The following are suggested corrections to the transcript of the public hearing submitted to the Safety Board by Airbus on August 24, 2009.

**MR. LOHMANN**

- page 376 line 13: read '...certification took place in 1984...' instead of '...certification took place in -- 84...'
- page 376 line 13: read '...with an weight of 77 tons and...' instead of '...with an -- of 77 tons and...'
- page 377 line 6 : read '...what we've heared from ...' instead of '...what we referred from...'
- page 377 line 11: read '...the installation of safety ...' instead of '...the insulation of safety...'
- page 379 line 10: read '...about .6 degrees...' instead of '...about .5 degrees...'
- page 379 line 14: read '...door will remain...' instead of '...doors will remain..'
- page 380 line 2: read '...fairly within the...' instead of '...fairly behind the...'
- page 380 line 23: read '...we do not know when this has happened, oxygen masks are fallen...' instead of '...we do not know when this -- oxygen masks are falling...'
- page 381 line 13: read '...seat was stowed not properly, was found...' instead of '...seat was stowed -- was found...'
- page 393 line 4: read '...Yes, this is our assumption...' instead of '...Yes, this is all assumption...'
- page 300 line 3: read '...structure would remain intact...' instead of '...pressure would remain intact...'
- page 400 line 22: read '...Two people and instructed by one...' instead of '...Two people and extracted by one...'
- page 462 line 16: read '...recommend this in our manuals...' instead of '...recommend this in our –
- ...'

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**MR. FITZSIMMONS**

MR. FITZSIMMONS: Okay. So this short presentation is ~~stripped~~ split 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~~ evacuate 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~~ approach 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 --~~ hydrodynamic pressures working on the fuselage itself are 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~~ and saw 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, In that way it ~~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 those 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~~ recommended 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 conservative 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~~ devided by an 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~~ on 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~~ around the cargo door, for example, or indeed you can see clearly the ~~circumvential~~ circumferential joint at C-65.  The one vertical line in light green is high reserve factors due to the reinforcement at the ~~circumvential~~ circumferential 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~~ such as , 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, at each ~~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 at about ~~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 of 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 is 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 – stress analysis 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 it. 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~~ then 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~~ regarding the engine and the engine – pylon 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~~ both 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-~~ frame 65.

MR. MURPHY: For ~~M-~~ frame 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~~ ingressed. So there's been a failure of the lower shell forward ~~to~~ of 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~~ allowing 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~~ 1:22 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 sensitive , 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 – nacelles 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~~ reserve 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~~ failures 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-~~ frame 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.

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**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 that occur 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 speed marked is the 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 the most significant point 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 thrust 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 alternate 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 difficulty 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 are 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 needed to put the airplane on the water at the right pitch attitude and at the right vertical velocity.

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**CAPTAIN VAN DER STICHEL**

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 way (…)

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 rationales used during the ditching evaluation of the aircraft. There 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 failure landing certification; and finish 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 rather 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 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 for 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 speed, on top of the aircraft attitude and especially having 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 case 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 bullet of that slide), when you have no thrust, you have only one attempt to perform your landing, and that changes the scenario. The planned ditching that occurred in the aviation history has been when (the aircraft was considered) the captain considered that he 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.

Unplanned ditching, as said,(I make a little difference here to enhanced fact without engine), is typically when the aircraft overruns the runway at landing or takeoff and (it is
) that sticks really to 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 about the certification: that it is difficult, specifying 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 previous design that has proved to be satisfactory. Most of the requirements, as well, are based on design criteria, that enable that comparison, and it is important to consider that, beyond those design criteria, usually there is no, as you mentioned Mr. O'Callaghan, there is no cliff effect. So there is a kind of continued behavior beyond. 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, I would call a general safety objective, and the natural, usual, accepted response, the global industry and certification process response, is to define some acceptable and consistent design criteria. And as I am concerned, I terms of 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. The sketches are showing you conventional pitch and glide path and the resulting angle of attack. 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 law for 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 those 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 generators, 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 reverts in 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: 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; an emergency electrical power supply is in force, meaning there is no APU restart. Those are the assumptions. As regards demonstration, it is progressive: (a dual engine) a dual hydraulic (pardon) failure, hydraulic loss, yellow and green, is considered. 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 obvious flight safety reasons.

That specific case I expand. So the initial flight conditions, if you remember yesterday the conditions: we start the exercise for the certification at flight level one hundred, 10,000 feet, and from clean, which is no slats extended. 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 representants and it was meeting the certification requirement. For your interest, the landing on the runway in such a case is more demanding than on a non-constraining landing strip, in terms 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 path into the water. As just a recall, the dual engine failure has demonstrated a capability to handle the aircraft under that 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 upper requirements, to minimize all the risk for other cases. And our duty is to provide even for cases which are beyond the certification, - 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, 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 case if the crew has no chance to look at the QRH.

So the first line you will see that, in blue, the “3” 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 3 and the flight control will remain normal. And if everyone remembers, 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 3. 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 certif. 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 a power off 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 significantly 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 Hudson case, this 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 can if you … 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 as an assessment process, to address unplanned 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. Of course, the Hudson River is not an unplanned ditching, as per that bullet, because, when there is no aircraft handling, when your aircraft is running on the ground and you continue to roll out into the water, 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, and 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 with what I would call planned.

As a pilot it's difficult for me to state that landing an aircraft without engine could be a plan. 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 those 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 representative for such exercise, it doesn't prevent us to review partially, not until the landing, but as much as we can, those failure cases 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, linked to the failure cases, are 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 operational judgment and some of them are run by the authorities representants themselves. Normally those are (under your control, I've got a representant 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,… (I think you can reduce because there is some Larsen – I'll do my best.)… 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 generic 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 altitude is something, which is far beyond what we usually expect for an all 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 those 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: you say normal, you say easily and without training; it's a lot.  With all that combined, I believe it's, to 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 exposed yesterday.

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 for me 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, in terms of threat management, referring to what we heard yesterday, gives 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: There are differences. 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 smooth, 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 important to be exposed to power off 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. 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 power 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 recommended today by the procedures, but there are 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, it's 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 power off landing will be interesting.  It is not aircraft specific, again.  It is something, which is generic. I agree with you as well that it is difficult in some specific weather or night light conditions, etc.  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 is being 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 can see the altimeter descending! And that gives you quite a representative 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 built -- 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 the use ditching in that very end part of the dual engine failure is a problem on the contrary; 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, -- so the maximum -- the checklist says maximum flaps available, and so it could go up to full and since you have all the systems available, it is a good assumption. For the checklist given for dual engine failure, it is a reasonable assumption that you will not get (flap selection) flap extension (pardon). And that checklist is driven globally to have a simple, unique path to follow, and flaps 3 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.

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CAPTAIN PARISIS

| Page | Line | Changes |
|---|---|---|
| 78 | 19 | I am in charge of and accountable for all flight operation**s data** and documents **provided** by Airbus. |
| 78 | 23 | I've been in my current position for two years and my previous |

| | | |
|---|---|---|
| | | position was **to be the Airbus Head of Flight Crew Training.** ~~Airbus flight crew training.~~ |
| 80 | 5 | we will **see** a summary of the operational documents |
| 80 | 7 | the development of ~~this~~ **these** **procedures** in this presentation, |
| 80 | 9 | to prepare the aircraft and passenger, and **an** immediate emergency |
| 80 | 15 | as a result of new or changed regulation, like new **ETOPS, LROPS regulations,** |
| 80 | 18 | the case for the **dual** engine failure; |
| 80 | 19 | some operator feedback, **that define how** ~~'s a different~~ it was difficult to |
| 80 | 21 | One **recent example** is the modification on the ground |
| 80 | 24 | we go through **a** formal process involving |
| 81 | 12 | ~~characterized~~ **prioritized** and set in the right order to be done. |
| 81 | 14 | **It** is a paper printed documents setting all the correction |
| 82 | 23 | we ~~command~~ **recommend** the crew to refer to the paper |
| 83 | 10 | ~~So~~ **Some** procedures must be applied without reference |
| 83 | 13 | could be ~~wind sheer~~ **wind-shear** or loss of braking during the landing run. |
| 83 | 14 | the human performance ~~and~~ **under stress,** we really |
| 83 | 21 | The crew will also have to ~~turn~~ **jump** and cross |
| 83 | 22 | reference to some other procedure**s**. |
| 83 | 23<br>24 | an ECAM exception of this procedure and that was **following** ~~for wing and emergency --~~ **an emergency landing with no fuel remaining** situation and so we recommend the crew to take this |
| 84 | 1 | So the ECAM exception, ~~we~~ **will** authorize a very |
| 84 | 4 | with no further need to ~~turn~~ **jump** to other |
| 84 | 9<br>10 | So one example could be a persisting cabin fire, ~~leaving~~ **leading** the **captain to have** ~~cabin to --~~ the decision to plan for a ditching. |
| 84 | 12 | and emergency procedure that **are** reviewed and approved by the |
| 84 | 15 | approval from their operation**al** aviation |
| 84 | 16 | Airbus~~, as it continues~~ **has a continuous** improvement process based |
| 84 | 17 | all this input **listed** on the screen |
| 84 | 2 | like the **fuel** low level procedure, |
| 85 | 3 | ECAM exception **to be sure to cover all situations** for some other case like the smoke procedure |
| 85 | 4 | that has been determined **following huge** ~~for the --~~ review of the smoke procedure |
| 85 | 7 | exception on**ly** -- following the ~~list~~ **lesson learnt from an** emergency landing in ~~2012~~ **2001**. |
| 85 | 13 | It's revised only when needed, as I said, ~~the I said,~~ the latest |

| | | |
|---|---|---|
| | 14<br>15 | one being this engine **dual failure** so this is very exception**al** and we try to keep it as a minimum number as possible |
| 86 | 5 | the best way ~~we determine~~ **will be to have** an ECAM |
| 86 | 7 | We have the ~~evaluation~~ **validation** of this scenario |
| 86 | 9<br>10 | we propose the ~~mitigation~~ **modification** to the authority and ~~that~~ **it** has been ~~satisfied~~ **certified** by the authority. |
| 86 | 10<br>11 | So that was available **and presented as a draft** ~~for -- presented as it arrived~~ to the customer in 2004 |
| 86 | 19 | to no fuel remaining situation or due to **external** conditions such as |
| 86 | 20<br>21 | volcanic ash **encounter** so we did not consider the very low altitude ~~or~~ **all** engine failure. |
| 87 | 14 | something like **half a page on more detailed information** ~~pitch on the -- information~~ about how to ditch |
| 87 | 16 | information and the time needed to read it ~~and~~ **in** what we will select |
| 87 | 17 | to be in the Quick Reference Handbook, so this is done by **our** expert**s**, |
| 87 | 23 | simulators with line pilots after **having this validation by the internal Airbus** ~~-- evaluation by the --~~ process. |
| 88 | 8 | surface because the simulator is not **the appropriate tool today** to go further. |
| 88 | 18 | So in this case, we have another **procedure** that |
| 88 | 23 | before, it's a **stay-in** concept. |
| 89 | 10 | provide directly the appropriate speed to ~~the front~~ **be flown**. |
| 89 | 12 | training when we **are** use**d** to practice no thrust landing situation on |
| 89 | 13 | the **lighter** aircraft |
| 89 | 19 | So we issue **other** documents ~~and~~ **than** the one |
| 89 | 21 | ~~all~~ **our** documents that are available |
| 89 | 24 | it's part of the **docket** of the |
| 89 | 25 | ~~Know on -- how~~ **Now on ou**r SOP. |
| 90 | 1 | procedure requesting to set all the light **ON** ~~on the --~~ before takeoff |
| 90 | 3<br>4 | being not type specific **are** ~~. I'm~~ not directly in the flight **crew operating** manual, so it's more the flight operation **briefing notes.** |
| 90 | 12 | this process and it's for sure ~~it will be~~ **a little bit** too early to have the |
| 90 | 13 | We are also still looking for **the facts** ~~-- defect~~. |
| 90 | 14 | thinking about the necessity **or not** to issue specific memory items |
| 90 | 15 | Decision is not **taken** we are in the review process. |
| 130 | 8 | If we ~~trend~~ **train** beyond the capacity, |
| 130 | 9 | of the simulator, this could lead to ~~a~~ negative training, |

| | | |
|---|---|---|
| 130 | 10 | we are not capable of having high fidelity ~~vision~~ **visual** that will be a |
| 130 | 19 | So the ~~vision~~ **visual scene** would not provide the |
| 130 | 20 | crew with the adequate cue that ~~you~~ **he** will have in the real |
| 130 | 21 | situation and ~~you~~ **he** may rely on specific cue that's only specific to |
| 130 | 22 | the simulator that ~~you~~ **he** will not have in the real situation, so |
| 132 | 8 | think that this was **a** very good initiative from the captain of this |
| 132 | 9 | flight, however it was **not stated in the procedure,** so we are looking to this to be inserted |
| 132 | 10<br>11<br>12 | maybe in ~~certain~~ **some** situation**s** and we would highlight ~~what would be~~ the situation**s** where it should **not** be done if during the review we find that it is appropriate in this **unique situation** but maybe not in all of them, so |
| 148 | 23<br>24 | The ditching, as it is prepared in ~~the~~ **our procedures** is a planned event with time to go through all the procedures. |
| 148 | 24<br>25 | with time to go through all the procedures **that will** ~~. We~~ give you some information on how to comply with~~,~~**;** time to |
| 149 | 1 | prepare for the aircraft, including the cabin **but also** the pilots in |
| 149 | 6 | time to refer to procedures, so it was definitely beyond **published** |
| 149 | 18 | So for me, in this situation, **it** would be |
| 149 | 20 | word ditching will be applicable in the flight **operational** context of this |
| 152 | 18 | situation, so that **taking in** ~~'s the --~~ consideration that you have **engine thrust** |
| 152 | 20 | the procedure is ditching, **it** is a paper procedure. |
| 152 | 22 | no fuel remaining, and ~~this --~~ both situation**s** can lead to a |
| 152 | 23 | decision because of the engine ~~and~~ **being** not capable of restarting to do |
| 153 | 1 | So it will be part on the **get-in stay-in concept,** ~~getting the -- would~~ **it will** be part of the |
| 153 | 22 | opportunity in case of **doubt to go around** ~~that to go wrong~~, to have another trial, so |

NOTHING FOLLOWS