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August 24, 1999

U.S. Dept. of Transportation Dockets
Docket No. FAA-1999-6001 - 7
400 Seventh Street, S.W.
Room Plaza 401
Washington, DC 20590

Re: Docket No. FAA-1999-6001; Notice No. 99-14

Gentlemen:

I oppose the introduction of a regulation that would allow the Federal Aviation Administration to afford protection of voluntary submitted information.

The predicate for this regulation is that those persons who might provide the FAA with useful safety or security information won't do so if they are fearful that the information will be disclosed in response to a FOIA request. Historically, this has been demonstrated to be an entirely false assumption. The FAA has had in place a Service Difficulty Reporting System for at least forty years to my knowledge. Mechanics and others, without any compensation or hope for it, or any fear of the disclosure of this information, have provided the necessary safety information concerning the failure or near failure of aviation components that could affect flight safety for years. Unfortunately, they are frustrated because they recognize that year after year the information they have provided is not utilized by the FAA to improve aviation safety. Many mechanics I have spoken to have said that they stopped providing service difficulty reporting information because they see model after model of aircraft with no improvements and no changes and failing for the same reasons.

Thus, the paucity of information now provided to the FAA in connection with safety has nothing to do with fear of this information being disclosed under FOIA, it has to do with the disgust by the people who are responsible for providing such information with those who are responsible for using the information effectively to prevent accident, *i.e.,* the FAA. Thus, the basic predicate for the regulatory change is unfounded in fact.

Indeed, the FAA in response to pressure from manufacturers has refused to divulge information provided both by the manufacturers and those in the field on the basis that it is proprietary and confidential. Thus the FAA has effectively introduced, without regulatory authority for the same, the protection that it now hopes to introduce by way of a new regulatory scheme designed for one purpose and one purpose only – preventing the public from knowing and obtaining access to safety information which has been previously withheld from them by both the Government and the private sector. That is the purpose of this rule, that is the thrust behind it, that is the reason it is introduced, and it is really so blatant that the FAA must really think the public are stupid by introducing a rule that is purportedly designed to enhance safety, but in reality is nothing more than an attempt to cover up the blunders of both the FAA and the industry with respect to aviation safety.

Indeed, even thought the FAA had no authority for it, even though the FAA kept from the public all the information concerning certification blunders (like the Boeing 737 rudder system), certification and safety blunders (like the lack of fire safety on all commercial aircraft wiring and insulation systems), and the list could go on and on, now the FAA wants to turn the Government into a secret repository of information that should be disclosed to the public anyway.

Why shouldn't the public know that an aircraft is unsafe, and then make a choice not to fly it? Why shouldn't the public know that there are failure rates of aircraft of such a magnitude they should buy or fly in it? Why shouldn't the public know that there are airlines not operating safely because they are conducting paper inspections and paper repairs? In short, what the aircraft manufacturers, the airlines and others

want the FAA to do, and the FAA is falling all over itself to comply with, is to make everything a secret so nobody knows how bad it is out there and how badly the FAA is doing its job.

One example strikes me as being especially telling. I wrote a FOIA request, repeated FOIA requests as a matter of fact, arising out of the crashes of United 585 and USAir 427, two Boeing 737s that crashed because of the failure of the rudder servo

valve, a probable cause found after nine years of investigation by the NTSB. Of course, the FAA in the State of Washington didn't have any information that it found releasable, and when we took the deposition of Ken Frye, the FAA person in charge, FAA's lawyers shut him down when we were asking sensitive certification questions. Of course, we didn't get the information from the defendants because they cited all sorts of reasons why the information was either unavailable, or they couldn't find it, or they couldn't supply it.

Well, something surfaced that was kind of remarkable, a copy of which I am providing to you, which are minutes of the certification meeting of the Boeing 737. Well, lo and behold, it turns out that the FAA did question the certification of this aircraft, the single slab rudder, the single actuator, and even suggested that it was prone to a single point failure. Well, it's pretty obvious that if this document had gotten out officially, it would have been pretty embarrassing to the FAA, and probably to the managers who overruled the guys who figured out that the 737 shouldn't have been certified this way, so it didn't get out officially, it got out unofficially.

That's the problem, you see, with your proposed regulation. Your proposed regulation is a simple attempt to hide the truth from the public, to hide the truth from victims' families, to hide the truth from the press, to hide the truth from everyone who has to make an intelligent decision about aviation safety.

In short, this regulation is a cruel and arrogant attempt to deny access to the public from the people who are on the public's payroll to find out whether the job for which Government is being paid is, in fact, being done honestly, accurately and effectively.

I oppose this regulation, because it has been bought and paid for by industry, because it is the FAA's continuing attempt to hide its ineptitude because it is completely and absolutely unnecessary.

Even the FAA should understand that it is the threat of public disclosure of critical safety information and the legal liability that may result from it that is the most effective tool at implementing aviation safety improvements, not hiding behind some regulatory device to keep the public in the dark.

Read the Constitution.

Very truly 'yours,

ARTHUR ALAN WOLK

AAW/cd

Enclosure

FEDERAL AVIATION AGENCY
PRELIMINARY TYPE CERTIFICATION BOARD MEETING
BOEING MODEL 737 SERIES

Renton, Washington
May 4-5, 1965

* * * *

G. A. Baisch, Reporter
Verbatim Reporting Group - Supporting Services Unit
Flight Test Section - Commercial Airplane Division
The Boeing Company - Renton, Washington

(Chart - 737 HYDRAULIC SYSTEM)

The hydraulic system looks very much on a schematic like the 727.

(General discussion off the record at the request of Mr. Steiner.)

MR. COPENHAVER: The hydraulic system looks very similar to the hydraulic systems schematic for the 727. And as a matter of fact, it should. It is designed by the same people and employs in many areas the same hardware.

It consists of a System "A," which is supplied by two engine driven pumps, a System "B," which is supplied by two electric driven pumps. These are by part number the same units that are used on the 727.

2-2-105

In addition it has a Standby System a la 727, again with an electric driven pump, the same part number as the pump employed on the 727.

Now, the flight controls and the rest of the hydraulic features are divided up as shown on this diagram.

There is a session scheduled on the hydraulics and flight controls systems that will considerably expand on the details on what I am saying.

The "A" System supplies half the elevator, part of the ground spoilers, the trailing edge flaps, the main and nose gear extension, and nose gear steering and the inboard brakes.

The "B" System and the "A" and the "B" are the normal — normally running system, which supplies half of the rudder, half of the elevator, half of the aileron, part of the flight spoilers — half the flight spoilers, and acts as a backup on the leading edge devices and the outboard brakes.

The Standby System, as is the case on the 727, is an alternate means of operating the rudder.

Now, in the case of the elevator there is manual reversion automatic, and in the case of the aileron there is automatic manual reversion.

In the case of the nose gear and main gear, the alternate method is free fall to the down and lock position.

In the case of the trailing edge flaps the backup or alternate system is an electric drive, of the very same type of concept as on the 727.

The system is pressure filled like the 727, from a common fill point, and all fluid introduced into the system goes through a filter.

So your work, if you are familiar with the 727, will make this system look very familiar to you.

I think I will back up here for a moment and talk, since I don't have a card specially for this, on the flight controls to explain what they are.

(Chart - 737 GENERAL ARRANGEMENT)

Here again the concept looks like the same design team did the

It has a single outboard aileron.

The elevator and the rudder I have already mentioned, they are being powered with a dual power pack, as is the aileron system.

This subject we will get into in considerable more detail on the session scheduled specifically for that.

So that the concept on flight controls is virtually the same concept as the 727 incorporated. . .

MR. LIPPIS: Do your conventional ailerons lock out like the 727 does now?

MR. COPENHAVER: No, they do nut,

There is the single outboard aileron and no lockout on it.

MR. STEINER: Generally the flight controls are considerably simplified from the 727. In many cases they have about half the parts. But the theory is roughly the same.

MR. BUSSEY: A question on the rudder.

There is no manual reversion on the rudder, I understand?

MR. COPENHAVER: That's right.

MR. BUSSEY: But it is a one piece rudder?

MR. COPENHAVER: Yes, it is.

MR. HAWKS: Did you say two-piece?

MR. COPENHAVER: One piece.

MR. STEINER: He showed a third hydraulic system.

Like a lot of other things on the airplane we may choose to change some of this. I don't believe the Regulations would require the third system, and he is describing it fairly by saying it is in the airplane, but I mention this only that he is describing the airplane as we are currently configurating it. What we eventually submit for certification may have slight deviations.

MR. BUSSEY: That's all right. I just asked the question.

12-1-1210

(10:45 AM - 12 :00 Noon Session)

MR. OLASON: All right, fellows, would you please get , organized. You're going to have to take notes, because they are going to have a quiz on this particular part of the discussion, and I don't want any of you to be caught napping.

Well, the flight controls have been described fairly thoroughly, and I had this chart made up to show the flight controls.

(Chart - 737 GENERAL CHARACTERISTICS)

I don't really think that there is anything left to be said about the flight controls, except that we're expecting to have a feel system very similar to the 727, and I don't think that people will be able to tell much difference in terms of flying qualities between this airplane and the 727.

With the engines on the wing we have traded a deep stall or pitchup consideration for an engine out consideration. But really, these engines aren't very far out. If you compare them with the 727 you will see that the engines are not way out. And we have a lot of experience around here with engine-out controls, so we are not worried a bit about engine out controls. We hare got a big rudder and a big fin to take care of it.

MR. STEINER: About twice as big as it ought to be! (Laughter)

MR. OLASON: Aerodynamics Department has never had a big enough tail! (Laughter!.

MR. BACHE: That's right!

MR. OLASON: The ground spoilers are shown here in orange, and will only be used on the ground.

One of the reasons that we could eliminate an inboard aileron is that we have only 25° of sweep, and the thickness of this wing IS about 20% thicker than that of the 727 in term of thickness ratio. So that the elastic problem is essentially eliminated and we don't need to lock out the outboard aileron.

So, we don't have an inboard aileron.

We have a very large flap span, as you can see, and we have a very small cut out here. As a matter of fact, in the flaps in, the take-off position we only have a 15-inch cut out for all takeoff positions,

(6)

because the flaps do not interfere with the engine tail pipe. They only affect the strut, and you can see this on the mockup when you get out there.

This airplane, as you know, is very, very critical from a second segment standpoint, being a two-engine airplane. So we are really tailoring the flap system for low drag at very low flap deflections, and it will be a little different from the 727 from that point of view.

MR. HAWKS: Before you leave that, it appears that you have a little aerodynamic balance on the rudder and the elevators. Is that right?

MR. OLASON: Yes. Oh, yes. We have a -- you mean a tab?

MR. HAWKS: No.

MR. OLASON: Oh, you mean the mass balance?

MR. STEINER: He means the horn balance.

MR. OLASON: Oh, yes. This is mass balance here and here. Right.

MR. STEINER: Just like the elevator on the 727. It has got an identical one.

(Chart - 737 RUDDER CONTROL SYSTEM)

MR. PFAFMAN: We're going to to start out with -- I don't know why I like to start out with the rudder control first. It seems to always be the tail end. But I will start with it anyway.

Can everybody see these charts? I realize -- I'm going to have to apologize for the charts, I saw then this morning for the first time myself because they were in the Art Group, and they are somewhat small. So I'm going to have to explain the details rather than have you see the details.

MR. STEINER: By the way, if there is anybody in the back of the room that is particularly concerned with the *control* systems, several of us here would be glad to change *places* with you.

Charlie, if you would mention who your control systems men are, Cope and I and Tryce --

MR. HAWKS: I think maybe they can see all tight. 3ack as far as Bill and Jim Hart -- can you see all right back there?

MR. HART: Yes.

MR. HAWKS: How about Jones? You are way back there.

MR. JONES: I have seen this before!

MR. STEINER: All right.

MR. HAWKS: Well, if they can't see, it is their responsibility to know about It. So go ahead.

MR. PFAFMAN: Okay. Up in the cockpit we have identical equipment ES far as the rudder *is concerned.* We have the same rudder throws,

We have the same rudder feel.

We will have the same rudder feel on the trim system.

We have the same rudder pedal trim adjustment.

Now, as I *say,* the feel will be the same. The feel will be the same on takeoff and at the lower speeds.

However, on this airplane la addition to the spring feel we have introduced q into the feel system, which of course you will feel at speeds up around anything above about 225, 240, you will start feeling q coming in, and it will make the rudder a little bit stiffer.

So the cockpit essentially for all practical purposes is the same.

Going buck to the rear end we have a single cable run on the

rudders the same as we have on the 727, in addition to the trim run.

We have less pulleys, of course, which should help our friction characteristics somewhat, because we don't have to go around the center engine duct like we did on the 7%

Also, as you notice, starting from completely the rear end, we have a single rudder. We do not have the dual rudder as we have had *on the 727.*

And also we have eliminated all tabs. There are no tabs on the rudder.

There are *no* aerodynamic balances on the rudder.

There are mass balances on the rudder itself.

The rudder is driven by three hydraulic systems similar to what we have had on the 727. However, System A and B go into a single dual package. It is package In completely dualized and isolated. That is, the *forging* -- you do not have a continuous forging from one end of the package to the other, so a single crack can not possibly get both hydraulic systems.

Cn this dual package we have our yaw damper, our transfer valves, and in this case first we have tw transfer valves and we have the autopilot or the yaw damper shutoff valves. And of course we have the various filter arrangements the same as we have in the 727, except of course they are dualized because we do have these two packages *on* the two yaw *damper* systems, *you might* say, *or the* two *servos* for the yaw damper on the same package.

MR. STEINER: There is only one yaw damper installed in the airplane. That wasn't clear in Lynn Olason's talk, either.

MR. PFAFMAN: I was going to bring that up next, Jack, that we have -- we are providing -- proceeding three ways on the yaw damper itself.

We have the capability of having four degrees of *yaw* dampening operating with one coupler, And than as n get in a little later in the autopilot n have a switch on the autopilot that will switch all channels. In other words, you will switch the rudder channel, the aileron channel, and the elevator channel all simultaneously. In other words, you will be all on *System* A *or* all on System B.

That is the way the airplane will be offered for certification. However, we do have provisions of course if ve need the second yaw

channel, we can always put the second coupler in as an optional feature for dispatch, depending on how the characteristics actually turn out under actual flight conditions.

So we are prepared. We are being a little b it f lexible, but we do have the capability there.

We tried awfully hard on this airplane to put in a manual system, and we had a manual system for quite a few months, but further analysis showed the extra complication of the tabs and the limited capability that you can get in the feel system, the fact that the trim itself is considerably heavier -- we finally went back and said, "Well, it looks like the third hydraulic system had a good reason for being on a 727. We had better go back to it on the 737."

MR. BUSSEY: *Excuse me,* Ed?

Before you get that *far,* on this power package here, your dualized or segmented power package, do you have one or two rods coming out of the package?

MR. PFAFMAN: *We* will have dualized redundant type rods coming out the package.

MR. BUSSEY: All right. Thank you.

MR. PFAFMAN: The package comes up next, so we will be getting into that very *shortly.*

We do have the feel system back at the aft end. And as I stated, it is a spring plus a q system.

Now, if you go. to the C System, for instance, on your auxiliary package, it will feel very similar to the 727. In other words, we *have* no q system on the third package. But likewise at that time you have just half your rudder capability, which will be enough, mare than ample to handle an engine-out condition and adequate maneuvering besides.

But when you have the A and B System -- either A or B System in operation, you will have the q system in operation also.

This q system is *actually* being fed from the elevator q system. So you will have a variation in bare with stabilizer setting. However, that gets into the higher regime only, which normally -- the pilot is never in that region anyway, but that does simplify the operation of the q system.

(Chart - 737 RUDDER POWER CONTROL UNIT)

Now here again I'm afraid some of you can't see this package, but we have dual tandem.

Now, as you can see, the package is split right down through the middle. By splitting, I mean the forgings that the packages are actually comprised of are actually split and bolted together. Very similar to the redundant features which we have on the 727 elevator.

We do have the tandem valve on this package very similar to what we have on our latest 707's and the 727.

In the event we have an internal valve seizure why we automatically pick up the secondary valve.

We have also of course in order to get two packages to work, or two yaw damper systems to work on one package, it has forced us into two mod pistons, of course, which are fed by the various -- the transfer valve, shutoff valve filter. Transfer valve shutoff valve filter.

And we do have a differential input at this particular point here for the mod pistons, so that if we want to combine, there is a certain capability here that we also have in mind, and that is, we may want to get more rudder capability to the yaw damper to help with the engine out condition.

And we do have this fixed up so that if you have two of them working, they can become additive. And of course, that would give you 8°.

Here again, this will not be released for our first flights, and this will be part of our development procedure. However, the capability is still there without changing the package.

We still have our thermal valves in the rudder system very similar to what we have on the 727.

I think from now on that the thermal valves are going to be a sustaining feature. I don't think we are ever going to get quite rid of them, because some of the areas that we have in the 727 of the spoiler system, if we had had some thermal valves in those we probably wouldn't have some of the roll-off on some occasions.after a long time at temperature or at high altitude.

We are still feeding this package, of course, from the two systems.

We still have our shutoff, our bypass, very similar to the 727. That is, if you get a failure -- or even a dual failure, as far as that is concerned, with the pilot holding in rudder, the rudder will stay-in that position until the pilot calls for It be be returned to a position toward neutral.

The C System will have to be *operated* by the pilot. In other words, it will be turned on and off by the pilot and will not be automatically switched on into the manual reversion, or the third system, you might say, as the other system are.

Any question on the boost package itself?

MR. YAGIELA: Yes. What is the meaning of that term "redundant" in redundant rod and rod end? Isn't that a single rod and rod end?

MR. FFAFMAN: No, sir. This is actually a dual. There is a rod inside of a rod, and we actually have a dual rod end also which is put together so if one fails the other one will take the full load.

The entire package -- now, for instance, a control valve itself, everything in this control input up to that dual valve, is dualized, with just the same a5 we have on the elevator on the 727.

The purpose of that is because this valve is what ve consider our safety feature.

So, everything up to that point is dualized.

Now here again, the point that you can argue is the attachment point. Now, what if the mechanic leaves off the attachment point? Hers again we have an attachment very similar to what we have on the 727 elevator now.

We don't have this on the 727 rudder, because there we use the redundancy, and in fact, we have two rudders.

Here we have just one rudder and one package. So we *are* putting • ♎◆♋• fastener in here in addition to the spring clip which holds the bolt in, which will hold it la even though the mechanic doesn't put on • lther one of the nuts attaching the bolt into the final position.

So, on this package here there is no way to put anything in here that won't stay in there, even though he forgets to leave off the final fasteners, because of the spring clip. In other words, if you get the bolt in there even for a test installation he has to solidify the spring clip. And that spring clip will be sufficient to hold the

joint together.

Any other questions?

MR. PETERSON: What you're saying is that no single failure will put this system out of commission? That you can think of?

MR. PFAFMAN: So single failure till put this system out of commission, except for a brute *force* seizure, of course, which your book says we don't have to worry about.

MR. JENKINS: Pete, *on* all this dualized linkage, you realize it is possible to be riding along without knowing one of your paths has failed, The internal path of the -- take the internal bolt, *of* the dual bolts --

MR. PFAFMAN: This is correct.

MR. JENKINS: -- this could have failed and no one is going to see this, no one is going to know this until the bolt is taken out and looked at.

MR. PETERSON: I see.

MR. JENKINS: This goes for the dual rods or any other dualized linkage they have.

MR. PFAFMAN: The only thing you could --

MR. JENKINS: It prevents a second failure there, they are saying, and the answer to your question is still correct. But remember, you have an undetected failure.

MR. PETERSON; Well, I think what I was getting at was protection during the takeoff or critical flight operation. Maybe that C System ought to be on, too.

Is that in *the* plan?

MR. PFAFMAN: No. The C System will never be on with A and B one

MR. PETERSON: I see.

MR. PFAFMAN: You would have to design the rudder for that condition if you do so.

HR. PETERSON: I see.

MR. BACHE: If one of those control valves seizes, does it make itself known in any way that that has seized?

MR. PFAFMAN: It will make itself known *only* through the yaw damper.

Now, also you will get -- if the pilot picks up the fact that he can't move his rudder quite so fast -- you see, you have half flow.

That same question came up on the 727 elevator, and I don't know even today that we have actually had a case where we can say, "Yes, it will definitely make itself know to the pilot."

We have removed one package on the 727 *where* we thought we had a seized valve, but we have never been able to confirm it.

In other words, sometimes you get a temporary seizure. due to a little contaminant, and it washes out, and you look for it, and it is not there.

We have never been able to confirm that we have had a seized valve. But you will very definitely feel and see a difference in speed.

We actually tested this out on the Iron bird. We actually seized *one* of these, and you can, you can pick up the difference. Especially if you know what you are looking for.

Now, I think the pilot would get used to two of them, but if he gets into one, he will complain about it awful fast.

I know on the iron bird It was quite easy to detect, but of course, we knew what we were looking for and we knew what we were expecting to happen.

MR. HAWKS: Ed, ue you going to have an iron bird on this airplane?

MR. PFAFMAN: Yes, sir. We are reworking the present Iron bird on the 727 at this time to put all these packages on the iron bird.

MR. STEINER: The iron bird will be technically complete, but it won't be as geometrically complete as it was before.

We have a lot of structure them, and there is really no purpose in our rebuilding the whole structure. But it will be technically acceptable, I'm sure.

(Several conversations simultaneously.)

MR. HAWKS: I think you will have to bear with ua a little bit, because I'm not smart enough to catch all this, and I don't know about the other fellows, but I've got to ask a couple of questions,

What happens if you have one valve fail in such a fashion as to give a hardover right rudder, we'll say?

MR. PFAFMAN: All right. Then the pilot moves the control and pulls the inner valve or the outer valve, as the case may be, over to counteract it.

If it fails hardover, then all you do is counterbalance it and counteract it.

MR. HAWKS: So you lose rudder control completely?

MR. PFAFMAN: You lose rudder control completely.

MR. HAWKS: Then how do you fly the airplane?

MR. PFAFMAN: Then you turn those two systems off and go to System C.

MR. PETERSON: Is that a separate cylinder?

MR. PFAFMAN: Yes.

C is a separate cylinder.

MR. HAWKS: Oh, that's what I didn't get. C then has another operating cylinder.

MR. PFAFMAN: Oh, yes, just like the 727.

MR. HAWKS: Oh, I see. All right.

MR. PFAFMAN: So actually we have one tandem cylinder and one separate cylinder.

MR. STEINER: I don't know that C is required by any regulation. The 111, for instance, is certificated right now with the dual --

MR. HAWKS: Jack, I'm nut trying to start an argument. We went through this on the 727 also, and we are just trying to find out what your design concept is, and then we can tell you whether we can accept it or whether we can argue about it.

MR. STEINER: Yes.

MR. HAWKS: System C, then, would be able to still operate the rudder even though one valve that failed would give a hardover signal in one direction?

MR. PFAFMAN: Oh, yes. If this valve has failed hard over in one direction and you countered it and got the airplane under control by putting your input into the opposite direction, then this is going to be true *of* all of the systems, if you get a seizure of any kind on this airplane with the way we have the systems configurated, we vould suggest you turn both hydraulic systems at once. Now this is -- on the 727 we kind. of recommend the same thing. We say, "Don't turn them off at all, as your first motion." In other words, get everything stabilized. Get the airplane under control, and then go ahead and try to diagnose your trouble. And the first, the best way of course is to turn both system off at once and go into manual reversion. And then sneak them back on, because if you have one hardover and you turn the other system off, of course, that puts you into a hardover and then you will have to flick the other system off real quick.

So the recommendation here is either you have to, if you have some kind of a seizure, to get the airplane under control first with hydraulics. Do not turn them off as your first operation,

And then secondly, turn them both off simultaneously and go into your manual system and that kind of thing. And do your experimenting from there.

MR. HAWKS: But you don't have any manual system here, so you would go to your c System?

MR. PFAFMAN: No. I would go to my C system here, my third backup, is what I should have said.

MR. AGEE: And *this* is only 50% *of* your other system?

MR. PFAFMAN: That will be only 50%. It is the same as the A, B and c Systems. It will give you all the same input as far as travel and force is concerned, by themselves.

MR. HAWKS: One other question I have been just itching to ask -- and I know some of the others have, too -- since you have ao tab, how could you possibly use trim to help you in this case?

You are going to tell us how your trim system works, but it looks to me like it is going to be common to a lot of the primary control system.

MR. PFAFMAN: The trim system will work identically to that

of the 727, where we actually trim the package.

So if you have trim in at this particular time -- now, you can trim Package C just as well as you can trim Package A and B. They are all trimmed simultaneously.

MR. HAWKS: You recall the horrible nightmare we had at the tail of the 727 because of that commonality of systems. I was hoping we wouldn't go through that again with this airplane. I don't know whether we can get into it at this stage of the design or not?

MR. PFAFMAN: Well, commonality was actually down in -- mainly down in the feel system, as you recall, and the commonality was whether or how we had our trim tab or trim screw tied in, and that eventually ended up with a dual fastener, and it will be a dual fastener on this airplane also.

And also there are several dual fasteners in the trim mechanism itself that had been omitted, and those are now in this package on the first go-around.

And I think that was where your main concern was, was actually in the trim mechanism itself.

MR. BUSSEY: Ed -- if I can trust my memory, Charlie -- the requirement says the trim system shall be independent of the primary control system.

MR. HAWKS: I have it in front of me. Do you want me to read it?

MR. PFAFMAN: I can quote it for you.

MR. HAWKS: 25.677(c) says, "Trim devices must be able to continue normal operation if any one connecting or transmitting elements of the primary flight control system fails. Trim control systems must be designed to prevent creeping in flight. Trim tab controls must be irreversible unless the tab is appropriately balanced and shown to be free from flutter."

That wording is a little different from 4(b), but the intent I think is the same.

MR. PFAFMAN: Yes.

MR. BUSSEY: Back with the 727 we stumbled on that, as you know, and decided that the intent of the Regulation was to allow capability of continued safe flight and landing, and we accepted the

C system in fulfillment of that portion of the -- as fulfilling the intent of that portion Of the Regulation, Charlie.

MR. HAWKS: Well, there was one other critical thing, as I recall, and that was we accepted certain item as being characteristically unlikely to fail, The remoteness was so great that we accepted the liability to failure as being zero.

MR. von BROCKDORFF: The test program on the critical elements in the 727 airplane - -

MR. BUSSEY: But that was not part of this question. This was another part of the control system.

MR. HAWKS: It is all tied together in this package concept, though, which worries me.

MR. BUSSEY: Yes, I see ground for coming up with the same finding in this one, so It doesn't bother me too much.

MR. SUTTER: Well, there is one other thing different about the 737.

If you lost all of your rudder control we see no problem in flying the airplane without any rudder or trim, and we could choose to demonstrate the airplane that way, to continue flight and landing without rudder.

MR. HAWKS: Yes, Joe, but you could go better on the 727. You could have one fail hardover and still fly the 727. And I'm not quite willing to accept that on this one yet.

MR. SUTTER: Well, but we have got hardover protection by having the dual system.

MR. HAWKS: Well, we hare got to think it out a little bit, I'm not entirely sure you have. Do you think you have?

MR. SUTTER: Yes.

MR. BUSSEY: I'm sorry? You have what?

MR. SUTTER: Hardover protection by having the dual valve in the control system.

MR. BUSSEY: YOU mean you are able to neutralize --

MR. SUTTER: Yes.

MR. PFAFMAN: Yes. We have hardover protection. There is no question about that. Now, whether you have maneuverability with the two systems I think depends on where the valve is seized. If the valve is seized in neutral, which is a normal position, of course you have full control.

MR. SUTTER: The only point here is that having three systems on the rudder is above and beyond the call of duty the way the rules read, and I believe one airplane has been certified dth only two systems, and no other backup.

MR. HAWKS: We are not going to base your certification on theirs however, because we don't know the similarity of the system.

MR. SUTTER: Well, it's good to drop it on the table, anyhow! (Laughter)

MR. HAWKS: Yell, Joe, we had an airplane way back -- the Caravelle, which as you know, has full powered systems with basic hydraulic systems with a third put as standby, but they used common parts, so I think every airplane has to stand on its own substantiation, and since the systems are always different in each case, you have to apply the appropriate philosophy.

MR. SUTTER: Well, I just wanted to comment, though, that this system as we are shaving It here now, we may change and simplify, and we would have to agree on a basis for certification which might be different than is being described here at the moment. That's all I'm saying.

MR. PFAFMAN: I think what he wants to do is say he wants to leave the door open until we find out the flight characteristics of the airplane and see hou it behaves.

And I agree, we are putting in a C System at this time just to make sure that we have all of our bridges crossed, and we may want to back up. It depends on the characteristics, the yaw requirements, and things of this nature. But ve still have to meet the specification. I mean, the requirements.

MR. STEINER: Charlie, you might have forgotten -- I don't know that you have -- that the tabs on the 727 are not -- they are not really tabs in the normal sense of the word. If you move the rudder, and the tab is an anti-balanced tab, it is merely to give you a farther aft spar. So really there is no difference between our solid rudder and the 727 rudder, as far as the use of a tab goes.

The only purpose of the 727 tab was to effectively give you more rudder control in the event the tab went the same way the rudder was going. It was a hinged rudder. It wasn't a normal tab at all.

MR. HAWKS: Well, I think that the thing that is disturbing me mostly is that you have more eggs in one basket here, because everything depends on that one single lousy rudder operating, and it is a powered rudder.

Nou, the powered rudder concept on the 727 was greatly improved in our concept because you had two segments --

MR. PFAFMAN: Two segments.

MR. HAWKS: -- and you bad isolation between the two complete systems, with the overpower capability and with the standby hydraulic system, which as a package represented to us a level of safety which was we felt equivalent to that required by the standards. Even though there was no specific coverage in some of those areas.

But we will have to put this one through the grinder and see how we end up in our thinking --

MR. STEINER: Sure.

MR. HAWKS: -- because we are still learning, but it does shake me a little bit. At this moment, at least, I'm still a little jumpy about it.

MR. CARTER: Well, I think there are two phases to this problem. One of them is the trim condition to meet the trim requirements with any single failure of the system.

The other is the argument about the duality or the triple system. Right?

MR. HAWKS: That's right.

MR. PFAFMAN: Well, that's correct. The Regulation of course is based upon any single element failing in either the trim or the main rudder system, you shall have one of them left. There shall be no common points.

Now, we have accomplished thison this airplane, on the737, mainly the same as we did on the 727. Now, there are certain areas where we have redundant type of structure. And if say redundant structure is nut satisfactory to satisfy this requirement, then of course -- then we are out in the open.

MR. HAWKS: Yell, actually --

MR. CARTER.. Not with one single element.

MR. HAWKS. In the 727 there was one other thing. We used the tern redundant structure. But you had sane common elements.

MR. PFAFMAN: Yes, we did.

MR. HAWKS: They were not in any way redundant. They were just simple common elements, and accepted them because the likelihood of failure was very remote. And there is nothing in the Regulation itself, or even in the interpretative material *on* this particular item, that permitted us to do this. We kind of stuck our neck out. And I'm not so sure we want to do it again, unless the system itself has other compensating features of it that provide that level --

MR. PFAFMAN: All right. Let me make this one statement. You won't catch us on that one again!

MR. HAWKS: Well, I hope we won't.

MR. PFAFMAN: There will be no common elements that are not redundant from the feel system up to the control safety features. That is, the dual valve.

MR. HAWKS: Well, but the requirement goes beyond that. It goes into the link, and if you want to read it specifically, it includes the hinges, for example.

MR. PFAFMAN: The hinges on the rudder?

MR. HAWKS: Any hinges, yes.

MR. PFAFMAN: I could fly without any hinges on it -- with a single hinge gone, because on this system *here* I have not gone to a box type of loop servo as we did in the 727. We are actually in -- the loop servo is completely within a plane by itself.

Now, this is very similar to the elevator on the 727 where we have our bar coming back where we have -- (draws on blackboard) -- we have the rudder here. We have a tappet point here.

We have a bar coming over here, and our boost package will be coming over to this point. In other words, this -- we are just going around this loop now-far our servo loop. We are not going -- now, on the 727 we had to go up to the two ribs, adjacent ribs, come back, and then come back down. And of course, you always get deflections,

And with this way you can always carry a little higher gain.

All surfaces will be of this type of Installation. There will be no type of installation similar to OUT 727 boost. And therefore you don't have to depend upon your rudder hinges, things of this nature, being intact, to make sure that you get our servo loop Intact.

MR. HAWKS: Now, where does the C cylinder hook on?

MR. PFAFMAN: I beg your pardon?

MR. HAWKS: Where does the --

MR. STEINER: Where does the C cylinder hook on?

MR. PFAFMAN: The C cylinder hooks on immediately above this In the adjacent compartment, but it still has a single plane loop, or a servo loop.

It doesn't depend upon the adjacent structure.

Now, the trim input only goes to the primary cylinder?

MR.PFAFMAN: The trim input?

No, sir. It goes to both primary and the secondary cylinder.

MR. HAWKS: To both of them.

MR. PFAFMAN: In other words, you can trim this airplane with System A, B or C the way it is presently today configurated.

MR. HAWKS: Well --

MR. PFAFMAN: And there will be dual rods up to that point.

MR. HAWKS: Well, if we as a Type Board evaluate the system just the way you are presenting it now, we should not mislead you into thinking that we would accept something less than that. If you are going to propose something less than that to us, you should make it clear right now, because we should evaluate whatever your minimum configuration proposal is, because this is a package deal.

MR. PFAFMAN: Well, we can't propose anything less at this time until we know what the airplane characteristics are.

However, as far as the redundancy of the trim versus the rudder system, the complete redundancy will be there even to just the single package, the single tandem package.

So what I'm saying is that we will *have met* the requirements that we discussed quite vigorously on the 727. We will have met those requirements on our first go-around even without a C System installed. Because those requirements say a single failure in any element in either the tab, the trim control or the rudder control, shall not leave you without the other, And this we will have accomplished,

MR. COPENHAVER: Well, we are only asking you to evaluate what the system is that we are proposing that it is at this juncture, a third system of the rudder.

MR. HAWKS: Okay. We *are* not *going to* decide it today. We want to be sure and be honest with you and lay out our concern. We will have to study very carefully what your detailed system is, and reach a conclusion with you as time goes along.

But I would rather raise false fears at this stage than I would to leave covered things which we had reserved, as It *were,* and we want to lay our hearts open to you here and *our* concern.

MR. COPENHAVER: It is not our intent to give *you* "either/or" choices --

MR. HAWKS: Yes.

MR. COPENHAVER: -- because this is the airplane that we are *proposing.* It has three systems. If we change our mind we will resubmit --

MR. HAWKS: That is where I was a little confused because I sensed that you were saying, "Well, now, we are going to put the C System, but we may take it out, and we want you to accept it either way."

We want you to tell us how you want us to evaluate it,

MR. STEINER: That's right, Charlie, but we thought it best to point out there were two or three areas where our own thinking is still gyrating inside the Company.

MR. PFAFMAN: I find the best way to lick some of my troubles is to take them out! (Laughter)

MR. SUTTER: Charlie, the removal of the C System may, if it ever happens, may only take place after a lot of flight testing is under our belt, because we definitely probably will have to continue the flight without any rudder control.

MR. PFAFMAN: I think that is probably correct. I don't think we have any intention of taking it out until the airplane has gotten well into its test program, and even then it is --

MR. SUTTER: -- and tell you we are changing our mind, and you will have to give us another reevaluation.

MR. HAWKS: Yes, But we would have to -- I think we are obligated to tell you now that our evaluation of such a thing as this will be a package evaluation.

MR. SUTTER: Sure.

MR. HAWKS: Became, clearly you don't meet a specific term of the requirement. So any acceptance of this kind has to be equivalent or better safety.

Bob, am I saying something that disagrees with your concept?

MR. PAULLIN: No. I think you are putting it like it should be put, Charlie.

MR. HAWKS: Okay.

MR. PAULLIN: But I can understand what they are saying, too. Today *this* is their package.

MR. HAWKS: Right.

MR. PFAFMAN: This is what we are going to start flying with.

(Chart - *737* RUDDER POWER CONTROL UNIT)

This particular package is being made by the same Company.

MR. CARTER: Gentlemen, shall we break for lunch, and finish this after lunch?

MR. HAWKS: It may be a good time, because then we can think a little about this and digest some of the details through our lunch hour.

MR. PFAFMAN: I just have a good start here!

MR. HAWKS: Well, we are going to come back to you, don't worry! (Laughter)

MR. BUSSEY: Ed, is this necessary *for* flutter damping?

MR. PFAFMAN: No; sir.

MR. HAWKS: This is no part of the damping?

MR. PFAFMAN: It is all mass. It is all mass balance rudder, and ♦≈ℳ⍓ ● dll not be -- it will be used for gust damping because we have no locks on the surfaces. It will be gust damped the same as the 727, and it will be demonstrated in that manner.

MR. HAWKS: We will reconvene here at 1:00 o'clock.

(Noon Recess)