the drill training. It might help for a visual reference. Thank you.

MS. BAKER: Other water-related training that is included in the drill training would be emergency exits. Use of the emergency exit includes opening the door, engaging the gust lock, the manual inflation of the slide, the windows. It would include the use of lifelines, drill training on the donning and inflation of life vests. We saw the picture from Mr. Hemphill. Special uses of life vests according to the air carrier procedures, such as use with children.

Use of flotation cushions. The ditching training, if applicable, includes crew coordination, passenger briefing, and cabin preparation, donning and inflation of life preservers, use of lifelines, and boarding of passengers and crew into -- excuse me -- a raft or slide raft. And then, as mentioned before, the observation drills. The flight attendants should observe the removal of each type of life raft and how to inflate it, the transfer of a slide raft, each type of slide raft that can be transferred, and the deployment, inflation and detachment of each slide or slide raft.

MR. FEDOK: Thank you. And can you just tell me, especially of those observed drills that you show up there, are those aircraft specific, airplane type specific?

MS. BAKER: Yes, they are.

MR. FEDOK: So you would need to perform those for each type of aircraft that you're qualified on?

MS. BAKER: Each type of aircraft or each piece of equipment, for example, a slide raft -- excuse me -- a life raft removal and inflation. And an air carrier may opt to only install one type of life raft, so they're all the same. In that case you'd only need to see it once. But if it were an observation of a slide raft and the slide rafts were different from aircraft to aircraft, you would need to see it for each aircraft type.

MR. FEDOK: Thank you. Mr. Hemphill, the flight attendant crew on 1549, when did these flight attendants go through their initial over water training?

MR. HEMPHILL: This particular crew, I believe that was actually on your Exhibit 3. Their initial training for Doreen Welsh was 1972.

MR. FEDOK: Specifically initial over water training.

MR. HEMPHILL: Oh, initial over water? Is that not on that chart, Mr. Fedok? I'm sorry.

MR. FEDOK: It was. Can we bring up 6 Alpha again?

MR. HEMPHILL: Yes.

MR. FEDOK: I believe it's on Page 4. It would be the second column there. It looks like between 1989 and 1990.

MR. HEMPHILL: That's correct.

MR. FEDOK: And we heard from Ms. Baker what the

requirements are for initial training. Can you just give us a little better understanding of what US Airways' initial training program consists of?

MR. HEMPHILL: Currently or at the time that these three flight attendants attended?

MR. FEDOK: If you can tell me back when they attended, that would be very helpful.

MR. HEMPHILL: Okay. Yeah, we did a query back and looked in the curriculum, which is very similar to what we have now, in that it met all the hands-on requirements with regards to equipment. The point that I made earlier was that in addition to meeting all the requirements which Ms. Baker just mentioned, they also did a wet drill and they also did, you know, rather than a dry raft drill, they did it in a pool, which I think is an added benefit to their training.

MR. FEDOK: Thank you. If we could keep 6 Alpha up there, I want to refer to Page 17. This document is excerpts from a student guide for your initial training program, dated January 2008.

MR. HEMPHILL: Um-hum.

MR. FEDOK: It's Page 17 on the PDF document. Thank you. And I'm looking at the top three items there, essentially.

MR. HEMPHILL: Um-hum.

MR. FEDOK: It says, "During a ditching, assess the door exit, look for water level, obstructions, fire, pitch of aircraft,

and structural damage." Ms. Baker, are you aware of any guidance that the FAA has on how flight attendants should assess out the door?

MS. BAKER: I'm not aware of any specific FAA guidance, but the doors -- how this is typically done, in many aircraft there's actually a window in the door and/or otherwise a window adjacent to the door where the flight attendants would assess outside the aircraft. I'll take that back. As far as assessing, there is guidance to assess. I'm not sure of the specifics of how is listed.

MR. FEDOK: Okay. You were an A320-qualified flight attendant, so I'm guessing you looked out that door on occasion, is that correct?

MS. BAKER: Correct.

MR. FEDOK: In your experience, is it possible to accurately determine the water level below that door by looking outside the window?

MS. BAKER: I can't tell if you could accurately assess it, because I never looked out a window and saw water.

MR. FEDOK: Mr. Hemphill, you were an A320-qualified flight attendant as well. I'll ask you the same question.

MR. HEMPHILL: That was my answer as well. Although I've never done that or have been in that situation, obviously I would presume it would be difficult because you're looking straight out and to determine at what point anything met, you

know, the threshold or the bottom of the aircraft could be problematic, in my opinion.

MR. FEDOK: And essentially, at the aft right door, we've heard that the -- in a best case scenario with an intact pressure vessel, that that aft right door would be approximately four and a half inches -- the waterline would be four and a half inches below that door sill. And do you think it's possible to assess with that level of accuracy?

MR. HEMPHILL: It would just be a speculation on my part.

MR. FEDOK: Thank you. One of the other items up there is the third bullet, which is a question from the self test: "Which exits are likely to be usable during a ditching?" And the correct answer provided by US Airways was forward doors, over-wing exits, if applicable. I don't believe that was specific to the A320. That was general guidance that was provided. But I just wanted to use that to talk a little bit about exit use. Can we switch exhibits, please? I'm looking for Exhibit 6 Foxtrot.

This is going to be some pages from the US Airways' flight attendant in-flight emergency manual. I'm looking for Pages 21 and 22. Okay. So this is for the -- right there. Stop, please. This is extended over water planned ditching procedures. So in the event that there was enough time to plan for an emergency, these are the procedures that the flight attendants would be expected to follow. Under likely exits, Mr. Hemphill, it

listed the 1L-1R and 2L-2R doors and that the window exits are not likely to be usable. In fact, in the next section there you'll see that they're listed as unlikely exits. Why is that?

MR. HEMPHILL: In the development of the evacuation procedures for this particular aircraft, our strategy, similar to the other air carriers, was to work with the manufacturer to determine which would be the primary exits that would be safest to be used in an evacuation. So based on the presumption that a water ditching would leave the vessel intact and all four doors usable, and therefore all four slides usable, with a maximum capacity of 55 each, which would accomplish safe egress from the aircraft right into a raft directly. Our position, along with many of the other mainline carriers, was that in a water ditching, given a number of different varieties of possible scenarios, night, wind, rough water, whatever, the safest mode of egress would be for passengers to exit directly out of the floor level exits into the rafts.

MR. FEDOK: Thank you. Can I see Page 27? And this is the same section except for the non-over water ditching procedures. And in this case you'll see the likely exits table there and the window exits in this case are likely exits.

MR. HEMPHILL: Um-hum.

MR. FEDOK: Essentially the same airplane, yet there's a difference here between over water equipped procedures and non-over water equipped procedures. Can you rectify that for me?

MR. HEMPHILL: Yeah. There is no slide rafts on the non-EOW aircraft. Passengers will, hopefully in a close-to-shore situation, be in the water. So the object here would be to just egress the airplane as soon as possible, using all possible exits and then once in the water, directing them to the detachable slides for them to hold on to using their portable -- I mean their personal flotation devices.

MR. FEDOK: And what instructions are provided to passengers regarding whether or not to open the window exits? The passengers are obviously unaware of whether they're on an over water equipped or not over water equipped aircraft in most cases.

MR. HEMPHILL: Well, there's two different scenarios. One, of course, would be in a situation like happened on 1549, which there was not an opportunity other than a passenger's personal responsibility to look at the safety card, which showed the mode of egress and showed it, you know, to not be over-wing but, you know, out the floor level exits forward and aft. In a planned scenario, which we believed, you know, would be the most likely scenario, that is part of the cabin preparation that the flight attendant does.

And using their -- which is the equivalent of a quick reference handbook, they begin in priority order to accomplish a safety demonstration on board, the securing of the cabin, the briefing of passengers seated near all exits forward and aft and over-wing, with an explanation of what their responsibilities are.

And so immediately when an emergency is declared, they brief with the captain, a time is established as to approximately how much time the flight attendants have to accomplish those tasks, and they begin in priority order to do those things, and it does include specific information to the passengers seated at over-wing.

MR. FEDOK: Thank you. And just a question for Mr. Lohmann. Of what you've just seen and heard from Mr. Hemphill, regarding US Airways' thoughts and procedures, is that consistent with Airbus guidance?

MR. LOHMANN: Yes, I would assume that.

MR. FEDOK: Thank you. Back to Ms. Baker. Let's talk about wet drills. Mr. Hemphill referred to that as something that they do in initial training and I'd like to read another recommendation here from the 1985 NTSB over water study. We recommended that cockpit and cabin crew members on aircraft being operated under these parts, Part 121 in this case, including hands-on wet drills, be given periodic training, including hands-on wet drills and the skills relevant to inadvertent water impact, which may increase the chances of post-crash survival. Are you familiar with that recommendation?

MS. BAKER: Yes, I am.

MR. FEDOK: And can you just tell me what happened to that one?

MS. BAKER: We have not currently, at this point,

modified the regulatory requirements for training. However, we have revised our FAA guidance -- I believe it was in 1991 -- to recommend to air carriers and principal operations inspectors that the air carriers should indeed conduct wet training drills, and in those wet training drills they should stress inadvertent water situations.

MR. FEDOK: Yes, very good. That was in response to, I believe, one of the other NTSB recommendations in 1992, that you require an evacuation or wet drill group exercise during recurrent training. Oh, excuse me, that was for recurrent training. But the Board has revisited this issue several times. 1972, we also have a recommendation to require periodic crew training in evacuation and wet ditching drills. I'm aware that there's a new NPRM out just in January 2009. Is that proposing anything new on wet ditching drills?

MS. BAKER: Yes, the NPRM does propose a wet training drill in initial training.

MR. FEDOK: Thank you. A quick question, crew resource management. Mr. Hemphill, in any of your wet ditching or dry ditching drills, are cockpit crew members involved?

MR. HEMPHILL: I don't believe they are, no.

MR. FEDOK: And Ms. Baker, what guidance does the FAA provide as far as crew resource management between cockpit crews and cabin crews, with specific reference to water-type situations or scenarios?

MS. BAKER: We have guidance that recommends joint training with cockpit crews and flight crews -- cabin crews together. I don't recall the specifics, as far as what training drills or ditching training drills.

MR. FEDOK: Okay, thank you. I'd like to move to recurrent training now if we could. Again, you gave a very good explanation, but I'd just like you to rehash, if you might, Ms. Baker, on what flight attendants are required to do every year when they go to recurrent training, that was related to this accident.

MS. BAKER: Every year, flight attendants receive 12 hours of training. It covers essentially all the topics that are covered in initial training, for example, the emergency situation training. However, the drill requirements are a 24-month requirement.

MR. FEDOK: Okay. And with specifics to planned versus unplanned training, can you just give me a little bit of description on what the difference is there?

MS. BAKER: Planned training implies that the flight attendants have adequate time to prepare the cabin and passengers. Unplanned basically takes up that the aircraft has already impacted, either the land or water.

MR. FEDOK: Okay. And there's a ditching prep drill that you talked about, and that's for a planned emergency, is that correct?

MS. BAKER: Yes.

MR. FEDOK: Does the FAA require or is there any guidance for operators, any unplanned situation drills?

MS. BAKER: Drills specifically, no, although many air carriers do incorporate it into their evacuation door drills every 24 months. We do have specific guidance on unplanned training for emergency situation training.

MR. FEDOK: So there are no drills that a flight attendant would go through every 24 months to prepare them for an unplanned water landing?

MS. BAKER: As I said, there's no specific line item reference in the regulation. That doesn't mean it's not occurring.

MR. FEDOK: But there is a line item regulation for a planned drill every 24 months?

MS. BAKER: Correct.

MR. FEDOK: Thank you. One of the other drills that occurs in the recurrent training is the dry ditching drill. In those kinds of drills like the dry ditching drill, what are each individual flight attendant supposed to do? Are they all required to, say, have hands-on on all the pieces of equipment? Or does one person touch the equipment and everyone else watches?

MS. BAKER: Drills are performance drills, so we expect that the air carrier is able to evaluate the flight attendant's ability to use the equipment.

MR. FEDOK: Okay. Specific on a dry ditching drill -- and I'll toss this to Mr. Hemphill. In your program, sir, do all the flight attendants, for instance, when you do your dry ditching drill, do they all have to pull the quick release handle to separate the slide raft from the airplane?

MR. HEMPHILL: No. Currently that particular portion of our drill is not done by every individual. It's demonstrated and then there's proficiency questions in the form of a test at the end of the day, to measure their knowledge.

MR. FEDOK: And does US Airways track in any way, you know, whether a flight attendant has done that or not? You know, well, it's somebody's turn this year, they hadn't done it in four, five or six years, and then go down. Or could a flight attendant go throughout their entire career, say, without ever touching the ditching handle? Quick release handle. Excuse me.

MR. HEMPHILL: Do you mean as far as a breakdown of every single component of every single part of a potential dry drill?

MR. FEDOK: Yes, sir.

MR. HEMPHILL: That is not tracked in that method, no.

MR. FEDOK: Okay, thank you. And Ms. Baker alluded to the fact that some operators out there may be doing unplanned drills for ditching. Does US Airways do any unplanned ditching drills during initial or recurrent training?

MR. HEMPHILL: Yeah, during our recurrent training. We

don't do it as a part of an annual rotation. But as a part of our door evacuation exercises, what we do, since it's scenario based, is, rather than simply say evacuate this 737 door, for example, we throw them into a scenario. You know, for example, the instructor will lead them to believe we've just taken off. All of a sudden we're going to crash, and then expect the flight attendant to perform, you know, the proper steps, yell the commands, do the evacuation, et cetera. And it could be both land and water. So much like an AQP program, it involves a variety of different scenarios, which would include unplanned situations.

MR. FEDOK: Okay, thank you. Flight attendants last went to recurrent training in the year prior to the accident. Some of them were in the recurrent year that starts on May 1st --

MR. HEMPHILL: Um-hum.

MR. FEDOK: -- and then two were outside of that. And I understand that in the May '08 to April '09 training year, that a dry ditching drill was performed.

MR. HEMPHILL: Yes, that is correct.

MR. FEDOK: And so two of the flight attendants actually wouldn't have been through that drill in that particular year. Do we know when the last time they would've performed that drill was?

MR. HEMPHILL: It would've been the year before. The dry ditch drill is a drill that we do perform every year even though it's a 24-month requirement.

MR. FEDOK: Okay. And just one last question before we

leave this topic. Mr. Hemphill, what were the flight attendants trained to do essentially with this situation? In other words, over water equipped aircraft with an inadvertent water contact, what were they trained to do?

MR. HEMPHILL: Start to finish every flight attendant's specific position or is there something specific you're looking for?

MR. FEDOK: No, just in general, what procedures would they do? I mean, opening their doors, all those sorts of things.

MR. HEMPHILL: Yeah, they would do -- obviously they would yell their commands, which they did, and with the idea in mind that they're going to help the passengers prepare for any potential impact. They're going to wait for a signal from the flight deck. They're going to turn on the cabin lights. They're going to assess the door, if it's safe to open, and an evacuation is warranted. And we do train flight attendants, again, since it's scenario-based training, that even if they don't hear a command from the flight deck or any instruction from the flight deck, if the situation warrants it or there's immediate danger or a need to evacuate the airplane, they're going to do that.

In this particular case they obviously opened the door. We do train them to pull the manual inflation handle on the slide, regardless of whether or not the slide inflates, just as a safeguard. And we think it's a good training technique to make sure that, rather than make a judgment call in the middle of an

emergency, we just build that into their rote procedure, that when they open the door they're going to grab an assist handle to secure themselves and have a ABAs hold passengers back and pull the inflation handle to make sure that the slide inflates. So in the B flight attendant situation, as the assessment was made in the back that the door was unusable, she did follow procedure and began to move passengers forward -- excuse me -- to the over-wing exits.

MR. FEDOK: Thank you. Switching topics, Ms. Baker, in that same -- we talked about, a little while ago, the FAA has proposed removing the slide raft transfer observation drill from recurrent training. Can you explain the reason for that?

MS. BAKER: Yes, I can. The NPRM was developed by an aviation rulemaking committee. They make recommendations to the FAA. It's made up of industry and government experts. The recommendation that was made to the FAA is that slide pack transfer training time should be better used elsewhere; that slide pack transfer could potentially introduce additional hazards into the cabin, such as the deployment of a slide raft in the cabin, as it was being moved; and therefore, the proposal did propose to remove it.

MR. FEDOK: I just want to be clear about that. Does the FAA believe that the flight attendants just don't need to have the training, or does the FAA believe that the flight attendants should actually never attempt to do this in an actual emergency?

MS. BAKER: I don't think I have adequate information to speak to whether or not it would, to differentiate between those two.

MR. FEDOK: Well, the reason I ask is because the FAA makes a statement that the FAA considered how effectively flight attendants could move stowed rafts on exits, from unusable exits to accessible doorways, even with the help of able-bodied passengers. The FAA also considered the possibility of inadvertent inflation and then concluded that the FAA does not consider it necessary to require observation and knowledge training on a maneuver that may be difficult and contrary to safety. And I'm wondering, if the FAA believes that this is contrary to safety, whether flight attendants should be doing this at all.

MS. BAKER: I believe the statement "contrary to safety" came out of the ARC (ph.) recommendation.

MR. FEDOK: It's in the FAA rulemaking. Do you know agree with that?

MS. BAKER: I didn't participate actively in the rulemaking. I want to stress also that this NPRM is still open for comment. It's not a final rule, it's still a proposal. So certainly any comments are still subject to consideration in our final rule.

MR. FEDOK: Okay, just because there seems to me to be a little bit of a disconnect between the certification. Mr. Gardlin

described that under 25.1411 the FAA requires operators to demonstrate this. Yet now we may be removing a training requirement for flight attendants who are actually supposed to do this in the event of an emergency. So Mr. Gardlin, do you want to comment about that at all?

MR. GARDLIN: Well, yeah, just to clarify. The 25.1411 doesn't actually require demonstration by operators. Basically, there's two issues related to the portability of rafts. One is consideration of loss of a raft, in which case there's a need to be able to adequately use the remaining rafts. And then really related to that is the portability of the rafts. But I think, from a type certification standpoint, detachability and portability of slide rafts is a capability that we believe that the device should have.

MR. FEDOK: Thank you. And just to finish the topic, Mr. Hemphill, how many different types of over water equipped airplanes does US Airways operate?

MR. HEMPHILL: We have -- do you want me to list them?

MR. FEDOK: Just a number is fine.

MR. HEMPHILL: 319, 320, 757, 767, 330.

MR. FEDOK: I count about six. Is that right?

MR. HEMPHILL: Yes.

MR. FEDOK: Okay. And this is a drill that flight attendants would have to watch an observation drill on how to remove slides from all six of those aircraft, is that right?

MR. HEMPHILL: Provided there's differences in the types of the removal and some of them have the same type of removal mechanism.

MR. FEDOK: Okay. And they're supposed to commit those steps to memory for all of those different types?

MR. HEMPHILL: They're in their operations manual and then, of course, they visually observe them every year as they watch the slide transfer video.

MR. FEDOK: And how many steps is the A320 removal and transfer process?

MR. HEMPHILL: I believe it's -- I believe it's 10. I would have to look that up.

MR. FEDOK: Fifteen.

MR. HEMPHILL: Fifteen, okay.

MR. FEDOK: Okay, I think that sums up that topic. I want to move on to another piece of equipment, the lifelines. Ms. Baker, can you just tell me again what the purpose of a lifeline is?

MS. BAKER: The purpose of a lifeline is listed in the certification requirement and it's for passengers to stay on the wing in the event of a ditching.

MR. FEDOK: Okay. And what training do flight attendants receive about the lifeline or what guidance does the FAA provide to operators on what training they should receive?

MS. BAKER: The use of lifelines is associated with the

flight attendants' emergency equipment training, aircraft-specific emergency equipment training, and it would be associated with their situational training as well.

MR. FEDOK: Thank you. And Mr. Hemphill, when and under what circumstances, sir, does US Airways train flight attendants to utilize lifelines?

MR. HEMPHILL: We train them to utilize lifelines provided that their primary exits would be in use, the floor-level exits that they are responsible for. So basically whenever they would need to move passengers forward or direct them over-wing and the flight attendant would then be available to do that, the flight attendant has been trained to use the lifelines; would at that point attach them.

MR. FEDOK: Can I ask for Exhibit 6 Foxtrot, please? Page 16, please. Those are the procedures that are in the flight attendants operating manual on how to use the lifelines. And again, I just want to emphasize that these lifelines are stowed over the wings. The flight attendants are not over the wings. The flight attendants on this aircraft are at the forward and aft exits. So under what circumstances again, sir, would they be able to get from their exits to the over-wing exits to utilize this piece of equipment?

MR. HEMPHILL: Provided that their exits were unusable.

MR. FEDOK: Thank you.

MR. HEMPHILL: The primary exits.

MR. FEDOK: Are passengers responsible for using this piece of equipment in any way?

MR. HEMPHILL: At this time they're not, because, as we mentioned, in these EOW situations we're evacuating, we're instructing passengers via the safety card and in the planned emergency to use the floor-level exits, which, you know, based on the certification, were available to be used as rafts. Now again, I do want to add that, you know, my feeling is this is the topic in industry right now, among all of our colleagues and that we're anxious to find out what the results of this final investigation would be and what sort of safety improvements could be made with that regard.

MR. FEDOK: Yes, sir, I'm a little bit confused. Can I see Exhibit 6 Charlie, please? And I apologize for the rapid change of exhibits here, but I just -- this is from the US Airways training. Page 36, please. This is the initial training and if we scroll down to the last question there, "Why do you think the windows would be usable exits?" And the window exits are located on the wings. Okay, please, next page. Step 5 there, sir.

MR. HEMPHILL: Um-hum.

MR. FEDOK: In initial training, flight attendants are asked to instruct ABPs, able-bodied persons, to use the escape rope on aircraft, where applicable, and attach to the loop located on the wing and near the leading edge inside the window frame.

MR. HEMPHILL: Um-hum. That would be using the ABAs to assist them in the process of attaching the lifelines.

MR. FEDOK: So that instruction there is just an assist to flight attendants? The passengers are never going to be required to use this piece of equipment on their own?

MR. HEMPHILL: When you say required, I'm not sure what you mean by that.

MR. FEDOK: Would a flight attendant ever be tasking a passenger with using this piece of equipment?

MR. HEMPHILL: Could you just scroll back, if you don't mind, just to Page 36? Okay. That is not the instruction that we have on our safety card and it's not currently part of our briefing that would be given during a planned emergency.

MR. FEDOK: Okay. And on a planned emergency on an extended over water aircraft, sir, what would a flight attendant tell the over-wing passengers to do?

MR. HEMPHILL: We would have them review the safety card, which would also review the escape path. And on that particular aircraft, the one that was used in, you know, 1549, had there been time for a planned emergency landing, the instruction would've been for them to use the two doors in front and the two doors in the back, and the words are that these exits are the most likely exits to be used. And so again, given a ditching scenario, the goal would be in an probable situation the safest place for them to evacuate out the floor-level exits directly into the

slides. And then, if this situation would occur outside of that window, the flight attendants, sir, use -- are trained using threat and error management to adjust to that, respond to that, move passengers over-wing, initiate the lifeline process, assist in the evacuation at over-wing, et cetera.

MR. FEDOK: So just to clarify that, had they had more time on 1549 and had the ability to begin a planned emergency, flight attendants would have actually told the passengers seated at the over-wing exits to block those exits and to send passengers to the doors, is that correct?

MR. HEMPHILL: Currently they would've been instructed to exit out the forward and aft. And again, that's based again on the assumption, we believe, that had there been time, that the end result, potentially, of the aircraft damage would've been different and allowed for that evacuation to occur, as it should've, out of the front and aft.

MR. FEDOK: And just to follow on with that, on a non-extended over water aircraft, again, a similar situation, a planned ditching, flight attendants would've gone back there, instructed those passengers to, in fact, open the exits, is that correct?

MR. HEMPHILL: That's correct.

MR. FEDOK: Thank you. Just a few more topics, I promise. The preflight briefing, Ms. Baker, there's a difference between extended over water and non-extended over water briefings.

What guidance does the FAA provide for the differences between those two in those briefings?

MS. BAKER: There is a regulatory requirement for just a standard passenger briefing. There's an additional regulatory requirement for aircraft that are equipped with life preservers for extended over water operation. That includes both a oral briefing and a demonstration. If an air carrier has installed both life preservers and flotation seat cushions or other individual flotation means on the aircraft, the FAA recommends that the air carrier brief on all means of installed flotation.

MR. FEDOK: Do they actually have to show the location of the life vests during the briefing?

MS. BAKER: I believe they don't have to necessarily show the location, they have to identify the location.

MR. FEDOK: Basically tell them where it is?

MS. BAKER: Tell them where it is.

MR. FEDOK: Thank you. And if a parent were to come on a flight, an extended over water flight, with a lap child, would they receive any additional information, a specialized briefing, in any way?

MS. BAKER: It depends on what kind of flotation is provided for the child. The briefing requirements would be the same as the briefing requirements for the adult. Are in an over water or non-over water?

MR. FEDOK: This is an over water.

MS. BAKER: On an over water flight the child -- the parent of the child would have to be provided with a comparable briefing on the donning and use of the flotation device.

MR. FEDOK: And is that prior to takeoff or is that during an emergency situation?

MS. BAKER: In an extended over water it's prior to the extended over water portion of the flight.

MR. FEDOK: And this was not an extended over water flight, as we've --

MS. BAKER: That is correct.

MR. FEDOK: Now, we did -- the FAA did a small survey of cabin safety inspectors. Are you familiar with that? It's in my factual report.

MS. BAKER: Yes, I am.

MR. FEDOK: And we saw some discrepancies between what airlines were doing as far as briefing or demo'ing the life vests. Can you explain the results of those?

MS. BAKER: I'm not familiar with the specific results, but it would be something to be -- I'm interested myself in looking into that as well.

MR. FEDOK: And it turns out, for the 12 airlines we talked to, both briefed and demonstrated life vests on all the flights, whereas six briefed and demoed the life vests only on the over water -- the non-over water flights. Or excuse me, six only briefed and did not demo on the non-over water flights. Is there

any reason for the discrepancy there that you know of?

MS. BAKER: Again, an actual physical demonstration is not required in non-over water operations.

MR. FEDOK: Thank you. Mr. Hemphill, US Airways -- can you just tell me, have you had the opportunity to review the cockpit voice recorder on this flight?

MR. HEMPHILL: Yes, yes, I have.

MR. FEDOK: And there are specific announcements to be made on an extended over water airplane for your fleet, is that correct?

MR. HEMPHILL: That's correct.

MR. FEDOK: Were those specific announcements specific to extended over water operations done on the accident flight?

MR. HEMPHILL: There's two specific portions. One would be that the seat cushion -- one would be -- excuse me -- with regards to the passenger life vest, a description of its location and its use. And the other one would be the detachable nature of the slides. Those are part of our scripted announcements that were to occur on that particular aircraft and it appears were omitted.

MR. FEDOK: Were omitted?

MR. HEMPHILL: Yes.

MR. FEDOK: What quality assurance steps does US Airways take to ensure that their flight attendants comply with those briefing requirements?

MR. HEMPHILL: We have a couple programs. One is a supervisor check-ride program, whereby base supervisors, who are trained, go out and check compliance of flight attendants based on a checklist of safety items. This is also one of those particular items. We also have what would be similar in the pilots' world to a LOSA program. We call it our coach and observation ride program.

We have a cadre of about 90 flight attendants who've been super-trained and most of them are training instructors, that 13 of them a month go out and we accomplish anywhere from three to five hundred segments observed. Data is collected. It's about 65-point checklist. And this, again, is one of the items on the checklist. That's the information -- part of the information that's reviewed monthly at our CDAG meeting. This particular event seems to be just an individual performance event, because this is not trending, as far as a problem at our airline.

MR. FEDOK: Thank you, sir. At any time has US Airways used video presentations on their A320s for the preflight briefings?

MR. HEMPHILL: Yes.

MR. FEDOK: And did this aircraft have a video system on it?

MR. HEMPHILL: No.

MR. FEDOK: Do any of the A320s currently flying for US Airways use the video presentation?

MR. HEMPHILL: Not at this point, they've been deactivated.

MR. FEDOK: Why did you move away from that, sir?

MR. HEMPHILL: It had to do with financial considerations.

MR. FEDOK: Ms. Baker, the NTSB recommendation from the evacuation study we did in 2000 had a recommendation that the FAA should conduct research and explore creative and effective methods that use state-of-the-art technology to convey safety information to passengers. And are you familiar with that at all?

MS. BAKER: I'm familiar with that safety study.

MR. FEDOK: Okay. There was a meeting with FAA staff in October of 2003 and the FAA stated that they believe that the new technology, primarily video systems for preflight briefings, satisfied the intent of those recommendations, which was eventually closed unacceptable action by the Safety Board. I'm concerned that, with financial considerations, we may be seeing airlines moving away from these new state-of-the-art technologies. Can you comment on that at all?

MS. BAKER: I have done no research in this matter, so no, I cannot comment.

MR. FEDOK: Okay, thank you. And the final topic is safety information cards. Can we bring up Exhibit 6 Lima, please? This is going to be the PDF version of the extended over water A320 safety information card that was on board the accident

flight. While that's happening, Ms. Baker, can you just describe what the FAA requirement and guidance is on briefing cards, what needs to be included?

MS. BAKER: The regulatory requirement on briefing cards states that the briefing card needs to include information about the emergency exit and that it needs to include other information, pertinent information regarding safety equipment. We have an Advisory Circular for air carriers that supplements that, that lists in greater detail the items that would be -- that are recommended for inclusion on the safety information card.

MR. FEDOK: And if we could look at the lower page first. First, is brace position required or is the FAA guidance to include that on cards?

MS. BAKER: Yes, FAA guidance does include the brace position.

MR. FEDOK: And do the cards have to show the location of the life vests?

MS. BAKER: I can't recall what it says. Yes, it does talk about flotation equipment.

MR. FEDOK: Okay. And Mr. Hemphill, this is your information card, so I'll direct these next questions to you. In the center -- I don't know if we can expand the box, the tan box in the lower center of the screen, at all. Can we zoom in on that? That's very good. The depiction there, sir, shows the over-wing exit is not to be utilized if water is outside the

window, if the passenger sees water outside the window. Again, just refresh my memory. What is the reason for that?

MR. HEMPHILL: Specifically the design of the card was to identify hazards, as to whether or not -- you know, that particular shot does not show a wing or anything like that, it just shows water. The presumption would be that, for whatever reason, water would make that unsafe to open that particular exit.

MR. FEDOK: And is that guidance consistent on the non-over water A320 briefing card?

MR. HEMPHILL: I believe it is. I would have to check, Mr. Fedok. I'm sorry, I don't know that.

MR. FEDOK: I have one here.

MR. HEMPHILL: Do you?

MR. FEDOK: I can confirm that is. Unfortunately I don't have a PDF version to show you.

MR. HEMPHILL: Okay.

MR. FEDOK: However, on the non-A320s, over water equipped A320s, as we've discussed, we want passengers to utilize those over-wing exits in the event of a water landing. So why would inconsistent guidance be provided on the card?

MR. HEMPHILL: Is the picture on the non-EOW identical to this?

MR. FEDOK: Yes, sir.

MR. HEMPHILL: Okay. In discussing these particular panes with our particular cabin safety inspector, the intent of

that particular picture was to show that water was such a factor that it would be unsafe to open the door. It wasn't to indicate that there's a wing necessarily to climb out on. It's just that water was a hazard to open the door. We're completely open to reevaluating the design of that particular picture.

MR. FEDOK: Thank you.

MR. HEMPHILL: You're welcome.

MR. FEDOK: Zoom back out and go to the upper page. I have a question on that as well. And on the left pane there, where it depicts the retrieval of a life vest, the very first pane there, sir, shows the woman seated, reaching down and there's a red arrow depicting an upward motion that she should use to retrieve the life vest from under the seat. With your knowledge, being involved in the survival factors group in this investigation, do you believe that that depiction is accurate?

MR. HEMPHILL: I believe the depiction, based on, obviously, our pool testing on the aircraft and things of that nature, can and will be improved the next time we do the card. So the intent, again, by the graphic design company that we used and the other airlines that we looked at and our FAA inspector as well, was to properly show her as she is opening the compartment, with the understanding that she's supposed to pull the life vest out of the compartment. So again, we believe improvements can be made on that particular slide and we intend to do so.

MR. FEDOK: Thank you, sir. And do you know, the

company that makes your cards, do they do any comprehension testing with passengers?

MR. HEMPHILL: I'm unaware of that. I don't know.

MR. FEDOK: Thank you. And one last question, sir, on the card, basically. The brace commands that flight attendants utilized in this instance were what?

MR. HEMPHILL: That they utilized?

MR. FEDOK: Yes, that they utilized in the accident flight.

MR. HEMPHILL: They said brace, brace, heads down, stay down.

MR. FEDOK: And what are US Airways' current brace commands for an inadvertent --

MR. HEMPHILL: They're currently bend over, heads down, stay down.

MR. FEDOK: Do you know why the flight attendants would've substituted brace for bend over?

MR. HEMPHILL: Well, in subsequent discussions with them and researching what happens as people merge or go from airline to airline, there's a tendency to revert to old commands and that was their former commands that they reverted to.

MR. FEDOK: Thank you. And one final question, sir. With a parent bringing a lap child on the aircraft, if there were an event of a planned ditching --

MR. HEMPHILL: Um-hum.

MR. FEDOK: -- what guidance would be provided to that parent?

MR. HEMPHILL: It would be -- obviously the life vest would be distributed and the explanation on how to don it and when to inflate it would be given to the passenger.

MR. FEDOK: Thank you. And I thank the whole panel. I appreciate the indulgence of the audience, the parties and the Board of Inquiry. I have no further questions, sir.

MR. MARCOU: I have one question for Mr. Gardlin and Mr. Lohmann. With your knowledge of the different kind of evacuation systems for past events on different kind of aircraft, could you please describe the different advantages and drawbacks of the slide rafts and the life rafts, please?

MR. GARDLIN: Well, I think the main advantage of the slide raft, and one of the reasons that its development was recommended, in fact, by the NTSB as well, is that it's located where it's intended to be used. So the idea of transportability anywhere is intended to no longer be a factor; but in order to preserve the capability, that they have the ability to be moved. But I think the biggest advantage is that they're already where they're intended to be used, whereas portable rafts have to be moved regardless of where they're going to be used.

MR. MARCOU: Mr. Lohmann?

MR. LOHMANN: I fully confirm this, definitely.

MR. MARCOU: Thank you.

MR. O'CALLAGHAN: Thank you. I have just a couple of brief questions, probably to Mr. Gardlin and to Mr. Lohmann. How are the strengths and weaknesses of the fuselage structure considered in the choice of exits for the location of group flotation devices? And I guess, Mr. Gardlin, if you could answer for airplanes in general, and Mr. Lohmann, if you could answer for the A320 in particular.

MR. GARDLIN: I'm not sure if I know exactly what you mean about the strengths and weaknesses.

MR. O'CALLAGHAN: Yeah, let me elaborate. Particularly, this morning we were discussing the ditching scenarios or water landing scenarios and the ensuing damage to the U.S. 1549 flight vis-a-vis what one would expect if you meet the ditching criteria and how the damage would progress as those parameters are exceeded. And I think what came out of that was that damage would -- it's not a cliff, but damage would progress as the vertical speed increases.

But primarily the damage would occur first, and sort of predictably, in the aft fuselage area. So I guess one way you could think about that is, is that perhaps the aft fuselage is the most vulnerable once the criteria are exceeded. And I'm wondering if that's sort of consideration is involved in locating the flotation devices.

MR. GARDLIN: Okay. Well, I think the key point is that the rafts, be they slide rafts or portable rafts, are there to

cater to the extended over water situation, which is the basis for the planned ditching scenario. So when that substantiation is conducted, it's really based on the damage that is shown or covered by the ditching substantiation. And in that scenario, if the aft exits are shown to be available, then those exits would be suitable for a location of a raft. If they're not shown to be available, then they would not be a suitable location for a raft. But in terms of addressing it, as well, what if those conditions are exceeded and the aft exits are no longer usable, that kind of takes it outside the realm of a certification requirement.

MR. O'CALLAGHAN: Thank you. And Mr. Lohmann, would you like to add anything to that?

MR. LOHMANN: I have nothing to add to this.

MR. O'CALLAGHAN: And then my last question would be that, in light of everything we've discussed over the last couple days, would the consideration of the vulnerabilities and strengths of the structure, would consideration of that and choice of the location of flotation devices have merit going forward?

MR. GARDLIN: Again, as I sort of said before, I don't know, in this specific accident, that anything is obviously wrong with the requirements, but I think it's prudent for us to look at the requirements and see whether there's things that we can address differently. But I can't presuppose right now whether that's something that would come from it.

MR. O'CALLAGHAN: Okay, thank you both very much.

MR. GEORGE: I have one, Mr. Hemphill. In an unplanned water landing such as 1549 -- sorry. In an unplanned water landing such as 1549, what would the flight attendants have instructed the passengers to do at the exits if there had not been slide rafts there but just regular slides? What would the commands have been to the passengers?

MR. HEMPHILL: Well, the flight attendants at that point would've detached the slides and then instructed the passengers to jump into the water using their flotation devices and go to the rafts, go to the --

MR. GEORGE: So if this airplane has been outfitted as operationally or it was supposed to be operationally or could've been operationally --

MR. HEMPHILL: Yes.

MR. GEORGE: -- with non-extended over water equipment, the passengers at all the floor-level exits would've been instructed to jump in the water?

MR. HEMPHILL: That's correct.

MR. GEORGE: Thank you.

CHAIRMAN SUMWALT: Okay, seeing that there are no more from the Technical Panel, I think, out of fairness to everyone in the room, we will take a 10-minute break and then we can finish it up. Thank you.

(Off the record.)

(On the record.)

CHAIRMAN SUMWALT: Okay, we will go ahead and reconvene. And I don't think anybody objected to the break. I think it'll put us a little later in the day, but we probably needed that one just for the hour of the day. Mr. Benzon, I'll turn it back over to you, sir. Well, that is correct, yes, thank you. I need good help over here, a good CRM, threat and error management. Okay, so we have FAA, Airbus and US Airways all had witnesses there. So all right, I'll start -- FAA, would you like to go -- let's see, would you like to go towards the end?

MR. HARRIS: Mr. Chairman, we would -- we'll be happy to sit anywhere in the last three rows.

CHAIRMAN SUMWALT: You'd like to?

MR. HARRIS: Sit anywhere in the last three rows. It doesn't make any difference to us.

CHAIRMAN SUMWALT: Okay, great. And Airbus, how would you like to go in the order?

CAPT. CANTO: We can go last if you don't mind.

CHAIRMAN SUMWALT: Okay, good. And US Airways, you'll go towards last as well?

CAPT. MORELL: No, we'll give up our seat. We have no questions at this time.

CHAIRMAN SUMWALT: Well, that's easy enough. Okay. So we'll start with CFM International, please.

MR. MILLS: Mr. Chairman, CFM has no further questions.

CHAIRMAN SUMWALT: Thank you.

MR. MILLS: No questions.

CHAIRMAN SUMWALT: Thank you, sir, Mr. Mills. And USAPA?

PARTY QUESTIONS

CAPT. SICCHIO: Thank you, Mr. Chairman. One question for the FAA witnesses. Ms. Baker, have you ever been involved in the ARAC process at all in your tenure?

MS. BAKER: I have not been involved in an ARAC, no.

CAPT. SICCHIO: Okay. And Mr. Gardlin, yourself?

MR. GARDLIN: Yes, yes, I have.

CAPT. SICCHIO: Okay. Would you -- okay, I'm sorry, Mr. Gardlin. Based on your experience with the ARAC process, would you comment on the length of time rulemaking takes from the inception or the first order of the rule to completion?

MR. GARDLIN: Well, I think it depends on the specific project, but it can take several years from the beginning through to completion. That's not unusual.

CAPT. SICCHIO: Okay. Of the projects you've been on, what is the shortest length of completion that you've seen?

MR. GARDLIN: Well, I guess it depends on -- yeah.

CHAIRMAN SUMWALT: Let me make sure I understand the question. Will you rephrase the question, please, or state it again, please?

CAPT. SICCHIO: Right. What I'm asking is, for Mr. Gardlin, of the ARAC projects that he's been involved with, in

other words, the rulemaking projects that he's been involved with, what is the shortest length of time that the ARAC process has taken from inception to the rule actually being issued?

MR. GARDLIN: Some of the ARAC activity I've been involved with was actually development of the advisory material and that was relatively quicker, but some of it was rulemaking. I think about five years is about as quick as I can recall off the top of my head.

CAPT. SICCHIO: Okay, thank you. And could you tell us about the longest time period that one of those projects had taken?

MR. GARDLIN: Well, we recently completed one that, I think, from beginning to end was on the order of nine years. I don't know if that's the longest one or not, but in my experience I guess that's the one that comes to mind.

CAPT. SICCHIO: Okay, thank you. And in that case has the rule finally been actually published?

MR. GARDLIN: Yes, it was.

CAPT. SICCHIO: Okay, thank you very much. No further questions. I appreciate the panel, thank you.

CHAIRMAN SUMWALT: Thank you, Captain Sicchio. AFA.

MS. KOLANDER: AFA has a question for every witness. Mr. Gardlin first. The evacuation certification requirement assumes a loss of 50 percent of the floor-level exits will not be available in an emergency. Now, the requirement for ditching

assumes the loss of one of the rafts at the largest capacity, rated capacity. So in that situation, basically, from my standpoint I'm seeing a loss of one door. Airbus in their presentation actually made an assumption that they lost two exits on one side of the aircraft because of high winds and rough seas. To me I think we've expressed some of this, but I still see a dichotomy in the certification for losing 50 percent of my doors, and yet, in a ditching, you only expect me as a flight attendant to lose one door. Can you highlight any of that or explain any of that to me?

MR. GARDLIN: Well, I think maybe the first thing is it's not so much an expectation, it's a set of certification criteria to determine capacity and capability. So as I mentioned, I think, in my presentation or during my presentation, the way that passenger capacity is allocated for ditching is different than it is for land evacuation, such that each exit, each individual exit is allowed a 35-passenger credit. And the same exit, for a land evacuation, the pair of exits might be worth twice that.

So there's a lot of differences in how those capacities are established. It's not that we think that only 35 people could egress through the main entry door, but it's sort of recognition that egress through exits in a ditching scenario is going to be probably slower than on the land and so there's been kind of a knockdown factor to cater to that. So I'm not sure that I could

directly equate the two situations and say that there's assumptions that are different. I think the total set of certification criteria are different.

MS. KOLANDER: Mr. Lohmann. And I apologize. Jason had quite a few questions, so I don't think this one was asked. At least I didn't hear it. But what was the condition of the cabin when you did your slide raft transfer? You quoted that you folks could do it in four minutes and 18 seconds. I'm just looking for, as a flight attendant, what conditions were happening in the cabin.

MR. LOHMANN: We have this done individually, so the transport from one door to the other door, the opposite door, because the other doors -- the one side was not useable, the cabin was empty.

MS. KOLANDER: So there were no passengers in there, pretend or otherwise. There was no debris in the cabin. There was no artificial anything in it, just a very pristine cabin when you did it?

MR. LOHMANN: Yes, it's not the cabin, it's the aisle area, yeah, or the door area.

MS. KOLANDER: You actually had mentioned, when we talked about the primary exits versus secondary exits, you said that the floor-level exits are the primary exits and that the over-wing are secondary and that based -- and the over-wing exit should only be used upon failure of the floor-level exits. Now,

the reality is, is we have passengers on board and we do know that passengers will do self-help. In other words, they may open up the doors if they are seated next to, let's say, an over-wing exit that they believe should be used. Are the over-wing exits on the A320 lockable in a ditching situation to stop the passengers from using those exits?

MR. LOHMANN: I would never lock them, yes --

MS. KOLANDER: Ms. Baker, as flight attendants, why do we brief our passengers?

MS. BAKER: In what context?

MS. KOLANDER: In the context of emergency equipment.

MS. BAKER: We brief passengers so they're familiar with the installed emergency equipment and its use.

MS. KOLANDER: So basically, from our standpoint as flight attendants, we are basing -- we are briefing passengers on emergency equipment that is on board the aircraft, so that they know what is available to them, what lifesaving equipment could be available for their personal use. Yet, if we took the situation, I think, that Jason mentioned, you have an air carrier that has life vests and seat cushions on board, the FAA does not require that the passenger, according to your -- that the briefing be conducted for, let's say, the life vest unless it is in EOW flight, is that correct?

MS. BAKER: That is what the regulations currently state. But as I also mentioned, our guidance does recommend that

you brief -- an air carrier brief on all types of installed flotation equipment.

MS. KOLANDER: You've actually mentioned guidance a couple times and other suggestions that you had given to the airlines. Is a carrier required to comply with any of the suggestions in these guidance documents? Required to comply.

MS. BAKER: An air carrier is not required to comply with the guidance documents, but those are the documents by which the FAA is evaluating an air carrier's procedures, so it's certainly strongly encouraged.

MS. KOLANDER: But again encouraged. Are they required?

MS. BAKER: Not with the same force of a regulation.

MS. KOLANDER: Ms. Baker, why do flight attendants do hands-on training on a yearly basis or every 24 months under the current regulation?

MS. BAKER: Flight attendants conduct hands-on training to maintain familiarity with the installed emergency equipment or the procedures that are included in the drills.

MS. KOLANDER: Would it be a fair assessment to say that the equipment, as an example, the doors, would be also relaying the forces and actions necessary to open those doors?

MS. BAKER: That is correct.

MS. KOLANDER: We actually had a flight attendant statement that said that she did not think that the ditching handle -- we had a flight attendant statement that the quick

release handle was not as easy as expected. So my assumption is, she hasn't had hands-on training on this. And since we attend training to see forces and actions, do you actually foresee that perhaps maybe we should look at requiring hands-on training, let's say, on the quick release handle or ditching handle?

MS. BAKER: FAA is always open to evaluating any recommendation that someone has about content of training.

MS. KOLANDER: Mr. Hemphill --

MR. HEMPHILL: Yes?

MS. KOLANDER: -- you mentioned that, in your A320 dry ditch, that you do a scenario that you talk about or there is basically a show-and-tell to the flight attendants in the dry ditch, regarding the ditching only flap, the quick release handle, life raft, boarding station, lifelines. Again, this is a showing of that. Do you happen to know where the flight attendants are standing during this show-and-tell when the instructors are actually doing the hands-on of this stuff?

MR. HEMPHILL: The flight attendants -- excuse me. The flight attendants, when they are reviewing the quick release mechanism or how the slide is attached on the airplane, are actually in the slide. We've made sure that they have boarded properly with their backs to the outside of the slide. We lift up the device and demonstrate the device so that all -- excuse me -- all the flight attendants can see that.

MS. KOLANDER: The document that I'm looking at --

MR. HEMPHILL: Um-hum.

MS. KOLANDER: -- which would be your recurrent training module --

MR. HEMPHILL: Um-hum.

MS. KOLANDER: -- it actually just says that you show them, and it's our understanding, in preparation for this hearing, we asked some of our chairs, safety chairs, FAA safety chairs at US Airways, where they were standing during recurrent training and they actually said that they were standing outside of the slide raft when they were shown the dry ditching -- the ditching only flap, quick release handle, and life raft. And the reason I'm asking this is because if we want to talk realism, and you've said that you've moved into a scenario-based training --

MR. HEMPHILL: Um-hum.

MS. KOLANDER: -- the realism would be because we know we had problems finding the knife --

MR. HEMPHILL: Um-hum.

MS. KOLANDER: -- on board the slide raft, that it would be more reasonable and more realistic if they were inside. So if this is incorrect, we apologize, but we were going by the document that was an exhibit.

MR. HEMPHILL: It does not mention in that document where they're standing, is that correct? Is that what you're saying?

CHAIRMAN SUMWALT: And what is that exhibit number?

MS. KOLANDER: It is Exhibit 6D.

CHAIRMAN SUMWALT: Six Bravo, for the record.

MS. KOLANDER: I'm sorry, 6D, David.

CHAIRMAN SUMWALT: Six Delta.

MR. HEMPHILL: And just so I'm clear, Ms. Kolander, you said it shows that it's demonstrated but it doesn't say where they are?

MS. KOLANDER: That is correct.

MR. HEMPHILL: Okay.

MS. KOLANDER: But it was our understanding, again, just in preparation from the hearing. So I think --

MR. HEMPHILL: Okay.

MS. KOLANDER: -- that was just our question. And I just have one last question.

MR. HEMPHILL: Well, let me just follow up on that --

MS. KOLANDER: Sure.

MR. HEMPHILL: -- good feedback. And during the trainer portion where we -- and every April, when we get ready to teach the program, we teach them to demonstrate it with the flight attendants and the raft. So if you have something for me to follow up on with a particular instructor and event, I'll be glad to do that.

MS. KOLANDER: Certainly. And I just have one more question. We've heard a lot of -- we've had a lot of discussion today regarding you A320 dry ditch that you say that you do

yearly.

MR. HEMPHILL: Um-hum.

MS. KOLANDER: How long is that training module?

MR. HEMPHILL: I believe it's actually in the record. I don't have that memorized. But we do have times associated with that and I think it's on the syllabus. I'm referring to Mr. Fedok. I don't know if he has that.

MS. KOLANDER: Actually in the same one --

MR. HEMPHILL: Do you have that? Yeah.

MS. KOLANDER: -- it says you only -- it is a 20-minute drill every year on your whole dry ditch, on all of the equipment associated with that.

MR. HEMPHILL: Then that is correct.

MS. KOLANDER: Um-hum, thank you. That's all the questions.

CHAIRMAN SUMWALT: Thank you, Ms. Kolander. FAA.

MR. HARRIS: Thank you, Mr. Chairman. Mr. Lohmann, in your testimony you mentioned one of the configurations for consideration in ditching and the use of slides. Is the fact that two exits would be unusable and the slides would be transported, is that correct?

MR. LOHMANN: Yes, that is correct.

MR. HARRIS: So in this particular event the two rear exits were unusable, and would the assumption be that the rear slide rafts could have been transported, or at least were

available for transport, would probably be a better way of saying it, and if they had gone to the forward exits, my calculation is that there would be seating for up to 176? I guess that's four times 44 people. Would that be correct?

MR. LOHMANN: Yes, but in an overload capacity 55 --

MR. HARRIS: And that would account for also then the circumstance, perhaps, of one of the rafts not being available, in which case three times 55 would give us 165 people?

MR. LOHMANN: Yes.

MR. HARRIS: Okay, thank you. Ms. Baker, regarding the slide portability demonstrations with no passengers on board, would you say it would be a priority to get the passengers off the available slide exit -- slide rafts, into the slide rafts before transitioning the aft slide rafts forward?

MS. BAKER: Yes, I would.

MR. HARRIS: Is there a specific reason why?

MS. BAKER: My understanding of slide raft transfer is that the slide raft actually has to be attached to the girt of the forward door. Therefore, the forward rafts have to be removed from the aircraft, so you would fill them before you'd remove them from the airplane.

MR. HARRIS: And certainly one of the lessons learned from maritime accidents is fill the rafts before you let them go, right?

MS. BAKER: I'm not familiar with maritime.

MR. HARRIS: Okay, I'm thinking more to the Titanic, I suppose. Mr. Gardlin, in earlier testimony you spoke to the issue of crash worthiness standards versus ditching standards, and earlier we heard Mr. Breneman's statement that the aircraft performed well in the water landing. Do you have any comment on the performance of the aircraft?

MR. GARDLIN: Well, again, I think the specific parameters of the water impact, the airplane performance, I think, is consistent with what we would expect in that case and you know, it absorbed energy under the conditions. So I think my previous comments stand.

CHAIRMAN SUMWALT: Would you get a little closer --

MR. GARDLIN: Sure.

CHAIRMAN SUMWALT: -- to the microphone for us, please?

MR. GARDLIN: Yeah. I think, under the conditions of this specific accident and the water contact, the airplane's crash worthiness became very important and it absorbed energy, and as I said earlier, in terms of the dominant element here, it was the airplane crash worthiness that was dominant.

MR. HARRIS: And had this been a planned ditching event versus an emergency landing on water, would you expect both the forward and aft slide rafts to have been available, meaning that the exits would've been available and clear of water?

MR. GARDLIN: Yes, I believe that's exactly what we would expect for the planned ditching.

MR. HARRIS: And I appreciate the candor of your testimony earlier, Ms. Baker, on the fact that it would be difficult to determine the water level viewed from the exit, and I believe, Mr. Hemphill, you also testified to that effect, but I'll direct my question to Ms. Baker. In fact, in this event, did not the crew identify which exits were above and below water and make the appropriate actions to use those exits?

MS. BAKER: Yes, they did.

MR. HARRIS: Thank you very much. We have no further questions.

CHAIRMAN SUMWALT: Thank you, Mr. Harris. And Airbus.

CAPT. CANTO: Thank you, Mr. Chairman. Ms. Baker, how are you?

MS. BAKER: Thank you.

CAPT. CANTO: Okay. So we're going to have a little chat. With regards to -- I would like to read you a statement and tell me if you either agree or disagree on the contents of that sentence, please. "During a planned ditching the cabin crew have notice and therefore sufficient time to prepare the cabin and to advise passengers to put on their life vest." Would you define this or understand this to mean a planned ditching?

MS. BAKER: I understand a planned ditching to mean that the crew has time to prepare the cabin and the passengers.

CAPT. CANTO: Correct. So what I stated, where the cabin crew has sufficient notice, sufficient time to prepare the

cabin, so we are in agreement with that, correct?

MS. BAKER: Yes, we are.

CAPT. CANTO: Okay, good. I hate to belabor this planned and unplanned, but I think we have to. Regarding unplanned, let me read you a statement here. "During unplanned ditching there has been no time for the cabin crew to prepare the passengers." For example, only have sufficient time to say brace positions, or whatever the correct phraseology is, depending on the airline. Do you agree with that?

MS. BAKER: I concur. That is how the cabin crew uses the term unplanned ditching.

CAPT. CANTO: Good, thank you. During the previous session, Topic 4, there seemed to be universal agreement by Mr. Blagden, Mr. Gardlin and Mr. Arnold, to those same understandings of definitions. So that's good that, because the certification efforts, everybody seems to be on the same page. So that's a good thing.

Now, Mr. Gardlin, given the testimony that we've had over the last two days and especially today, do you believe that Captain Sullenberger made nothing by a conscientious, deliberate decision to make an emergency landing on water? Once he evaluated his position and the give and take between air traffic control about locations of La Guardia and Teterboro, once he made that decision, do you think he made a conscientious, deliberate decision to make an emergency landing on water?

CHAIRMAN SUMWALT: And have you studied the cockpit voice recorder and listened to the testimony concerning Captain Sullenberger?

MR. GARDLIN: I have not studied the voice recorder, but I did hear his testimony yesterday.

CHAIRMAN SUMWALT: Well, I think your expertise is in the area of certification, is that correct?

MR. GARDLIN: That is correct.

CHAIRMAN SUMWALT: I'm not sure that you're in a position to answer that question, so I'm going to disallow it.

MR. GARDLIN: That's what I was going to say.

CAPT. CANTO: Okay, thank you. Could you please pull up Slide 6G? And that's the FAA "Getting to Grips with Cabin Safety," please. Correction, that's the Airbus "Getting to Grips with Cabin Safety." And I think it's -- Chairman Sumwalt, I think your point was well taken. But it seems that once -- and obviously we cannot interpolate and be in the mindset of Captain Sullenberger, but once he made that decision, he was deliberately going to put that airplane on the water. So I think that's clear.

But what is evident as well, that we've identified, that the term planned ditching, ditching, unplanned ditching, or unplanned emergency landing on water, or however, I'm sure we've categorized that within the last two days at least a half a dozen different ways. And I think it has been pointed out, as the

documentation that we have submitted in conjunction with everybody else, DOT and FAA studies and reports that have categorized it differently, and we feel that we have done so as well, incorrectly in that first sentence. So we are -- this just adds to the further confusion and the definition. Also, Mr. Gardlin, you made earlier a statement that at the conclusion of this event, that your department at the FAA would be making a review of certification requirements, is that correct, of the documents?

MR. GARDLIN: Well, yeah, we are going to review all the data associated with this accident and use that to identify any priority areas that need further focus.

CAPT. CANTO: Good, good. And Airbus will be doing a similar exercise in reviewing all of our operational documentation to be sure there's a level of consistency, so that we don't have different words meaning different things. Mr. Lohmann, with regards to the slide that was just on, 6G, that is purely an operational recommendation for cabin safety that Airbus has made available to airlines, is that correct?

MR. LOHMANN: Yeah.

CAPT. CANTO: Okay. In any way, shape or form, do you take this into consideration when you're looking at aircraft design and certification?

MR. LOHMANN: This particular situation, I think not.

CAPT. CANTO: Okay, good, thank you. Because that's nowhere specified, where operational documentation is required for

that type of effort that we do. Mr. Lohmann, what effect would rafts stored in the overhead bins do to cabin evacuation times, if they were so placed on a given aircraft with passengers in the aisles, versus slide rafts located at the doors, where they're conveniently available?

MR. LOHMANN: Can you repeat this question? I didn't get it.

CAPT. CANTO: Yes. Basically, if you had slide rafts at the doors and then on other aircraft you had rafts stored in the overhead bins, would rafts in the overhead bins affect the evacuation time of the cabin under an emergency situation?

MR. LOHMANN: They would affect the evacuation time, because you have to pull them out of the overhead storage compartment and make use of them. But you can use also the slides as flotation means. Yes, this is also important. We also recommend this in our --

CAPT. CANTO: Okay, very good. So that basically means, for those aircraft that are not extended over water equipped, that only have slides instead of slide rafts, those can be used as flotation devices, correct?

MR. LOHMANN: Yes, it is correct.

CAPT. CANTO: All right, good.

MR. LOHMANN: We recommend this.

CAPT. CANTO: Good, thank you. Can you certify -- correction. Can you clarify, in the -- where you discussed in

your presentation regarding certification tests for 186-passenger certification, or clarify why there was an additional raft in the overhead bin during certification tests?

MR. LOHMANN: This was linked due to the passenger capacity of that aircraft, which was scheduled for 186 passengers. So three rafts available. Because one was not usable, 165. And therefore we have one additional -- you need to have one additional raft in the cabin.

CAPT. CANTO: Okay, good. That's all we have, thank you.

CHAIRMAN SUMWALT: Captain Canto, thank you, and thank you for your remarks. And I want to remind all parties that all parties to the hearing and all parties to the investigation will have the opportunity to make a submission to express your viewpoints. So I appreciate your making the point and that's just a reminder that that would be a way to -- the preferred way to get your comments on the material that has not been covered in this hearing. Thank you. US Airways, you had previously indicated that you did not want to go, but would you have anything at this point?

CAPT. MORELL: No, Mr. Chairman, we have no questions at this time.

CHAIRMAN SUMWALT: Thank you. How about follow-up, follow-up from the parties? Okay, we'll just start in turn. USAPA?

CAPT. SICCHIO: Nothing, thank you, Mr. Chairman.

CHAIRMAN SUMWALT: I'm sorry, CFM, I should just start with --

MR. MILLS: Mr. Chairman, we have nothing further, thanks.

CHAIRMAN SUMWALT: Thank you. Okay, AFA, thank you.

MS. KOLANDER: AFA has one, just, follow-up question for Mr. Lohmann. I'm actually just kind of curious. We just heard another comment that regarding assessing outside the door might be difficult and even earlier on today we had heard that with -- in reference to pilots, that it could be difficult to assess the altitude above water because of water characteristics. So just out of curiosity, how does one validate the view out the viewing window for flight attendants? I mean, basically, do you take into consideration flight attendants of all heights and sizes and their ability to assess outside?

MR. LOHMANN: I'm sorry, I cannot answer this question because I'm not involved in that subject.

MS. KOLANDER: Thank you. No further questions.

CHAIRMAN SUMWALT: Thank you. FAA, any follow-up?

MR. HARRIS: Yes, sir, we just have one relatively short question to Mr. Gardlin. ARAC only makes recommendations to FAA for potential rulemaking, is that correct?

MR. GARDLIN: Yeah, that is correct.

MR. HARRIS: And ARAC does not actually manage or follow

through on the entire rulemaking process, just a submission of recommendations?

MR. GARDLIN: ARAC is not involved in the entire rulemaking process. The other part of the process they may get involved with, depending upon the project, in disposition of comments occasionally.

MR. HARRIS: Okay. And there is a specific rulemaking process embedded within our protocols within the FAA to respond to statute and regulation requirements, that is, that has to be done whether ARAC participates or not, is that correct?

MR. GARDLIN: That is absolutely correct, yes.

MR. HARRIS: Thank you, Mr. Chairman.

CHAIRMAN SUMWALT: Thank you. Captain Canto, would Airbus like to follow up with a question?

CAPT. CANTO: Nothing.

CHAIRMAN SUMWALT: Thank you. And so that completes that parties. Technical Panel, any follow-up questions? Okay, good. We turn now to the Board of Inquiry and Dr. Kolly. No questions from Dr. Kolly. Mr. DeLisi.

BOARD OF INQUIRY QUESTIONS

MR. DeLISI: Thank you. Mr. Hemphill, how does a US Airways flight attendant know if the airplane that they're on is equipped for extended over water?

MR. HEMPHILL: They do that during their preflight, so they're going to be looking for -- they start at the beginning and

look at all the emergency equipment. They would discover the survival kits and other forms of EOW equipment.

MR. DeLISI: So it's not something that they know before they get on the airplane? They just get on the airplane and take a look and make that assessment?

MR. HEMPHILL: Not necessarily. Unless they're intuitive enough to look at the routing, they could probably understand based on where the flight goes.

MR. DeLISI: Okay. Ms. Baker, are lifelines mandatory equipment?

MS. BAKER: In 121 operations there's no reference to the lifeline.

MR. DeLISI: Okay. And finally, Mr. Hemphill, is US Airways considering any procedural changes to help ensure the maximum utilization of the lifelines?

MR. HEMPHILL: Yes, we are.

MR. DeLISI: Great.

MR. HEMPHILL: That is under consideration.

MR. DeLISI: Thank you.

CHAIRMAN SUMWALT: Okay, thank you. And Mr. Lohmann, did you state that the overhead bins were overstuffed and they were filled in excess capacity to what the certification design criteria is?

MR. LOHMANN: Pardon, please rephrase.

CHAIRMAN SUMWALT: Yes, it was a question that needs to

be restated. Did you state that the overhead bins on this aircraft, when you did your -- when Airbus looked -- when the NTSB looked at it when it was pulled out of the water, were the overhead bins filled in excess of what they were designed to be? Did you make that statement?

MR. LOHMANN: No, definitely not, no.

CHAIRMAN SUMWALT: Okay. As I think you've figured out, I can't hear up here, so I thought you had said that.

MR. LOHMANN: No, I didn't say that.

CHAIRMAN SUMWALT: Thank you. So I will ask -- okay, very good. Mr. Hemphill, someone earlier had stated and we heard that Mr. Skiles said, First Office Skiles said in his witness -- in his interview the NTSB and we heard from Billy Campbell, a passenger, yesterday, that the first officer did have trouble finding the cutting knife to cut the tether line between the airplane and the slide raft. Has US Airways done anything to increase the ability of crew members to locate that?

MR. HEMPHILL: No, that still is a part of the dry ditch drill that we did or that we do every year. We make a reference to that, and the event that happened in 1549 did draw a little extra attention to it. But we're still investigating ways that that can be brought out or clarified further to both our pilots and our flight attendants. I think it's important to mention, too, that, you know, procedurally we do, say, for the raft to stay tethered to the aircraft until it's safe to -- you know, unless

it's unsafe to do so, so in a longer-scale survivability situation it would be more easily located. And there also is a provision within the design of Airbus, that if the fuselage does go down, that the tether will break and release the raft from the aircraft as well.

CHAIRMAN SUMWALT: Okay, that's reassuring. So okay, good. And does that -- you specifically deal with in-flight training. Here was a case of a flight crew member, a pilot, who had difficulty to it. Does that sort of training propagate over to the flight training, to the pilot side of the house, so that the pilots would know?

MR. HEMPHILL: I know that they do get familiarity training on it. I can't speak to the specifics of how that particular item is discussed.

CHAIRMAN SUMWALT: Thank you, because I note that First Officer Skiles also had difficulty in releasing the girt bar.

So I think I'm the only thing between you and dinner. And so tomorrow we will do it differently. We will begin at 8:00 in the morning. We will begin at 8:00. The Board room opens one hour before that. The reason I want to start at 8:00, I want to make sure that we can be through by lunch so that people can make their flights home. So that's why we want to make sure we get an early start on the day. And I think we will have a good day. I want to thank all of the parties and the Tech Panels and the Board of Inquiry for their cooperation as we work our way through this

hearing. This hearing is in recess.

(Whereupon, at 5:30 p.m., the hearing in the above-entitled matter was adjourned, to be reconvened on the following day, Thursday, June 11, 2009, at 8:00 a.m.)

CERTIFICATE

This is to certify that the attached proceeding before the

NATIONAL TRANSPORTATION SAFETY BOARD

IN THE MATTER OF:	PUBLIC HEARING IN THE MATTER OF THE LANDING OF US AIRWAYS FLIGHT 1549, N106US, IN THE HUDSON RIVER, WEEHAWKEN, NEW JERSEY, JANUARY 15, 2009
DOCKET NUMBER:	SA-532
PLACE:	Washington, D.C.
DATE:	June 10, 2009

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.

_____

Timothy Atkinson
Official Reporter